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(54) **OPTICAL IMAGING LENS ASSEMBLY**

(56) **References Cited**

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Reissue of:

(64) Patent No.: **10,942,334**
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U.S. Applications:

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(57) **ABSTRACT**

The present disclosure discloses an optical imaging lens assembly. The optical imaging lens assembly includes, sequentially from an object side to an image side along an optical axis, a first lens, a second lens, a third lens, a fourth lens, a fifth lens, a sixth lens, and a seventh lens. The first lens has a positive refractive power and a convex object-side surface. The second lens has a negative refractive power. The third lens has a positive refractive power. Each of the fourth lens and the fifth lens has a positive refractive power or a negative refractive power. The sixth lens has a positive refractive power. The seventh lens has a negative refractive power, a concave object-side surface and a concave image-side surface. A combined focal length f_{12} of the first and second lenses and a combined focal length f_{34} of the third and fourth lenses satisfy: $|f_{12}/f_{34}| \leq 0.3$.

(30) **Foreign Application Priority Data**

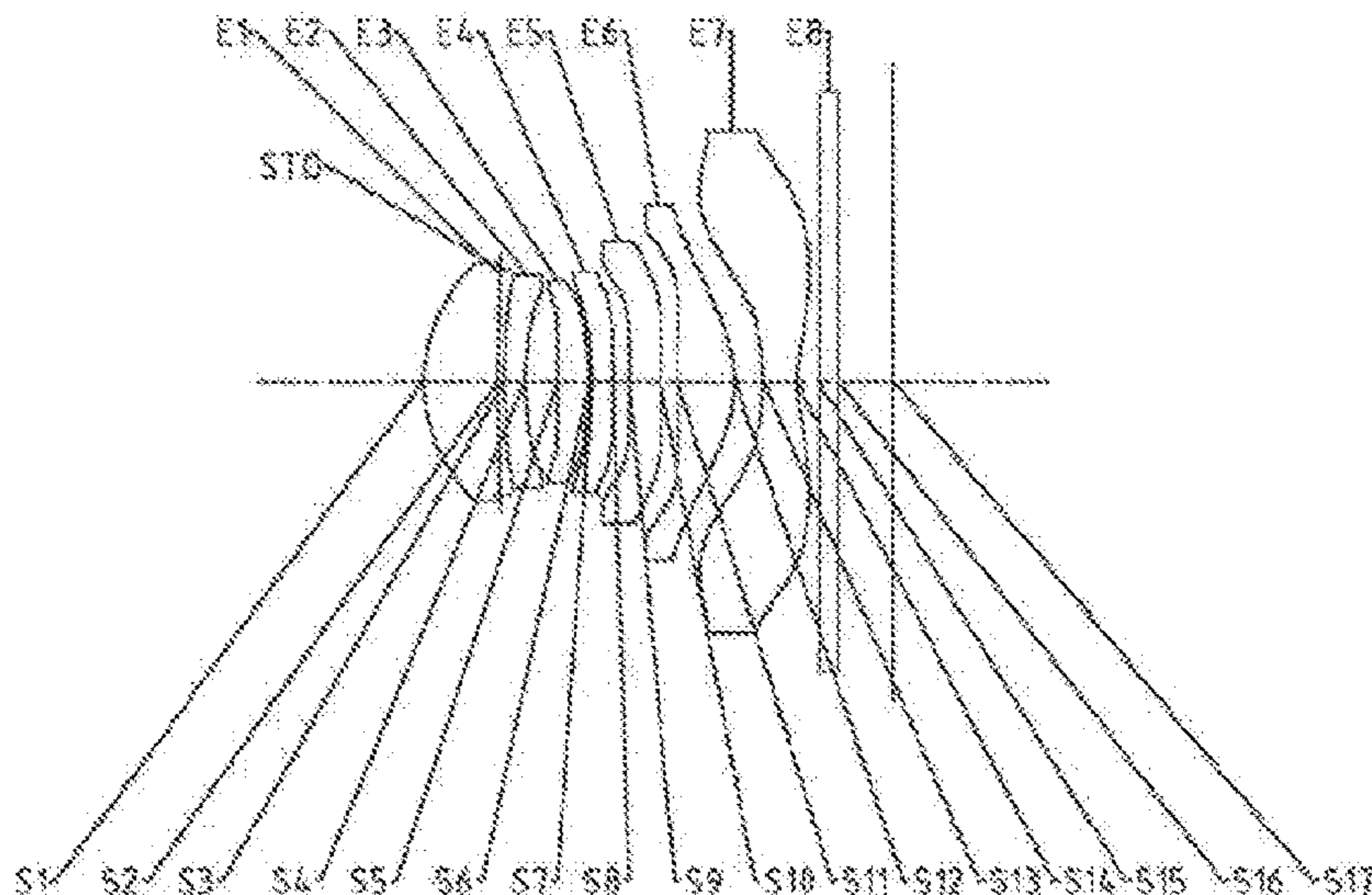
Oct. 26, 2017 (CN) 201711012647.6
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(51) **Int. Cl.**
G02B 9/64 (2006.01)
G02B 13/00 (2006.01)
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(2013.01); **G02B 13/0045** (2013.01); **G02B**
27/0025 (2013.01)

(58) **Field of Classification Search**
CPC H04N 23/55; G02B 27/0025; G02B
13/0045; G02B 9/64
See application file for complete search history.

18 Claims, 18 Drawing Sheets



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H04N 5/225 (2006.01)
H04N 23/55 (2023.01)

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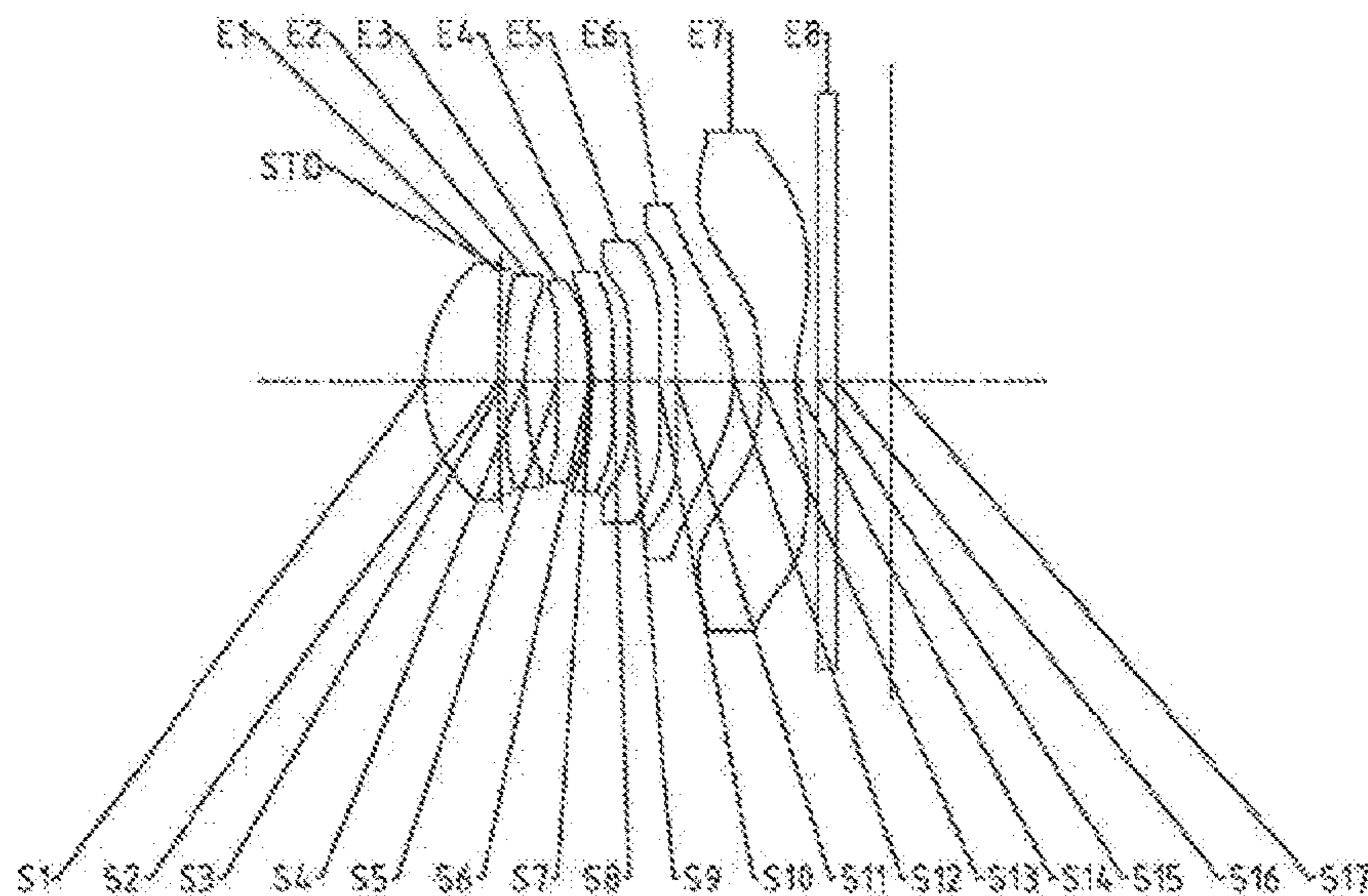


Fig. 1

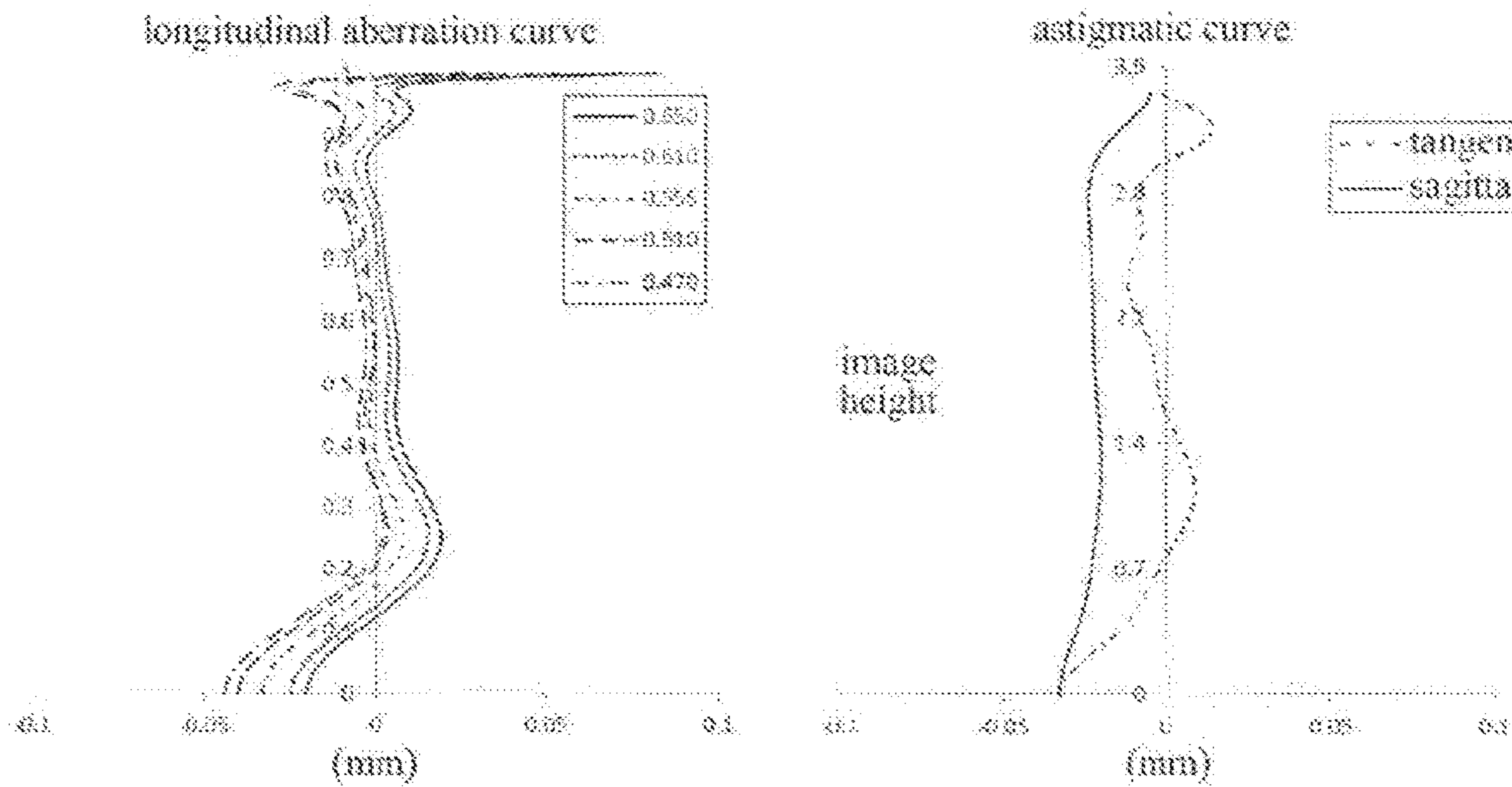


Fig. 2A

Fig. 2B

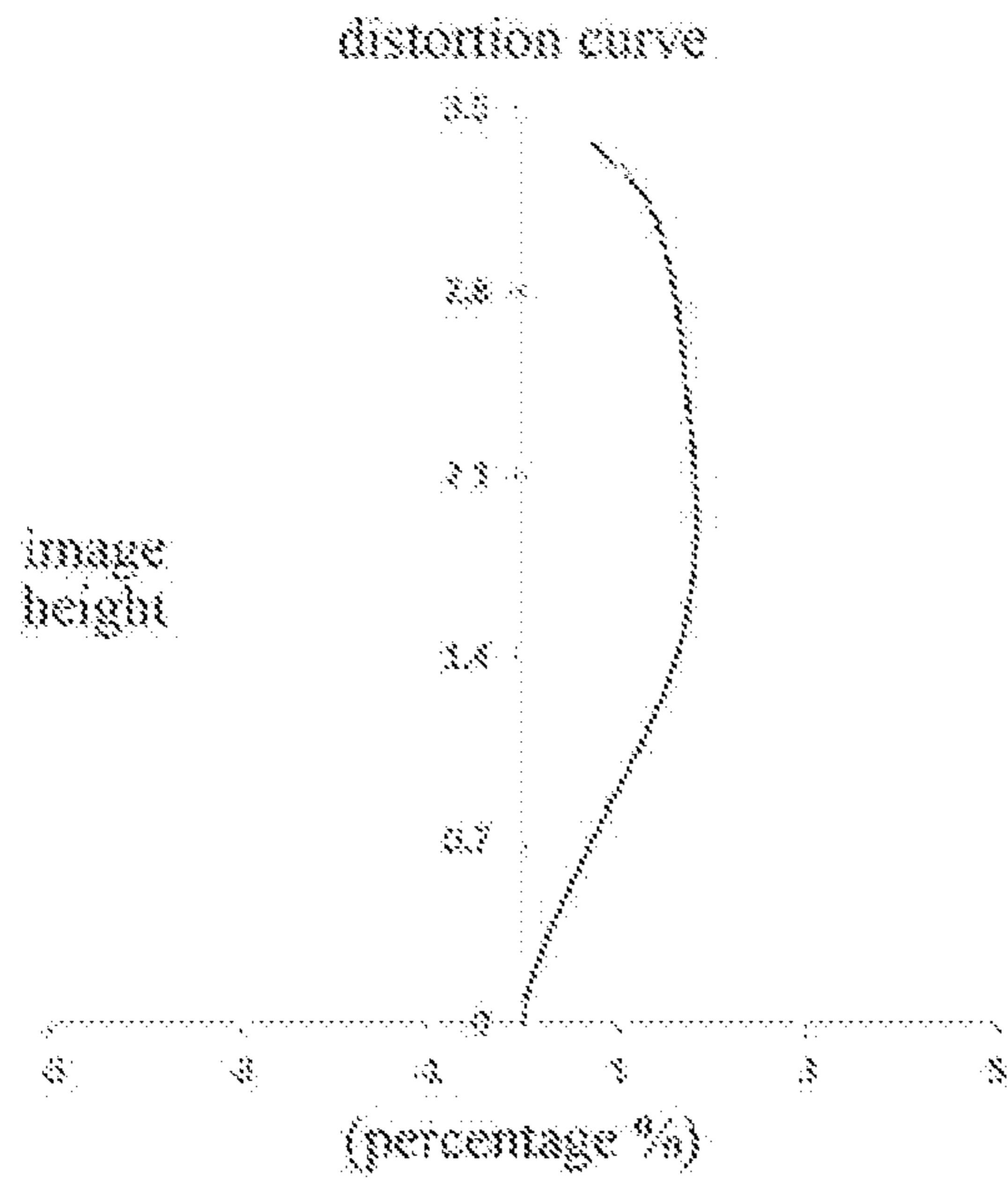


Fig. 2C

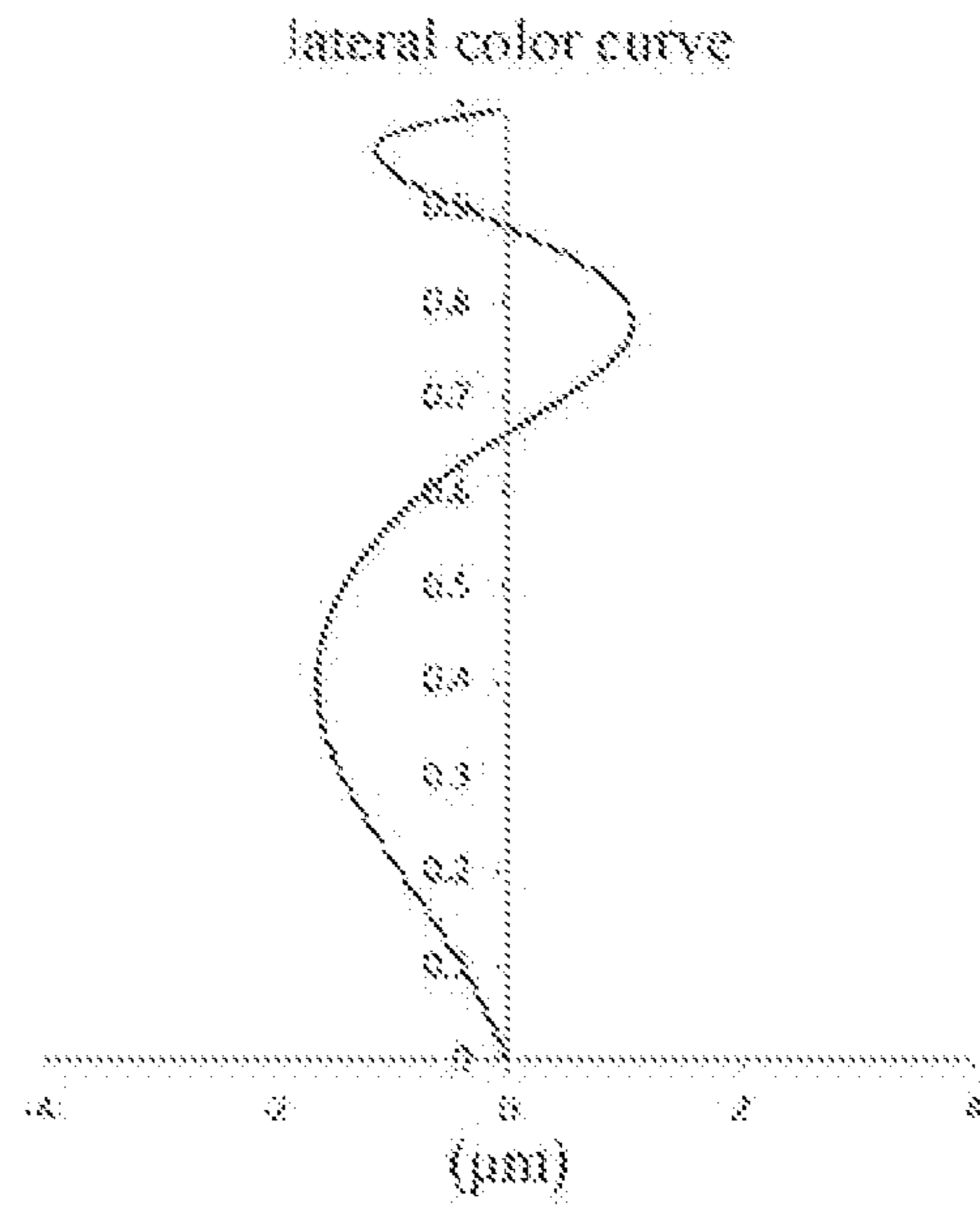


Fig. 2D

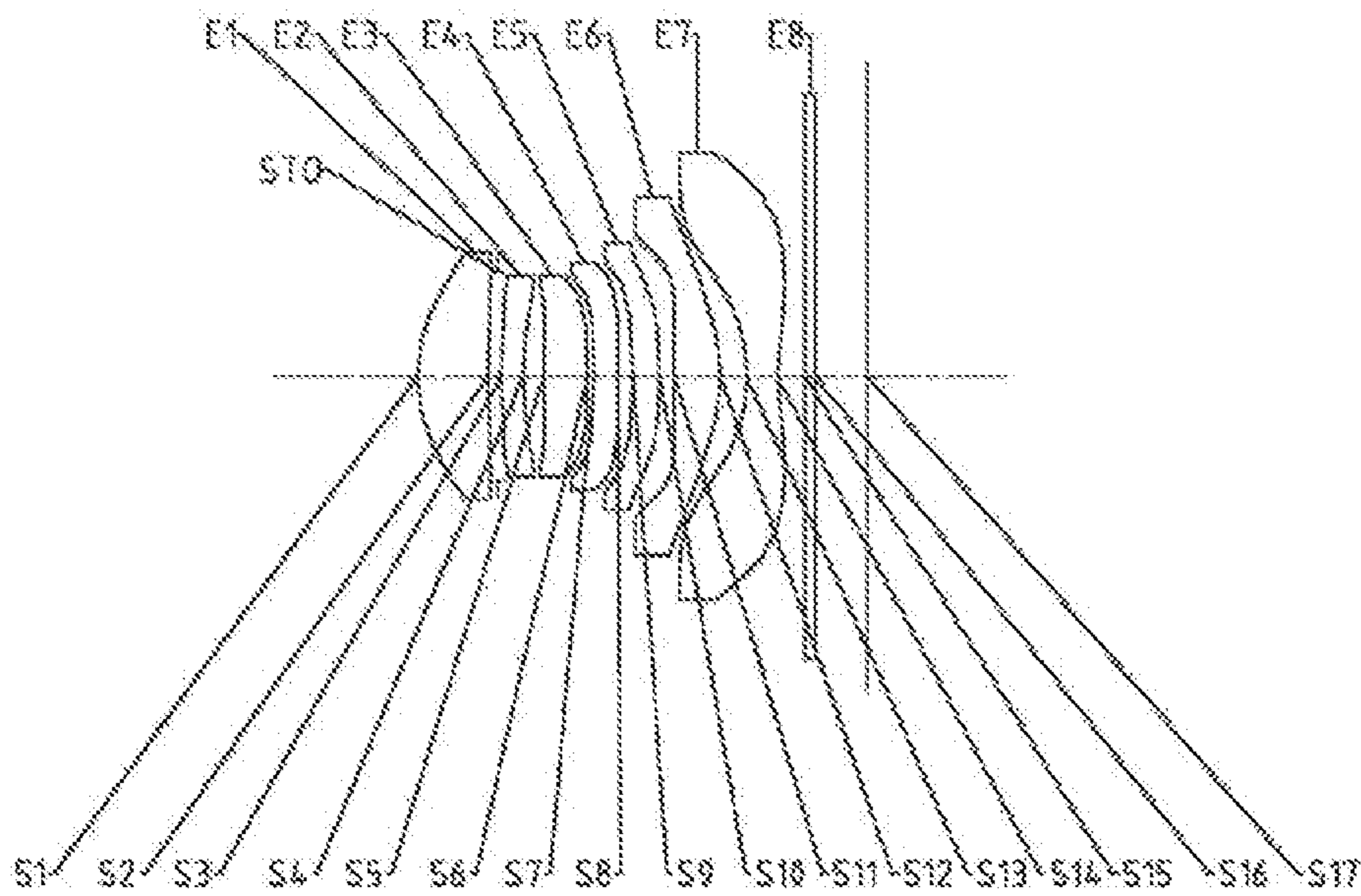


Fig. 3

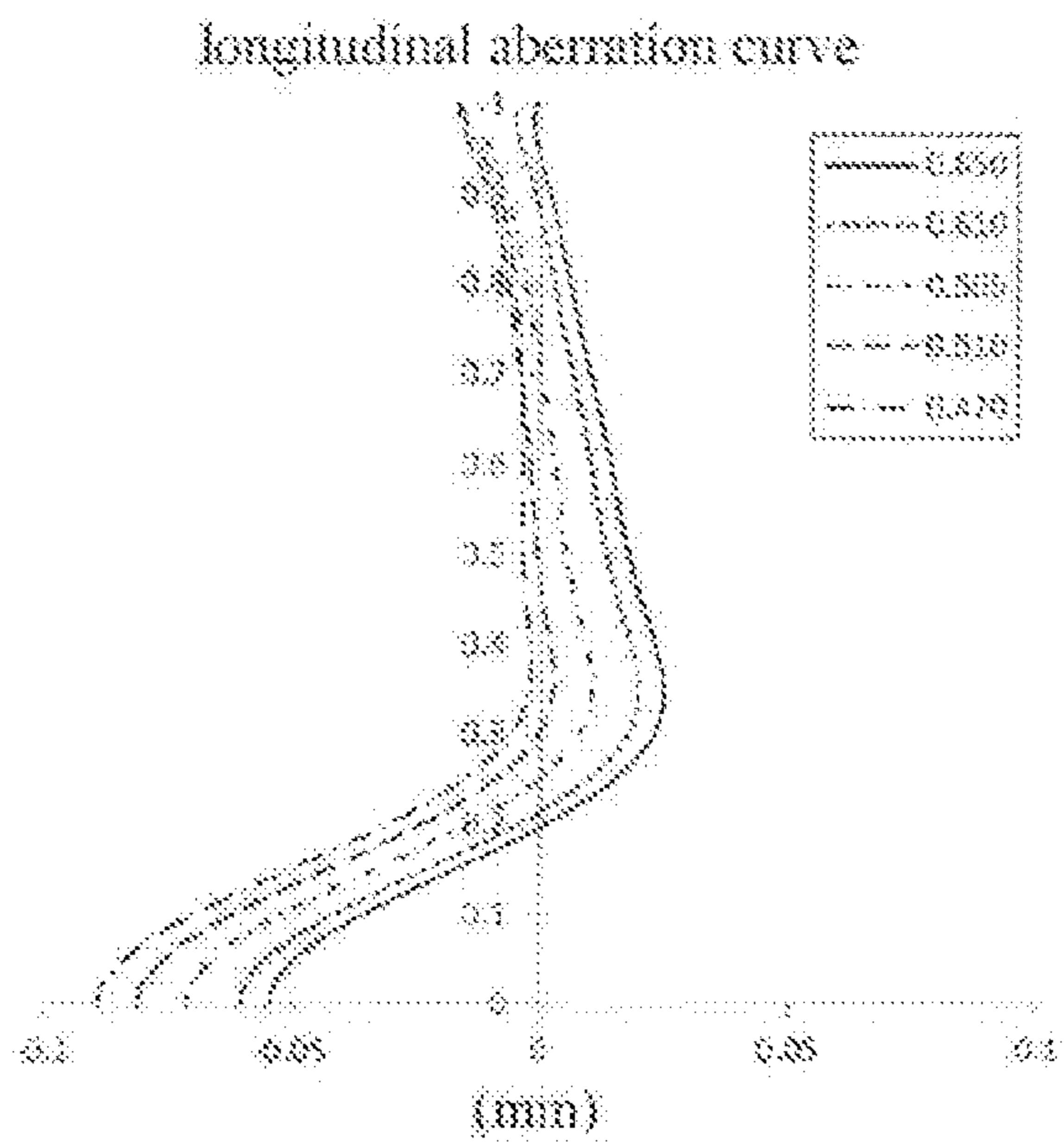


Fig. 4A

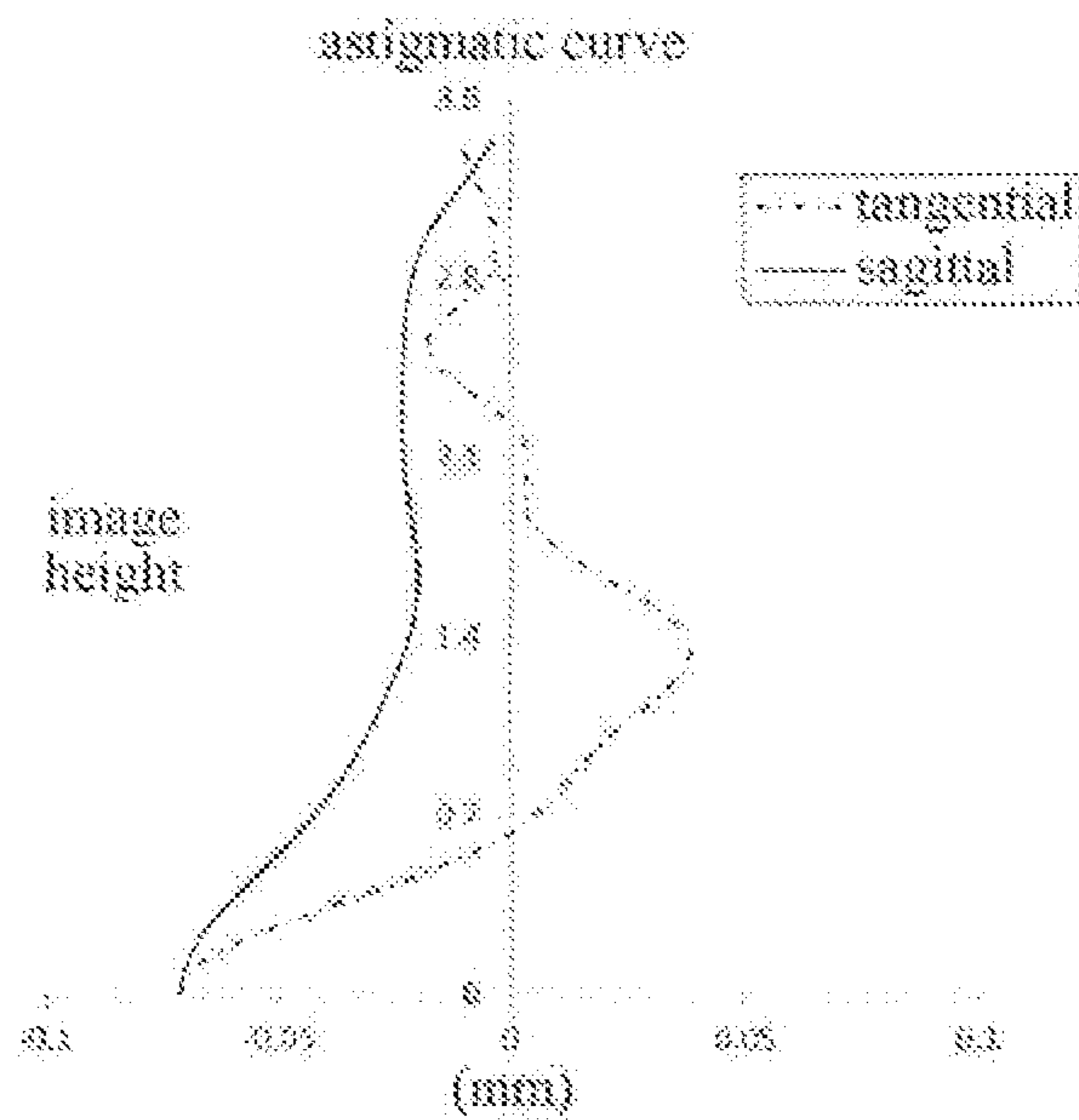


Fig. 4B

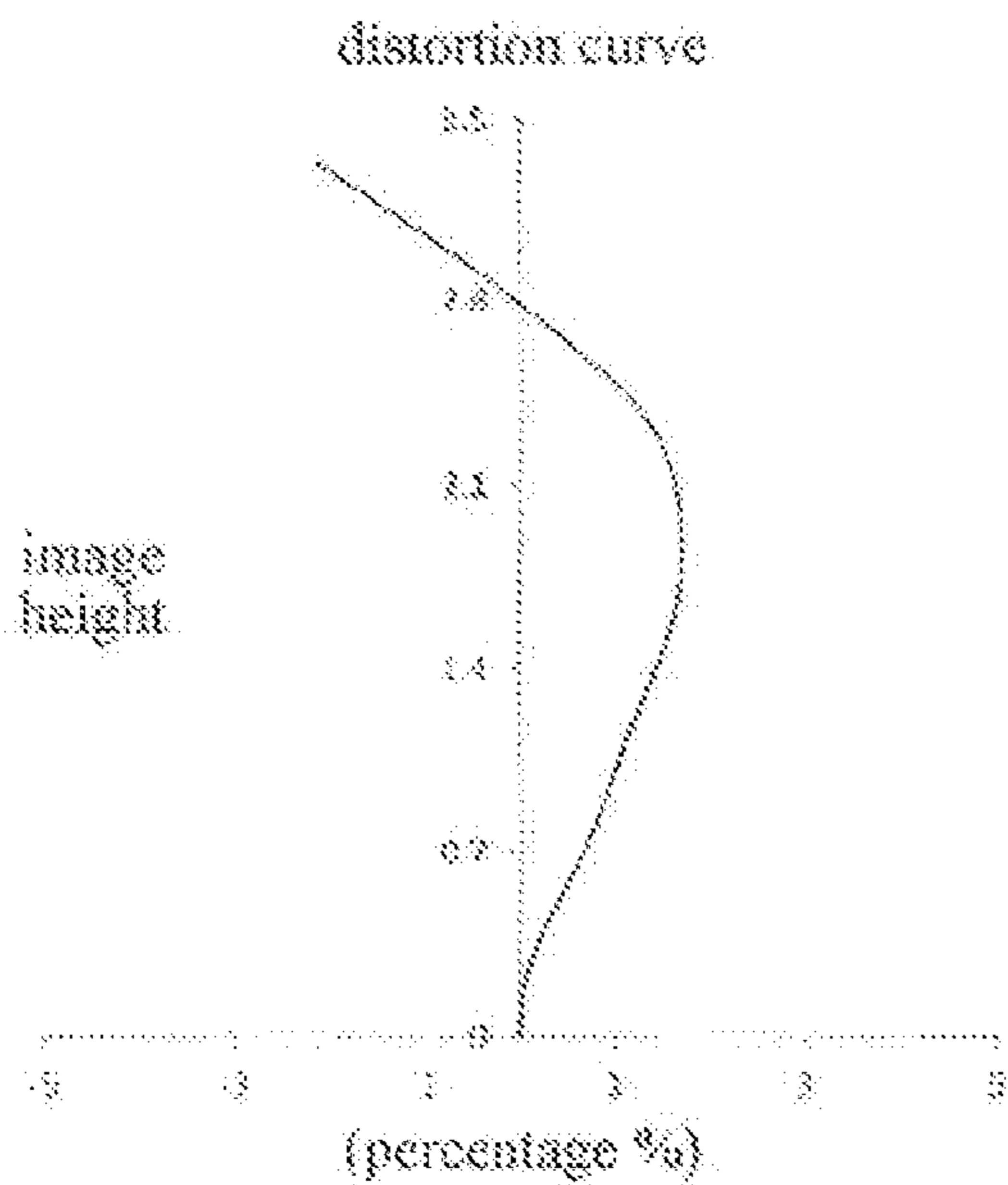


Fig. 4C

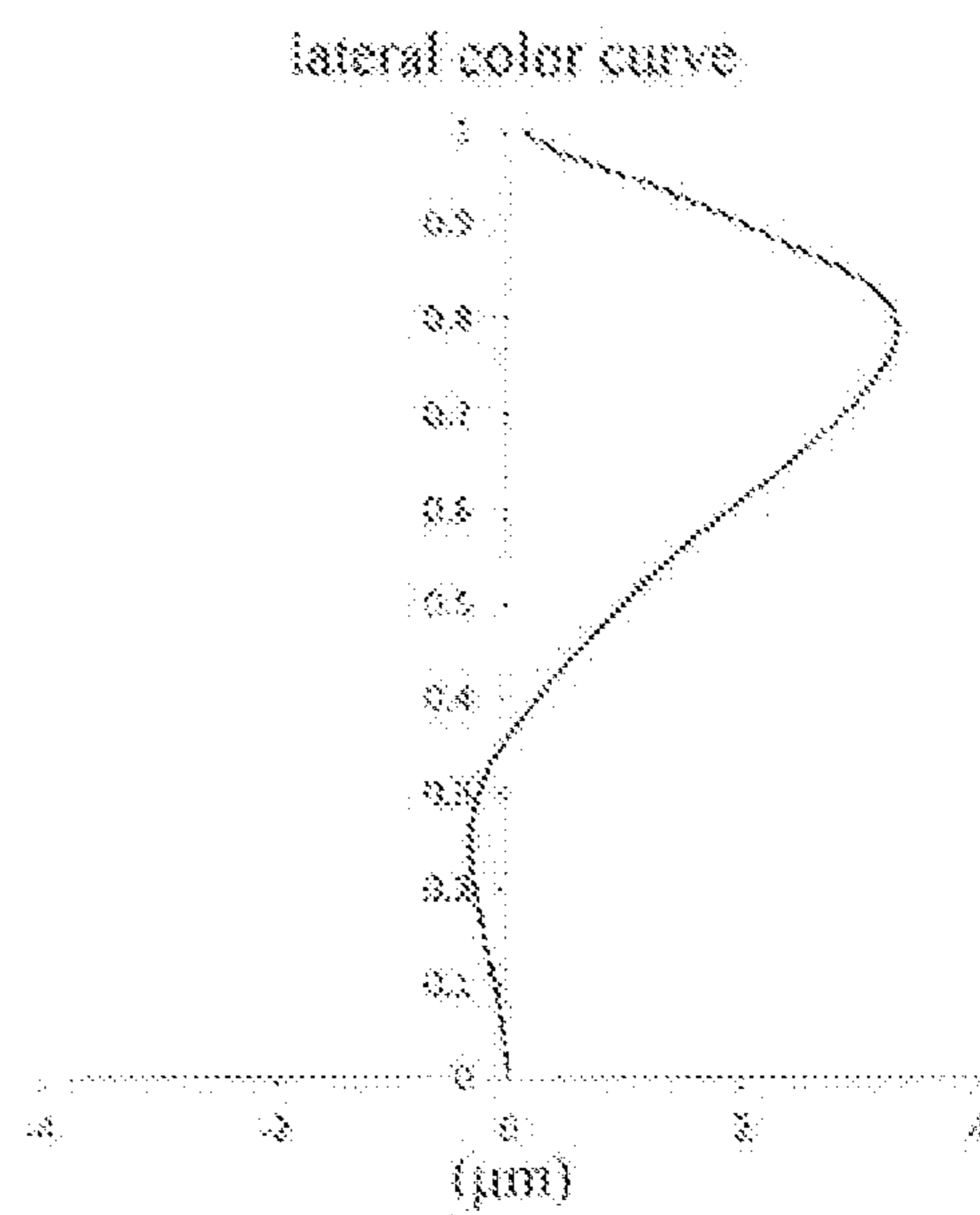


Fig. 4D

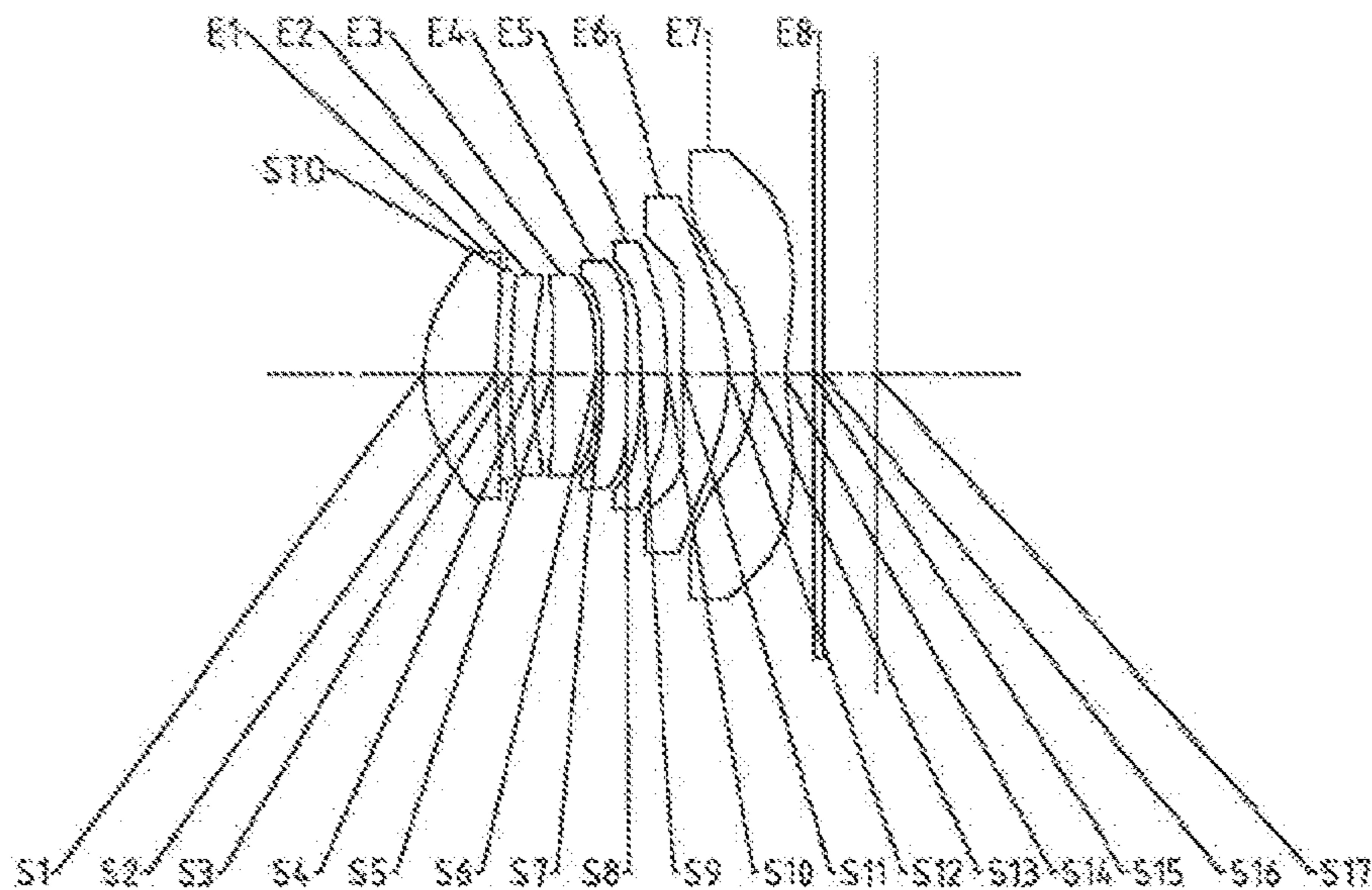


Fig. 5

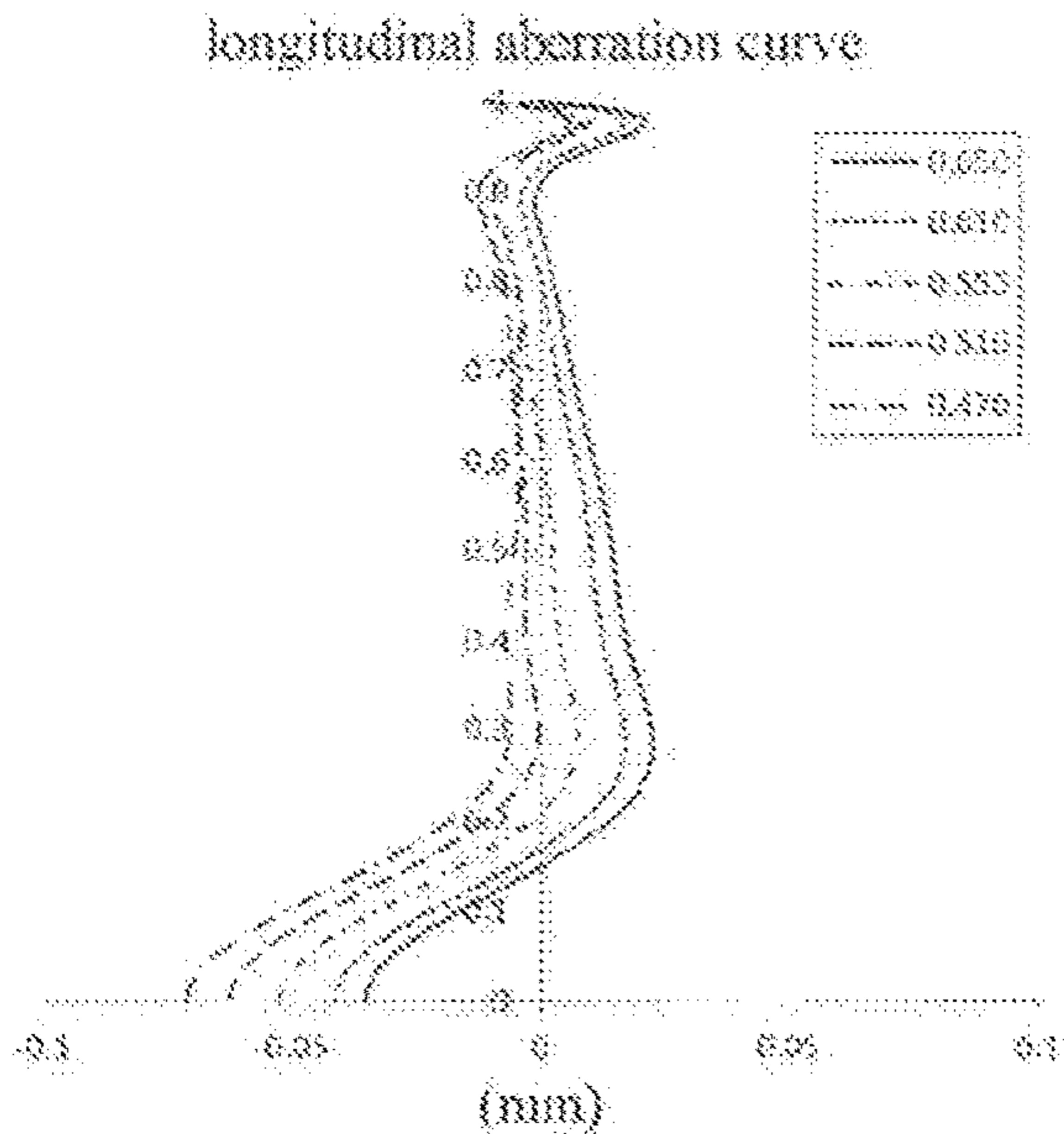


Fig. 6A

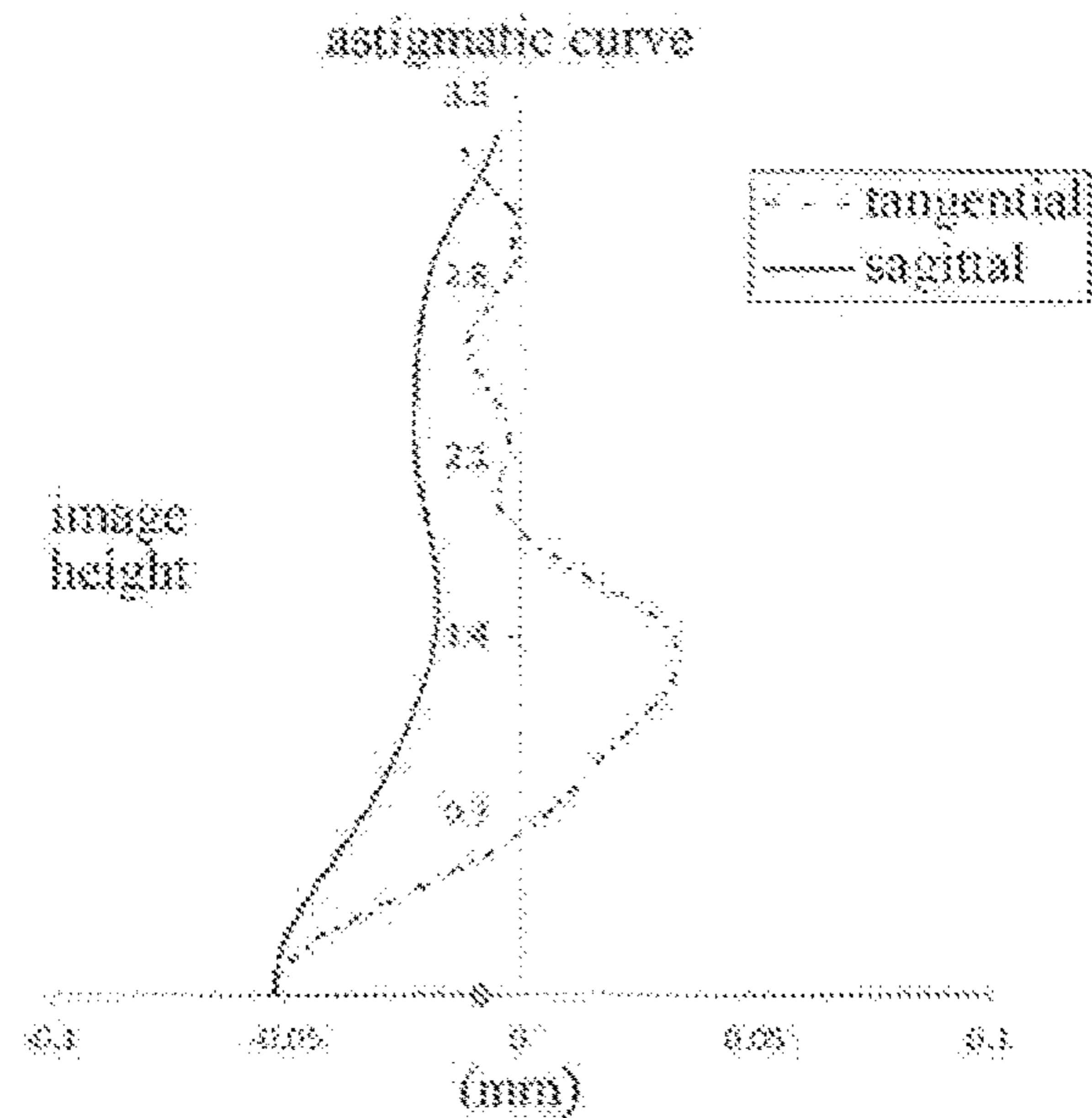


Fig. 6B

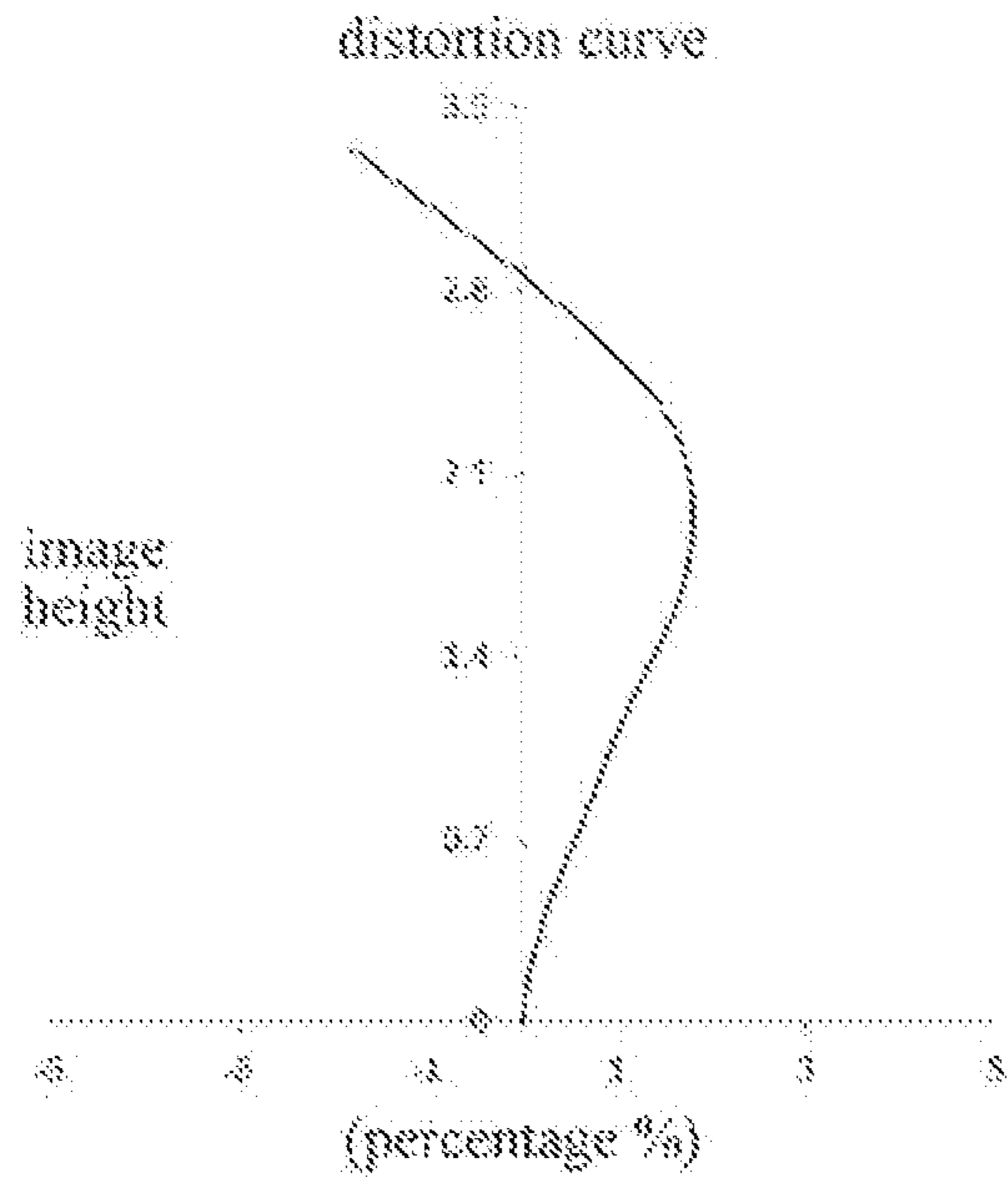


Fig. 6C

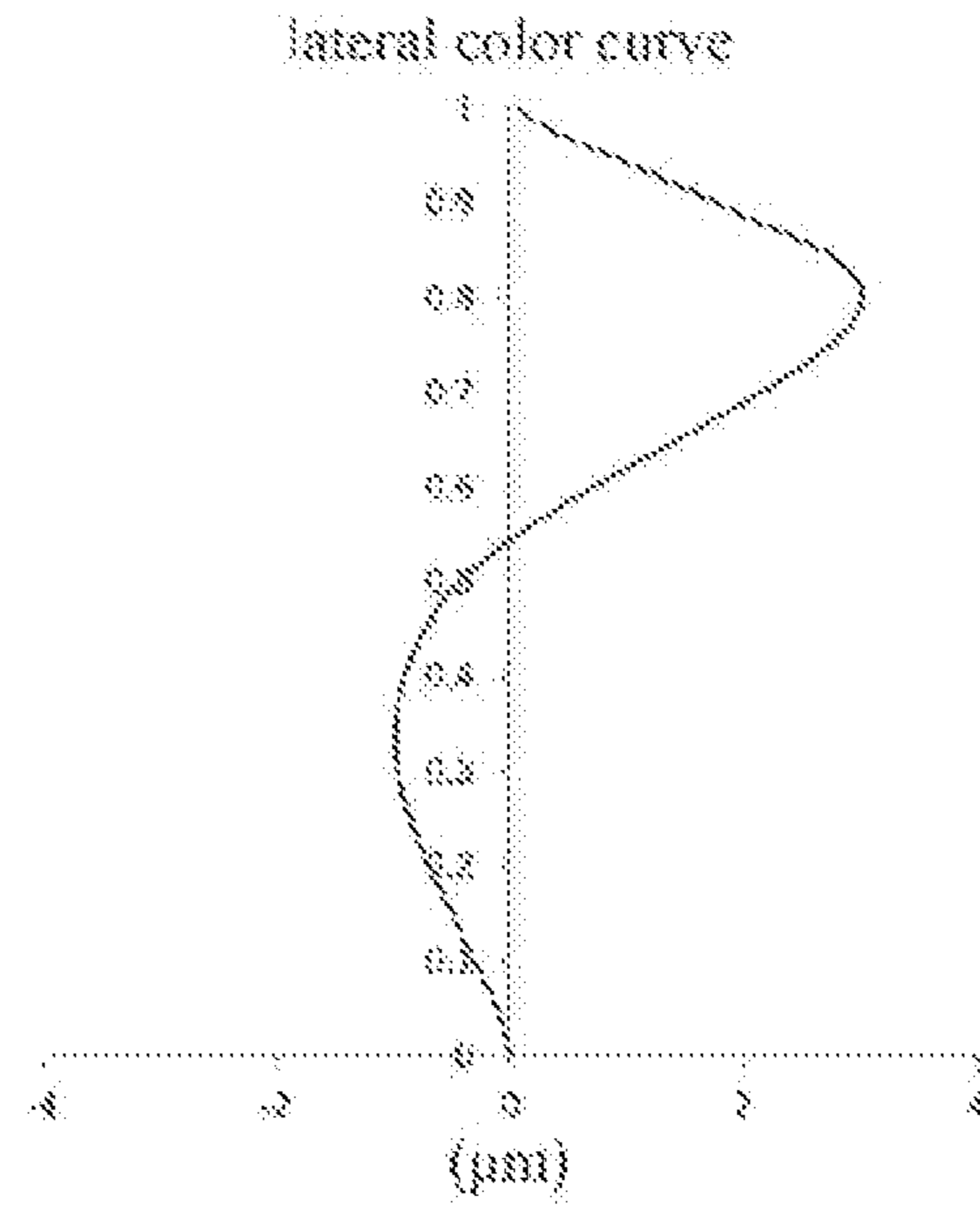


Fig. 6D

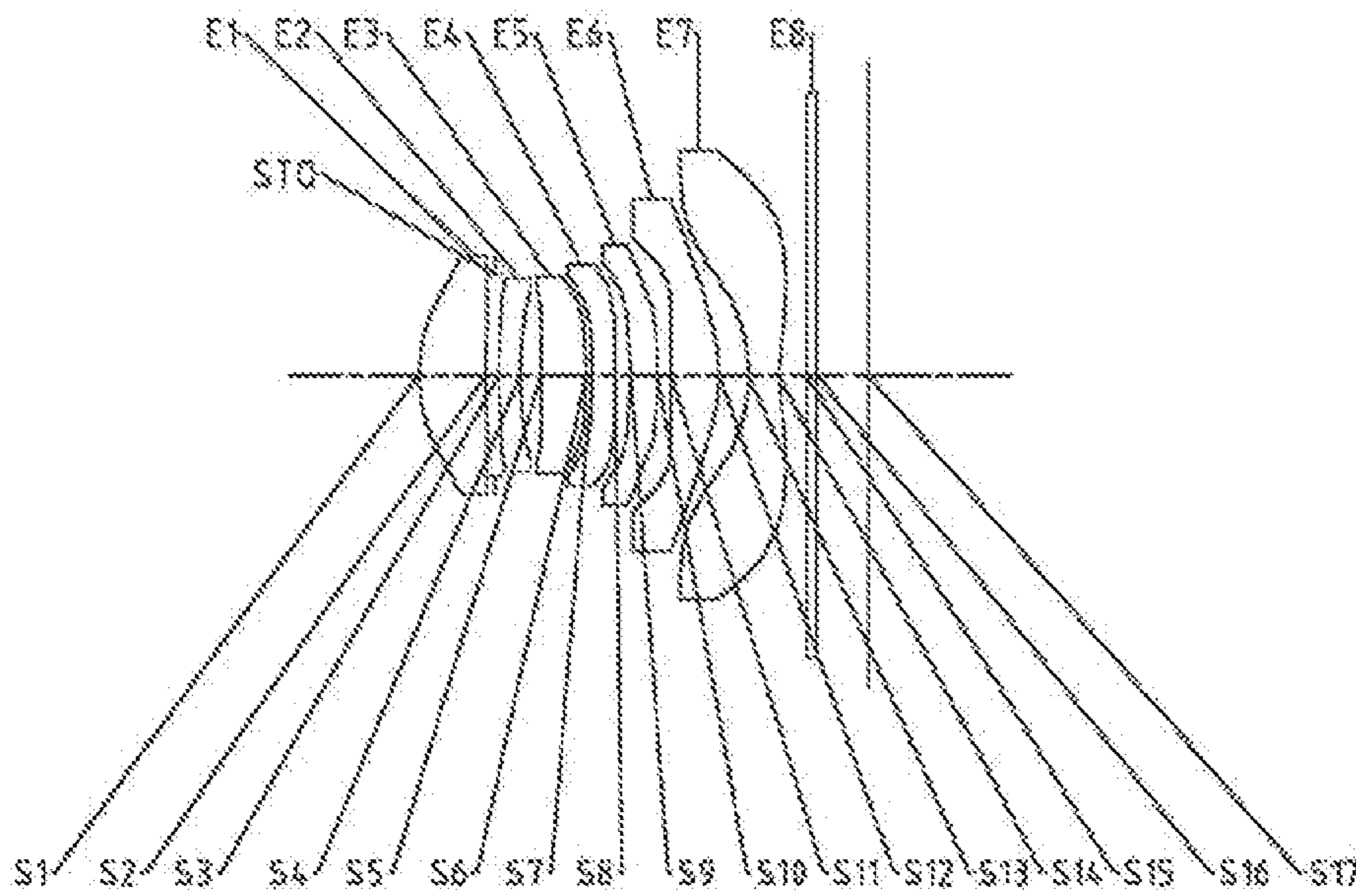


Fig. 7

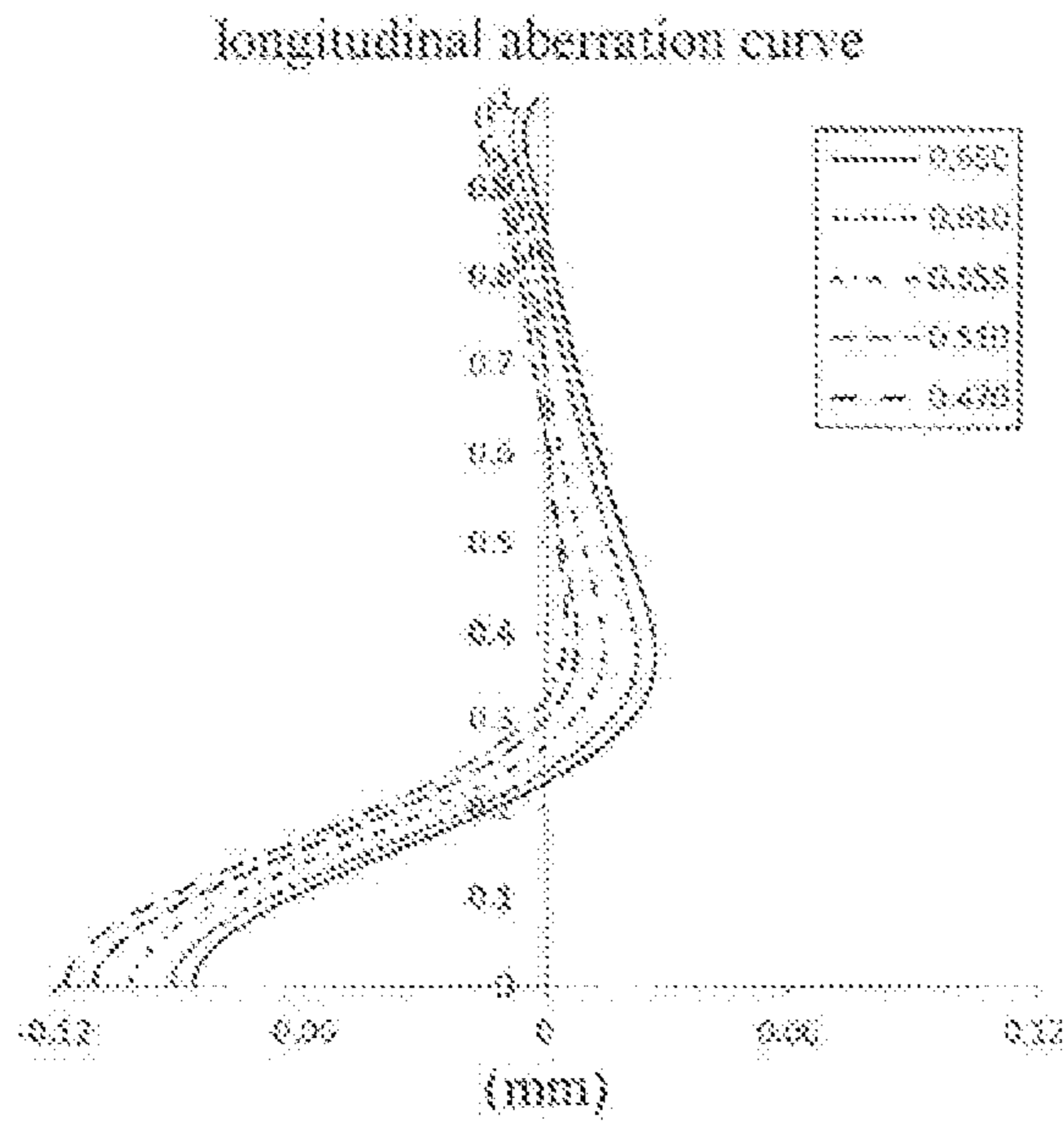


Fig. 8A

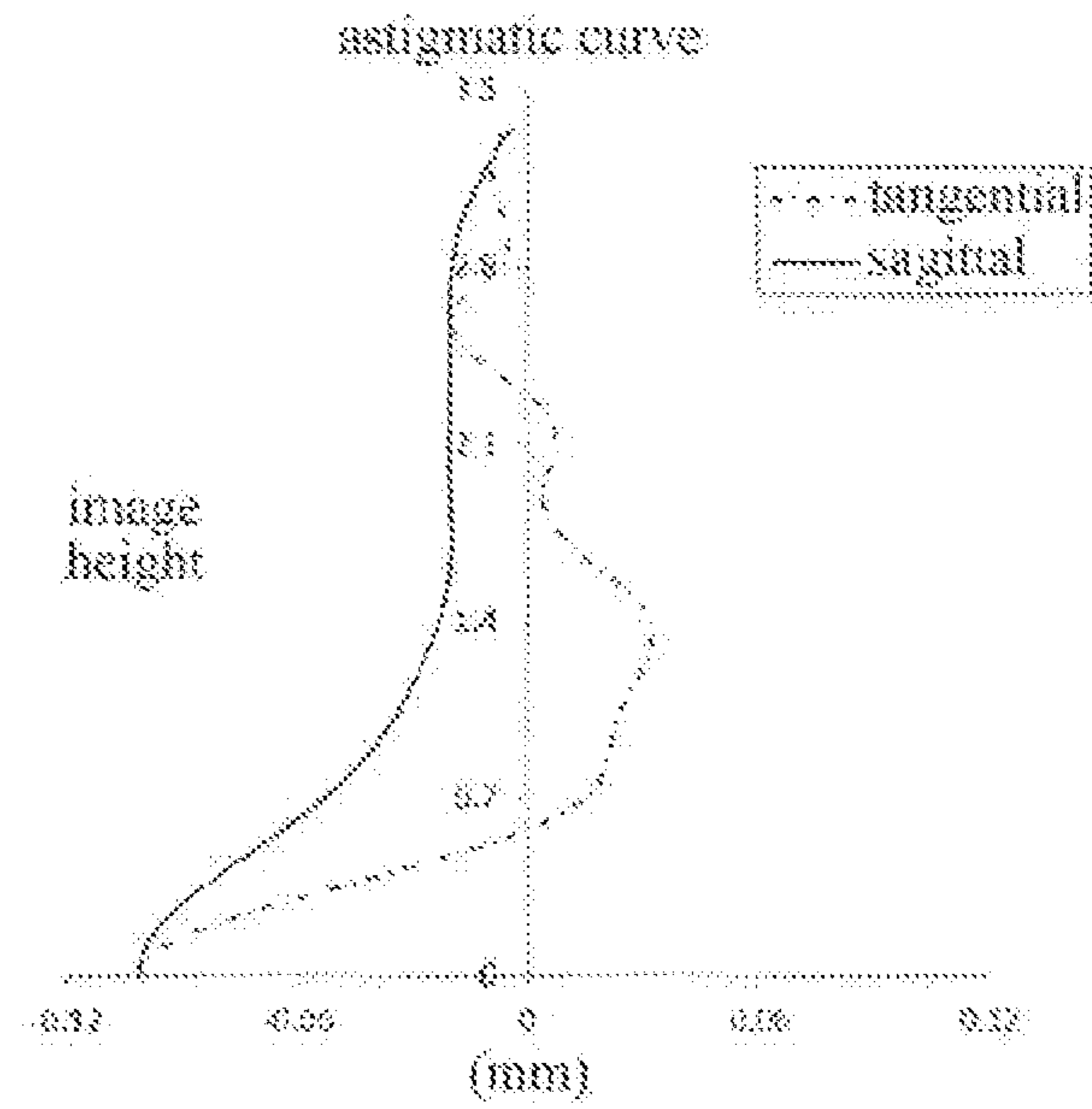


Fig. 8B

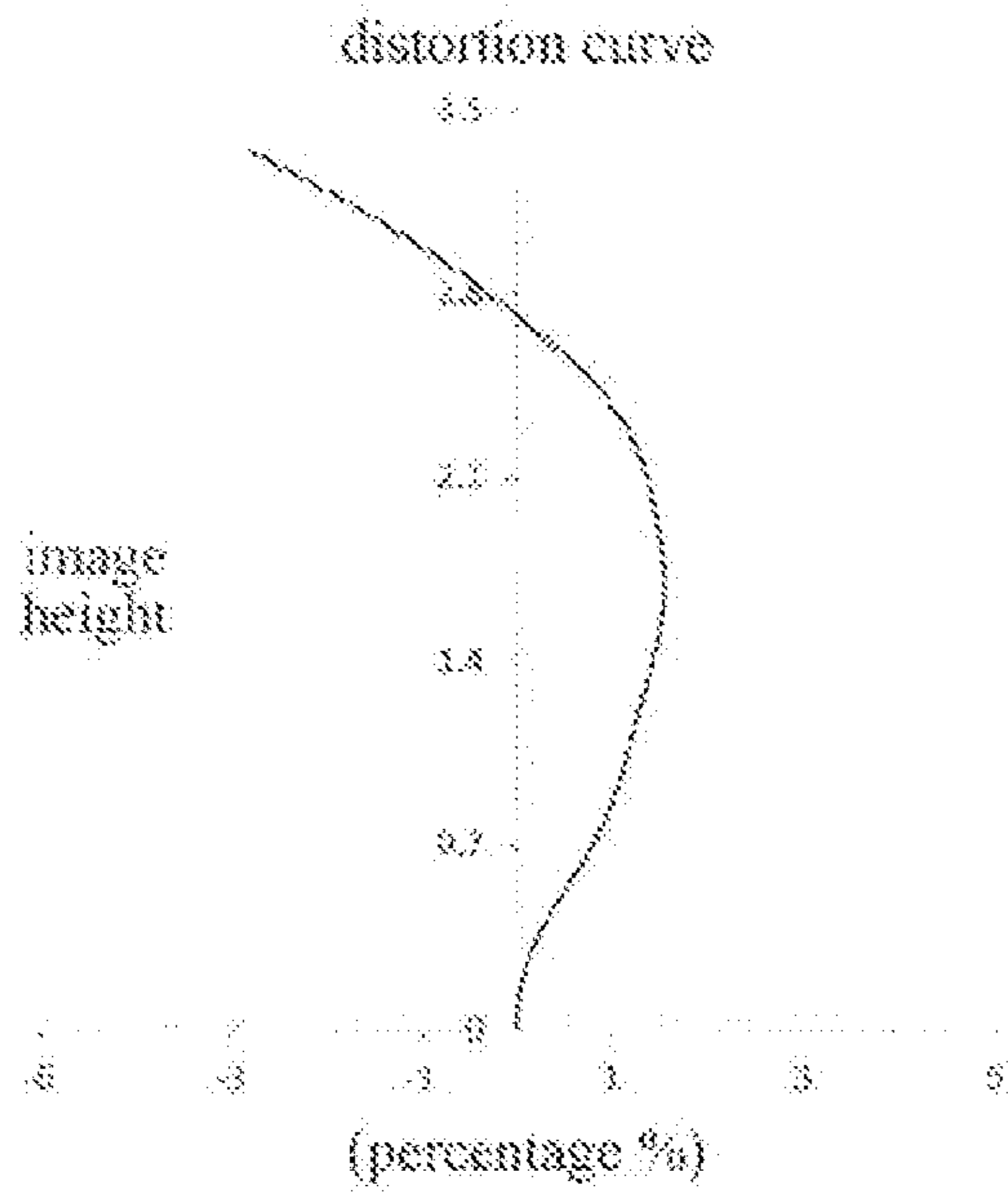


Fig. 8C

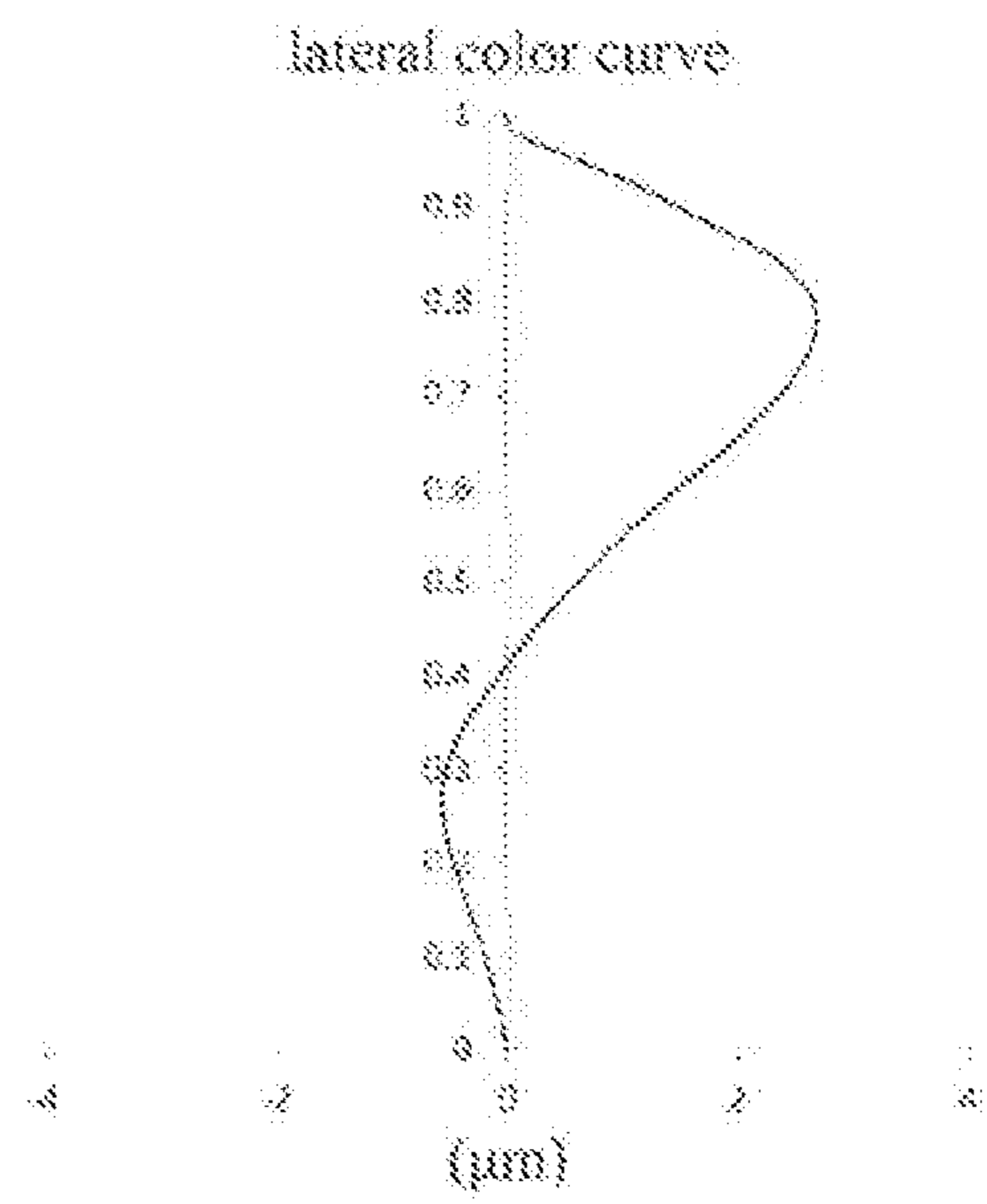


Fig. 8D

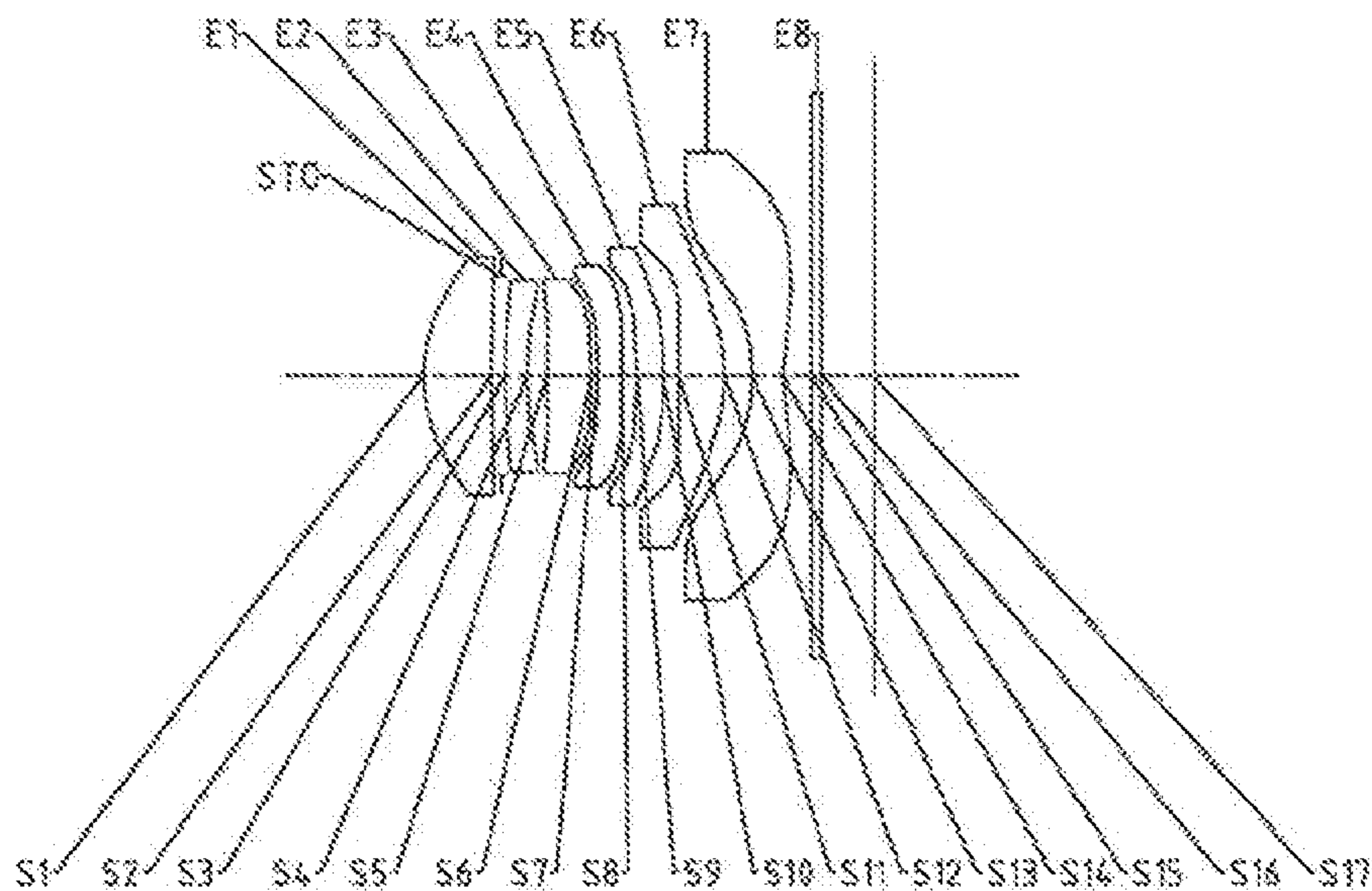


Fig. 9

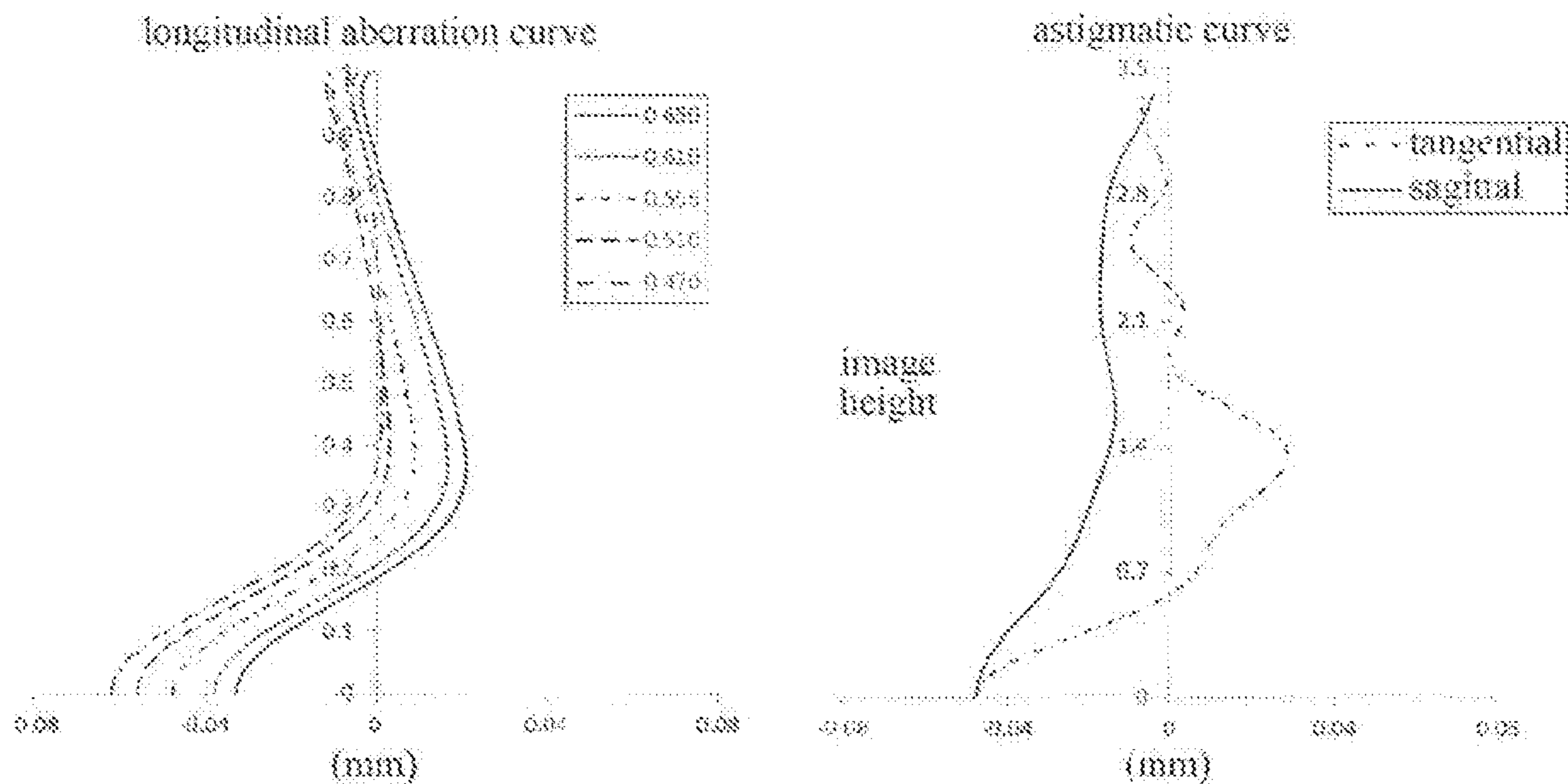


Fig. 10A

Fig. 10B

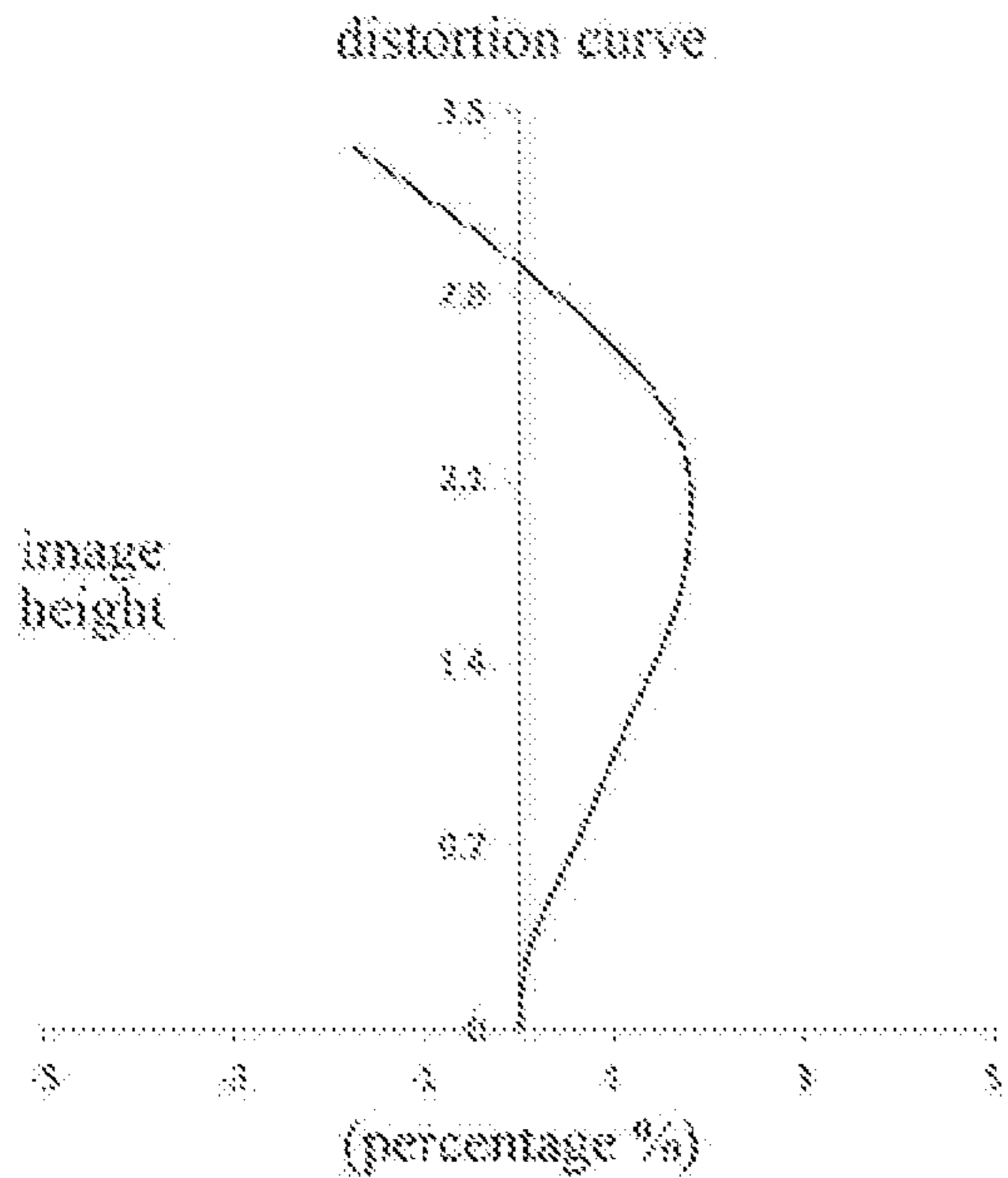


Fig. 10C

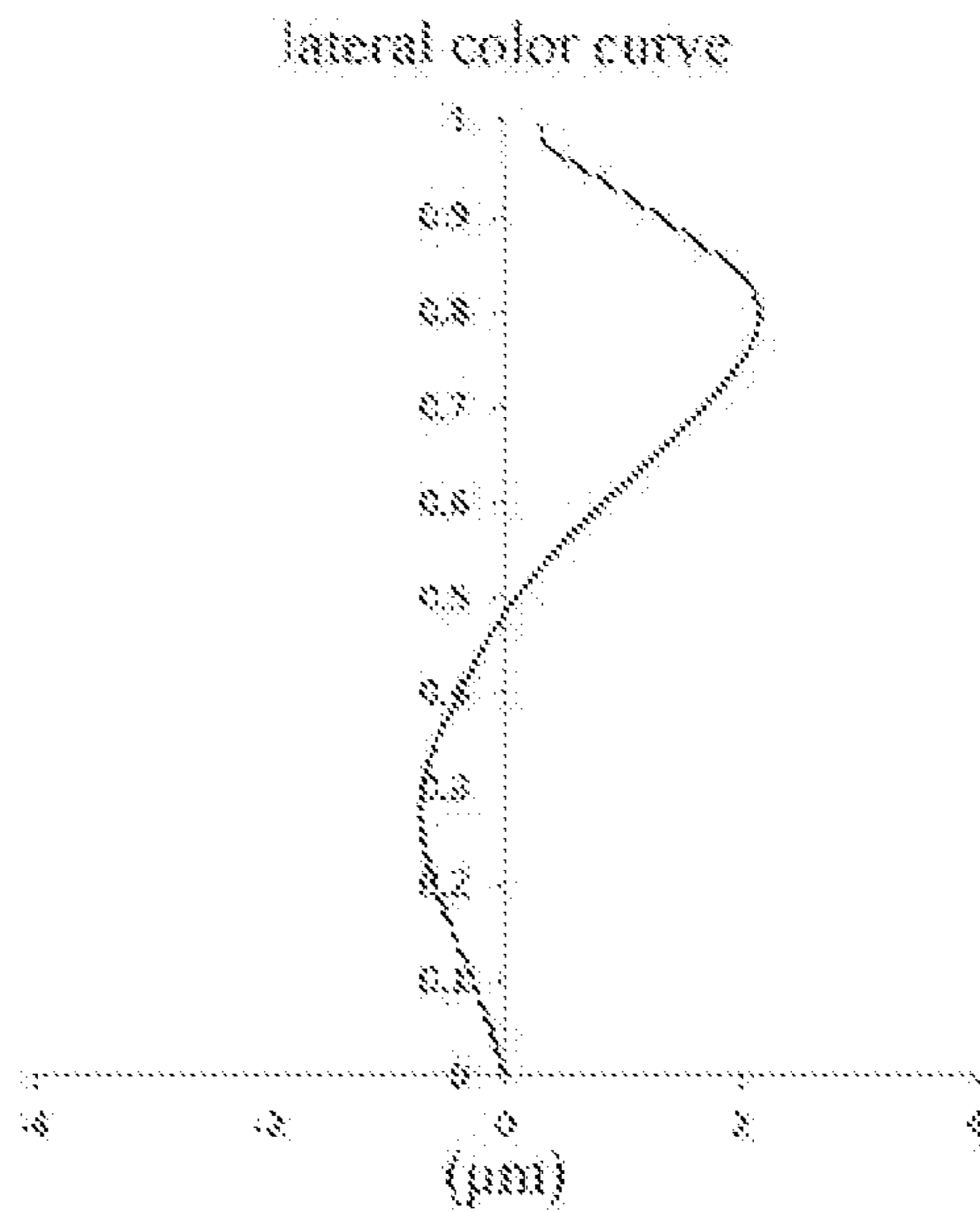


Fig. 10D

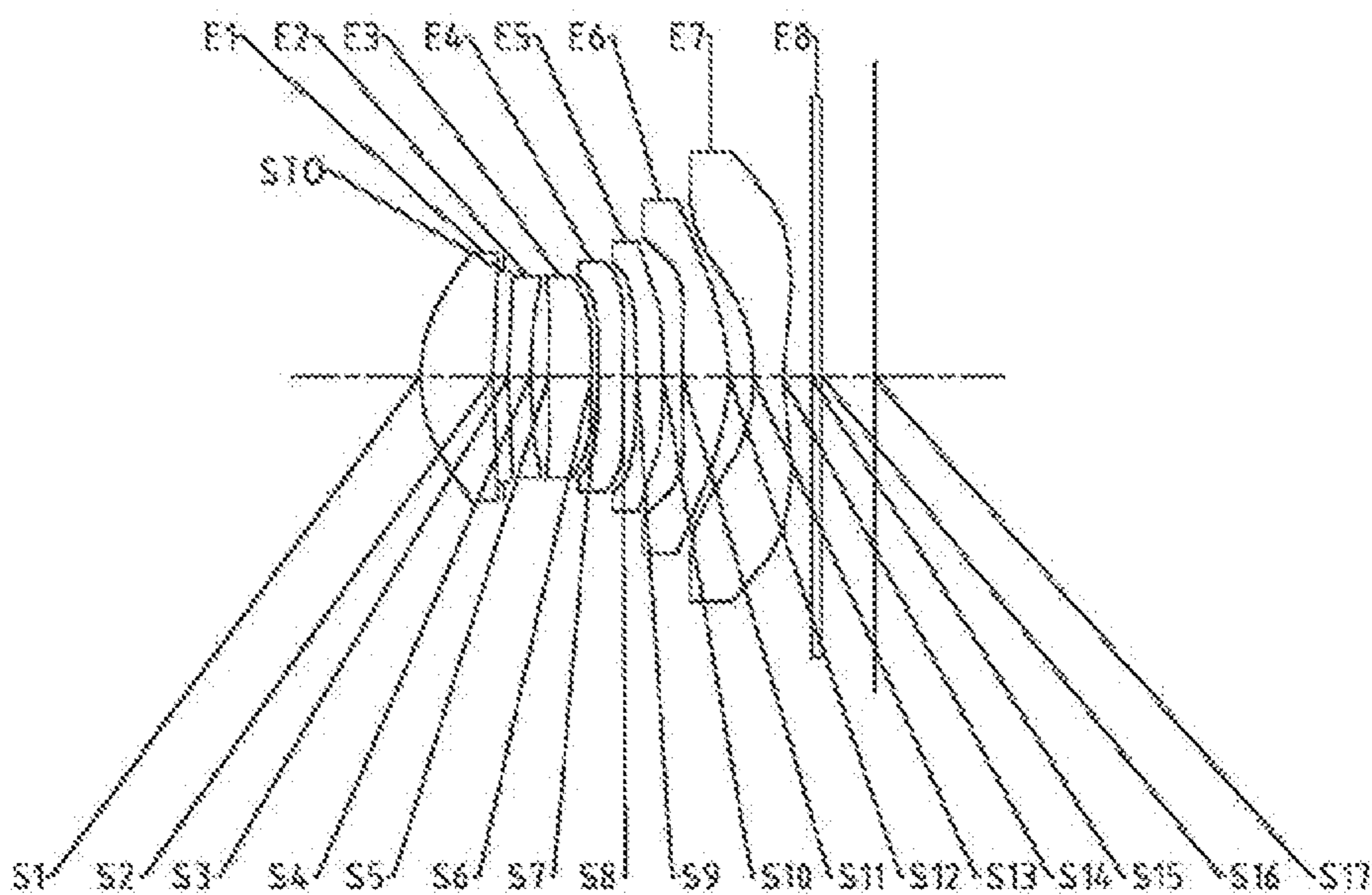


Fig. 11

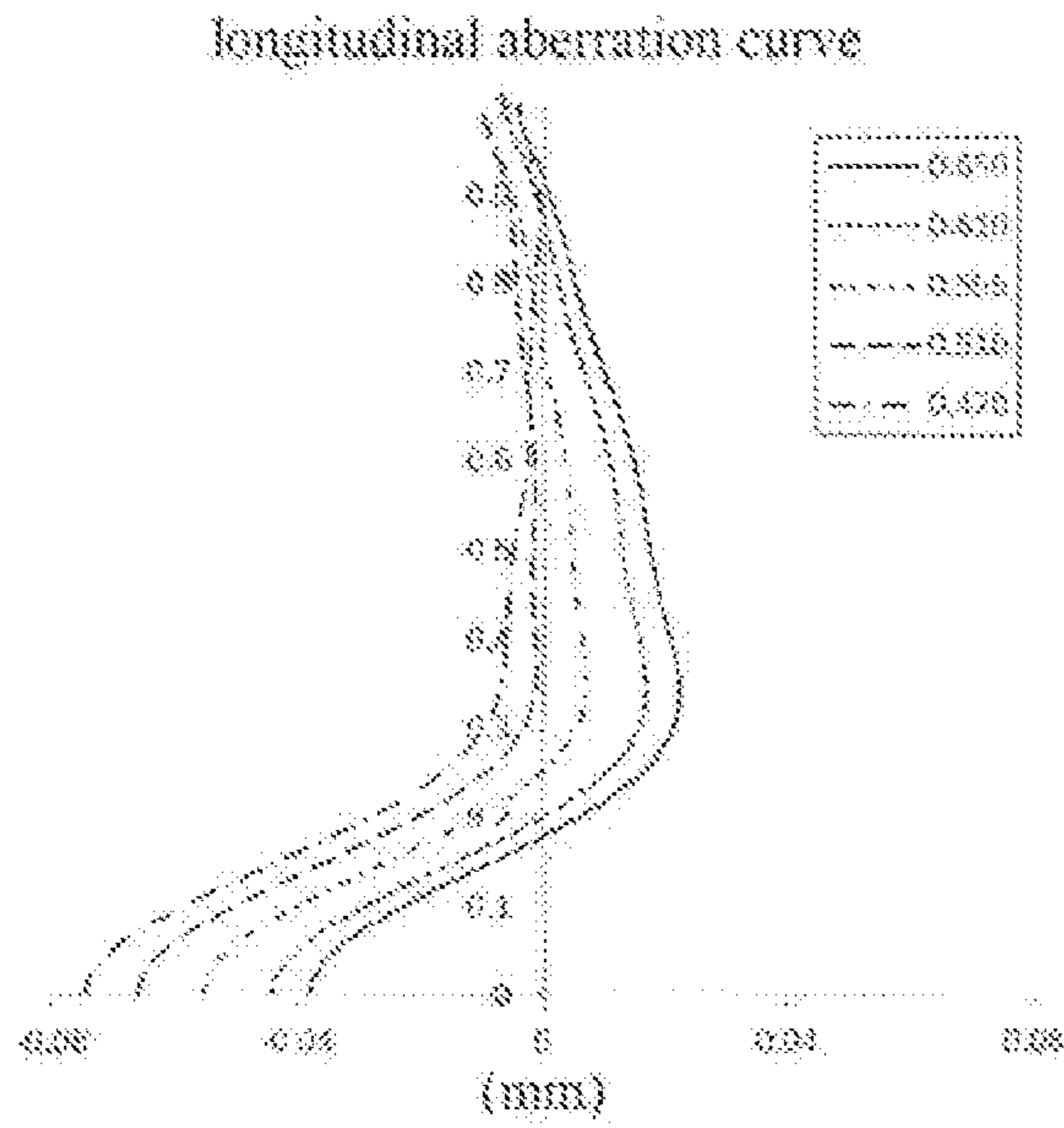


Fig. 12A

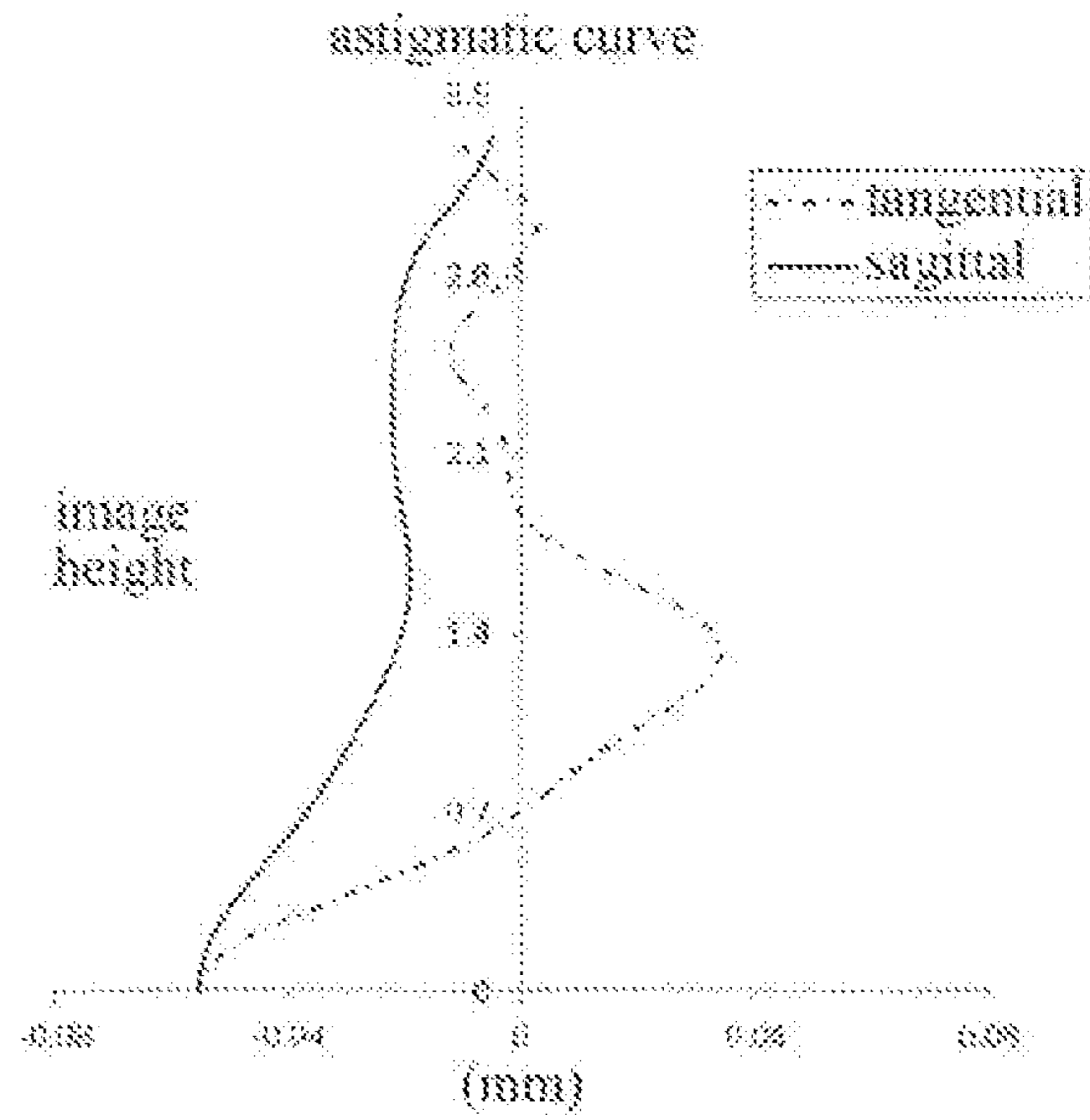


Fig. 12B

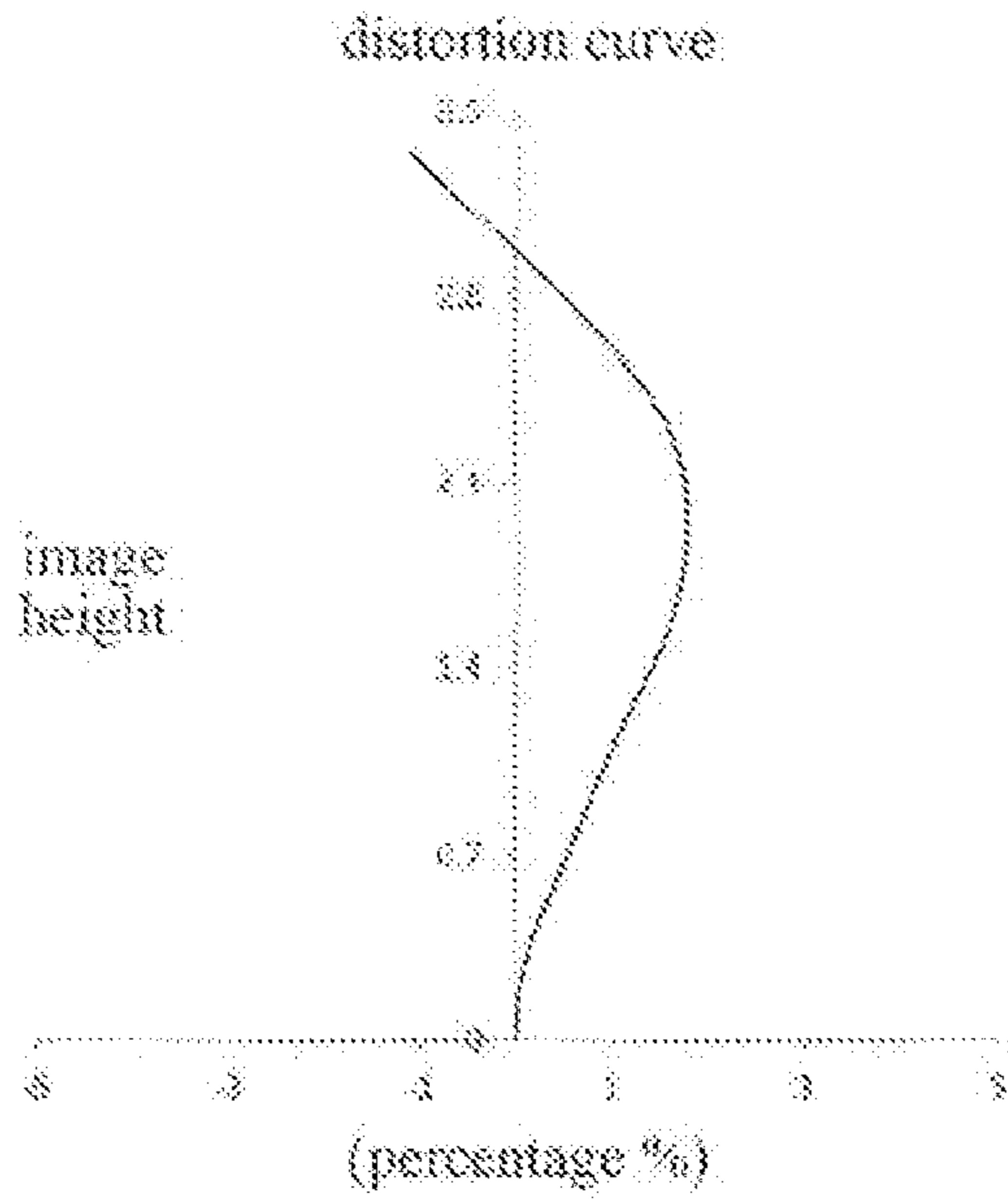


Fig. 12C

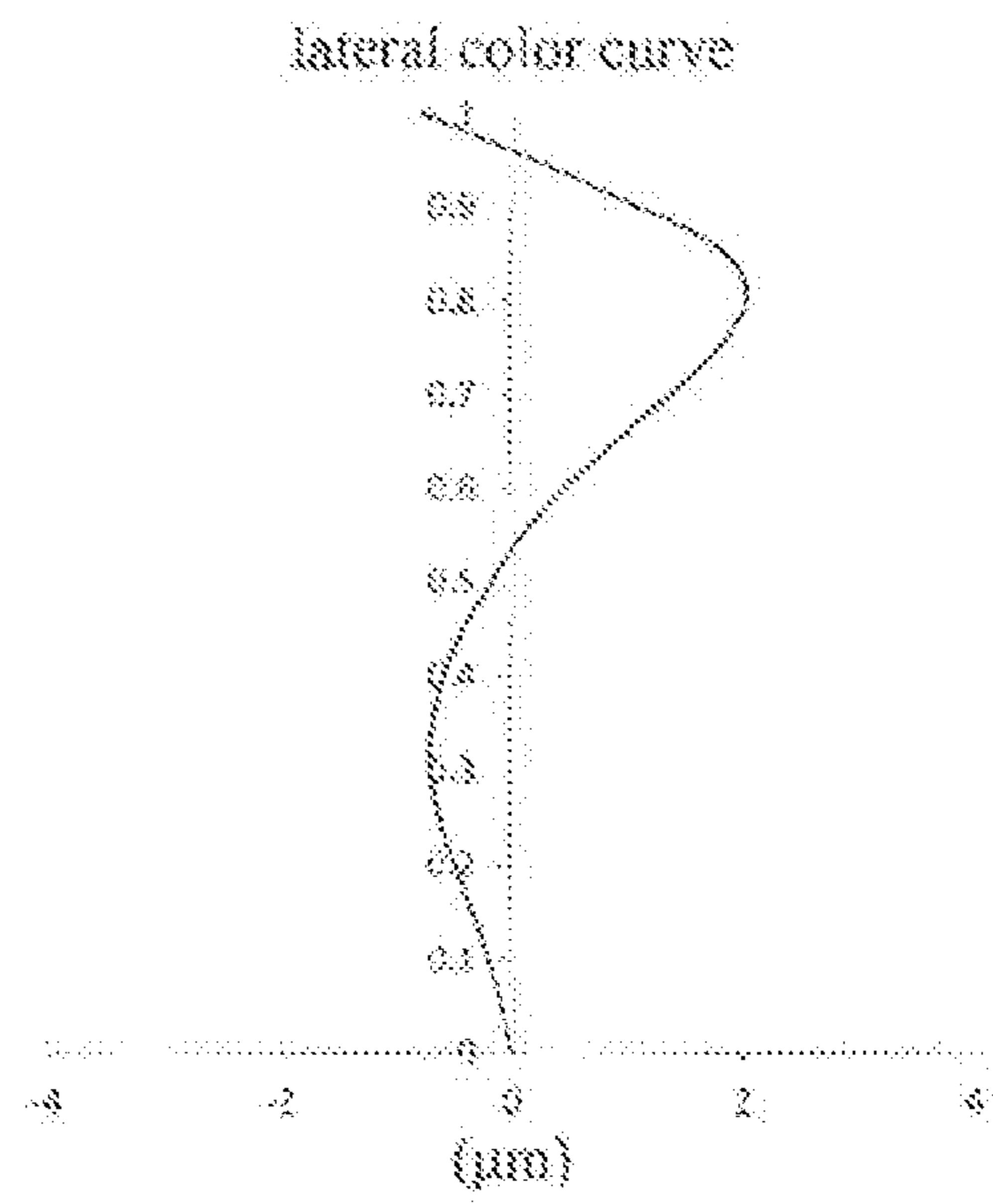


Fig. 12D

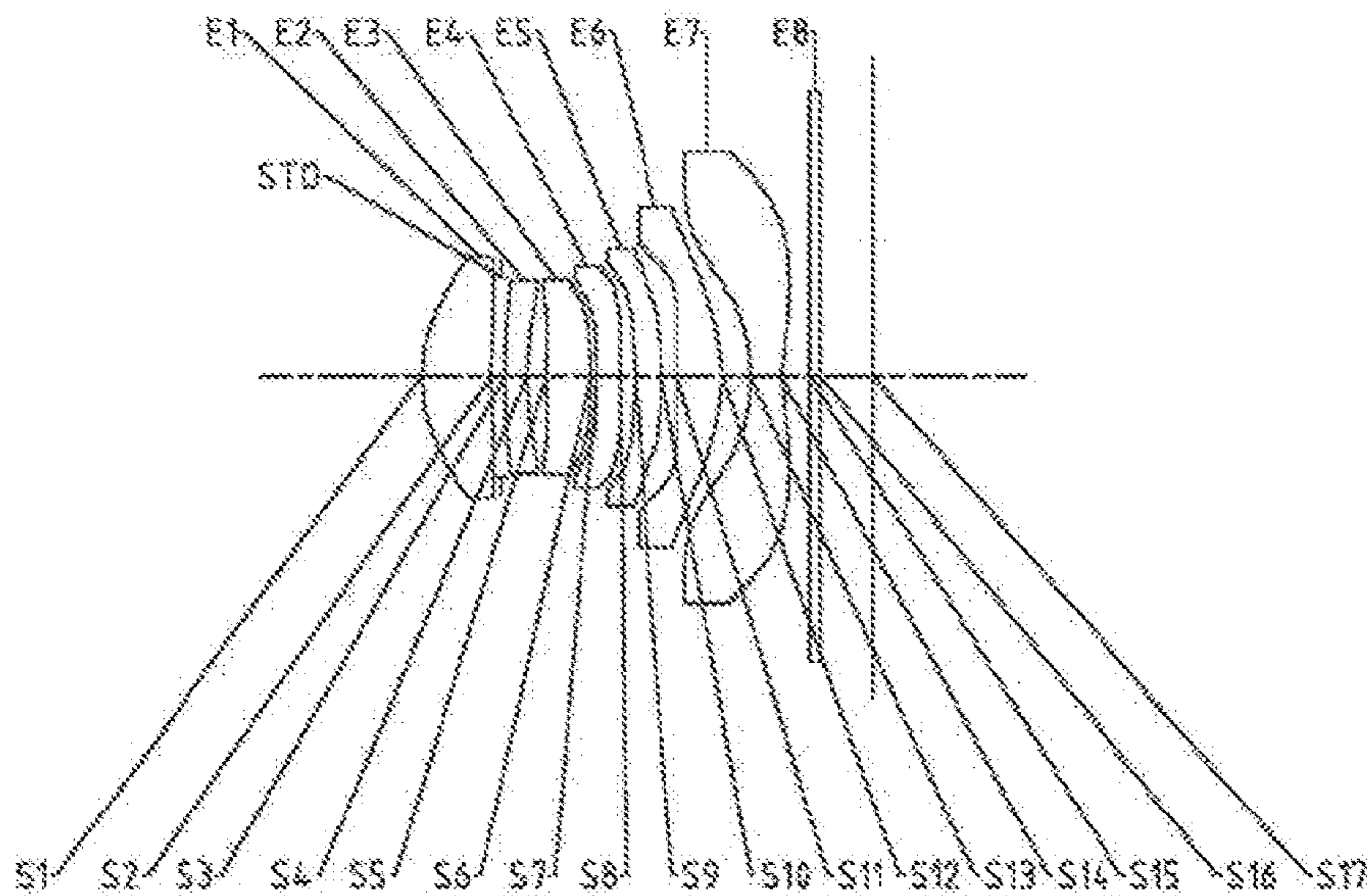


Fig. 13

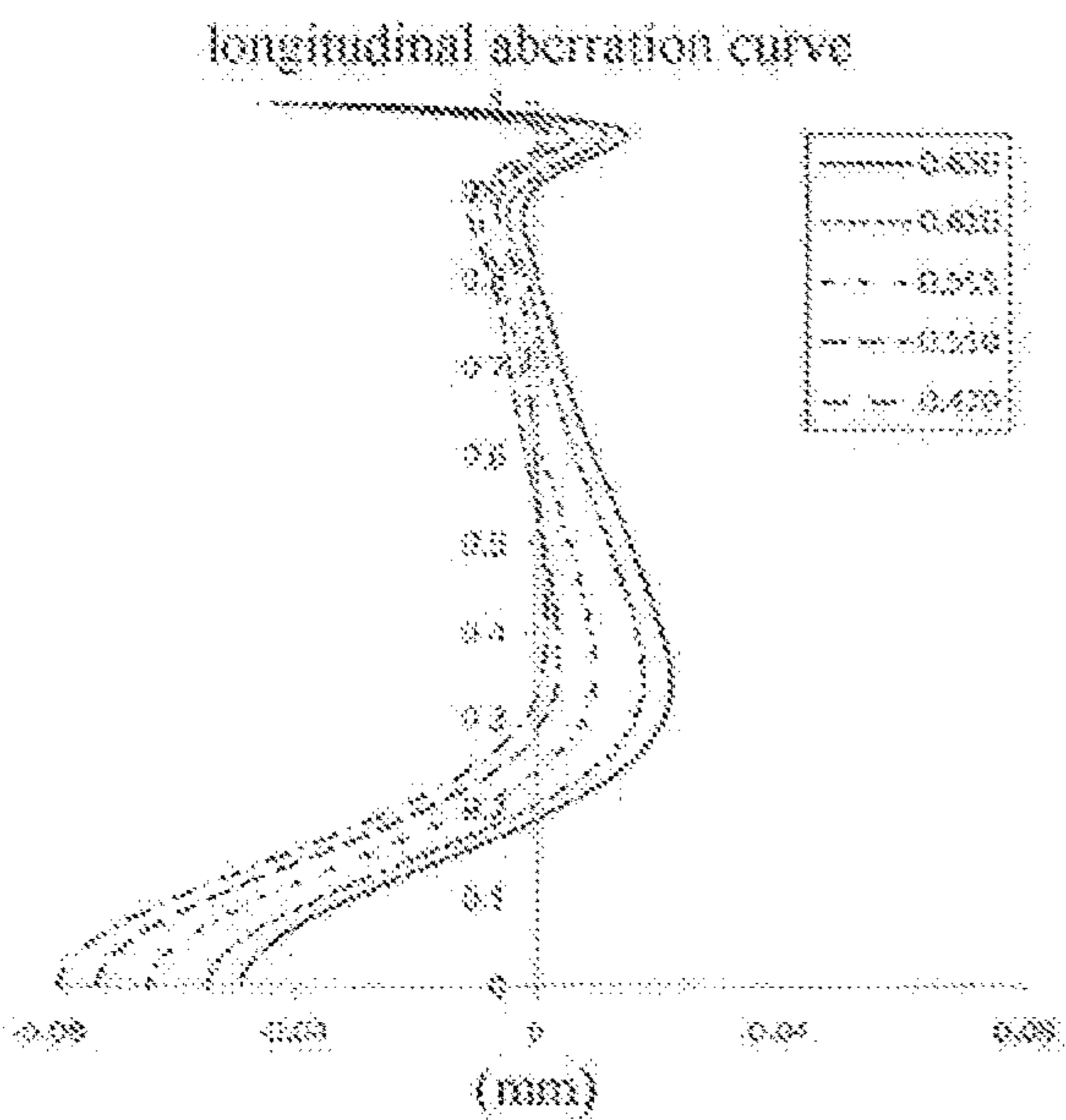


Fig. 14A

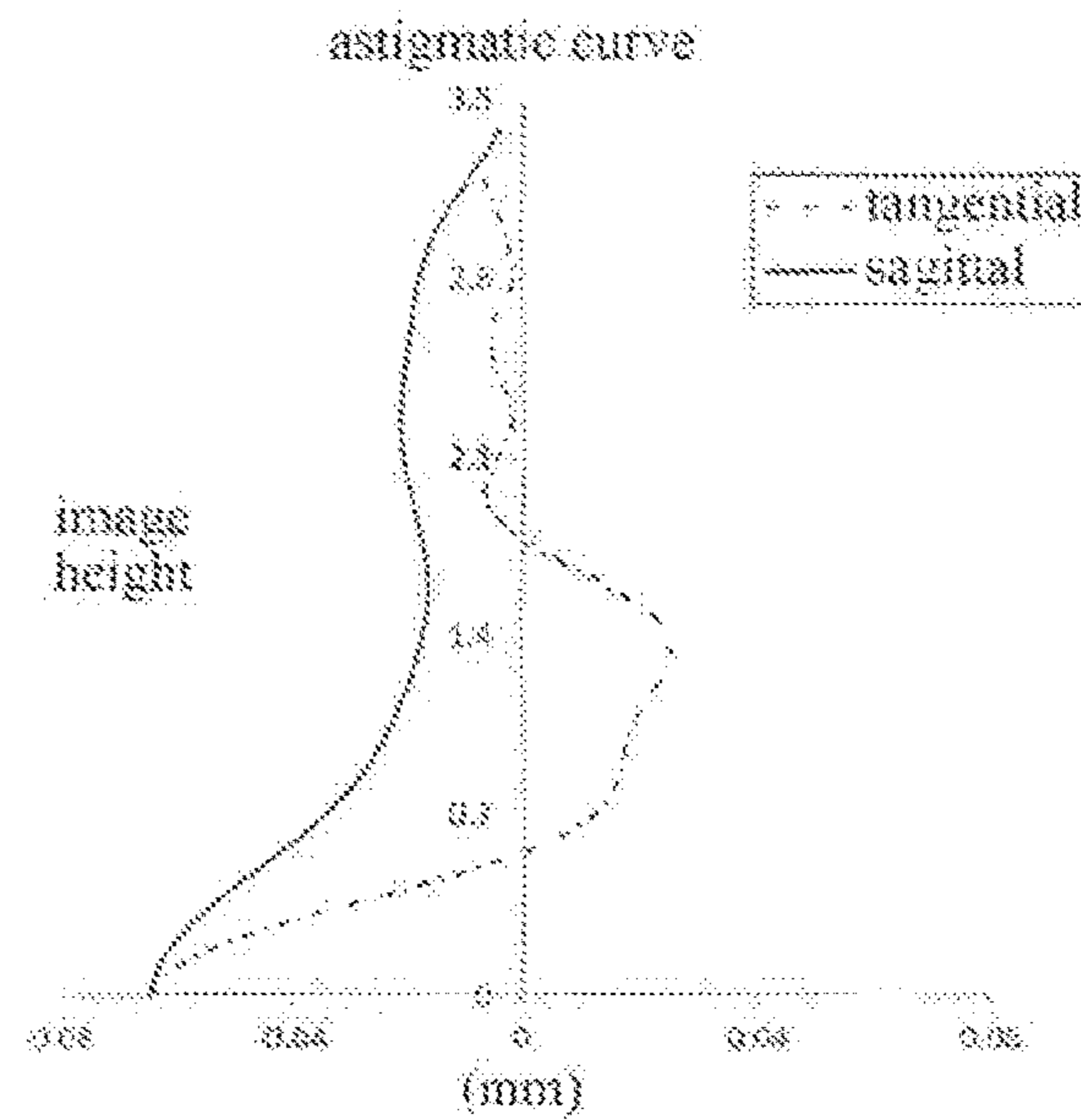


Fig. 14B

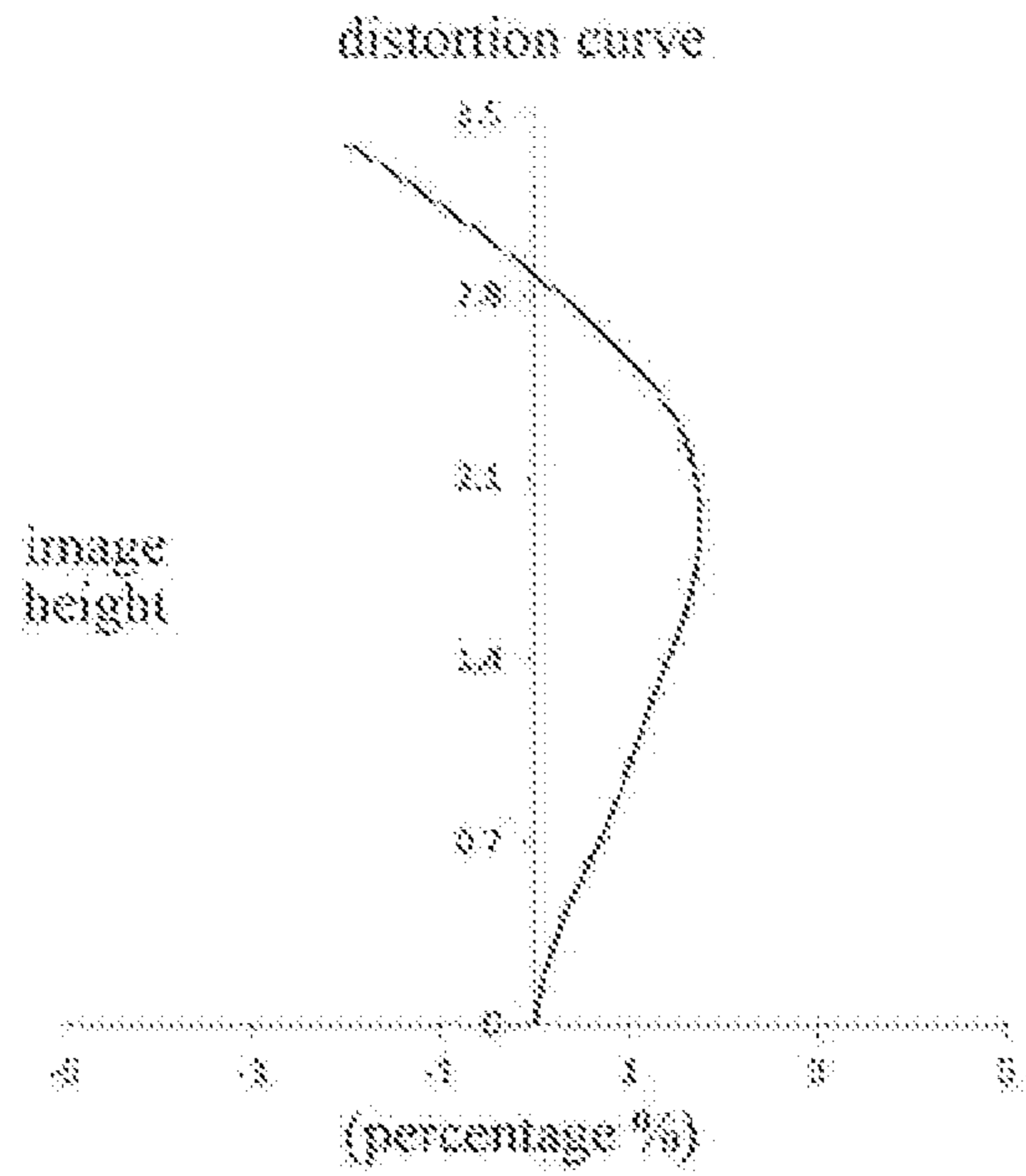


Fig. 14C

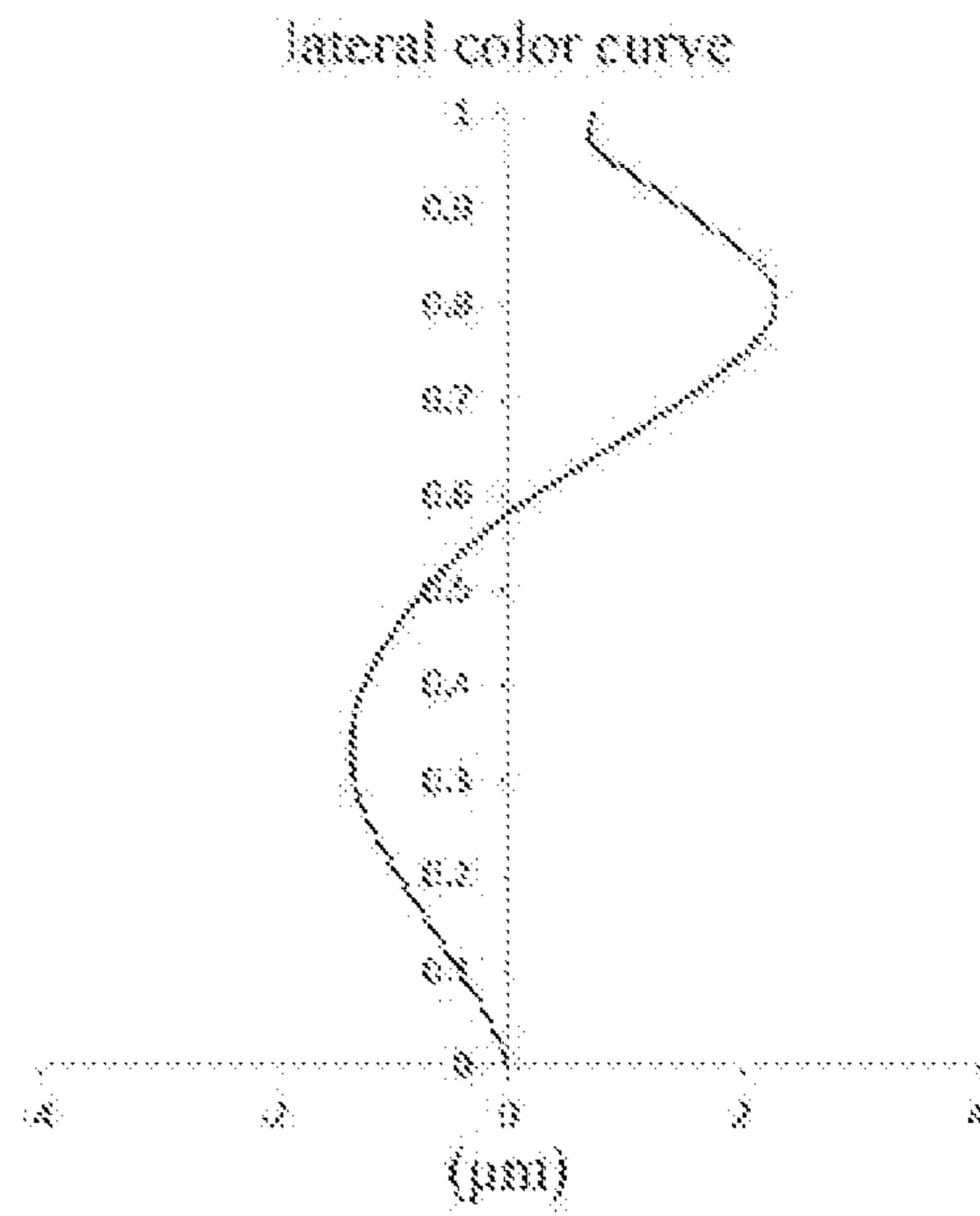


Fig. 14D

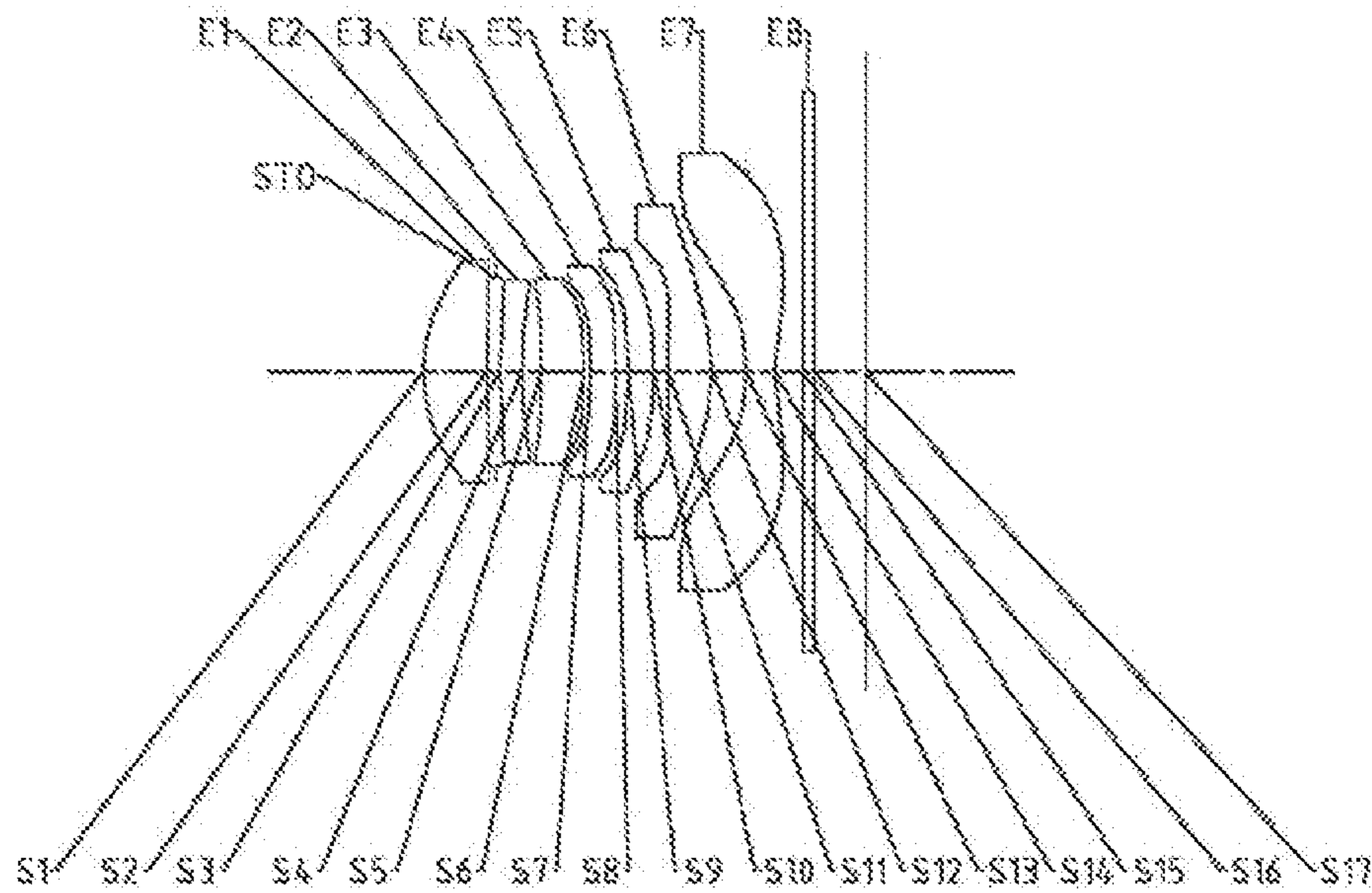


Fig. 15

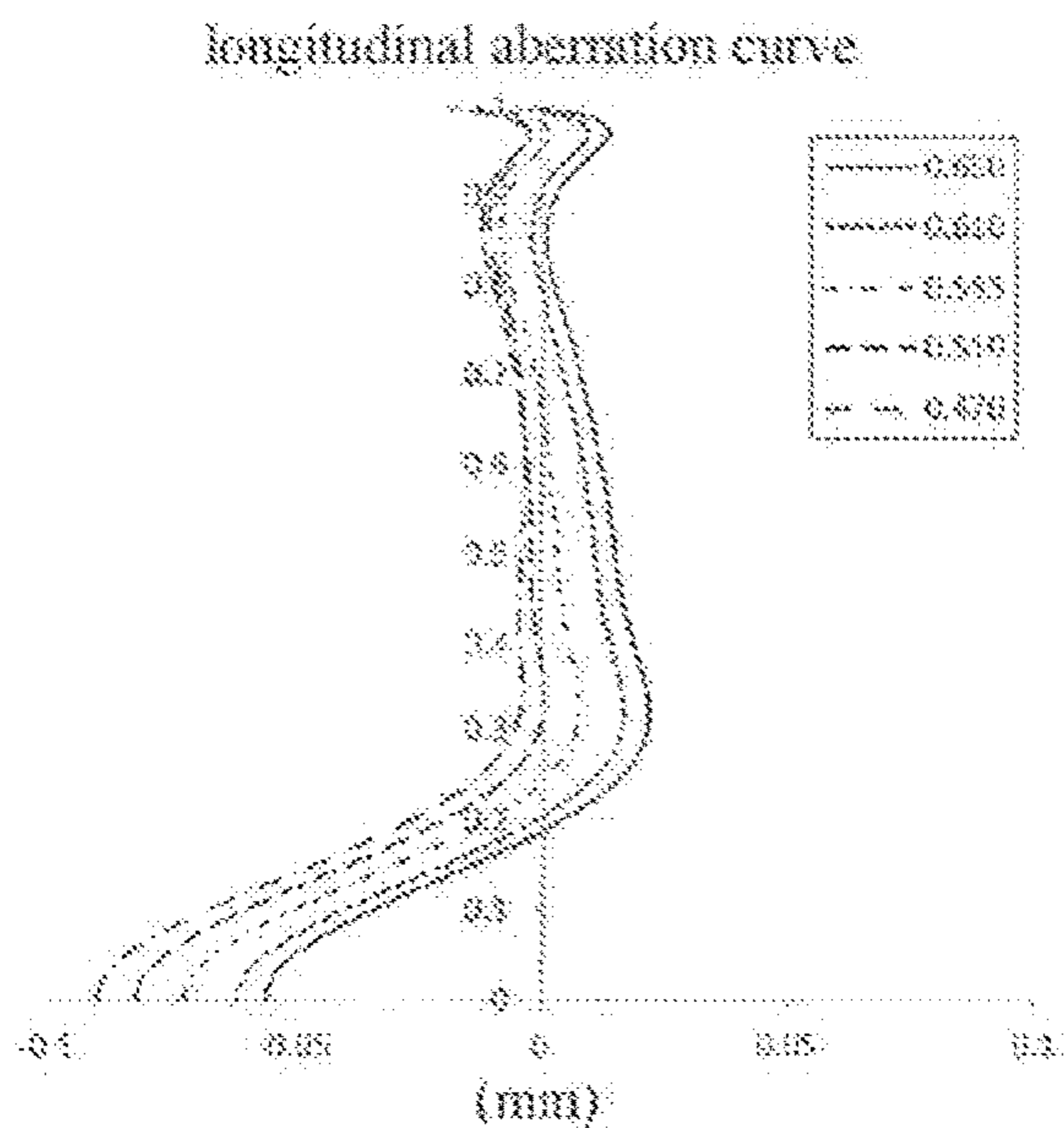


Fig. 16A

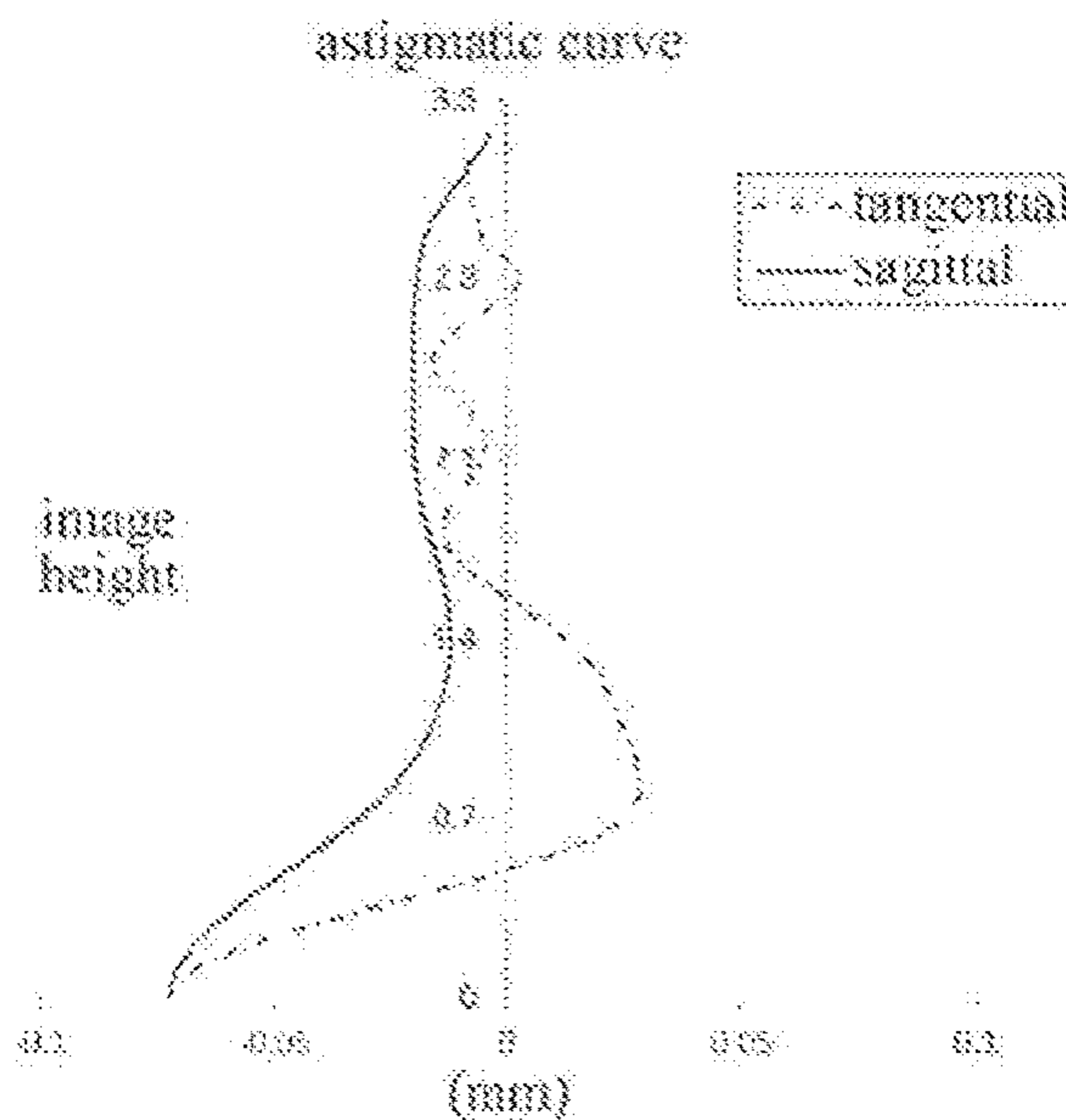


Fig. 16B

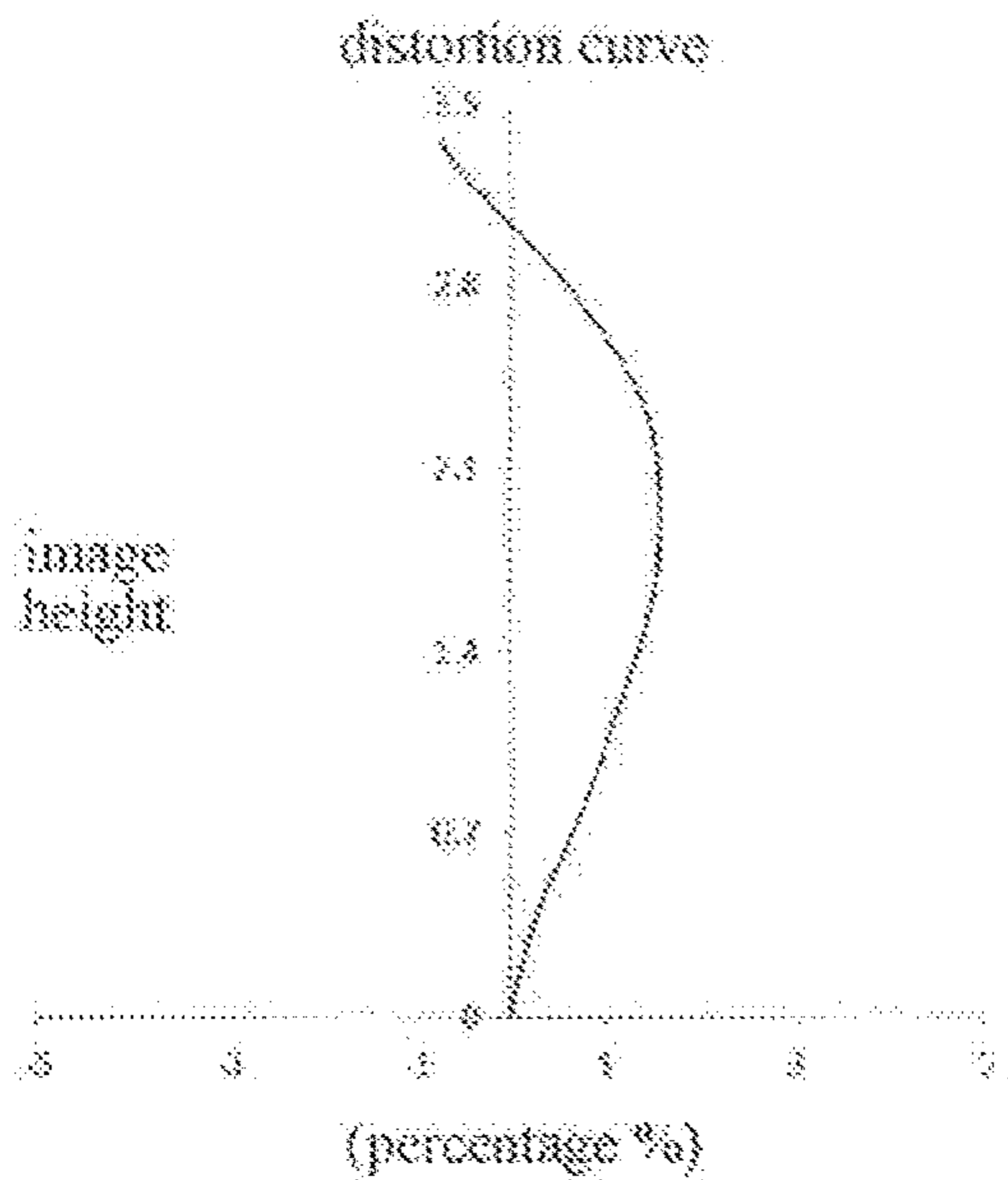


Fig. 16C

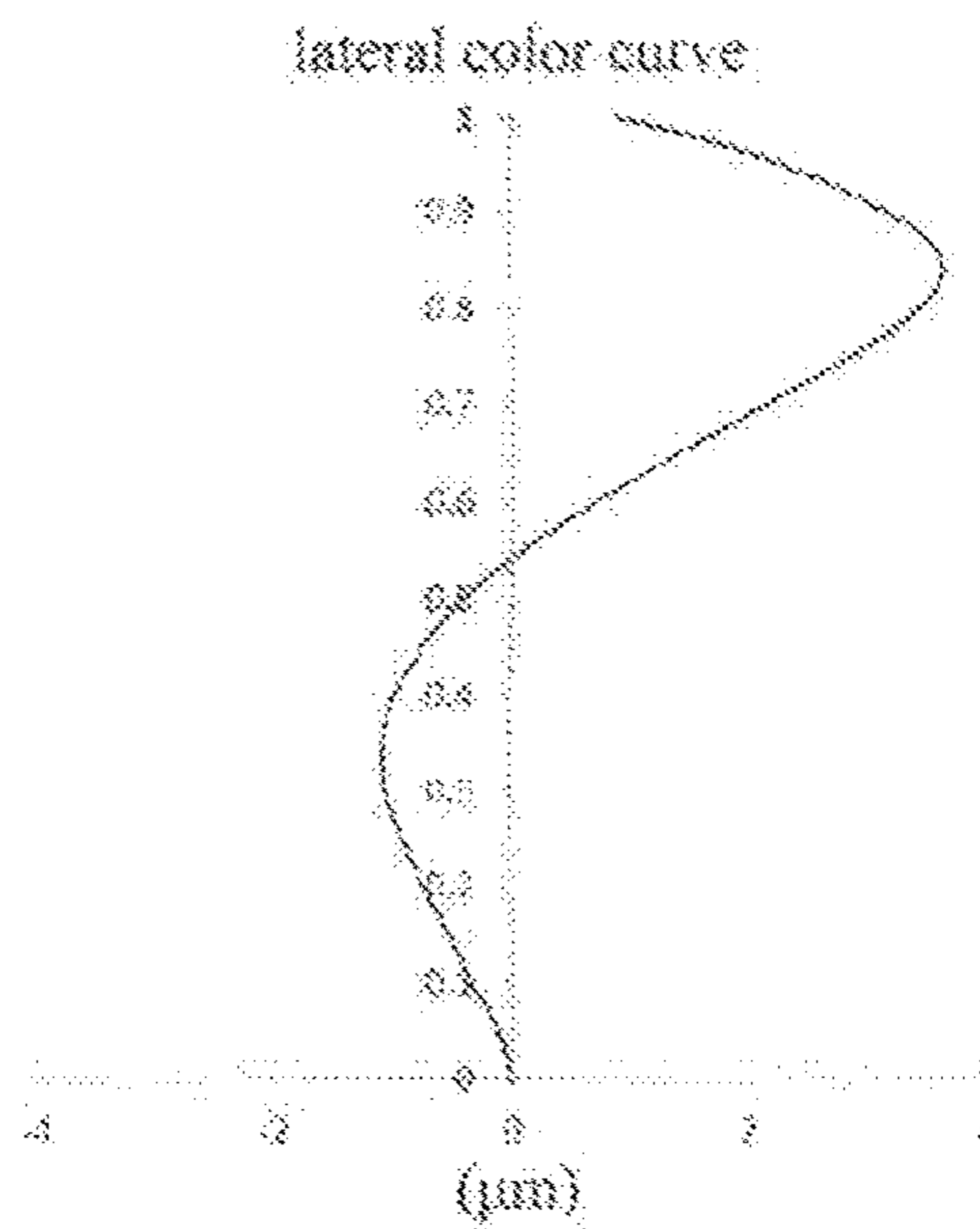


Fig. 16D

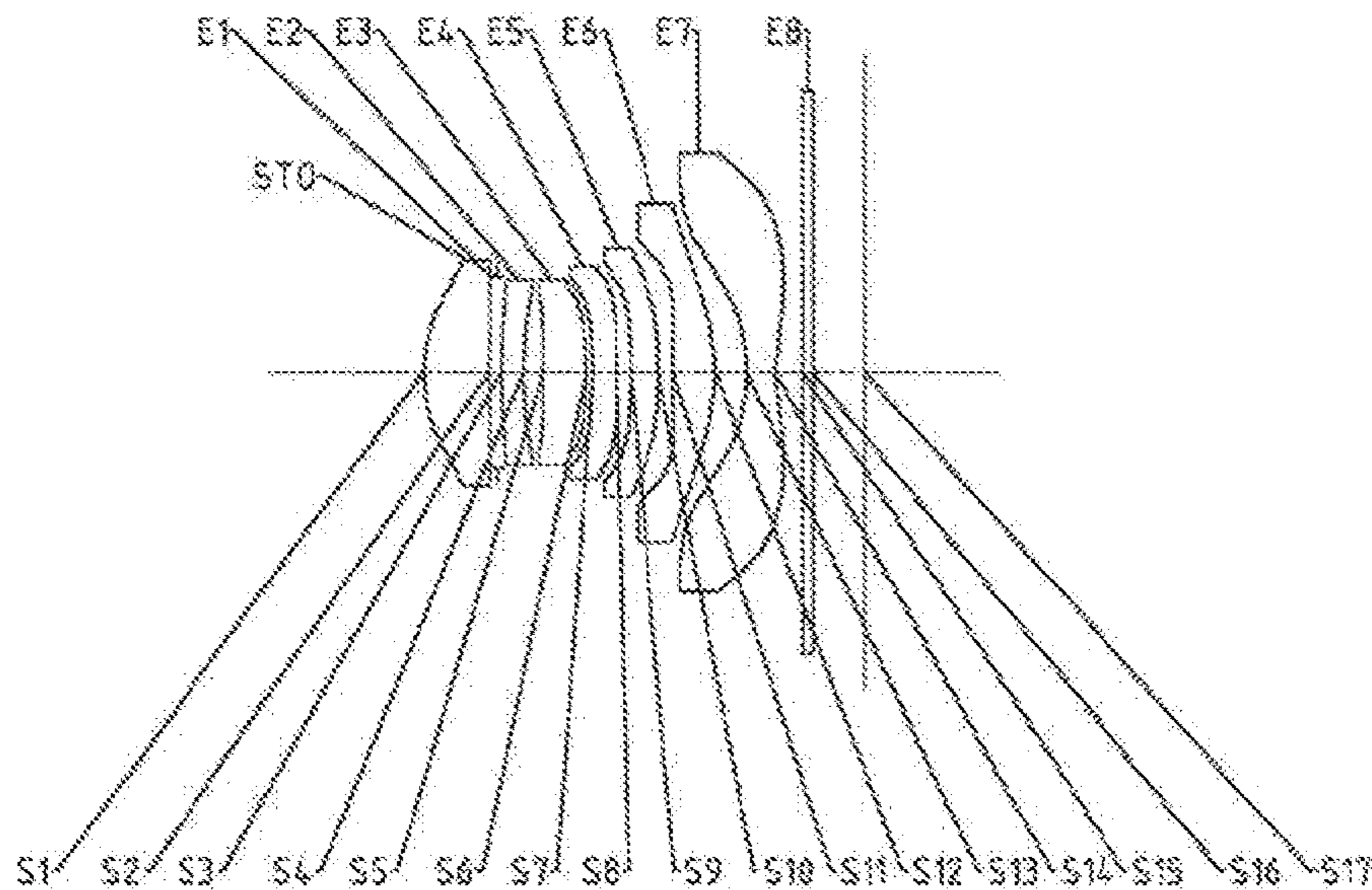


Fig. 17

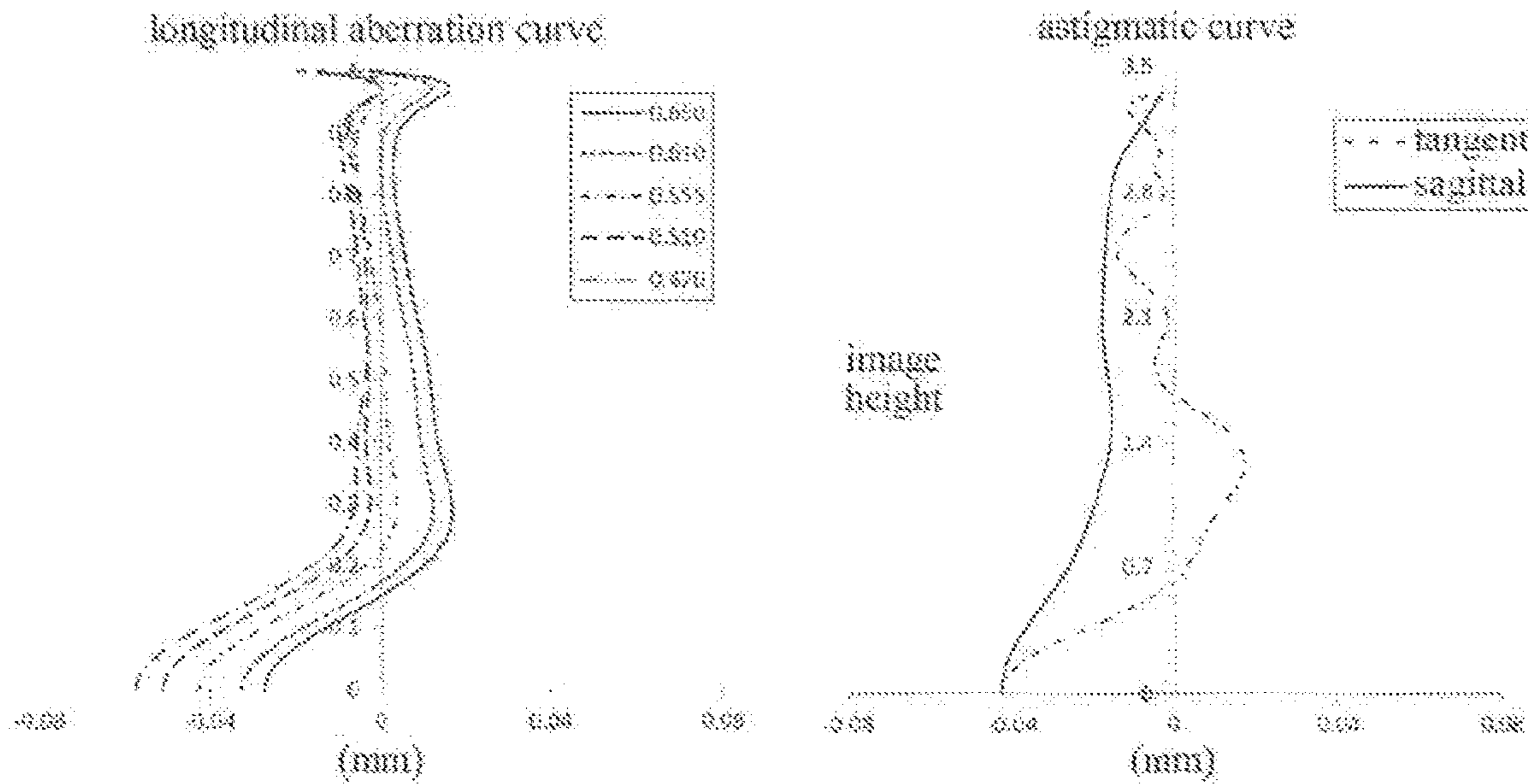


Fig. 18A

Fig. 18B

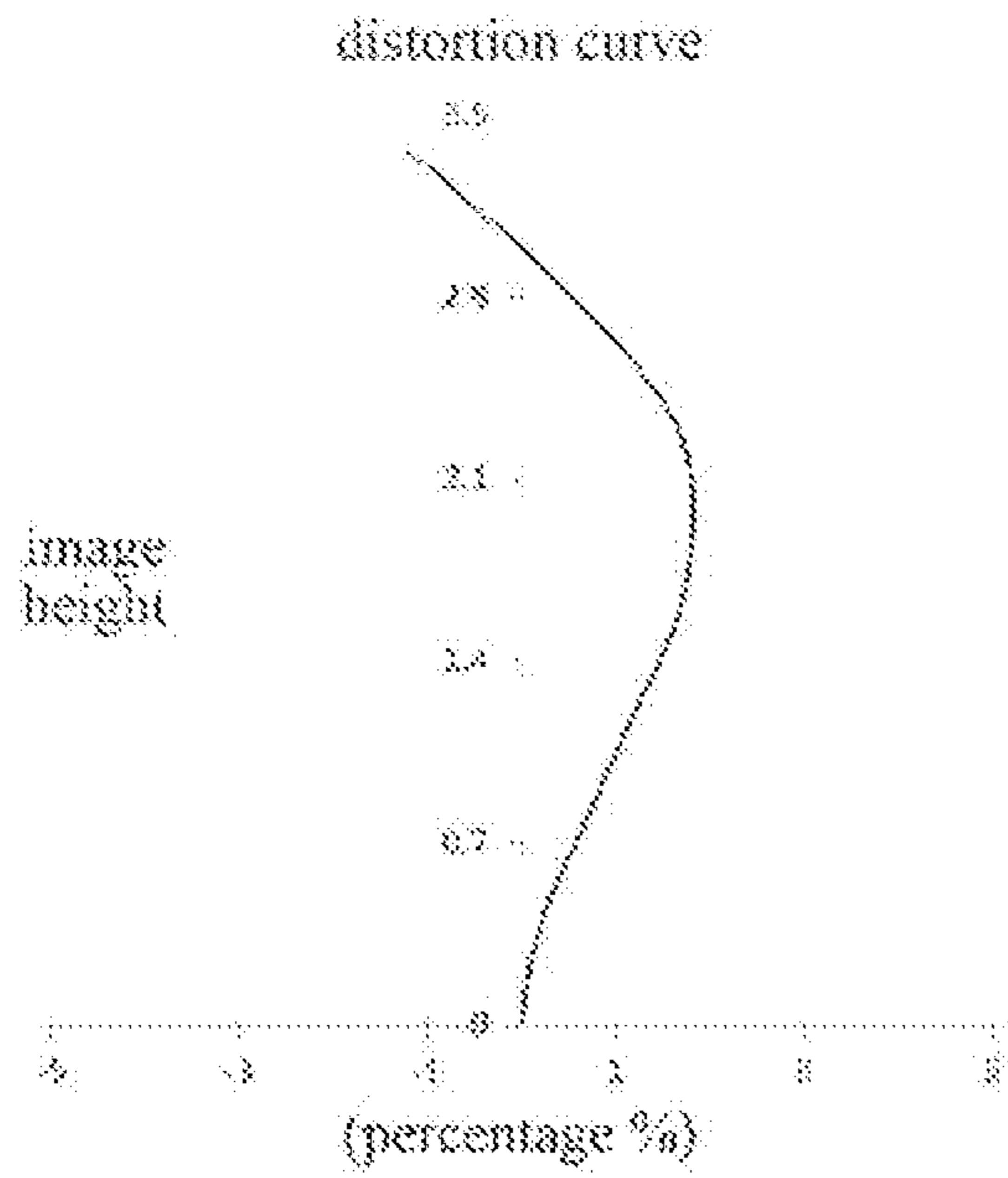


Fig. 18C

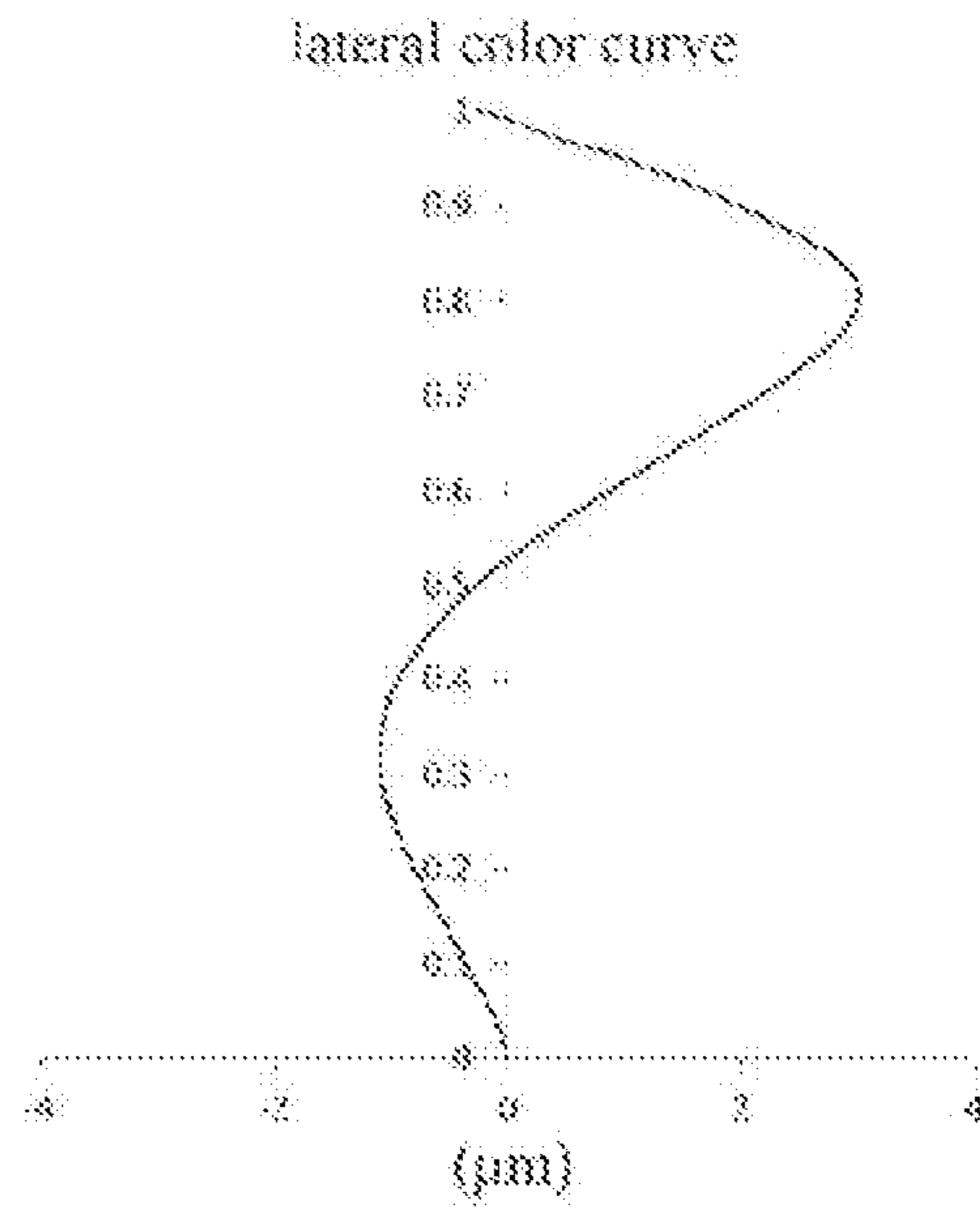


Fig. 18D

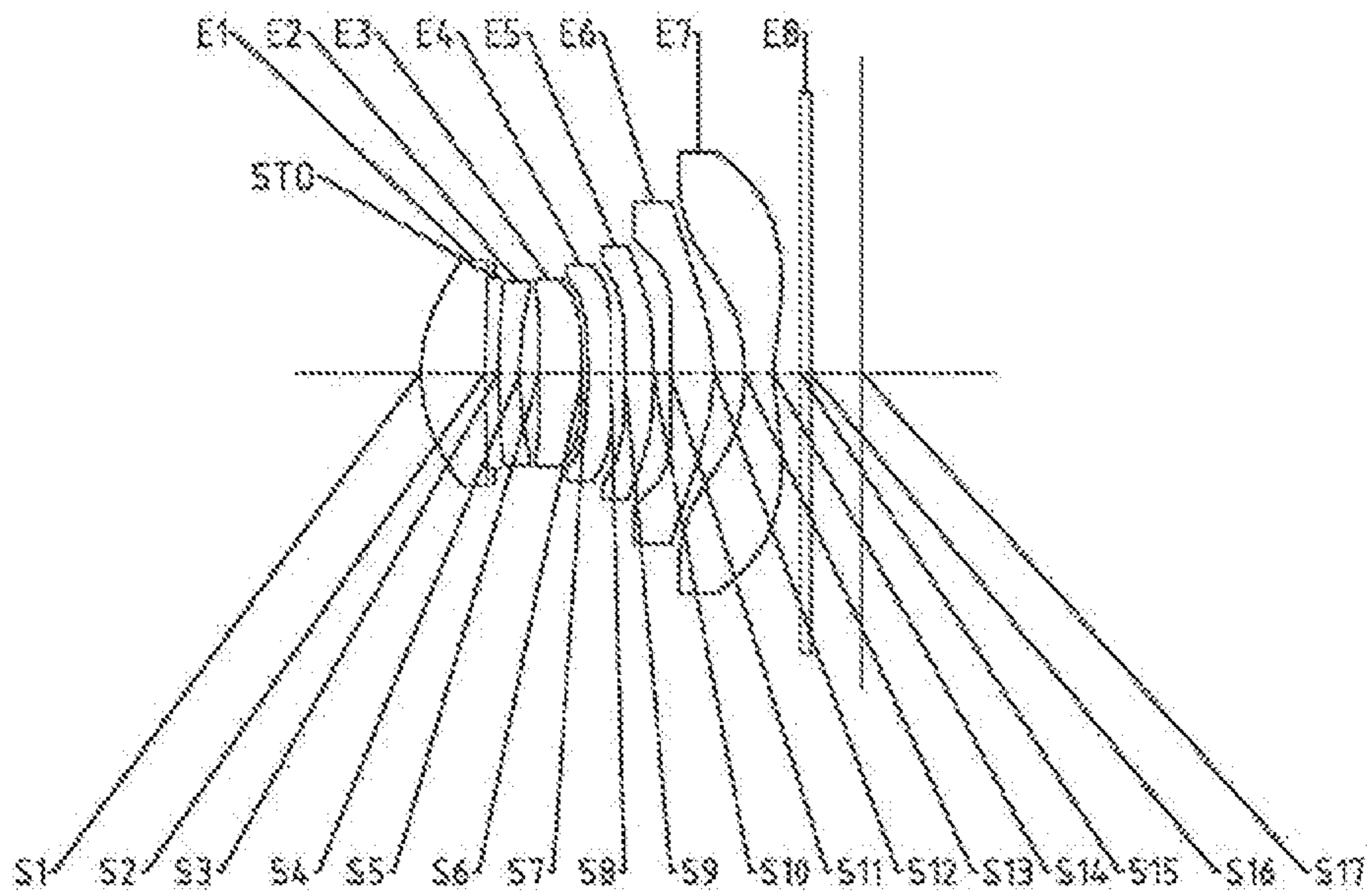


Fig. 19

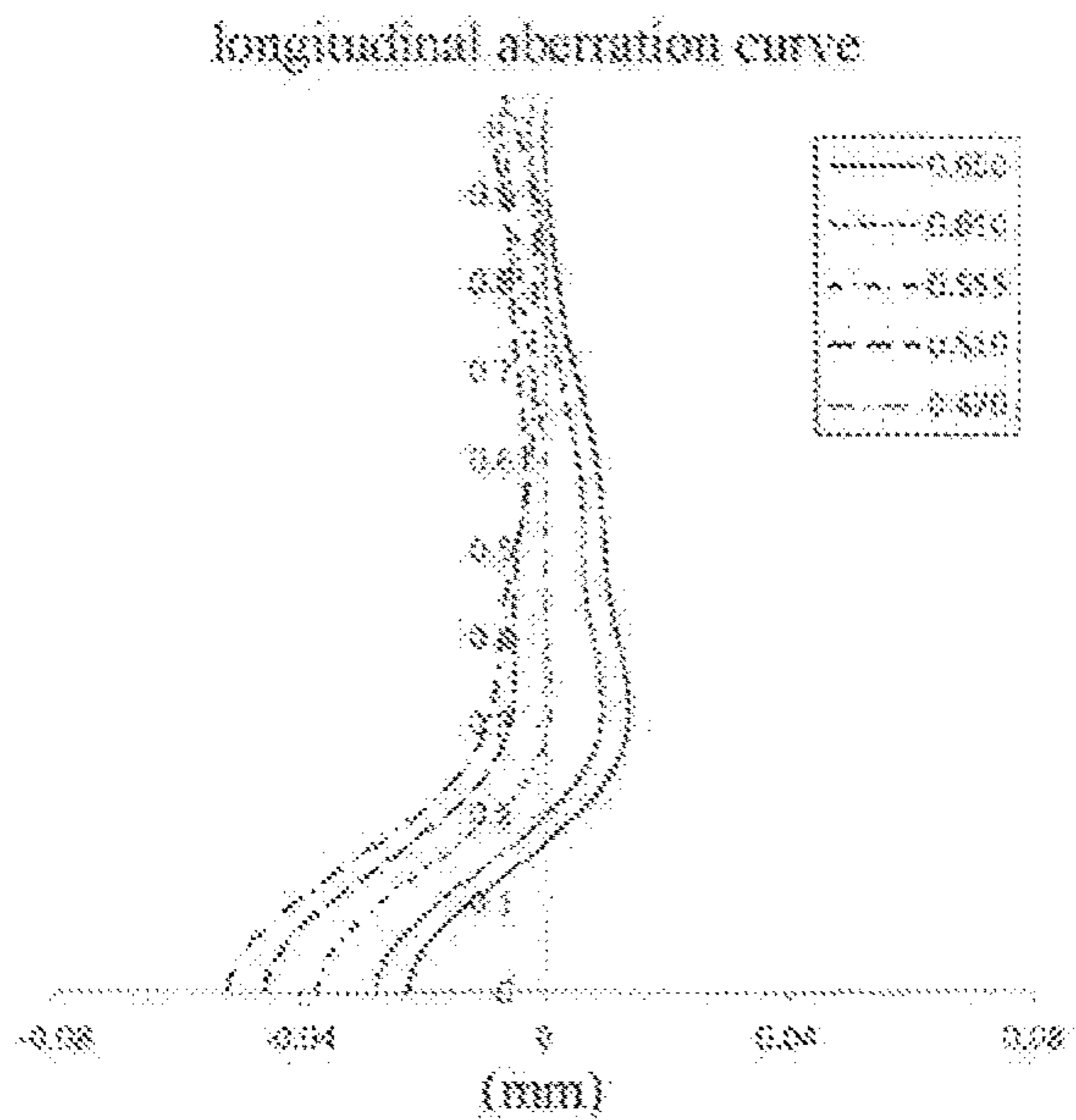


Fig. 20A

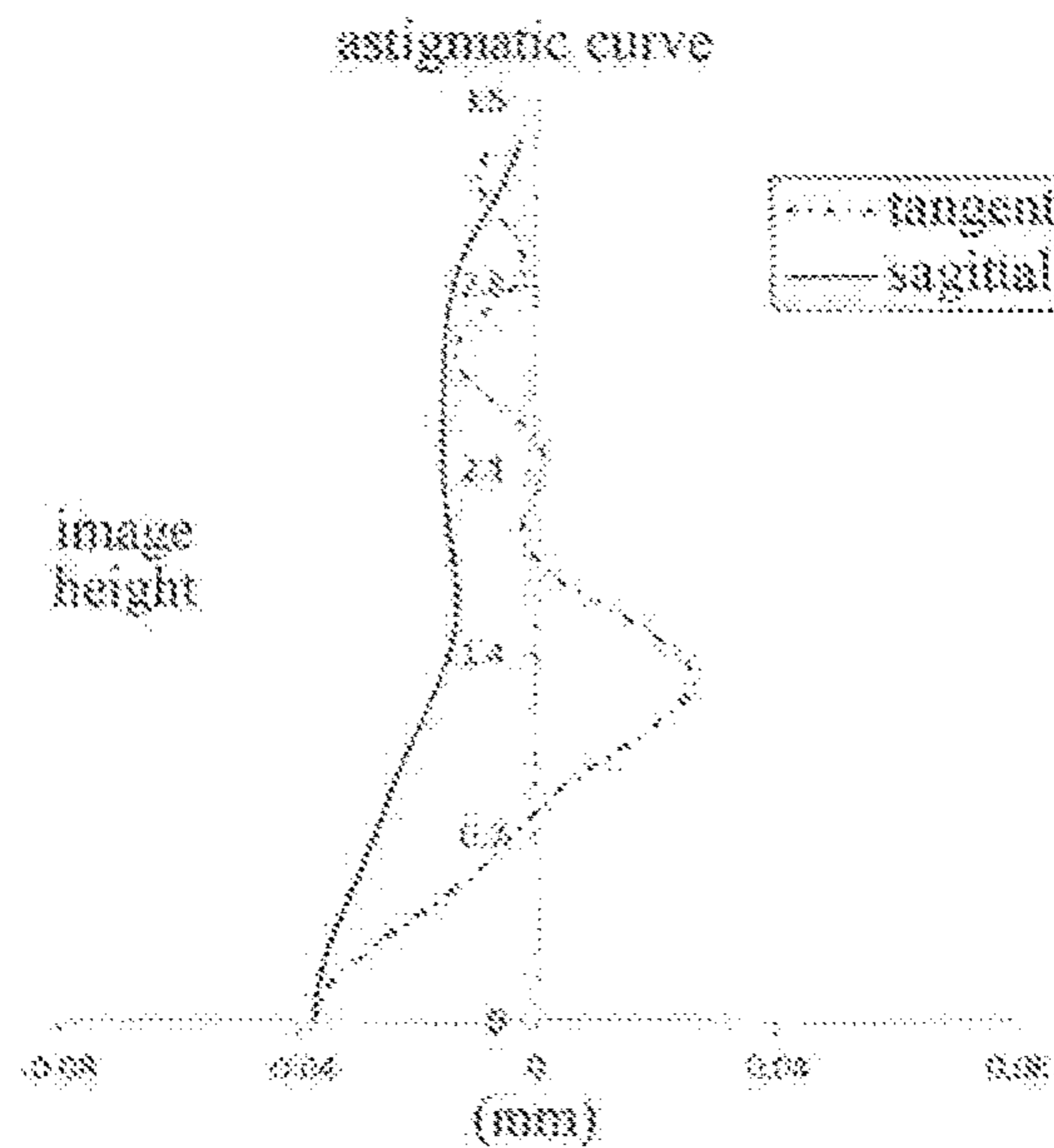


Fig. 20B

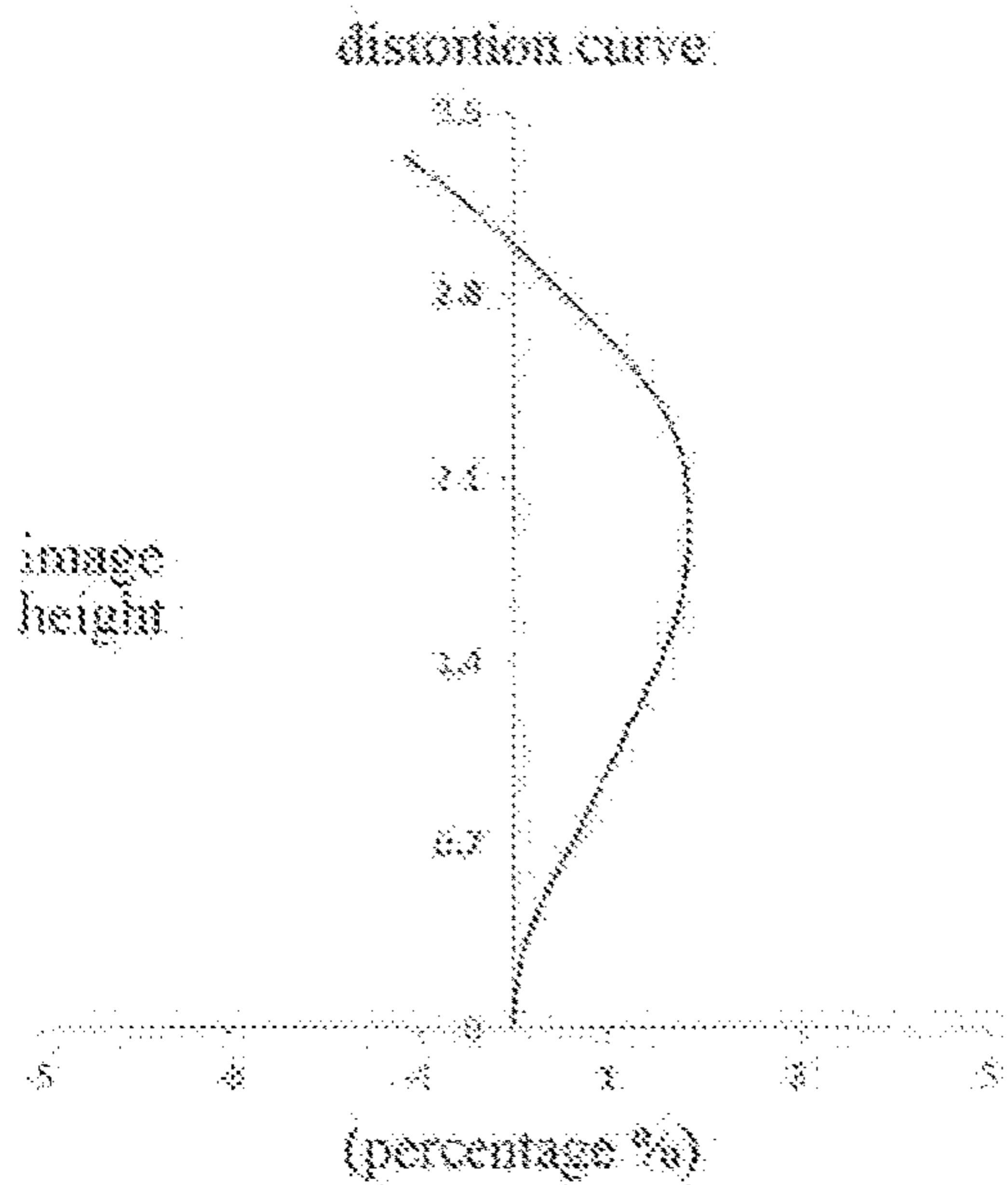


Fig. 20C

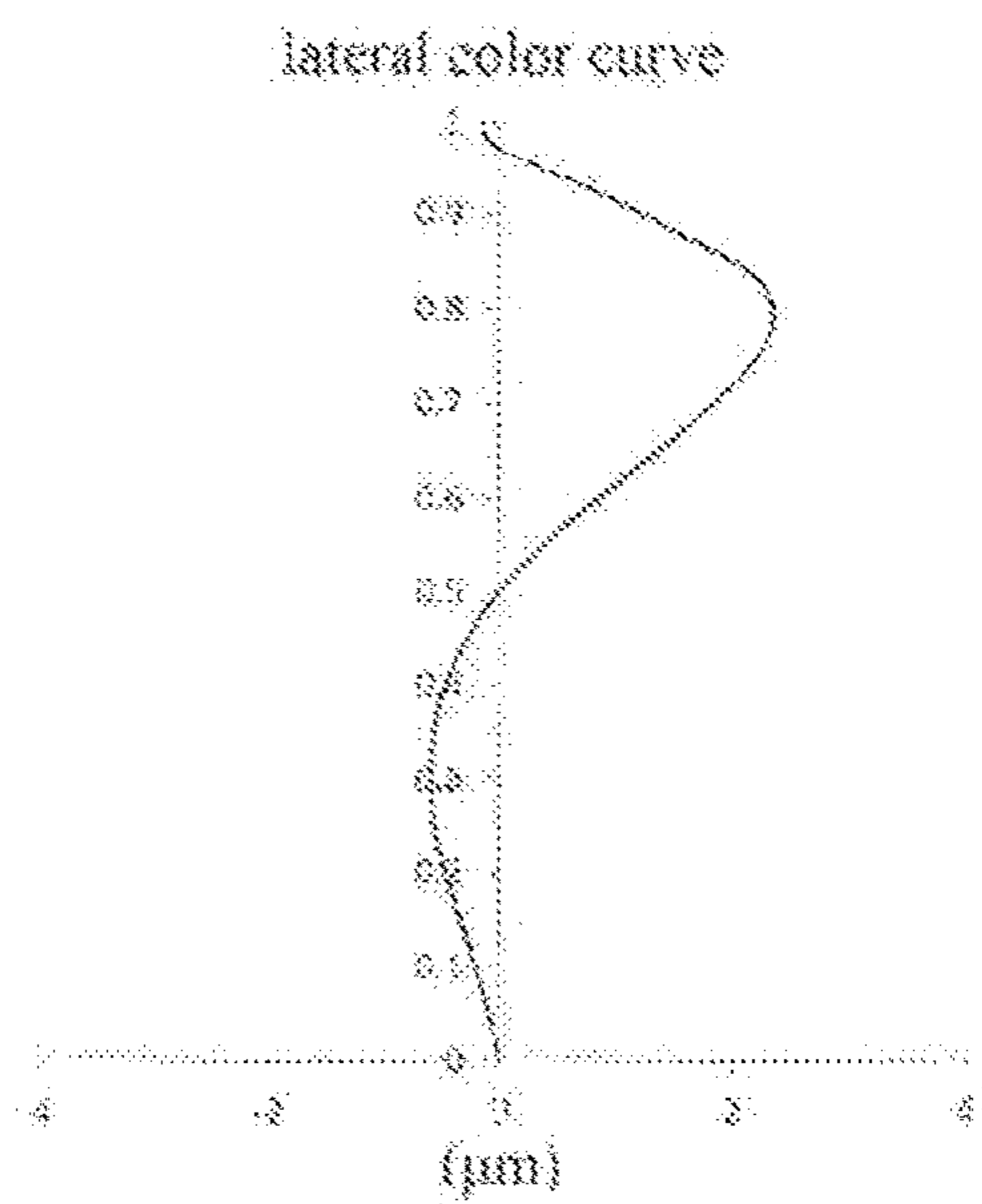


Fig. 20D

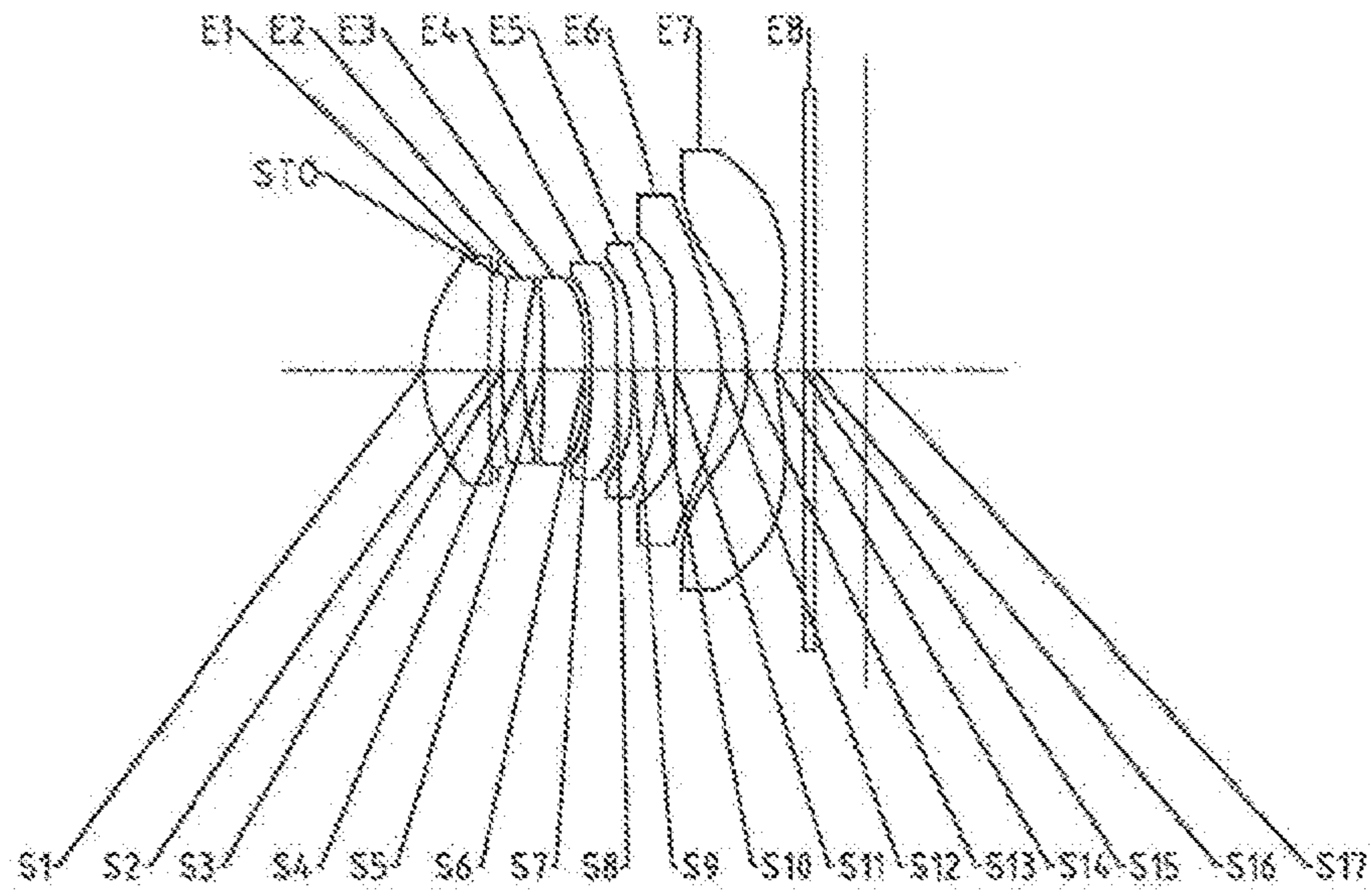


Fig. 21

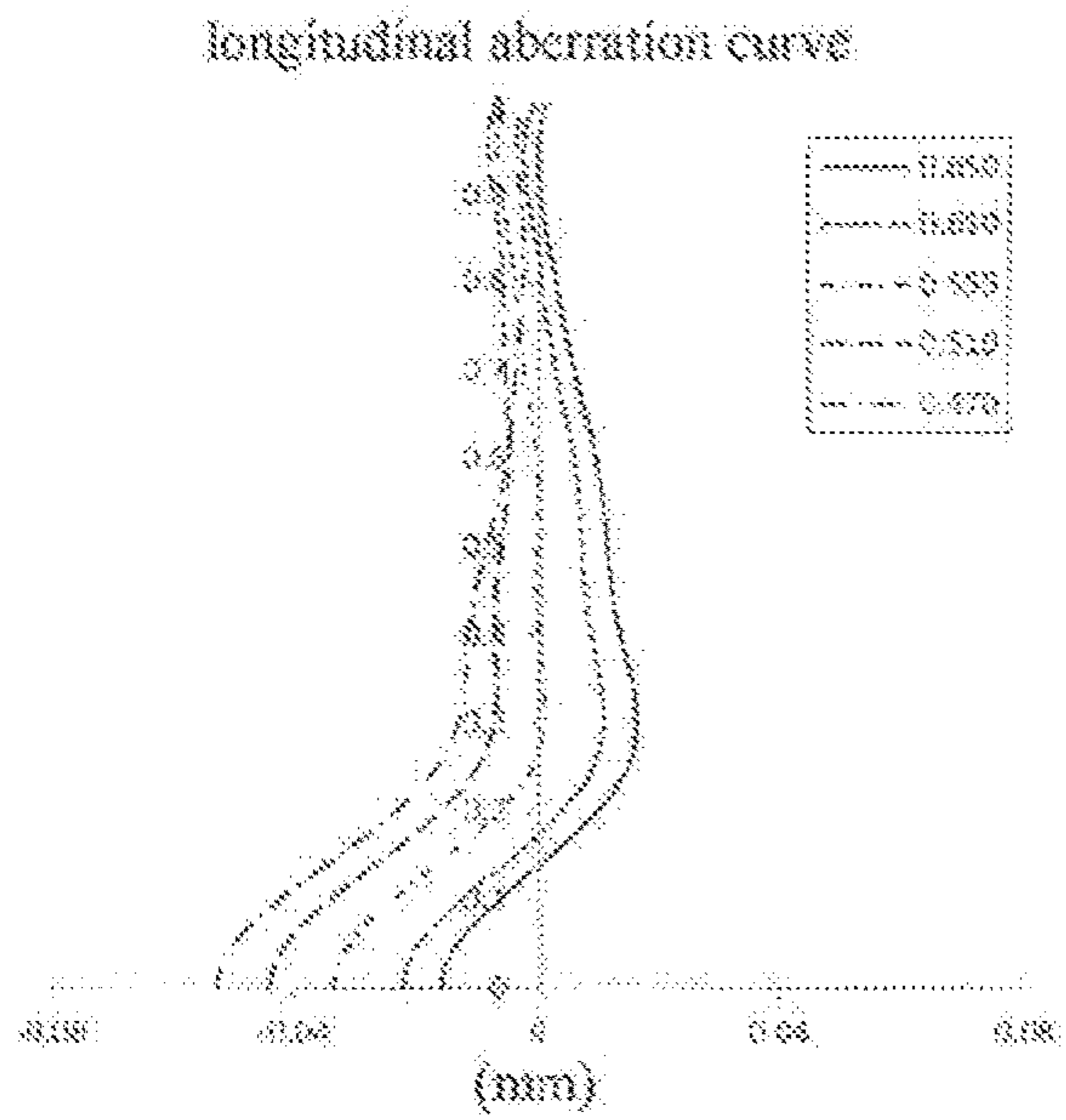


Fig. 22A

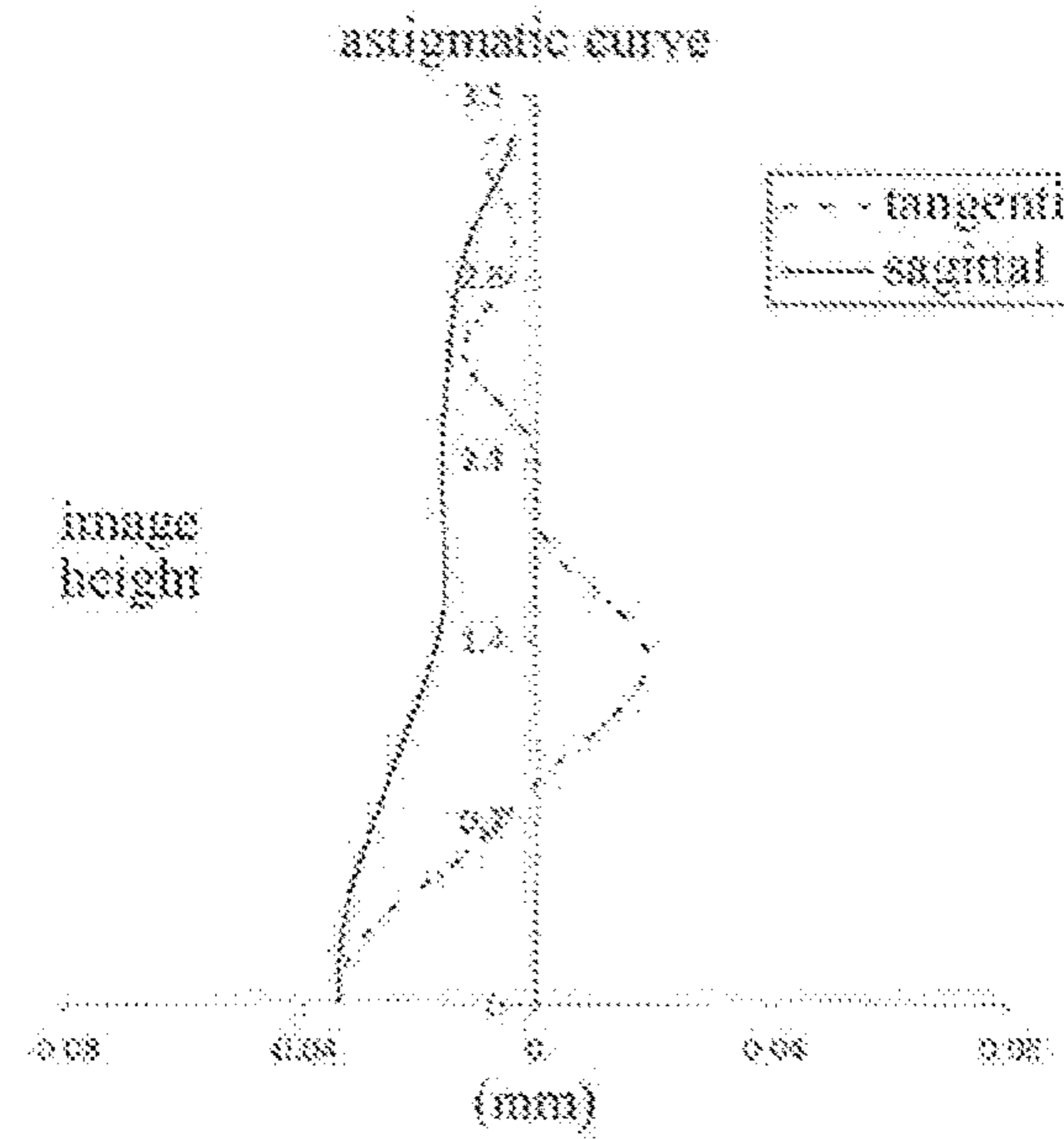


Fig. 22B

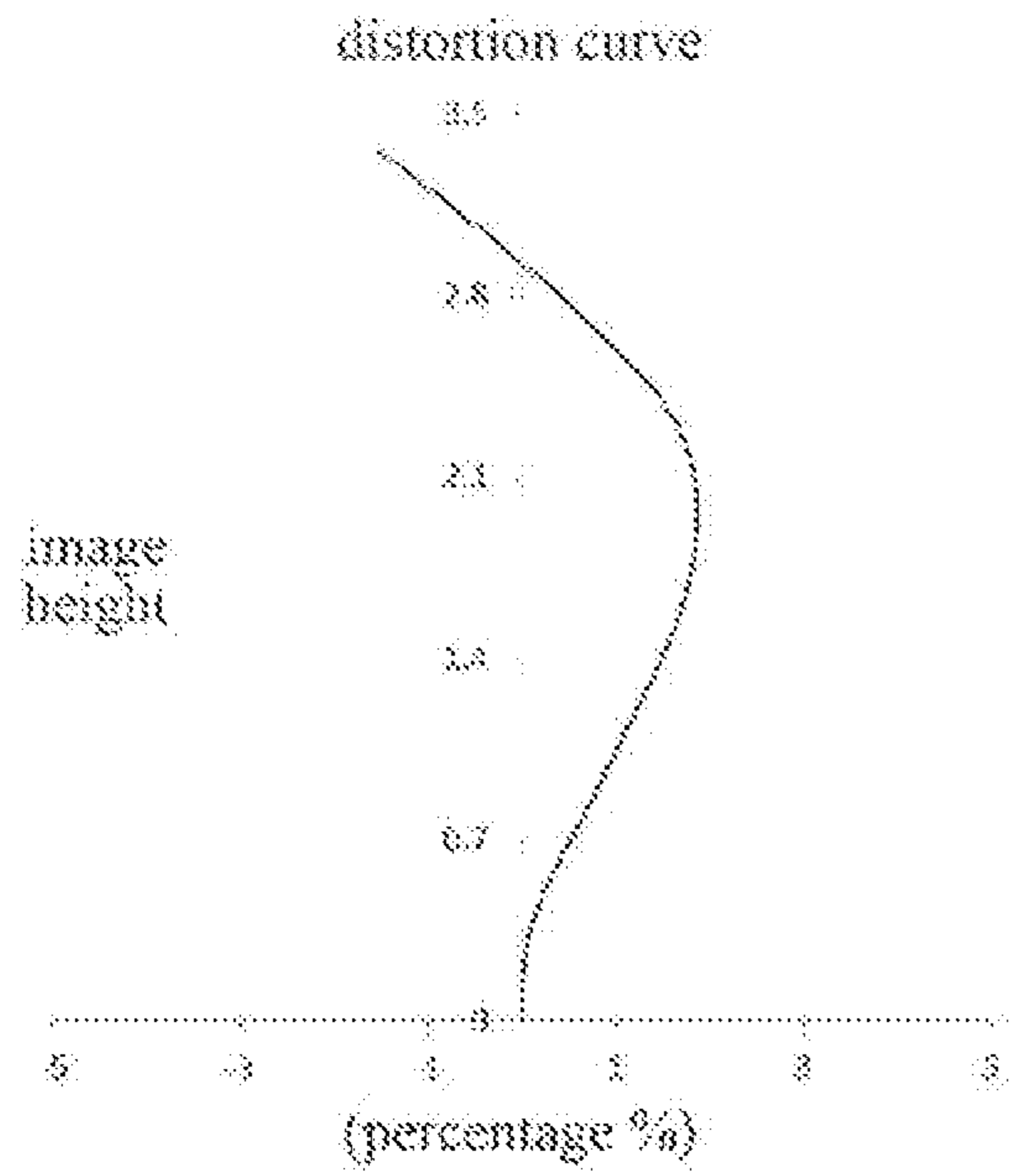


Fig. 22C

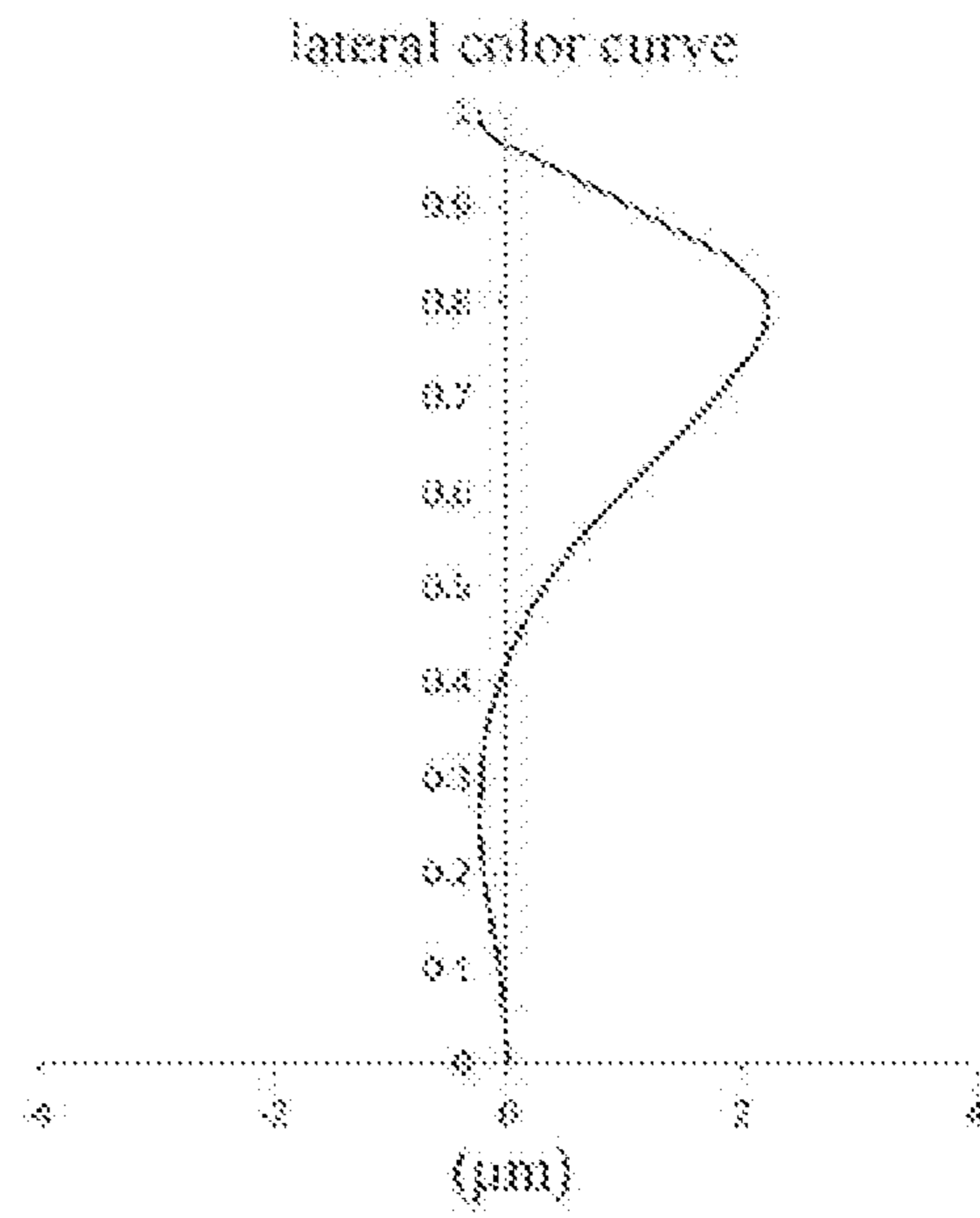


Fig. 22D

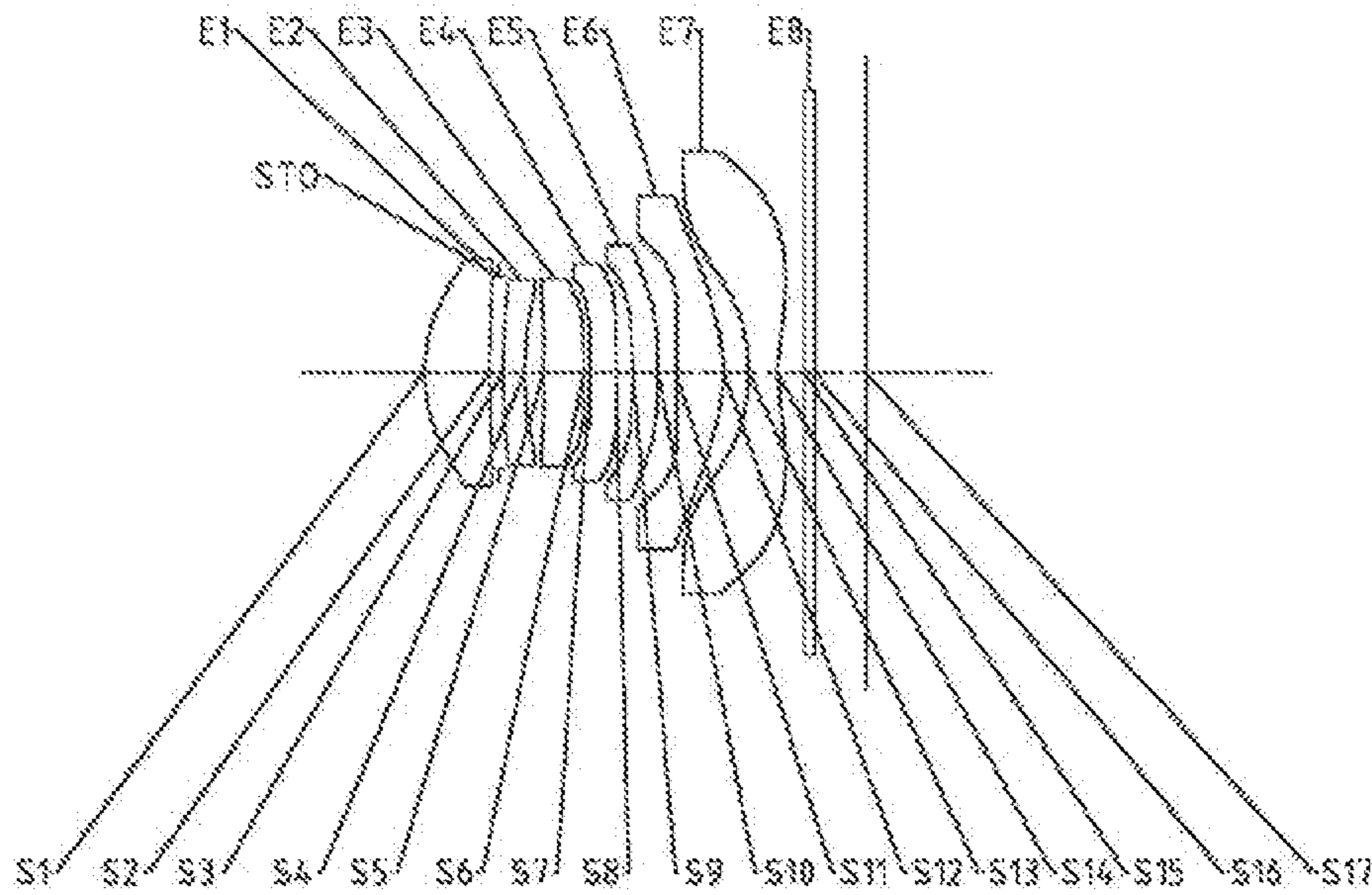


Fig. 23

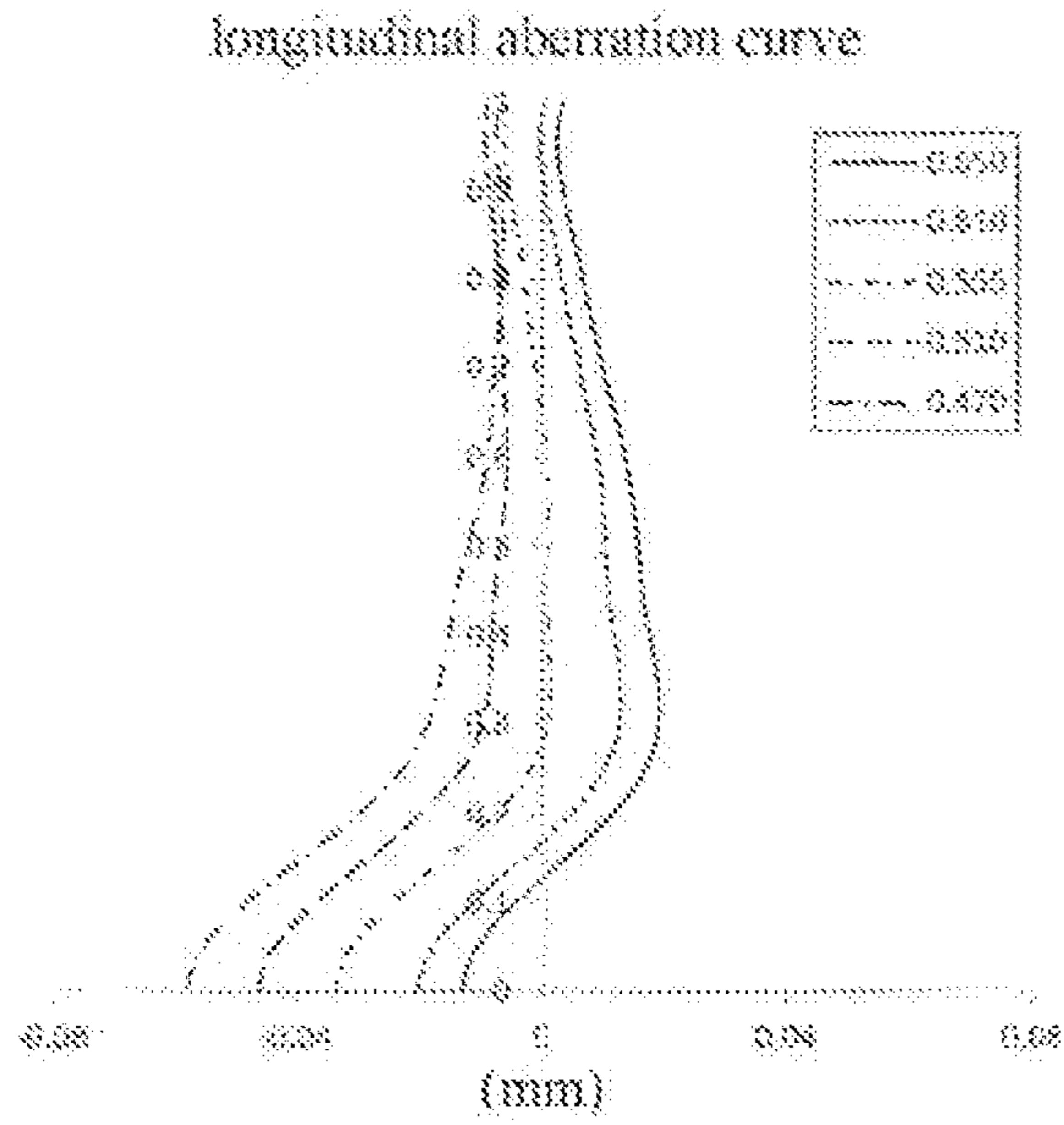


Fig. 24A

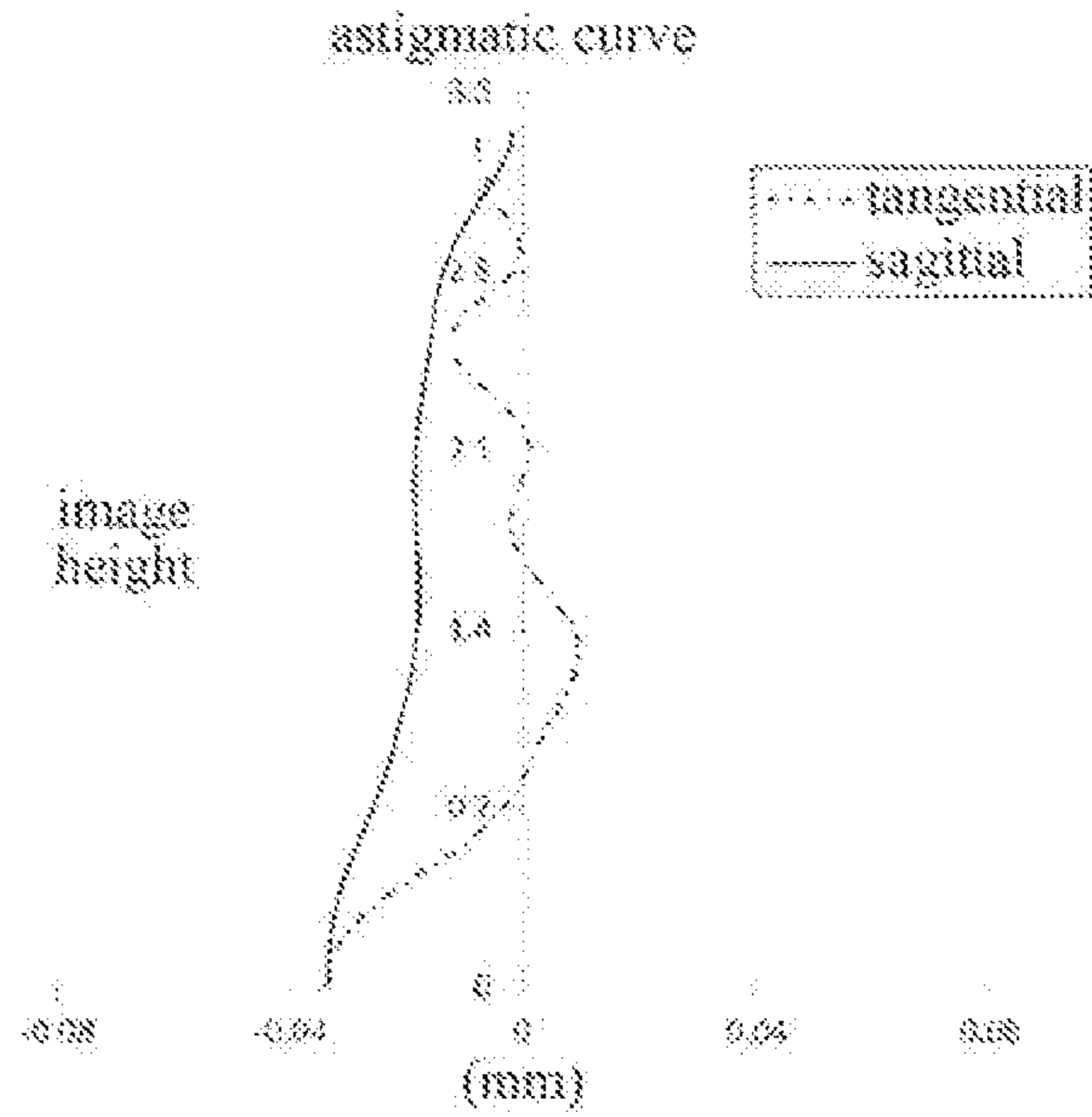


Fig. 24B

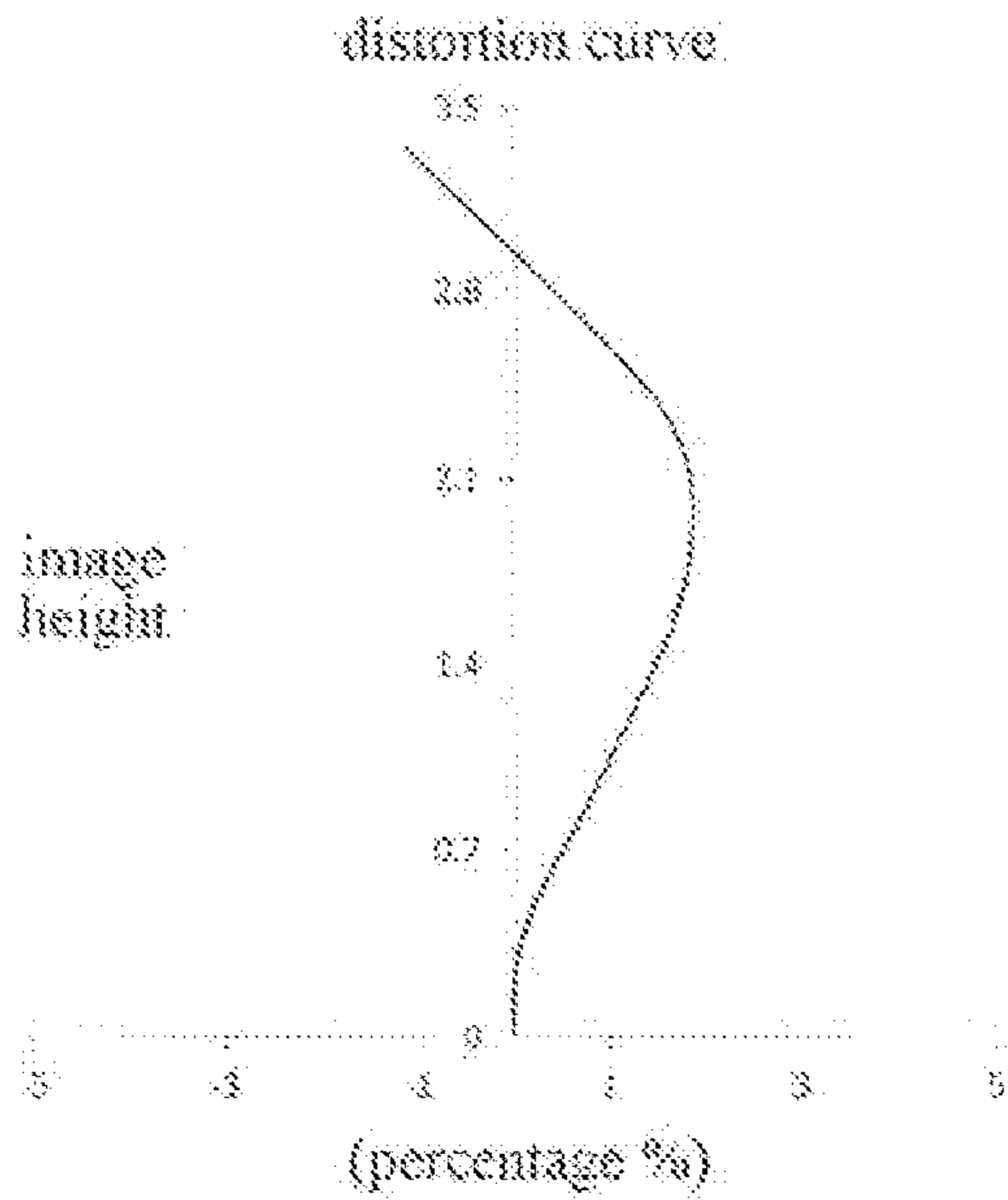


Fig. 24C

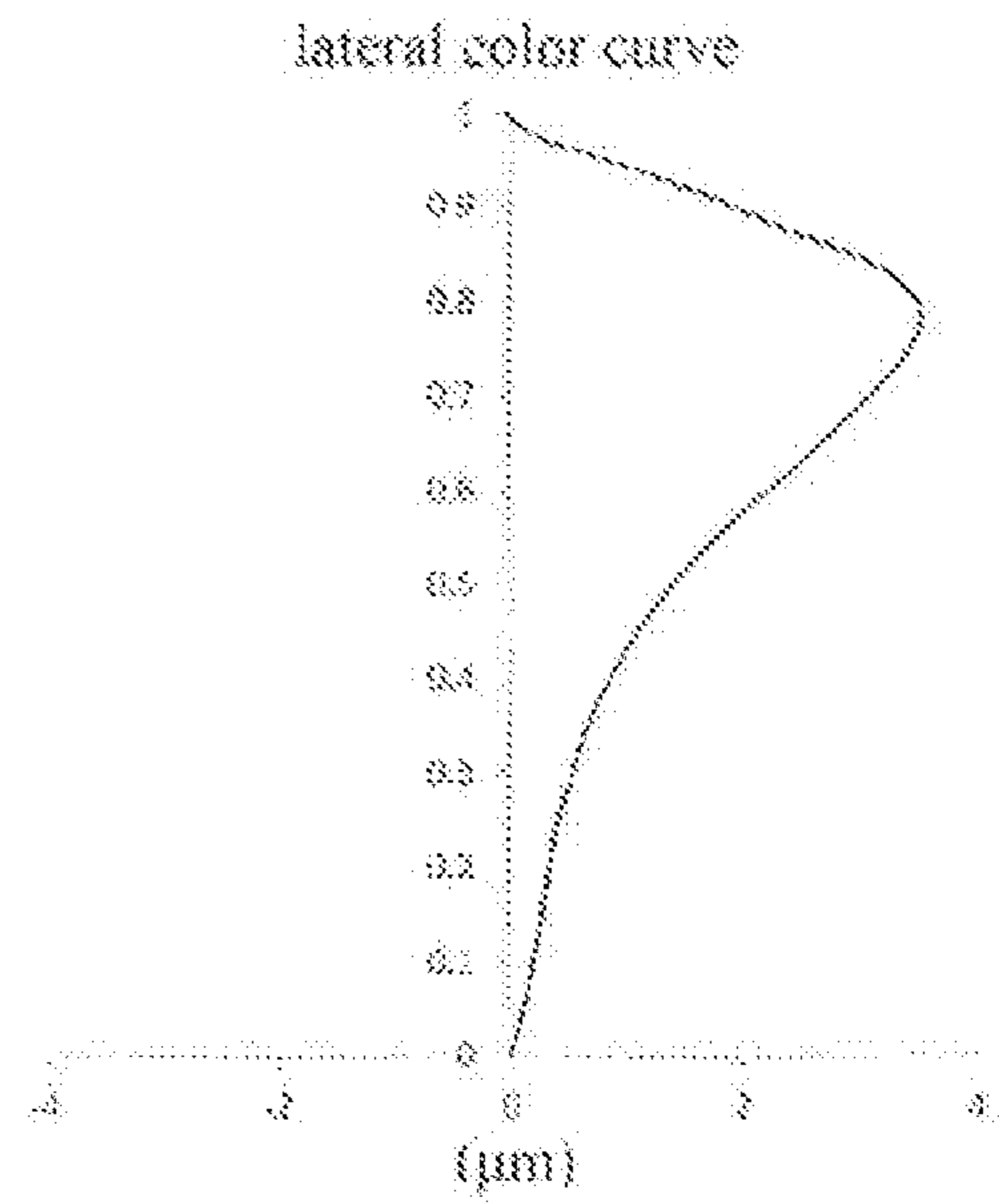


Fig. 24D

OPTICAL IMAGING LENS ASSEMBLY

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation of International Application PCT/CN2018/095835, with an international filing date of Jul. 16, 2018, which claims the priorities and rights to Chinese Patent Application No. 201711012647.6 and Chinese Patent Application No. 201721402226.X filed with the China National Intellectual Property Administration (CNIPA) on Oct. 26, 2017, the disclosures of which are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

The present disclosure relates to an optical imaging lens assembly, and more specifically to an optical imaging lens assembly including seven lenses.

BACKGROUND

With the improvement in performance and reduction in size of the commonly used photosensitive elements such as charge-coupled devices (CCD) or complementary metal-oxide semiconductor elements (CMOS), the number of pixels of the photosensitive elements is increased and the size of the pixels is reduced. Accordingly, higher requirements on high imaging quality and miniaturization of the counterpart optical imaging lens assemblies have been brought forward.

The reduction in pixel size means that the amount of light passing through the lens may become less during the same exposure time. However, in the condition of a dim environment (e.g., cloudy and rainy days, or at dusk), the lens assembly needs to have a large amount of light passing through to ensure the imaging quality. A general configuration for an existing lens assembly includes an F-number F_{no} (total effective focal length of the lens assembly/entrance pupil diameter of the lens assembly) of 2.0 or above. Although this type of lens assembly can fulfill the miniaturization requirement, the imaging quality of the lens assembly cannot be ensured in a situation with insufficient light. Therefore, the lens assembly having the F-number F_{no} of 2.0 or above can no longer fulfill the higher-order imaging requirements.

SUMMARY

The present disclosure provides an optical imaging lens assembly which may be applicable to portable electronic products and may at least or partially solve at least one of the above disadvantages in the existing technology, for example, an imaging lens assembly having a large aperture.

According to an aspect, the present disclosure provides an optical imaging lens assembly. The optical imaging lens assembly includes, sequentially from an object side to an image side along an optical axis, a first lens, a second lens, a third lens, a fourth lens, a fifth lens, a sixth lens, and a

seventh lens. The first lens may have a positive refractive power, and an object-side surface of the first lens may be a convex surface. The second lens may have a negative refractive power. The third lens may have a positive refractive power. Each of the fourth lens and the fifth lens has a positive refractive power or a negative refractive power. The sixth lens may have a positive refractive power. The seventh lens may have a negative refractive power, and an object-side surface and an image-side surface of the seventh lens may both be concave surfaces. A combined focal length f_{12} of the first lens and the second lens and a combined focal length f_{34} of the third lens and the fourth lens may satisfy: $|f_{12}/f_{34}| \leq 0.3$.

In an embodiment, a total effective focal length f of the optical imaging lens assembly and an entrance pupil diameter EPD of the optical imaging lens assembly may satisfy: $f/EPD \leq 1.80$.

In an embodiment, the total effective focal length f of the optical imaging lens assembly and an effective focal length f_7 of the seventh lens may satisfy: $-2.5 < f/f_7 < -1.5$.

In an embodiment, an effective focal length f_2 of the second lens and the effective focal length f_7 of the seventh lens may satisfy: $4.5 < f_2/f_7 < 11.0$.

In an embodiment, an effective focal length f_6 of the sixth lens and the effective focal length f_7 of the seventh lens may satisfy: $-1.5 < f_6/f_7 < -1.0$.

In an embodiment, the effective focal length f_7 of the seventh lens and a radius of curvature R_{14} of the image-side surface of the seventh lens may satisfy: $-1.5 < f_7/R_{14} < -1.0$.

In an embodiment, an effective focal length f_1 of the first lens and a radius of curvature R_1 of the object-side surface of the first lens may satisfy: $2.0 < f_1/R_1 < 3.0$.

In an embodiment, a center thickness CT_1 of the first lens on the optical axis and the effective focal length f_2 of the second lens may satisfy: $-0.2 < CT_1/f_2 < 0$.

In an embodiment, the effective focal length f_6 of the sixth lens and an effective focal length f_3 of the third lens may satisfy: $0 < f_6/f_3 < 0.5$.

In an embodiment, the radius of curvature R_1 of the object-side surface of the first lens and a radius of curvature R_4 of an image-side surface of the second lens may satisfy: $0 < R_1/R_4 < 1$.

In an embodiment, a radius of curvature R_{12} of an image-side surface of the sixth lens and the radius of curvature R_{14} of the image-side surface of the seventh lens may satisfy: $-1.5 < R_{12}/R_{14} < -0.5$.

In an embodiment, a center thickness CT_6 of the sixth lens on the optical axis may satisfy: $0.3 \text{ mm} < CT_6 < 0.8 \text{ mm}$.

In an embodiment, a total track length TTL of the optical imaging lens assembly and half of a diagonal length $ImgH$ of an effective pixel area on an image plane of the optical imaging lens assembly may satisfy: $TTL/ImgH \leq 1.50$.

According to another aspect, the present disclosure provides an optical imaging lens assembly. The optical imaging lens assembly includes, sequentially from an object side to an image side along an optical axis, a first lens, a second lens, a third lens, a fourth lens, a fifth lens, a sixth lens, and a seventh lens. The first lens may have a positive refractive power, an object-side surface of the first lens may be a convex surface, and an image-side surface of the first lens may be a concave surface. The second lens may have a negative refractive power. The third lens may have a positive refractive power. Each of the fourth lens and the fifth lens has a positive refractive power or a negative refractive power. The sixth lens may have a positive refractive power. The seventh lens may have a negative refractive power, and an object-side surface and an image-side surface of the

seventh lens may both be concave surfaces. A total track length TTL of the optical imaging lens assembly and half of a diagonal length ImgH of an effective pixel area on an image plane of the optical imaging lens assembly may satisfy: $\text{TTL}/\text{ImgH} \leq 1.50$.

The present disclosure adopts a plurality of lenses (e.g., seven lenses). By reasonably distributing the refractive powers and the surface types of the lenses, the center thicknesses of the lenses, the spacing distances on the optical axis between the lenses, etc., the above optical imaging lens assembly has at least one of the beneficial effects such as ultra-thin, miniaturization, large aperture, and high imaging quality.

BRIEF DESCRIPTION OF THE DRAWINGS

By describing non-limiting embodiments below in detail and in combination with the accompanying drawings, other features, objectives and advantages of the present disclosure will be more apparent. In the accompanying drawings:

FIG. 1 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 1 of the present disclosure;

FIGS. 2A-2D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 1;

FIG. 3 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 2 of the present disclosure;

FIGS. 4A-4D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 2;

FIG. 5 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 3 of the present disclosure;

FIGS. 6A-6D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 3;

FIG. 7 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 4 of the present disclosure;

FIGS. 8A-8D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 4;

FIG. 9 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 5 of the present disclosure;

FIGS. 10A-10D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 5;

FIG. 11 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 6 of the present disclosure;

FIGS. 12A-12D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 6;

FIG. 13 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 7 of the present disclosure;

FIGS. 14A-14D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 7;

FIG. 15 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 8 of the present disclosure;

FIGS. 16A-16D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 8;

FIG. 17 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 9 of the present disclosure;

FIGS. 18A-18D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 9;

FIG. 19 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 10 of the present disclosure;

FIGS. 20A-20D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 10;

FIG. 21 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 11 of the present disclosure;

FIGS. 22A-22D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 11;

FIG. 23 is a schematic structural diagram illustrating an optical imaging lens assembly according to Embodiment 12 of the present disclosure; and

FIGS. 24A-24D respectively illustrate a longitudinal aberration curve, an astigmatic curve, a distortion curve, and a lateral color curve of the optical imaging lens assembly according to Embodiment 12.

DETAILED DESCRIPTION

For a better understanding of the present disclosure, various aspects of the present disclosure will be described in more detail with reference to the accompanying drawings. It should be understood that the detailed description is merely an illustration for the exemplary embodiments of the present disclosure rather than a limitation to the scope of the present disclosure in any way. Throughout the specification, the same reference numerals designate the same elements. The expression "and/or" includes any and all combinations of one or more of the associated listed items.

It should be noted that in the specification, the expressions, such as "first," "second," and "third" are only used to distinguish one feature from another, rather than represent any limitations to the features. Thus, the first lens discussed below may also be referred to as the second lens or the third lens without departing from the teachings of the present disclosure.

In the accompanying drawings, the thicknesses, sizes and shapes of the lenses have been slightly exaggerated for the convenience of explanation. Specifically, shapes of spherical surfaces or aspheric surfaces shown in the accompanying drawings are shown by examples. That is, the shapes of the spherical surfaces or the aspheric surfaces are not limited to the shapes of the spherical surfaces or the aspheric surfaces

shown in the accompanying drawings. The accompanying drawings are merely illustrative and not strictly drawn to scale.

Herein, the paraxial area refers to an area near the optical axis. If a surface of a lens is a convex surface and a position of the convex surface is not defined, it indicates that the surface of the lens is a convex surface at least in the paraxial area; and if a surface of a lens is a concave surface and a position of the concave surface is not defined, it indicates that the surface of the lens is a concave surface at least in the paraxial area. The surface closest to the object in each lens is referred to as the object-side surface, and the surface closest to the image plane in each lens is referred to as the image-side surface.

It should be further understood that the terms “comprising,” “including,” “having” and variants thereof, when used in the specification, specify the presence of stated features, elements and/or components, but do not exclude the presence or addition of one or more other features, elements, components and/or combinations thereof. In addition, expressions such as “at least one of,” when preceding a list of listed features, modify the entire list of features rather than an individual element in the list. Further, the use of “may,” when describing the embodiments of the present disclosure, relates to “one or more embodiments of the present disclosure.” Also, the term “exemplary” is intended to refer to an example or illustration.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by those of ordinary skill in the art to which the present disclosure belongs. It should be further understood that terms (i.e., those defined in commonly used dictionaries) should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

It should also be noted that the embodiments in the present disclosure and the features in the embodiments may be combined with each other on a non-conflict basis. The present disclosure will be described below in detail with reference to the accompanying drawings and in combination with the embodiments.

Features, principles, and other aspects of the present disclosure are described below in detail.

The optical imaging lens assembly according to exemplary embodiments of the present disclosure may include, for example, seven lenses (i.e., a first lens, a second lens, a third lens, a fourth lens, a fifth lens, a sixth lens, and a seventh lens) having refractive powers. The seven lenses are arranged in sequence from an object side to an image side along an optical axis.

In the exemplary embodiments, the first lens may have a positive refractive power. An object-side surface of the first lens may be a convex surface. The second lens may have a negative refractive power. The third lens may have a positive refractive power. The fourth lens has a positive refractive power or a negative refractive power. The fifth lens has a positive refractive power or a negative refractive power. The sixth lens may have a positive refractive power. The seventh lens may have a negative refractive power. An object-side surface of the seventh lens may be a concave surface, and an image-side surface of the seventh lens may be a concave surface.

In the exemplary embodiments, an image-side surface of the first lens may be a concave surface.

In the exemplary embodiments, an object-side surface of the second lens may be a convex surface, and an image-side surface of the second lens may be a concave surface.

In the exemplary embodiments, an object-side surface of the third lens may be a convex surface.

In the exemplary embodiments, an object-side surface of the sixth lens may be a convex surface, and an image-side surface of the sixth lens may be a convex surface.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $f/EPD \leq 1.80$. Here, f is the total effective focal length of the optical imaging lens assembly, and EPD is the entrance pupil diameter of the optical imaging lens assembly. More specifically, f and EPD may further satisfy: $1.58 \leq f/EPD \leq 1.76$. The smaller the F-number F_{no} (i.e., the total effective focal length f of the lens assembly/the entrance pupil diameter EPD of the lens assembly) of the optical imaging lens assembly is, the larger the clear aperture of the lens assembly is, and the greater the amount of light entering the lens assembly in the same unit time is. The reduction of the F-number F_{no} may effectively enhance the brightness of the image plane, so that the lens assembly can better fulfill the shooting requirements when the light is insufficient (e.g., in cloudy and rainy days, or at dusk), and thus the lens assembly has the advantage of large aperture. When the lens assembly is configured to satisfy the conditional expression $f/EPD \leq 1.60$, the lens assembly may have the advantage of the large aperture. Thus, the amount of light passing through the system may be increased, thereby enhancing the illuminance of the image plane. At the same time, the aberration of the edge field-of-view may also be reduced.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $|f_{12}/f_{34}| \leq 0.3$. Here, f_{12} is the combined focal length of the first lens and the second lens, and f_{34} is the combined focal length of the third lens and the fourth lens. More specifically, f_{12} and f_{34} may further satisfy: $0.061 \leq f_{12}/f_{34} \leq 0.28$. Reasonably distributing f_{12} and f_{34} is conducive to improving the optical performance of the imaging system.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $4.5 < f_2/f_7 < 11.0$. Here, f_2 is the effective focal length of the second lens, and f_7 is the effective focal length of the seventh lens. More specifically, f_2 and f_7 may further satisfy: $4.94 \leq f_2/f_7 \leq 10.02$. By reasonably distributing the effective focal length of the second lens and the effective focal length of the seventh lens, the deflection angle of light may be reduced, thereby improving the imaging quality of the optical system.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $0 < R_1/R_4 < 1$. Here, R_1 is the radius of curvature of the object-side surface of the first lens, and R_4 is the radius of curvature of the image-side surface of the second lens. More specifically, R_1 and R_4 may further satisfy: $0.35 < R_1/R_4 < 0.65$, for example, $0.40 \leq R_1/R_4 \leq 0.63$. The range of the ratio of the radius of curvature R_1 of the object-side surface of the first lens to the radius of curvature R_4 of the image-side surface of the second lens is reasonably controlled, which facilitates the system achieving the deflection of the optical path well.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $-1.5 < R_{12}/R_{14} < -0.5$. Here, R_{12} is the radius of curvature of the image-side surface of the sixth

lens, and R14 is the radius of curvature of the image-side surface of the seventh lens. More specifically, R12 and R14 may further satisfy: $-1.1 < R12/R14 < -0.8$, for example, $-1.08 \leq R12/R14 \leq -0.88$. By reasonably controlling the ratio of R12 to R14, the aberration of the system can be easily balanced, thereby improving the imaging quality of the imaging system.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $TTL/ImgH \leq 1.50$. Here, TTL is the total track length of the optical imaging lens assembly (i.e., the distance from the center of the object-side surface of the first lens to the image plane of the optical imaging lens assembly on the optical axis), and ImgH is the half of the diagonal length of the effective pixel area on the image plane. More specifically, TTL and ImgH may further satisfy: $1.40 \leq TTL/ImgH \leq 1.48$. When the conditional expression $TTL/ImgH \leq 1.50$ is satisfied, the size of the system may be effectively compressed, which ensures the ultra-thin characteristic of the imaging lens assembly.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $-2.5 < f/f7 < -1.5$. Here, f is the total effective focal length of the optical imaging lens assembly and f7 is the effective focal length of the seventh lens. More specifically, f and f7 may further satisfy: $-2.1 < f/f7 < -1.8$, for example, $-2.07 \leq f/f7 \leq -1.98$. By controlling the negative refractive power of the seventh lens within a reasonable range, the positive astigmatism in a reasonable range may be obtained, which can balance the negative astigmatism generated by the six lenses (i.e., the lenses between the object side and the seventh lens) before the seventh lens, so that the imaging system can obtain a good imaging quality.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $0.3 \text{ mm} < CT6 < 0.8 \text{ mm}$. Here, CT6 is the center thickness of the sixth lens on the optical axis. More specifically, CT6 may further satisfy: $0.4 \text{ mm} < CT6 < 0.7 \text{ mm}$, for example, $0.46 \text{ mm} \leq CT6 \leq 0.61 \text{ mm}$. By properly controlling the center thickness CT6 of the sixth lens, the optical element may be ensured to have a good processing characteristic. At the same time, the total track length TTL of the lens assembly may be ensured to be kept within a certain reasonable range.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $2.0 < f1/R1 < 3.0$. Here, f1 is the effective focal length of the first lens, and R1 is the radius of curvature of the object-side surface of the first lens. More specifically, f1 and R1 may further satisfy: $2.1 < f1/R1 < 2.6$, for example, $2.20 \leq f1/R1 \leq 2.55$. By reasonably controlling the ratio of the effective focal length f1 of the first lens to the radius of curvature R1 of the object-side surface of the first lens, the deflection angle of the edge field-of-view at the first lens can be effectively controlled, and thus the sensitivity of the system can be effectively reduced.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $-0.2 < CT1/f2 < 0$. Here, CT1 is the center thickness of the first lens on the optical axis, and f2 is the effective focal length of the second lens. More specifically, CT1 and f2 may further satisfy: $-0.1 < CT1/f2 < 0$, for example, $-0.08 \leq CT1/f2 < -0.04$. Reasonably controlling the ratio of CT1 to f2 is conducive to ensuring the processing characteristic of the first lens and the spherical aberration contribution of the second lens. Thus, the imaging system has a good imaging quality in the on-axis field-of-view area.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $-1.5 < f6/f7 < -1.0$. Here, f6 is the effective focal length of the sixth lens, and f7 is the effective focal length of the seventh lens. More specifically, f6 and f7 may further satisfy: $-1.44 \leq f6/f7 \leq -1.08$. By reasonably controlling the ratio of the effective focal length of the sixth lens to the effective focal length of the seventh lens, the residual spherical aberrations obtained after the balance between the sixth lens and the seventh lens can be balanced with the spherical aberrations generated by the five lenses (i.e., the lenses between the object side and the sixth lens) before the sixth lens. Thus, the fine adjustment on the spherical aberration of the system is realized, and the effect of reducing the aberration in the on-axis field-of-view area is achieved.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $-1.5 < f7/R14 < -1.0$. Here, f7 is the effective focal length of the seventh lens, and R14 is the radius of curvature of the image-side surface of the seventh lens. More specifically, f7 and R14 may further satisfy: $-1.3 < f7/R14 < -1.1$, for example, $-1.28 \leq f7/R14 \leq -1.14$. By reasonably controlling the radius of curvature of the image-side surface of the seventh lens, the third-order comatic aberration of the seventh lens is controlled within a reasonable range. Thus, the comatic aberrations generated by the six lenses before the seventh lens can be balanced, so that the imaging system has a good imaging quality.

In the exemplary embodiments, the optical imaging lens assembly of the present disclosure may satisfy the conditional expression $0 < f6/f3 < 0.5$. Here, f6 is the effective focal length of the sixth lens, and f3 is the effective focal length of the third lens. More specifically, f6 and f3 may further satisfy: $0.1 < f6/f3 < 0.4$, for example, $0.11 \leq f6/f3 \leq 0.38$. By reasonably controlling the ratio of f6 to f3, the spherical aberration contribution of the sixth lens and the spherical aberration contribution of the third lens can be reasonably controlled, so that the imaging system has a good imaging quality in the on-axis field-of-view area.

In the exemplary embodiments, the optical imaging lens assembly may further include at least one diaphragm, to further improve the imaging quality of the lens assembly. For example, the diaphragm may be disposed between the first lens and the second lens.

Alternatively, the optical imaging lens assembly may further include an optical filter for correcting color deviations and/or a protective glass for protecting a photosensitive element on the image plane.

The optical imaging lens assembly according to the above embodiments of the present disclosure may use a plurality of lenses, for example, the seven lenses described above. By reasonably distributing the refractive powers and the surface types of the lenses, the center thicknesses of the lenses, the spacing distances between the lenses on the axis, etc., it is possible to effectively reduce the size of the lens assembly, reduce the sensitivity of the lens assembly, and enhance the processibility of the lens assembly, so that the optical imaging lens assembly is more conducive to the production and processing and applicable to the portable electronic products. At the same time, the optical imaging lens assembly with the above configuration also has beneficial effects such as ultra-thin, miniaturization, large aperture, and high imaging quality.

In the embodiments of the present disclosure, at least one of the surfaces of the lenses is an aspheric surface. The aspheric lens is characterized in that the curvature continuously changes from the center of the lens to the periphery.

Different from a spherical lens having a constant curvature from the center of the lens to the periphery, the aspheric lens has a better radius-of-curvature characteristic, and has advantages of improving the distortion aberration and the astigmatic aberration. The use of the aspheric lens can eliminate as much as possible the aberrations that occur during the imaging, thereby improving the imaging quality.

However, it should be understood by those skilled in the art that the various results and advantages described in the present specification may be obtained by changing the number of the lenses constituting the optical imaging lens assembly without departing from the technical solution claimed by the present disclosure. For example, although the optical imaging lens assembly having seven lenses is described as an example in the embodiments, the optical imaging lens assembly is not limited to include seven lenses. If desired, the optical imaging lens assembly may also include other numbers of lenses.

Specific embodiments of the optical imaging lens assembly that may be applied to the above embodiments are further described below with reference to the accompanying drawings.

Embodiment 1

An optical imaging lens assembly according to Embodiment 1 of the present disclosure is described below with

is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a convex surface, and an image-side surface S10 of the fifth lens E5 is a concave surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 1 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 1. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 1

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6825	0.7887	1.55	56.1	0.0128
S2	aspheric	8.3068	0.0328			3.8896
STO	spherical	infinite	0.0350			
S3	aspheric	4.6640	0.2172	1.67	20.4	-7.9131
S4	aspheric	2.6839	0.3484			-1.7896
S5	aspheric	24.2341	0.3401	1.55	56.1	25.7166
S6	aspheric	-3.5372	0.0300			7.3000
S7	aspheric	-3.5773	0.2177	1.55	56.1	5.6401
S8	aspheric	41.7512	0.1745			-99.0000
S9	aspheric	12.0879	0.3352	1.67	20.4	46.2401
S10	aspheric	5.1346	0.1816			-79.5381
S11	aspheric	7.3861	0.6069	1.55	56.1	-97.8337
S12	aspheric	-1.3762	0.3036			-8.4969
S13	aspheric	-3.7331	0.3500	1.54	55.7	-2.2333
S14	aspheric	1.5688	0.2340			-9.6678
S15	spherical	infinite	0.2103	1.52	64.2	
S16	spherical	infinite	0.5740			
S17	spherical	infinite				

reference to FIGS. 1-2D. FIG. 1 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 1 of the present disclosure.

As shown in FIG. 1, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2

As may be obtained from Table 1, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. In this embodiment, the surface type x of each aspheric surface may be defined using, but not limited to, the following formula:

$$x = \frac{ch^2}{1 + \sqrt{1 - (k+1)c^2h^2}} + \sum A_i h^i \quad (1)$$

Here, x is the sag—the axis-component of the displacement of the surface from the aspheric vertex, when the surface is at height h from the optical axis; c is the paraxial curvature of the aspheric surface, and $c=1/R$ (i.e., the paraxial curvature c is the reciprocal of the radius of curvature R in Table 1 above); k is the conic coefficient (given in Table 1); and A_i is the correction coefficient of the

i^{th} order of the aspheric surface. Table 2 below shows the high-order coefficients A_4 , A_6 , A_8 , A_{10} , A_{12} , A_{14} , A_{16} , A_{18} , and A_{20} applicable to the aspheric surfaces S1-S14 in Embodiment 1.

$R1/R4=0.63$, here R1 is the radius of curvature of the object-side surface S1 of the first lens E1, and R4 is the radius of curvature of the image-side surface S4 of the second lens E2.

TABLE 2

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-9.6100E - 03	6.4354E - 02	-2.2752E - 01	4.9383E - 01	-6.8363E - 01	6.0365E - 01	-3.2970E - 01	1.0100E - 01	-1.3360E - 02
S2	-9.9670E - 02	1.1211E - 01	1.8602E - 01	-9.7186E - 01	1.8102E + 00	-1.9196E + 00	1.2028E + 00	-4.1341E - 01	5.9939E - 02
S3	-1.7887E - 01	3.4329E - 01	-4.8103E - 01	7.4328E - 01	-1.1333E + 00	1.2693E + 00	-8.7261E - 01	3.2940E - 01	-5.2440E - 02
S4	-7.8170E - 02	-2.1530E - 02	1.1801E - 00	-5.0751E + 00	1.2193E + 01	-1.7899E + 01	1.5876E + 01	-7.7921E + 00	1.6308E + 00
S5	-7.9840E - 02	1.3189E - 01	-8.5200E - 01	2.4292E + 00	-4.5264E + 00	5.3997E + 00	-4.0601E + 00	1.8226E + 00	-3.8096E - 01
S6	3.5613E - 02	-2.0127E - 01	9.6660E - 01	-3.4935E + 00	7.4444E + 00	-9.4690E + 00	7.0676E + 00	-2.8355E + 00	4.6899E - 01
S7	-3.6800E - 03	7.6484E - 02	-4.3323E - 01	1.1785E + 00	-2.0201E + 00	2.4372E + 00	-2.0035E + 00	9.5575E - 01	-1.8947E - 01
S8	-1.2773E - 01	1.1835E - 01	-2.2444E - 01	3.0869E - 02	5.4935E - 01	-1.0628E + 00	9.8617E - 01	-4.7910E - 01	9.7996E - 02
S9	-2.2027E - 01	2.3157E - 01	-5.0670E - 01	8.9234E - 01	-1.2931E + 00	1.1957E + 00	-5.7771E - 01	1.1223E - 01	-8.3000E - 04
S10	-1.7177E - 01	1.9157E - 01	-4.6011E - 01	8.6283E - 01	-1.0810E + 00	8.3132E - 01	-3.6968E - 01	8.7028E - 02	-8.9300E - 03
S11	-5.0510E - 02	3.6812E - 02	-2.3171E - 01	4.8139E - 01	-5.2615E - 01	3.3309E - 01	-1.2318E - 01	2.4682E - 02	-2.0600E - 03
S12	-1.5094E - 01	2.5511E - 01	-4.2149E - 01	4.4916E - 01	-2.8015E - 01	1.0389E - 01	-2.2650E - 02	2.6860E - 03	-1.3000E - 04
S13	-1.3929E - 01	1.5506E - 01	2.9978E - 01	-1.1730E - 01	1.1160E - 03	2.5100E - 04	-7.6000E - 05	7.6500E - 06	-2.8000E - 07
S14	-1.1865E - 01	7.1242E - 02	-3.3840E - 02	1.1731E - 02	-2.9400E - 03	5.1200E - 04	-5.9000E - 05	3.9700E - 06	-1.2000E - 07

Table 3 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 1, the total effective focal length f of the optical imaging lens assembly, the total track length TTL (i.e., the distance from the center of the object-side surface S1 of the first lens E1 to the image plane S17 on the optical axis) of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 3

f1(mm)	3.71	f(mm)	4.00
f2(mm)	-9.93	TTL(mm)	4.98
f3(mm)	5.68	ImgH(mm)	3.36
f4(mm)	-6.03		
f5(mm)	-13.67		
f6(mm)	2.18		
f7(mm)	-2.01		

The optical imaging lens assembly in Embodiment 1 satisfies at least one of the following conditions.

$f/EPD=1.58$, here f is the total effective focal length of the optical imaging lens assembly, and EPD is the entrance pupil diameter of the optical imaging lens assembly.

$|f12/f34|=0.06$, here f12 is the combined focal length of the first lens E1 and the second lens E2, and f34 is the combined focal length of the third lens E3 and the fourth lens E4.

$f2/f7=4.94$, here f2 is the effective focal length of the second lens E2, and f7 is the effective focal length of the seventh lens E7.

$R12/R14=-0.88$, here R12 is the radius of curvature of the image-side surface S12 of the sixth lens E6, and R14 is the radius of curvature of the image-side surface S14 of the seventh lens E7.

$TTL/ImgH=1.48$, here TTL is the total track length of the optical imaging lens assembly, and ImgH is the half of the diagonal length of the effective pixel area on the image plane S17.

$f/f7=-1.99$, here f is the total effective focal length of the optical imaging lens assembly, and f7 is the effective focal length of the seventh lens E7.

$CT6=0.61$ mm, here CT6 is the center thickness of the sixth lens E6 on the optical axis.

$f1/R1=2.20$, here f1 is the effective focal length of the first lens E1, and R1 is the radius of curvature of the object-side surface S1 of the first lens E1.

$CT1/f2=-0.08$, here CT1 is the center thickness of the first lens E1 on the optical axis, and f2 is the effective focal length of the second lens E2.

$f6/f7=-1.08$, here f6 is the effective focal length of the sixth lens E6, and f7 is the effective focal length of the seventh lens E7.

$f7/R14=1.28$, here f7 is the effective focal length of the seventh lens E7, and R14 is the radius of curvature of the image-side surface S14 of the seventh lens E7.

$f6/f3=0.38$, here f6 is the effective focal length of the sixth lens E6, and f3 is the effective focal length of the third lens E3.

In addition, FIG. 2A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 1, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 2B illustrates the astigmatic

curve of the optical imaging lens assembly according to Embodiment 1, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 2C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 1, representing amounts of distortion at different viewing angles. FIG. 2D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 1, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 2A-2D that the optical imaging lens assembly according to Embodiment 1 can achieve a good imaging quality.

Embodiment 2

An optical imaging lens assembly according to Embodiment 2 of the present disclosure is described below with reference to FIGS. 3-4D. In this embodiment and the following embodiments, for the purpose of brevity, the description of parts similar to those in Embodiment 1 will be omitted. FIG. 3 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 2 of the present disclosure.

As shown in FIG. 3, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a

surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a convex surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 4 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 2. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 4

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6934	0.7548	1.55	56.1	-0.0460
S2	aspheric	5.6686	0.1078			-11.9183
STO	spherical	infinite	0.0400			
S3	aspheric	5.4212	0.2300	1.67	20.4	-18.2078
S4	aspheric	3.5559	0.2183			-6.5924
S5	aspheric	10.4477	0.4711	1.55	56.1	61.8278
S6	aspheric	-15.2323	0.0700			-80.7875
S7	aspheric	45.6790	0.2525	1.67	20.4	99.0000
S8	aspheric	9.8325	0.1640			42.6534
S9	aspheric	-14.4916	0.2831	1.67	20.4	99.0000
S10	aspheric	-15.4206	0.1586			-73.8173
S11	aspheric	9.8826	0.4951	1.55	56.1	37.8164
S12	aspheric	-1.6547	0.2791			-9.9228
S13	aspheric	-2.8588	0.3262	1.54	55.7	-1.4621
S14	aspheric	1.6811	0.3033			-16.1601
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5561			
S17	spherical	infinite				

fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex

As may be obtained from Table 4, in Embodiment 2, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 5 shows the high-order coefficients applicable to each aspheric surface in Embodiment 2. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 5

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.5350E - 02	1.0145E - 01	-3.1309E - 01	5.6998E - 01	-6.6437E - 01	4.8971E - 01	-2.2201E - 01	5.5676E - 02	-5.8600E - 03
S2	-5.7620E - 02	5.0630E - 03	8.3859E - 02	-2.1507E - 01	2.8456E - 01	-2.3303E - 01	1.1650E - 01	-3.2450E - 02	3.8530E - 03

TABLE 5-continued

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S3	-1.2819E - 01	-1.4773E - 01	-2.2369E - 01	6.7720E - 01	-1.3000E + 00	1.4322E + 00	-8.7899E - 01	2.7052E - 01	-2.9030E - 02
S4	-7.5860E - 02	-2.7090E - 02	8.0357E - 01	-3.4884E + 00	9.5854E + 00	-1.6845E + 01	1.8140E + 01	-1.0869E + 01	2.7806E + 00
S5	-7.1420E - 02	1.1944E - 01	-8.0707E - 01	2.2062E + 00	-3.4885E + 00	2.6573E + 00	-1.0300E - 02	-1.3225E + 00	6.1824E - 01
S6	-1.0921E - 01	3.5019E - 02	-3.8527E - 01	1.0732E + 00	-2.2377E + 00	3.0822E + 00	-2.4136E + 00	9.4839E - 01	-1.4123E - 01
S7	-2.5378E - 01	5.1600E - 01	-1.8389E + 00	4.1775E + 00	-6.5243E - 00	6.8301E + 00	-4.3455E + 00	1.4329E + 00	-1.7397E - 01
S8	-1.9886E - 01	2.4443E - 01	-2.7913E - 01	-7.2550E - 02	5.5365E - 01	-6.7788E - 01	4.1268E - 01	-1.3907E - 01	2.2527E - 02
S9	-1.7260E - 01	3.1883E - 01	-7.9364E - 01	1.9253E + 00	-3.5565E + 00	4.1007E + 00	-2.7863E + 00	1.0264E + 00	-1.5815E - 01
S10	-1.7197E - 01	4.5801E - 02	4.1281E - 02	4.2585E - 02	-3.0715E - 01	3.9925E - 01	-2.2613E - 01	6.0136E - 02	-6.1600E - 03
S11	-1.4290E - 02	-1.7641E - 01	1.5278E - 01	1.7267E - 01	-5.6933E - 01	5.8103E - 01	-3.0034E - 01	7.9629E - 02	-8.5800E - 03
S12	-3.1100E - 03	-7.8940E - 02	1.6942E - 01	-1.7014E - 01	9.3437E - 02	-2.9180E - 02	5.0730E - 03	-4.4000E - 04	1.3200E - 05
S13	-2.8553E - 01	2.7594E - 01	-2.1155E - 01	1.3942E - 01	-6.1360E - 02	1.6676E - 02	-2.7100E - 03	2.4200E - 04	-9.2000E - 06
S14	-1.5178E - 01	1.2222E - 01	-7.2300E - 02	2.8620E - 02	7.3000E - 03	1.0720E - 03	-6.4000E - 05	-2.9000E - 06	4.2600E - 07

Table 6 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 2, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 6

f1(mm)	4.15	f(mm)	3.88
f2(mm)	-16.33	TTL(mm)	4.82
f3(mm)	11.43	ImgH(mm)	3.34
f4(mm)	-18.87		
f5(mm)	-411.43		
f6(mm)	2.64		
f7(mm)	-1.92		

FIG. 4A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 2, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 4B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 2, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 4C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 2, representing amounts of distortion at different viewing angles. FIG. 4D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 2, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 4A-4D that the optical imaging lens assembly according to Embodiment 2 can achieve a good imaging quality.

Embodiment 3

An optical imaging lens assembly according to Embodiment 3 of the present disclosure is described below with reference to FIGS. 5-6D. FIG. 5 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 3 of the present disclosure.

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As shown in FIG. 5, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

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The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a convex surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a positive refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

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Table 7 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 3. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 7

surface number	surface type	radius of curvature	thickness	material		conic coefficient
				refractive index	abbe number	
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6801	0.7742	1.55	56.1	-0.0224
S2	aspheric	5.1923	0.1168			-9.3561
STO	spherical	infinite	0.0400			
S3	aspheric	5.6121	0.2300	1.67	20.4	-25.5929
S4	aspheric	3.6551	0.2044			-8.1217
S5	aspheric	9.3440	0.4689	1.55	56.1	59.8335
S6	aspheric	-17.7217	0.0700			-89.5502
S7	aspheric	28.5631	0.2505	1.67	2-0.4	34.2567
S8	aspheric	8.5630	0.1561			38.8580
S9	aspheric	-20.0000	0.2892	1.67	20.4	81.6473
S10	aspheric	-19.8393	0.1719			-99.0000
S11	aspheric	9.1229	0.4878	1.55	56.1	32.4787
S12	aspheric	-1.6995	0.2707			-10.2471
S13	aspheric	-3.0210	0.3178	1.54	55.7	-1.4137
S14	aspheric	1.6601	0.3045			-15.2913
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5573			
S17	spherical	infinite				

As may be obtained from Table 7, in Embodiment 3, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 8 shows the high-order coefficients applicable to each aspheric surface in Embodiment 3. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

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TABLE 9

f1(mm)	4.22	f(mm)	3.92
f2(mm)	-16.52	TTL(mm)	4.82
f3(mm)	11.28	ImgH(mm)	3.34
f4(mm)	-18.46		
f5(mm)	2157.54		

TABLE 8

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.5110E - 02	1.0818E - 01	-3.0971E - 01	5.5640E - 01	-6.3575E - 01	4.5669E - 01	-1.9996E - 01	4.7892E - 02	-4.7600E - 03
S2	-5.0320E - 02	-6.4500E - 03	8.4655E - 02	-1.9261E - 01	2.4587E - 01	-1.9882E - 01	9.8900E - 02	-2.7480E - 02	3.2560E - 03
S3	-1.2023E - 01	1.1884E - 01	-2.0927E - 01	7.1792E - 01	-1.3992E + 00	1.5598E + 00	-9.9462E - 01	3.3538E - 01	-4.4970E - 02
S4	-7.0790E - 02	-6.8650E - 02	9.5569E - 01	-4.0189E + 00	1.0873E + 00	-1.8731E + 00	1.9715E + 00	-1.1538E + 01	2.8850E + 00
S5	-5.9600E - 02	5.9986E - 02	-6.2202E - 01	1.8806E + 00	-3.4013E + 00	3.4044E + 00	-1.4350E + 00	-2.2399E - 01	2.9631E - 01
S6	-1.2867E - 01	2.1240E - 01	-1.0013E + 00	2.1955E + 00	-3.2117E + 00	3.0916E + 00	-1.7060E + 00	4.1643E - 01	-1.4020E - 02
S7	-2.6235E - 01	5.0293E - 01	-1.4849E + 00	2.5300E + 00	-2.5912E + 00	1.4054E + 00	-8.6700E - 03	-4.2226E - 01	1.5230E - 01
S8	-2.0817E - 01	2.8366E - 01	-3.8914E - 01	8.0413E - 02	4.9164E - 01	-7.4772E - 01	5.0053E - 01	-1.7380E - 01	2.6967E - 02
S9	-1.3891E - 01	1.6107E - 01	-2.6656E - 01	7.4229E - 01	-1.8758E + 00	2.6417E + 00	-2.0439E + 00	8.2287E - 01	-1.3479E - 01
S10	-1.4675E - 01	-3.4440E - 02	2.6558E - 01	-4.0922E - 01	2.8134E - 01	-7.3580E - 01	-2.3500E - 01	3.1480E - 03	-1.4000E - 04
S11	-3.9900E - 03	-2.3724E - 01	3.4309E - 01	-1.9006E - 01	-1.4980E - 01	2.8339E - 01	-1.7499E - 01	5.1120E - 02	-5.9000E - 03
S12	1.0208E - 02	-1.0144E - 01	1.9555E - 01	-1.8663E - 01	9.6083E - 02	-2.6920E - 02	3.7640E - 03	-1.7000E - 04	-65.000E - 06
S13	-2.8510E - 01	2.7288E - 01	-2.0701E - 01	1.3592E - 01	-5.9610E - 02	1.6088E - 02	-2.5800E - 03	2.2800E - 04	-8.5000E - 06
S14	-1.5834E - 01	1.3546E - 01	-8.7290E - 02	3.8896E - 02	-1.1770E - 02	2.3080E - 03	-2.7000E - 04	1.6900E - 05	-3.8000E - 07

Table 9 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 3, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

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TABLE 9-continued

f6(mm)	2.67
f7(mm)	-1.95

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FIG. 6A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 3, representing deviations of focal points of light of different

wavelengths converged after passing through the lens assembly. FIG. 6B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 3, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 6C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 3, representing amounts of distortion at different viewing angles. FIG. 6D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 3, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 6A-6D that the optical imaging lens assembly according to Embodiment 3 can achieve a good imaging quality.

Embodiment 4

An optical imaging lens assembly according to Embodiment 4 of the present disclosure is described below with reference to FIGS. 7-8D. FIG. 7 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 4 of the present disclosure.

As shown in FIG. 7, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave

surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 10 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 4. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 10

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6929	0.7193	1.55	56.1	-0.0998
S2	aspheric	6.2949	0.0984			-16.2736
STO	spherical	infinite	0.0400			
S3	aspheric	5.4549	0.2300	1.67	20.4	-8.0637
S4	aspheric	3.5446	0.2248			-3.9727
S5	aspheric	13.9387	0.4856	1.55	56.1	56.0398
S6	aspheric	-10.6543	0.0600			57.2530
S7	aspheric	-87.3703	0.2466	1.67	20.4	-99.0000
S8	aspheric	15.8550	0.1684			34.0353
S9	aspheric	-12.2494	0.2837	1.67	20.4	87.6792
S10	aspheric	-18.2539	0.1452			10.2729
S11	aspheric	10.1481	0.5160	1.55	56.1	43.3042
S12	aspheric	-1.6827	0.3108			-10.5698
S13	aspheric	-2.8863	0.3232	1.54	55.7	-1.3827
S14	aspheric	1.6674	0.3026			-16.7588
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5554			
S17	spherical	infinite				

As may be obtained from Table 10, in Embodiment 4, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 11 shows the high-order coefficients applicable to each aspheric surface in Embodiment 4. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 11

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.5890E - 02	1.0865E - 01	-3.5138E - 01	6.7315E - 01	-8.3500E - 01	6.5883E - 01	-3.2197E - 01	8.7814E - 02	-1.0140E - 02
S2	-6.2480E - 02	9.9910E - 03	9.0788E - 02	-2.6462E - 01	3.8786E - 01	-3.5028E - 01	1.9258E - 01	-5.8840E - 02	7.6400E - 03
S3	-1.3177E - 01	1.6835E - 01	-2.4957E - 01	7.2560E - 01	-1.3738E + 00	1.4515E + 00	-7.7477E - 01	1.4665E - 01	1.3634E - 02
S4	-7.5470E - 02	-4.3040E - 02	1.0885E + 00	-5.0563E + 00	1.4662E + 00	-2.7060E + 00	3.0635E + 00	-1.9343E + 01	5.2285E + 00
S5	-8.9620E - 02	2.4116E - 01	-1.5112E + 00	4.7468E + 00	-9.0751E + 00	1.0071E + 00	-5.5574E + 00	5.9752E - 01	4.8979E - 01
S6	-1.1733E - 01	-1.1623E - 01	7.0810E - 03	1.0801E + 00	-4.2291E + 00	7.8223E + 00	-7.6858E + 00	3.8581E + 00	-7.8080E - 01
S7	-2.9272E - 01	7.5147E - 01	-3.5448E + 00	1.0605E + 00	-2.0599E + 00	2.5822E + 00	-1.9902E + 00	8.4883E + 00	-1.5242E + 00
S8	-1.8046E - 01	1.7187E - 01	-8.1840E - 02	-4.4769E - 01	1.0441E + 00	-1.1093E + 00	6.3482E - 01	-1.9095E - 01	2.5334E - 02
S9	-1.9603E - 01	3.6782E - 01	-8.0634E - 01	1.6715E + 00	-2.8911E + 00	3.2928E + 00	-2.2697E + 00	8.6785E - 01	-1.4164E - 01
S10	-1.9583E - 01	5.3010E - 02	1.2246E - 01	-1.7709E - 01	-4.9240E - 02	2.4633E - 01	-1.8148E - 01	5.5222E - 02	-6.2500E - 03
S11	-3.9140E - 02	-9.1390E - 02	-1.1181E - 01	7.026E - 01	-1.2754E + 00	1.1743E + 00	-5.9789E - 01	1.6068E - 01	-1.7790E - 02
S12	-1.8100E - 02	-3.1820E - 02	1.1872E - 01	-1.6136E - 01	1.1427E - 01	-4.6090E - 02	1.0739E - 02	-1.3500E - 03	7.1700E - 05
S13	-2.9839E - 01	3.1043E - 01	-2.6363E - 01	1.8559E - 01	-8.5520E - 02	2.4251E - 02	-4.1100E - 03	1.8400E - 04	-1.5000E - 05
S14	-1.4746E - 01	1.1305E - 01	-6.5200E - 01	2.5753E - 02	-6.7400E - 03	1.0800E - 03	-9.0000E - 05	1.8500E - 06	1.4400E - 07

Table 12 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 4, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 12

f1(mm)	4.02	f(mm)	3.85
f2(mm)	-15.97	TTL(mm)	4.82
f3(mm)	11.14	ImgH(mm)	3.34
f4(mm)	-20.14		
f5(mm)	-57.01		
f6(mm)	2.69		
f7(mm)	-1.92		

FIG. 8A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 4, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 8B illustrates the astigmatic curve of the lens assembly according to Embodiment 4, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 8C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 4, representing amounts of distortion at different viewing angles. FIG. 8D illustrates the lateral color curve of the lens assembly according to Embodiment 4, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 8A-8D that the optical imaging lens assembly according to Embodiment 4 can achieve a good imaging quality.

Embodiment 5

An optical imaging lens assembly according to Embodiment 5 of the present disclosure is described below with reference to FIGS. 9-10D. FIG. 9 is a schematic structural

diagram illustrating the optical imaging lens assembly according to Embodiment 5 of the present disclosure.

As shown in FIG. 9, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 13 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 5. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 13

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6750	0.7273	1.55	56.1	-0.0623
S2	aspheric	5.8618	0.1060			-10.3301
STO	spherical	infinite	0.0400			
S3	aspheric	5.5840	0.2300	1.67	20.4	-11.2212
S4	aspheric	3.5200	0.2132			-4.4226
S5	aspheric	2.6027	0.4765	1.55	56.1	74.8032
S6	aspheric	-9.4775	0.0600			49.4828
S7	aspheric	-51.6312	0.2581	1.67	20.4	-99.0000
S8	aspheric	13.7361	0.1634			53.6477
S9	aspheric	-12.6335	0.2824	1.67	20.4	89.3588
S10	aspheric	-16.9533	0.1672			-72.9299
S11	aspheric	9.6674	0.4857	1.55	56.1	37.6323
S12	aspheric	-1.6945	0.2925			-8.7349
S13	aspheric	-2.9293	0.3256	1.54	55.7	-1.4382
S14	aspheric	1.6659	0.3046			-15.1421
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5574			
S17	spherical	infinite				

As may be obtained from Table 13, in Embodiment 5, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 14 shows the high-order coefficients applicable to each aspheric surface in Embodiment 5. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 15

f1(mm)	4.05	f(mm)	3.94
f2(mm)	-14.97	TTL(mm)	4.80
f3(mm)	9.98	ImgH(mm)	3.36
f4(mm)	-16.27		
f5(mm)	-76.47		

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-1.7260E - 02	6.8051E - 02	-2.2949E - 01	4.4964E - 01	-5.6729E - 01	4.5059E - 01	-2.1933E - 01	5.8548E - 02	-6.4900E - 03
S2	-5.7290E - 02	1.5112E - 02	3.6099E - 02	-1.1342E - 01	1.5791E - 01	-1.3998E - 01	7.7662E - 02	-2.4310E - 02	3.2580E - 03
S3	-1.2131E - 01	1.2347E - 01	-1.2959E - 01	4.6878E - 01	-1.0693E + 00	1.3614E + 00	-9.6208E - 01	3.4927E - 01	-4.7830E - 02
S4	-7.3950E - 02	-6.9700E - 03	7.0336E - 01	-3.3506E + 00	1.0202E + 00	-1.9903E + 00	2.3804E + 00	-1.5835E + 01	4.5041E + 00
S5	-6.5670E - 02	5.9553E - 02	-5.3307E - 01	1.3721E + 00	-1.7753E + 00	7.6472E - 01	2.8857E + 00	-3.4441E + 00	1.3474E + 00
S6	-1.1546E - 01	-4.0930E - 02	1.4215E - 01	-9.5878E - 01	2.5269E + 00	-3.6575E + 00	3.2872E + 00	-1.7407E + 00	4.0778E - 01
S7	-2.4432E - 01	3.7026E - 01	-1.1876E + 00	2.2278E + 00	-2.6523E + 00	2.0459E + 00	-8.0582E - 01	-2.8830E - 02	9.0787E - 02
S8	-1.8359E - 01	2.3274E - 01	-3.0643E - 01	1.7276E - 01	4.0842E - 01	-5.0568E - 01	2.5393E - 01	-5.1220E - 02	2.9410E - 03
S9	-1.6250E - 01	2.1360E - 01	-2.8721E - 01	6.2611E - 01	-1.6848E + 00	2.5613E + 00	-2.1179E + 00	9.1352E - 01	-1.6137E - 01
S10	-1.6941E - 01	-7.3110E - 01	5.1071E - 01	-9.0683E - 01	8.4206E - 01	-4.6180E - 01	1.6512E - 01	-3.8510E - 02	4.4030E - 03
S11	-3.2230E - 02	-1.6901E - 01	4.5289E - 02	5.1759E - 01	-1.1239E - 01	1.0955E + 00	-5.7944E - 01	1.6147E - 01	-1.8530E - 02
S12	2.8779E - 02	-1.5061E - 01	2.1817E - 01	-1.6309E - 01	6.2391E - 02	-8.4900E - 03	-1.6200E - 03	6.6000E - 04	-6.0000E - 05
S13	-2.7308E - 01	2.2675E - 01	-1.3912E - 01	8.4432E - 02	-3.7110E - 02	1.0919E - 02	-1.6700E - 03	1.5000E - 04	-5.7000E - 06
S14	-1.5661E - 01	1.3081E - 01	-8.2490E - 02	3.6520E - 02	-1.1160E - 02	2.2480E - 03	-2.8000E - 04	1.9000E - 05	-5.2000E - 07

Table 15 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 5, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 15-continued

f6(mm)	2.68
f7(mm)	-1.93

FIG. 10A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 5, representing deviations of focal points of light of different

wavelengths converged after passing through the lens assembly. FIG. 10B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 5, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 10C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 5, representing amounts of distortion at different viewing angles. FIG. 10D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 5, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 10A-10D that the optical imaging lens assembly according to Embodiment 5 can achieve a good imaging quality.

Embodiment 6

An optical imaging lens assembly according to Embodiment 6 of the present disclosure is described below with reference to FIGS. 11-12D. FIG. 11 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 6 of the present disclosure.

As shown in FIG. 11, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a convex surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a positive refractive power, an object-side surface S9 of the fifth lens E5 is a convex surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 16 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 6. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 16

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6526	0.7744	1.55	56.1	-0.0179
S2	aspheric	4.9179	0.1227			-7.9777
STO	spherical	infinite	0.0400			
S3	aspheric	6.0435	0.2300	1.67	20.4	-28.3104
S4	aspheric	3.7495	0.1965			-7.3895
S5	aspheric	8.7775	0.4612	1.55	56.1	59.7351
S6	aspheric	-23.7448	0.0700			-98.8063
S7	aspheric	17.7789	0.2588	1.67	20.4	89.8404
S8	aspheric	7.4627	0.1456			33.5544
S9	aspheric	201.7599	0.2788	1.67	20.4	99.0000
S10	aspheric	-497.1700	0.2044			-99.0000
S11	aspheric	8.5562	0.4943	1.55	56.1	28.5352
S12	aspheric	-1.7358	0.2558			-10.1241
S13	aspheric	-3.1243	0.3115	1.54	55.7	-1.4066
S14	aspheric	1.6285	0.3050			-14.5668
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5578			
S17	spherical	infinite				

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive

As may be obtained from Table 16, in Embodiment 6, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 17 shows the high-order coefficients applicable to each aspheric surface in Embodiment 6. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 17

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.2990E-02	9.6412E-02	-2.9850E-01	5.4329E-01	-6.2498E-01	4.4874E-01	-1.9448E-01	4.5436E-02	-4.3200E-03
S2	-4.4900E-02	-1.4090E-02	8.1942E-02	-1.7777E-01	2.3282E-01	-1.9819E-01	1.0449E-01	-3.0790E-02	3.8680E-03

TABLE 17-continued

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S3	-1.1630E-01	9.8568E-02	-1.5952E-01	6.0029E-01	-1.1718E+00	1.2694E+00	-7.7053E-01	2.4000E-01	-2.7720E-02
S4	-7.0630E-02	-3.7810E-02	6.6015E-01	-2.6832E+00	7.4011E+00	-1.3205E+01	1.4426E+01	-8.7536E+00	2.2675E+00
S5	-5.2210E-02	1.7792E-02	-4.3394E-01	1.3392E+00	-2.4129E+00	2.2781E+00	-6.7545E-01	-5.0271E-01	3.4176E-01
S6	-1.1854E-01	1.5745E-01	-7.5891E-01	1.5284E+00	-1.9096E+00	1.3801E+00	-3.3095E-01	-1.8477E-01	9.6125E-02
S7	-2.4843E-01	4.7234E-01	-1.4941E+00	2.8342E+00	-3.4064E+00	2.5451E+00	-1.0222E+00	1.2813E-01	1.7206E-02
S8	-1.8674E-01	2.3413E-01	-3.2258E-01	5.7694E-02	4.4253E-01	-6.6750E-01	4.3720E-01	-1.4424E-01	2.0347E-02
S9	-1.4461E-01	2.1000E-01	-4.9195E-01	1.2525E+00	-2.5242E+00	3.1256E+00	-2.2424E+00	8.5625E-01	-1.3428E-01
S10	-1.4717E-01	-4.0000E-04	1.6840E-01	-2.7910E-01	1.9195E-01	-4.6170E-02	-3.6100E-03	2.3850E-03	-1.0000E-04
S11	-9.6500E-03	-1.8147E-01	2.0645E-01	-1.4400E-03	-3.1467E-01	3.7506E-01	-2.0770E-01	5.8326E-02	-6.6600E-03
S12	2.4436E-02	-1.2564E-01	2.2571E-01	-2.0861E-01	1.0152E-01	-2.5130E-02	2.3990E-03	1.2200E-04	-2.9000E-05
S13	-2.8427E-01	2.6953E-01	-2.0218E-01	1.3204E-01	-5.7670E-02	1.5471E-02	-2.4600E-03	2.1500E-04	-7.9000E-06
S14	-1.6803E-01	1.5103E-01	-1.0319E-01	4.9357E-02	-1.6240E-02	3.5450E-03	-4.9000E-04	3.7500E-05	-1.2000E-06

Table 18 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 6, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 18

f1(mm)	4.21	f(mm)	3.95
f2(mm)	-15.46	TTL(mm)	4.82
f3(mm)	11.80	ImgH(mm)	3.34
f4(mm)	-19.51		
f5(mm)	215.62		
f6(mm)	2.69		
f7(mm)	-1.95		

FIG. 12A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 6, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 12B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 6, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 12C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 6, representing amounts of distortion at different viewing angles. FIG. 12D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 6, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 12A-12D that the optical imaging lens assembly according to Embodiment 6 can achieve a good imaging quality.

Embodiment 7

An optical imaging lens assembly according to Embodiment 7 of the present disclosure is described below with reference to FIGS. 13-14D. FIG. 13 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 7 of the present disclosure.

As shown in FIG. 13, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 19 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 7. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 19

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6770	0.7364	1.55	56.1	-0.0566
S2	aspheric	5.6504	0.1091			-9.5792

TABLE 19-continued

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
STO	spherical	infinite	0.0400			
S3	aspheric	5.5717	0.2300	1.67	20.4	-11.2918
S4	aspheric	3.5890	0.2080			-4.6149
S5	aspheric	12.1907	0.4758	1.55	56.1	75.4970
S6	aspheric	-9.4060	0.0600			48.6557
S7	aspheric	-58.4894	0.2539	1.67	20.4	99.0000
S8	aspheric	12.4212	0.1608			51.3574
S9	aspheric	-12.7628	0.2891	1.67	20.4	92.9118
S10	aspheric	-16.5685	0.1617			-44.7911
S11	aspheric	9.3158	0.4868	1.55	56.1	35.4018
S12	aspheric	-1.7122	0.3004			-9.0470
S13	aspheric	-2.9542	0.3262	1.54	55.7	-1.4352
S14	aspheric	1.6722	0.3045			-14.7187
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5573			
S17	spherical	infinite				

As may be obtained from Table 19, in Embodiment 7, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 20 shows the high-order coefficients applicable to each aspheric surface in Embodiment 7. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 20

surface number	A4	A6	A8	A10	A12	A14
S1	-1.9030E-02	7.5352E-02	-2.5016E-01	4.8666E-01	-6.0904E-01	4.8019E-01
S2	-5.4640E-02	1.2288E-02	2.6543E-02	-7.7780E-02	9.9760E-02	-8.4420E-02
S3	-1.1890E-01	1.2950E-01	-2.1427E-01	7.7503E-01	-1.6828E+00	2.1105E+00
S4	-7.0740E-02	-2.4680E-02	7.2864E-01	-3.2732E+00	9.7183E+00	-1.8780E+01
S5	-6.6870E-02	8.0941E-02	-6.9384E-01	2.0745E+00	-3.6917E+00	3.3671E+00
S6	-1.0324E-01	-6.9140E-02	2.0517E-01	-1.0637E+00	2.6216E+00	-3.6931E+00
S7	-2.4602E-01	4.2832E-01	-1.4790E+00	2.9561E+00	-3.6749E+00	2.7958E+00
S8	-1.8124E-01	2.1875E-01	-2.3501E-01	-2.3922E-01	9.5595E-01	-1.1901E+00
S9	-1.6076E-01	2.5397E-01	-4.9472E-01	1.1880E+00	-2.6258E+00	3.5744E+00
S10	-1.5446E-01	-1.4282E-01	7.1051E-01	-1.2868E+00	1.3156E+00	-8.3280E-01
S11	-2.3350E-02	-1.9653E-01	8.8314E-02	4.7121E-01	-1.0930E+00	1.0875E+00
S12	3.3003E-02	-1.5378E-01	2.0922E-01	-1.4299E-01	4.3131E-02	1.5880E-03
S13	-2.6632E-01	2.0595E-01	-1.1276E-01	6.6190E-02	-2.9530E-02	8.2360E-03
S14	-1.6128E-01	1.3708E-01	-8.8350E-02	4.0417E-02	-1.2900E-02	2.7510E-03

surface number	A16	A18	A20
S1	-2.3186E-01	6.1452E-02	-6.7700E-03
S2	4.5863E-02	-1.4180E-02	1.8750E-03
S3	-1.5152E+00	5.7618E-01	-8.7480E-02
S4	2.2425E+01	-1.4954E+01	4.2738E+00
S5	-5.6571E-01	-1.4283E+00	8.4680E-01
S6	3.2825E+00	-1.7308E+00	4.0448E-01
S7	-9.7928E-01	-1.1882E-01	1.3513E-01
S8	7.5466E-01	-2.5232E-01	3.7370E-02
S9	-2.7909E+00	1.1589E+00	-1.9827E-01
S10	3.3780E-01	-8.1750E-02	8.8720E-03
S11	-5.8336E-01	1.6465E-01	-1.9120E-02
S12	-4.6000E-03	1.1260E-03	-9.0000E-05
S13	-1.3600E-03	1.2300E-04	-4.7000E-06
S14	-3.7000E-04	2.8100E-05	-9.1000E-07

Table 21 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 7, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 21

f1(mm)	4.10	f(mm)	3.91
f2(mm)	-15.89	TTL(mm)	4.81
f3(mm)	9.80	ImgH(mm)	3.38
f4(mm)	-15.37		
f5(mm)	-86.08		

TABLE 21-continued

f6(mm)	2.69
f7(mm)	-1.94

FIG. 14A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 7, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 14B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 7, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 14C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 7, representing amounts of distortion at different viewing angles. FIG. 14D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 7, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 14A-14D that the optical imaging lens assembly according to Embodiment 7 can achieve a good imaging quality.

Embodiment 8

An optical imaging lens assembly according to Embodiment 8 of the present disclosure is described below with reference to FIGS. 15-16D. FIG. 15 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 8 of the present disclosure.

As shown in FIG. 15, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm

surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a convex surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 22 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 8. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 22

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6681	0.6789	1.55	56.1	-0.1076
S2	aspheric	6.4700	0.0977			-14.5084
STO	spherical	infinite	0.0400			
S3	aspheric	6.3252	0.2346	1.67	20.4	-13.9417
S4	aspheric	4.1795	0.2027			-7.9043
S5	aspheric	130.2306	0.4580	1.55	56.1	99.0000
S6	aspheric	-7.5496	0.0700			53.9205
S7	aspheric	-15.3798	0.2631	1.67	20.4	99.0000
S8	aspheric	-314.8320	0.1356			-99.0000
S9	aspheric	-8.3601	0.2662	1.67	20.4	51.2127
S10	aspheric	-13.4416	0.1553			-78.7624
S11	aspheric	9.9106	0.4670	1.55	56.1	44.5943
S12	aspheric	-1.7365	0.3590			-13.4666
S13	aspheric	-3.0354	0.3083	1.54	55.7	-1.3098
S14	aspheric	1.6296	0.3026			-16.7446
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5554			
S17	spherical	infinite				

STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex

As may be obtained from Table 22, in Embodiment 8, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 23 shows the high-order coefficients applicable to each aspheric surface in Embodiment 8. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 23

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.7000E-02	1.3381E-01	-4.7609E-01	1.0048E+00	-1.348E+00	1.1376E+00	-5.8510E-01	1.6553E-01	-1.9570E-02
S2	-6.0890E-02	-4.5000E-05	1.4826E-01	-4.6498E-01	8.1381E-01	-8.9752E-01	6.0390E-01	-2.2540E-01	3.5723E-02
S3	-1.3370E-01	2.4910E-01	-9.4772E-01	3.7054E+00	-8.9618E+00	1.3295E+01	-1.1864E+01	5.8601E+00	-1.2288E+00
S4	-7.0870E-02	-9.3510E-02	1.3573E+00	-6.4228E+00	1.9222E+01	-3.6966E+01	4.4062E+01	-2.9617E+01	8.6336E+00
S5	-5.5950E-02	-1.4029E-01	7.2036E-01	-3.5267E+00	1.0430E+01	-1.9359E+01	2.2043E+01	-1.4172E+01	4.0089E+00
S6	-1.3976E-01	-1.5729E-01	1.6681E+00	-8.1718E+00	2.1503E+01	-3.3904E+01	3.2455E+01	-1.7436E+01	4.0322E+00
S7	-3.0373E-01	5.7895E-01	-1.9464E+00	4.0577E+00	-5.6361E+00	4.8159E+00	-1.5019E+00	-8.6748E-01	5.9068E-01
S8	-1.8090E-01	-2.1730E-01	2.5574E+00	-9.4381E+00	1.8761E+01	-2.2527E+01	1.6492E+01	-6.8388E+00	1.2376E+00
S9	-1.6898E-01	-2.8920E-02	1.3734E+00	-4.3093E+00	6.6017E+00	-6.2090E+00	3.9630E+00	-1.6668E+00	3.4116E-01
S10	-1.8094E-01	-1.1353E-01	7.5605E-01	1.2196E+00	5.9388E-01	4.9136E-01	-7.3783E-01	3.3389E-01	-5.3470E-02
S11	-9.4500E-03	-2.5279E-01	3.0755E-01	1.1036E-01	-8.5286E-01	1.0697E+00	-6.4076E-01	1.9293E-01	-2.3430E-02
S12	-2.0570E-02	-3.7170E-02	1.7938E-01	-2.8558E-01	2.3254E-01	-1.0782E-01	2.8998E-02	-4.2300E-03	2.6100E-04
S13	-3.0751E-01	3.4077E-01	-3.1625E-01	2.3588E-01	-1.1315E-01	3.3205E-02	-5.8000E-03	5.5300E-04	-2.2000E-05
S14	-1.5369E-01	1.3093E-01	-8.9180E-02	4.3295E-02	-1.4420E-02	3.1540E-03	-4.3000E-04	3.2200E-05	-1.0000E-06

Table 24 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 8, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 24

f1(mm)	3.92	f(mm)	3.82
f2(mm)	-19.35	TTL(mm)	4.70
f3(mm)	13.09	ImgH(mm)	3.36
f4(mm)	-24.30		
f5(mm)	-33.93		
f6(mm)	2.75		
f7(mm)	-1.93		

FIG. 16A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 8, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 16B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 8, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 16C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 8, representing amounts of distortion at different viewing angles. FIG. 16D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 8, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 16A-16D that the optical imaging lens assembly according to Embodiment 8 can achieve a good imaging quality.

Embodiment 9

An optical imaging lens assembly according to Embodiment 9 of the present disclosure is described below with reference to FIGS. 17-18D. FIG. 17 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 9 of the present disclosure.

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As shown in FIG. 17, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

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The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 25 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 9. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 25

surface number	surface type	radius of		material		
		curvature	thickness	refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6562	0.6938	1.55	56.1	-0.1366
S2	aspheric	7.0991	0.0933			-14.5353
STO	spherical	infinite	0.0400			
S3	aspheric	6.6566	0.2326	1.67	20.4	3.0678
S4	aspheric	3.9957	0.2121			-3.4649
S5	aspheric	33.3863	0.4559	1.55	56.1	99.0000
S6	aspheric	-8.6820	0.0700			61.8981
S7	aspheric	-32.6449	0.2499	1.67	20.4	22.6435
S8	aspheric	19.5229	0.1578			-49.7187
S9	aspheric	-11.1681	0.2980	1.67	20.4	83.6636
S10	aspheric	-16.5667	0.1557			14.4277
S11	aspheric	10.1120	0.4563	1.55	56.1	44.6883
S12	aspheric	-1.7208	0.3271			-11.4462
S13	aspheric	-3.0226	0.3009	1.54	55.7	-1.3309
S14	aspheric	1.6395	0.2919			-16.1993
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5447			
S17	spherical	infinite				

As may be obtained from Table 25, in Embodiment 9, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 26 shows the high-order coefficients applicable to each aspheric surface in Embodiment 9. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

wavelengths converged after passing through the lens assembly. FIG. 18B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 9, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 18C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 9, representing amounts of dis-

TABLE 26

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-2.2620E-02	1.0553E-01	-3.7553E-01	7.8141E-01	-1.0466E+00	8.8543E-01	-4.6094E-01	1.3307E-01	-1.6160E-02
S2	-6.0040E-02	-1.0330E-02	2.0487E-01	-6.1586E-01	1.0285E+00	-1.0673E+00	6.7380E-01	-2.3631E-01	3.5264E-02
S3	-1.2715E-01	1.9884E-01	-5.0188E-01	1.9033E+00	-4.6772E+00	6.9937E+00	-6.2273E+00	3.0508E+00	-6.3124E-01
S4	-7.2510E-02	-6.9990E-02	1.4853E+00	-7.8475E+00	2.5424E+01	-5.1810E+01	6.4338E+01	-4.4436E+01	1.3136E+01
S5	-8.4960E-02	1.2516E-01	-1.1373E+00	4.4366E+00	-1.0823E+01	1.6138E+01	-1.3829E+01	5.7840E+00	-6.4253E-01
S6	-2.1479E-01	5.3499E-01	-2.4030E+00	6.3186E+00	-1.0998E+01	1.2640E-01	-8.9673E+00	3.4515E+00	-5.3232E-01
S7	-3.2318E-01	6.8338E-01	-2.2423E+00	4.2313E+00	-4.4320E+00	1.5752E+00	1.8228E+00	-2.3198E+00	7.7517E-01
S8	-2.1930E-01	2.5688E-01	3.2200E-03	-1.6873E+00	4.5341E+00	-6.1466E+00	4.7670E+00	-2.0287E+00	3.7102E-01
S9	-1.7134E-01	1.2516E-01	3.4906E-01	-1.4318E+00	2.0855E+00	-1.6302E+00	7.2452E-01	-1.7717E-01	2.0883E-02
S10	-1.7822E-01	-9.1830E-02	6.9725E-01	-1.3950E+00	1.4778E+00	-9.1275E-01	3.3653E-01	-6.9360E-02	6.1290E-03
S11	-8.6500E-03	-3.7510E-01	7.9218E-01	-9.1083E-01	4.8218E-01	-2.1400E-02	-1.0577E-01	4.9792E-02	-7.3900E-03
S12	5.1810E-03	-1.4263E-01	3.5248E-01	-4.3468E-01	3.0218E-01	-1.2372E-01	2.9730E-02	-3.9000E-03	2.1500E-04
S13	-3.0314E-01	3.2065E-01	-2.7383E-01	1.9151E-01	-8.7630E-02	2.4717E-02	-4.1700E-03	3.8800E-04	-1.5000E-05
S14	-1.5355E-01	1.3084E-01	-8.7770E-02	4.1201E-02	-1.3150E-02	2.7380E-03	-3.5000E-04	2.4600E-05	-7.0000E-07

Table 27 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 9, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 27

f1(mm)	3.79	f(mm)	3.87
f2(mm)	-15.56	TTL(mm)	4.69
f3(mm)	12.67	ImgH(mm)	3.36
f4(mm)	-18.32		
f5(mm)	-52.64		
f6(mm)	2.73		
f7(mm)	-1.94		

FIG. 18A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 9, representing deviations of focal points of light of different

tortion at different viewing angles. FIG. 18D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 9, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 18A-18D that the optical imaging lens assembly according to Embodiment 9 can achieve a good imaging quality.

Embodiment 10

An optical imaging lens assembly according to Embodiment 10 of the present disclosure is described below with reference to FIGS. 19-20D. FIG. 19 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 10 of the present disclosure.

As shown in FIG. 19, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm

STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a concave surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a positive refractive power, an object-side

surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 28 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 10. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 28

surface number	surface type	radius of curvature	thickness	material		conic coefficient
				refractive index	abbe number	
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6490	0.6904	1.55	56.1	-0.1181
S2	aspheric	5.9180	0.1016			-15.7506
STO	spherical	infinite	0.0400			
S3	aspheric	5.6983	0.2300	1.67	20.4	-7.0855
S4	aspheric	3.5428	0.2082			-3.9431
S5	aspheric	14.2190	0.4622	1.55	56.1	-23.9406
S6	aspheric	-9.7417	0.0600			58.7646
S7	aspheric	-119.8980	0.2407	1.67	20.4	99.0000
S8	aspheric	10.0940	0.1493			-70.8319
S9	aspheric	-65.0945	0.3006	1.67	20.4	-99.0000
S10	aspheric	-61.8179	0.1830			-99.0000
S11	aspheric	10.1306	0.4706	1.55	56.1	44.5735
S12	aspheric	-1.7183	0.3213			-11.9523
S13	aspheric	-3.0241	0.3042	1.54	55.7	-1.3600
S14	aspheric	1.6394	0.2907			-15.7329
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5435			
S17	spherical	infinite				

As may be obtained from Table 28, in Embodiment 10, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 29 shows the high-order coefficients applicable to each aspheric surface in Embodiment 10. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 29

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-1.7380E-02	7.7566E-02	-2.8554E-01	6.0469E-01	-8.1997E-01	6.9609E-01	-3.6082E-01	1.0257E-01	-1.2110E-02
S2	-6.2860E-02	8.9000E-03	1.1926E-01	-3.9342E-01	6.7405E-01	-7.1367E-01	4.5798E-01	-1.6266E-01	2.4514E-02
S3	-1.3630E-01	1.7966E-01	-3.1396E-01	1.1530E+00	-2.7793E+00	3.9676E+00	-3.3025E+00	1.4884E+00	-2.7783E-01
S4	-8.2400E-02	-7.8900E-03	9.9858E-01	-5.1836E+00	1.6731E+01	-3.4440E+01	4.3488E+01	-3.0618E+01	9.2406E+00
S5	-7.9330E-02	1.6065E-01	-1.4462E+00	5.8240E+00	-1.4636E+01	2.2568E+01	-2.0366E+01	9.4812E+00	-1.5474E+00
S6	-1.7268E-01	1.9280E-01	-8.8212E-01	2.0155E+00	-2.9087E+00	2.5489E+00	-9.4930E-01	-2.0031E-01	1.8613E-01
S7	-2.9779E-01	5.4750E-01	-1.8255E+00	3.8506E+00	-5.1559E+00	4.2182E+00	-1.7133E+00	3.9857E-02	1.2704E-01
S8	-2.1558E-01	3.6186E-01	-6.5395E-01	6.2028E-01	-1.7674E-01	-3.1684E-01	3.9401E-01	-1.8547E-01	3.5077E-02
S9	-1.8084E-01	1.1928E-01	3.7779E-01	-1.6145E+00	2.6698E+00	-2.5092E+00	1.3608E+00	-3.7886E-01	3.9035E-02
S10	-1.9847E-01	6.1582E-02	1.3811E-01	-3.1057E-01	2.4267E-01	-6.3750E-02	-5.2000E-03	3.5010E-03	-6.2000E-05
S11	-2.3980E-02	-2.1877E-01	3.5142E-01	-2.6565E-01	-5.8380E-02	2.3261E-01	-1.5984E-01	4.8651E-02	-5.7000E-03
S12	-1.9100E-02	-4.3450E-02	1.6225E-01	-2.2485E-01	1.6350E-01	-6.8010E-02	1.6380E-02	-2.1400E-03	1.1700E-04
S13	-3.0199E-01	3.1892E-01	-2.7941E-01	2.0261E-01	-9.5650E-02	2.7733E-02	-4.8100E-03	4.5900E-04	-1.9000E-05
S14	-1.5254E-01	1.2322E-01	-7.6850E-02	3.3295E-02	-9.7300E-03	1.8120E-03	-2.0000E-04	1.0400E-05	-1.3000E-07

Table 30 shows the effective focal lengths f_1 - f_7 of the respective lenses in Embodiment 10, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 30

f_1 (mm)	3.96	f (mm)	3.89
f_2 (mm)	-14.69	TTL(mm)	4.71
f_3 (mm)	10.66	ImgH (mm)	3.34
f_4 (mm)	-13.97		
f_5 (mm)	1779.54		
f_6 (mm)	2.73		
f_7 (mm)	-1.94		

FIG. 20A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 10, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 20B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 10, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 20C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 10, representing amounts of distortion at different viewing angles. FIG. 20D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 10, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 20A-20D that the optical imaging lens assembly according to Embodiment 10 can achieve a good imaging quality.

Embodiment 11

An optical imaging lens assembly according to Embodiment 11 of the present disclosure is described below with

STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a convex surface. The fourth lens E4 has a negative refractive power, an object-side surface S7 of the fourth lens E4 is a convex surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 31 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 11. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 31

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6412	0.6986	1.55	56.1	-0.1192
S2	aspheric	5.7580	0.1026			-16.4815
STO	spherical	infinite	0.0400			
S3	aspheric	5.4284	0.2300	1.67	20.4	-7.9765
S4	aspheric	3.4584	0.2055			-3.4895
S5	aspheric	13.0646	0.4471	1.55	56.1	37.5886
S6	aspheric	-17.9056	0.0650			-99.0000
S7	aspheric	39.5440	0.2793	1.67	20.4	-62.8799
S8	aspheric	16.3602	0.1737			47.7653
S9	aspheric	-12.1547	0.2692	1.67	20.4	87.3608
S10	aspheric	-18.7459	0.1845			-64.7304
S11	aspheric	10.5842	0.4978	1.55	56.1	41.4357
S12	aspheric	-1.7131	0.2741			-11.0587
S13	aspheric	-3.0050	0.3066	1.54	55.7	-1.3581
S14	aspheric	1.6121	0.2976			-15.7143
S15	spherical	infinite	0.1100	1.52	64.2	
S16	spherical	infinite	0.5504			
S17	spherical	infinite				

reference to FIGS. 21-22D. FIG. 21 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 11 of the present disclosure.

As shown in FIG. 21, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm

As may be obtained from Table 31, in Embodiment 11, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 32 shows the high-order coefficients applicable to each aspheric surface in Embodiment 11. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

TABLE 32

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-1.6240E-02	7.0344E-02	-2.6148E-01	5.4968E-01	-7.3946E-01	6.2268E-01	-3.2092E-01	9.0937E-02	-1.0720E-02
S2	-6.3190E-02	1.1604E-02	9.7205E-02	-3.2132E-01	5.4132E-01	-5.6494E-01	3.5854E-01	-1.2624E-01	1.8889E-02
S3	-1.3608E-01	1.8562E-01	-3.9985E-01	1.5701E+00	-3.8963E+00	5.7667E+00	-5.0323E+00	2.4024E+00	-4.8255E-01
S4	-7.9540E-02	-2.5910E-02	1.0713E+00	-5.2608E+00	1.6271E+01	-3.2328E+01	3.9608E+01	-2.7157E+01	8.0043E+00
S5	-7.9240E-02	1.6525E-01	-1.3571E+00	5.3378E+00	-1.1373E+01	2.0927E+01	-1.9571E+01	9.7706E+00	-1.8691E+00
S6	-2.2401E-01	4.2030E-01	-1.9596E+00	5.6196E+00	-1.0869E+01	1.3811E+01	-1.0781E+01	4.6252E+00	-8.3228E-01
S7	-3.0103E-01	5.6466E-01	-1.9663E+00	4.6390E+00	-7.4520E+00	7.9855E+00	-5.2942E+00	1.9057E+00	-2.8973E-01
S8	-1.8959E-01	2.3251E-01	-2.5152E-01	-1.8550E-01	9.5978E-01	-1.4359E+00	1.1311E+00	-4.7758E-01	8.6829E-02
S9	-1.6698E-01	1.0682E-01	2.8352E-01	-1.0654E+00	1.4622E+00	-1.0733E+00	3.9277E-01	-3.5080E-02	-1.0150E-02
S10	-1.9234E-01	5.4477E-02	1.6822E-01	-3.5857E-01	2.9158E-01	-1.0800E-01	2.5089E-02	-8.2900E-03	1.8160E-03
S11	-2.3410E-02	-2.4441E-01	4.9879E-01	-6.3858E-01	4.9699E-01	-2.6359E-01	1.0016E-01	-2.4950E-02	2.9750E-03
S12	-3.1300E-03	-8.8940E-02	2.015311E-01	-2.2562E-01	1.4146E-01	-5.1430E-02	1.0732E-02	-1.1900E-03	5.3100E-05
S13	-3.0455E-01	3.1545E-01	-2.6327E-01	1.8306E-01	-8.3550E-02	2.3428E-02	-3.9200E-03	3.6000E-04	-1.4000E-05
S14	-1.5685E-01	1.3077E-01	-8.3160E-02	3.6409E-02	-1.0670E-02	1.9720E-03	-2.1000E-04	9.9900E-06	-5.5000E-08

Table 33 shows the effective focal lengths $f1-f7$ of the respective lenses in Embodiment 11, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length $ImgH$ of the effective pixel area on the image plane $S17$ of the optical imaging lens assembly.

TABLE 33

$f1$ (mm)	3.97	f (mm)	3.95
$f2$ (mm)	-15.02	TTL(mm)	4.73
$f3$ (mm)	13.91	$ImgH$ (mm)	3.35
$f4$ (mm)	-42.12		
$f5$ (mm)	-52.79		
$f6$ (mm)	2.74		
$f7$ (mm)	-1.91		

FIG. 22A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 11, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 22B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 11, representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 22C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 11, representing amounts of distortion at different viewing angles. FIG. 22D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 11, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 22A-22D that the optical imaging lens assembly according to Embodiment 11 can achieve a good imaging quality.

Embodiment 12

An optical imaging lens assembly according to Embodiment 12 of the present disclosure is described below with reference to FIGS. 23-24D. FIG. 23 is a schematic structural diagram illustrating the optical imaging lens assembly according to Embodiment 12 of the present disclosure.

As shown in FIG. 23, the optical imaging lens assembly according to the exemplary embodiments of the present disclosure includes, sequentially from an object side to an image side along an optical axis, a first lens E1, a diaphragm STO, a second lens E2, a third lens E3, a fourth lens E4, a fifth lens E5, a sixth lens E6, a seventh lens E7, an optical filter E8, and an image plane S17.

The first lens E1 has a positive refractive power, an object-side surface S1 of the first lens E1 is a convex surface, and an image-side surface S2 of the first lens E1 is a concave surface. The second lens E2 has a negative refractive power, an object-side surface S3 of the second lens E2 is a convex surface, and an image-side surface S4 of the second lens E2 is a concave surface. The third lens E3 has a positive refractive power, an object-side surface S5 of the third lens E3 is a convex surface, and an image-side surface S6 of the third lens E3 is a concave surface. The fourth lens E4 has a positive refractive power, an object-side surface S7 of the fourth lens E4 is a convex surface, and an image-side surface S8 of the fourth lens E4 is a concave surface. The fifth lens E5 has a negative refractive power, an object-side surface S9 of the fifth lens E5 is a concave surface, and an image-side surface S10 of the fifth lens E5 is a convex surface. The sixth lens E6 has a positive refractive power, an object-side surface S11 of the sixth lens E6 is a convex surface, and an image-side surface S12 of the sixth lens E6 is a convex surface. The seventh lens E7 has a negative refractive power, an object-side surface S13 of the seventh lens E7 is a concave surface, and an image-side surface S14 of the seventh lens E7 is a concave surface. The optical filter E8 has an object-side surface S15 and an image-side surface S16. Light from an object sequentially passes through the surfaces S1-S16 and finally forms an image on the image plane S17.

Table 34 shows the surface type, the radius of curvature, the thickness, the material and the conic coefficient of each lens of the optical imaging lens assembly in Embodiment 12. The radius of curvature and the thickness are both in millimeters (mm).

TABLE 34

surface number	surface type	radius of curvature	thickness	material		
				refractive index	abbe number	conic coefficient
OBJ	spherical	infinite	infinite			
S1	aspheric	1.6368	0.6978	1.55	56.1	-0.1191

TABLE 34-continued

surface number	surface type	radius of		material		
		curvature	thickness	refractive index	abbe number	conic coefficient
S2	aspheric	5.7298	0.1028			-16.7004
STO	spherical	infinite	0.0400			
S3	aspheric	5.3950	0.2300	1.67	20.4	-7.9391
S4	aspheric	3.4031	0.2045			-3.1585
S5	aspheric	11.9768	0.4273	1.55	56.1	33.1956
S6	aspheric	100.0000	0.0650			-99.0000
S7	aspheric	11.0278	0.2783	1.67	20.4	-35.9270
S8	aspheric	15.4004	0.1793			89.0948
S9	aspheric	-12.6749	0.2610	1.67	20.4	87.5077
S10	aspheric	-20.9226	0.1963			-99.0000
S11	aspheric	10.3194	0.5021	1.55	56.1	42.4025
S12	aspheric	-1.7145	0.2653			-10.9203
S13	aspheric	-3.0009	0.3030	1.54	55.7	-1.3538
S14	aspheric	1.5936	0.2901			-15.6887
S15	spherical	infinite	0.1100	1.57	64.2	
S16	spherical	infinite	0.5429			
S17	spherical	infinite				

As may be obtained from Table 34, in Embodiment 12, the object-side surface and the image-side surface of any lens among the first to seventh lenses E1-E7 are both aspheric surfaces. Table 35 shows the high-order coefficients applicable to each aspheric surface in Embodiment 12. The surface type of each aspheric surface may be defined by the formula (1) given in Embodiment 1.

FIG. 24A illustrates the longitudinal aberration curve of the optical imaging lens assembly according to Embodiment 12, representing deviations of focal points of light of different wavelengths converged after passing through the lens assembly. FIG. 24B illustrates the astigmatic curve of the optical imaging lens assembly according to Embodiment 12,

TABLE 35

surface number	A4	A6	A8	A10	A12	A14	A16	A18	A20
S1	-1.4420E-02	5.8328E-02	-2.2036E-01	4.6401E-01	-6.2591E-01	5.2639E-01	-2.7046E-01	7.6127E-02	-8.8700E-03
S2	-6.3200E-02	1.0365E-02	1.0113E-01	-3.3138E-01	5.6127E-01	-5.8938E-01	3.7619E-01	-1.3319E-01	2.0041E-02
S3	-1.3583E-01	1.8423E-01	-3.9722E-01	1.5816E+00	-3.9708E+00	5.9412E+00	-5.2412E+00	2.5294E+00	-5.1357E-01
S4	-7.9920E-02	-3.6300E-03	8.8641E-01	-4.3594E+00	1.3594E+01	-2.7436E+01	3.4222E+01	-2.3885E+01	7.1622E+00
S5	-7.7760E-02	1.3463E-01	-1.1467E+00	4.5245E+00	-1.1454E+01	1.8127E+01	-1.7135E+01	8.6299E+00	-1.6539E+00
S6	-2.4825E-01	5.5658E-01	-2.5078E+00	7.0824E+00	-1.3517E+01	1.6976E+01	-1.3167E+01	5.6618E+00	-1.0329E+00
S7	-3.1361E-01	7.0620E-01	-2.7089E+00	7.0846E+00	-1.2641E+01	1.5041E+01	-1.1275E+01	4.8087E+00	-9.1042E-01
S8	-1.7584E-01	1.5842E-01	-7.0100E-03	-7.5617E-01	1.9530E+00	-2.6181E+00	2.0132E+00	-8.4612E-01	1.5239E-01
S9	-1.7130E-01	1.4790E-01	3.4917E-02	-4.1790E-01	5.6992E-01	-3.6337E-01	6.7390E-02	4.1375E-02	-1.6240E-02
S10	-1.9690E-01	1.1871E-01	-7.6880E-02	1.2201E-01	-2.5342E-01	2.6379E-01	-1.2553E-01	2.4995E-02	-1.2500E-03
S11	-3.3320E-02	-1.6708E-01	2.8210E-01	-2.9849E-01	1.7105E-01	-6.2290E-02	2.0035E-02	-5.9200E-03	9.1100E-04
S12	-5.3000E-03	-7.0400E-02	1.4942E-01	-1.5643E-01	9.0951E-02	-2.9930E-02	5.4000E-03	-4.7000E-04	1.2800E-05
S13	-3.0506E-01	3.1576E-01	-2.6300E-01	1.8255E-01	-8.3170E-02	2.3271E-02	-3.8800E-03	3.5600E-04	-1.4000E-05
S14	-1.5689E-01	1.2924E-01	-7.995013-02	3.3529E-02	-9.2200E-03	1.5290E-03	-1.3000E-04	1.8700E-06	2.8900E-07

Table 36 shows the effective focal lengths f1-f7 of the respective lenses in Embodiment 12, the total effective focal length f of the optical imaging lens assembly, the total track length TTL of the optical imaging lens assembly, and the half of the diagonal length ImgH of the effective pixel area on the image plane S17 of the optical imaging lens assembly.

TABLE 36

f1(mm)	3.96	f(mm)	3.91
f2(mm)	-14.51	TTL(mm)	4.70
f3(mm)	24.88	ImgH(mtn)	3.35
f4(mm)	56.90		
f5(mm)	-48.92		
f6(mm)	2.73		
f7(mm)	-1.90		

representing a curvature of the tangential image plane and a curvature of the sagittal image plane. FIG. 24C illustrates the distortion curve of the optical imaging lens assembly according to Embodiment 12, representing amounts of distortion at different viewing angles. FIG. 24D illustrates the lateral color curve of the optical imaging lens assembly according to Embodiment 12, representing deviations of different image heights on the image plane after light passes through the lens assembly. It can be seen from FIGS. 24A-24D that the optical imaging lens assembly according to Embodiment 12 can achieve a good imaging quality.

To sum up, Embodiments 1-12 respectively satisfy the relationships shown in Table 37 below.

TABLE 37

Conditional Expression	Embodiment											
	1	2	3	4	5	6	7	8	9	10	11	12
f/EPD	1.58	1.60	1.61	1.65	1.69	1.62	1.67	1.74	1.74	1.75	1.76	1.75
f12/f34	0.06	0.18	0.19	0.20	0.20	0.19	0.20	0.16	0.12	0.12	0.24	0.28
f2/f7	4.94	8.49	8.47	8.31	7.75	7.93	8.18	10.02	8.03	7.59	7.86	7.66
R1/R4	0.63	0.48	0.46	0.48	0.48	0.44	0.47	0.40	0.41	0.47	0.47	0.48
R12/R14	-0.88	-0.98	-1.02	-1.01	-1.02	-1.07	-1.02	-1.07	-1.05	-1.05	-1.06	-1.08
TTL/ImgH	1.48	1.44	1.44	1.44	1.43	1.44	1.42	1.40	1.40	1.41	1.41	1.40
f/f7	-1.99	-2.02	-2.01	-2.01	-2.04	-2.03	-2.01	-1.98	-2.00	-2.01	-2.07	-2.06
CT6 (mm)	0.61	0.50	0.49	0.52	0.49	0.49	0.49	0.47	0.46	0.47	0.50	0.50
f1/R1	2.20	2.45	2.51	2.37	2.42	2.55	2.44	2.35	2.29	2.40	2.42	2.42
CT1/f2	-0.08	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05	-0.04	-0.04	-0.05	-0.05	-0.05
f6/f7	-1.08	-1.37	-1.37	-1.40	-1.39	-1.38	-1.39	-1.42	-1.41	-1.41	-1.43	-1.44
f7/R14	-1.28	-1.14	-1.17	-1.15	-1.16	-1.20	-1.16	-1.19	-1.18	-1.18	-1.19	-1.19
f6/f3	0.38	0.23	0.24	0.24	0.27	0.11	0.27	0.21	0.22	0.26	0.20	0.11

The present disclosure further provides an imaging device having a photosensitive element which may be a photosensitive charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) element. The imaging device may be an independent imaging device such as a digital camera, or may be an imaging module integrated in a mobile electronic device such as a mobile phone. The imaging device is equipped with the optical imaging lens assembly described above.

The foregoing is only a description for the preferred embodiments of the present disclosure and the applied technical principles. It should be appreciated by those skilled in the art that the inventive scope of the present disclosure is not limited to the technical solution formed by the particular combinations of the above technical features. The inventive scope should also cover other technical solutions formed by any combinations of the above technical features or equivalent features thereof without departing from the concept of the invention, for example, technical solutions formed by replacing the features as disclosed in the present disclosure with (but not limited to) technical features with similar functions.

What is claimed is:

1. An optical imaging lens assembly comprising, sequentially from an object side to an image side along an optical axis, a first lens, a second lens, a third lens, a fourth lens, a fifth lens, a sixth lens, and a seventh lens,

wherein the first lens has a positive refractive power, an object-side surface of the first lens is a convex surface, and an image-side surface of the first lens is a [convex] concave surface;

the second lens has a negative refractive power;

the third lens has a positive refractive power;

each of the fourth lens and the fifth lens has a positive refractive power or a negative refractive power;

the sixth lens has a positive refractive power;

the seventh lens has a negative refractive power, and an object-side surface and an image-side surface of the seventh lens are concave surfaces; and

a combined focal length f12 of the first lens and the second lens and a combined focal length f34 of the third lens and the fourth lens satisfy: $|f12/f34| \leq 0.3$,

wherein an effective focal length f2 of the second lens and an effective focal length f7 of the seventh lens satisfy: $4.5 < f2/f7 < 11.0$, and

wherein a radius of curvature R1 of the object-side surface of the first lens and a radius of curvature R4 of an image-side surface of the second lens satisfy: $0 < R1/R4 < 1$.

2. The optical imaging lens assembly according to claim 1, wherein a total effective focal length f of the optical imaging lens assembly and an entrance pupil diameter EPD of the optical imaging lens assembly satisfy: $f/EPD \leq 1.80$.

3. The optical imaging lens assembly according to claim 1, wherein a total effective focal length f of the optical imaging lens assembly and an effective focal length f7 of the seventh lens satisfy: $-2.5 < f/f7 < -1.5$.

4. The optical imaging lens assembly according to claim 3, wherein an effective focal length f6 of the sixth lens and the effective focal length f7 of the seventh lens satisfy: $-1.5 < f6/f7 < -1.0$.

5. The optical imaging lens assembly according to claim 3, wherein an effective focal length f7 of the seventh lens and a radius of curvature R14 of the image-side surface of the seventh lens satisfy: $-1.5 < f7/R14 < -1.0$.

6. The optical imaging lens assembly according to claim 1, wherein an effective focal length f1 of the first lens and a radius of curvature R1 of the object-side surface of the first lens satisfy: $2.0 < f1/R1 < 3.0$.

7. The optical imaging lens assembly according to claim 1, wherein a center thickness CT1 of the first lens on the optical axis and an effective focal length f2 of the second lens satisfy: $-0.2 < CT1/f2 < 0$.

8. The optical imaging lens assembly according to claim 1, wherein an effective focal length f6 of the sixth lens and an effective focal length f3 of the third lens satisfy: $0 < f6/f3 < 0.5$.

[9. The optical imaging lens assembly according to claim 1, wherein a radius of curvature R1 of the object-side surface of the first lens and a radius of curvature R4 of an image-side surface of the second lens satisfy: $0 < R1/R4 < 1$.]

10. The optical imaging lens assembly according to claim 1, wherein a radius of curvature R12 of an image-side surface of the sixth lens and a radius of curvature R14 of the image-side surface of the seventh lens satisfy: $-1.5 < R12/R14 < -0.5$.

11. The optical imaging lens assembly according to claim 1, wherein a center thickness CT6 of the sixth lens on the optical axis satisfies: $0.3 \text{ mm} < CT6 < 0.8 \text{ mm}$.

12. The optical imaging lens assembly according to claim 11, wherein a total track length TTL of the optical imaging lens assembly and half of a diagonal length ImgH of an effective pixel area on an image plane of the optical imaging lens assembly satisfy: $TTL/ImgH \leq 1.50$.

13. The optical imaging lens assembly according to claim 1, wherein the effective focal length f2 of the second lens and the effective focal length f7 of the seventh lens satisfy: $7.59 \leq f2/f7 < 11.0$.

14. The optical imaging lens assembly according to claim 1, wherein the effective focal length f_2 of the second lens and the effective focal length f_7 of the seventh lens satisfy: $7.59 \leq f_2/f_7 \leq 10.02$.

15. The optical imaging lens assembly according to claim 1, wherein a total effective focal length f of the optical imaging lens assembly and the effective focal length f_7 of the seventh lens satisfy: $-2.1 < f/f_7 < -1.8$.

16. The optical imaging lens assembly according to claim 1, wherein an effective focal length f_6 of the sixth lens and the effective focal length f_7 of the seventh lens satisfy: $-1.44 \leq f_6/f_7 \leq -1.08$.

17. The optical imaging lens assembly according to claim 1, wherein the effective focal length f_7 of the seventh lens and a radius of curvature R_{14} of the image-side surface of the seventh lens satisfy: $-1.3 < f_7/R_{14} < -1.1$.

18. The optical imaging lens assembly according to claim 1, wherein a total effective focal length f of the optical imaging lens assembly and an entrance pupil diameter EPD of the optical imaging lens assembly satisfy: $f/EPD \leq 1.76$.

19. The optical imaging lens assembly according to claim 1, wherein the combined focal length f_{12} of the first lens and the second lens and the combined focal length f_{34} of the third lens and the fourth lens satisfy: $|f_{12}/f_{34}| \leq 0.28$.

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