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Mirror Design for an Omnidirectional Camera with a Space Variant Imager

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Omnicaamera



m p



Omnicaamera



Raw image



Panoramic image

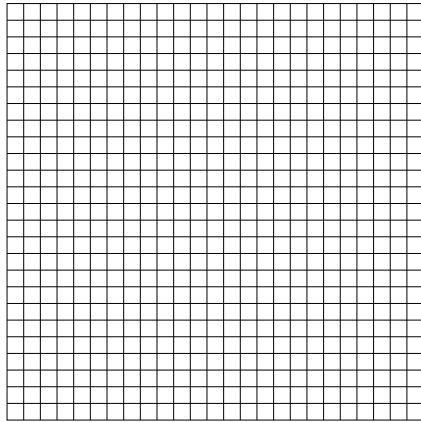
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Space variant imager

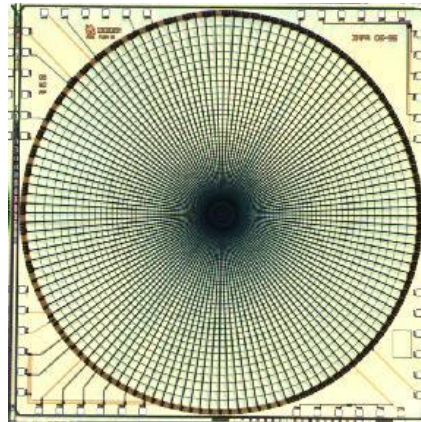


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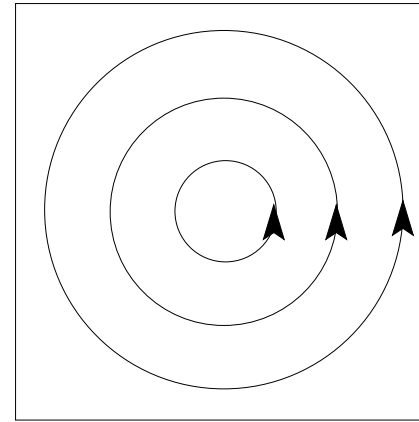
Polar arrangement of pixels \implies no need to transform the image



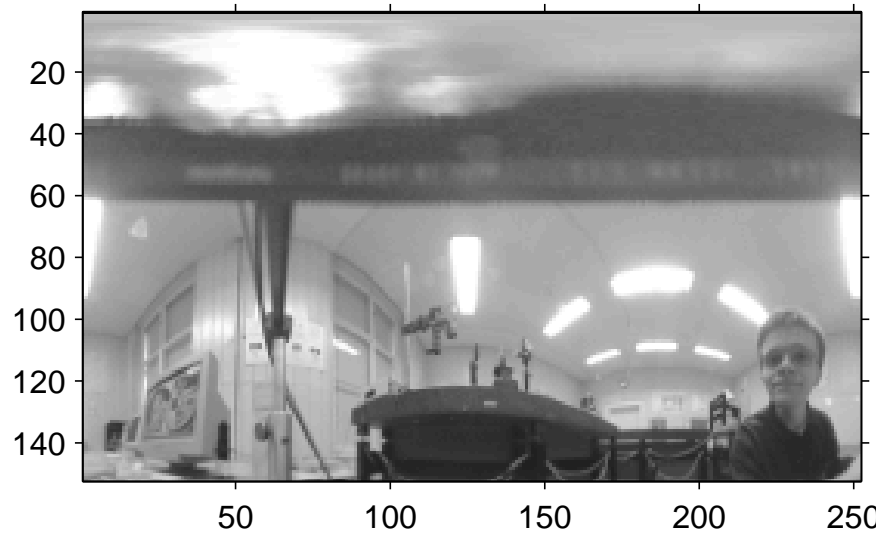
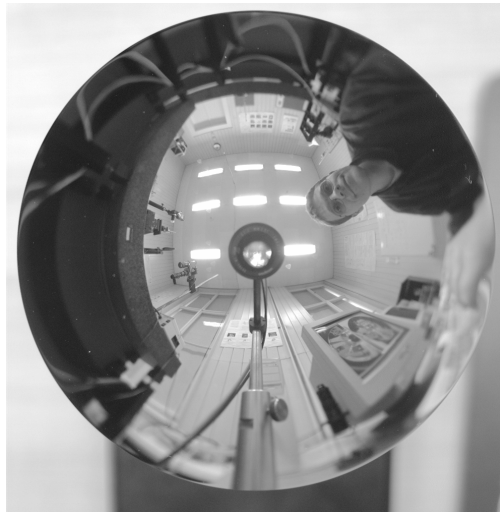
Conventional imager



Space variant imager



Reading pixels out



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Hyperbolic mirror

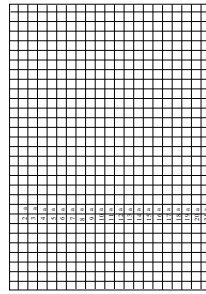


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central projection but non-uniform sampling



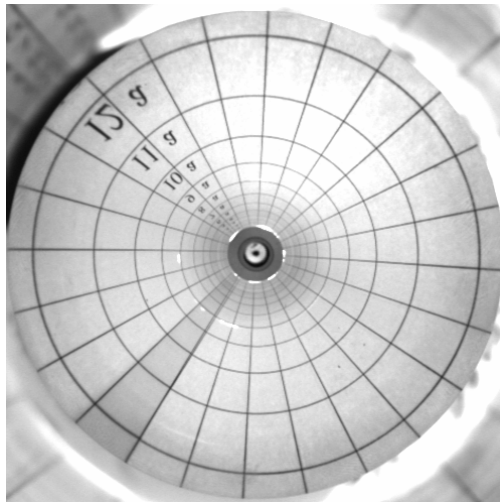
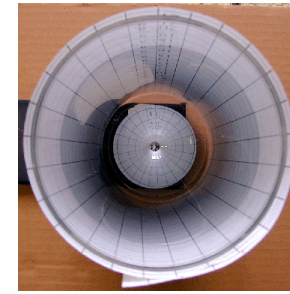
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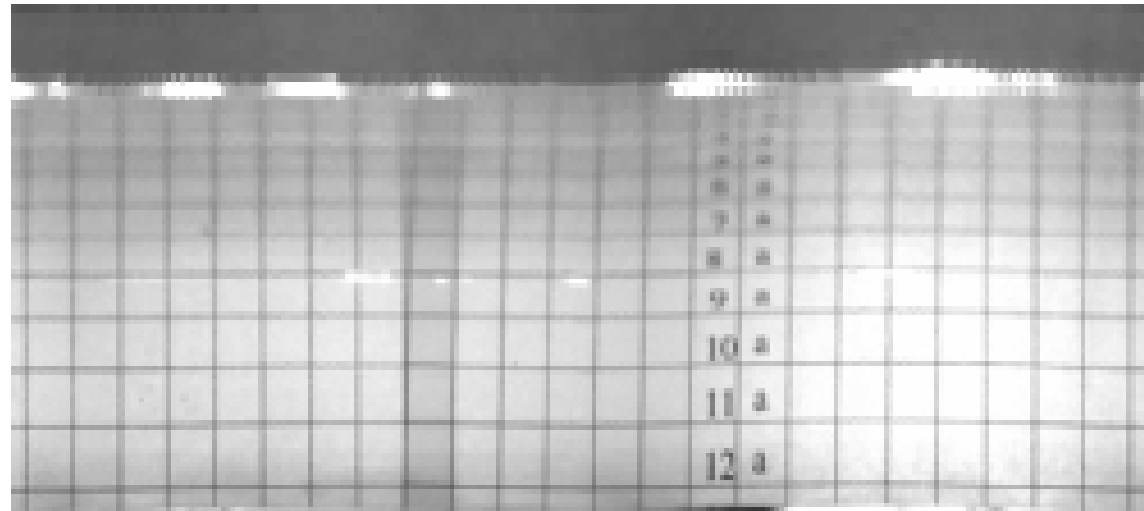
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Raw image



Non-uniform sampling of panoramic image

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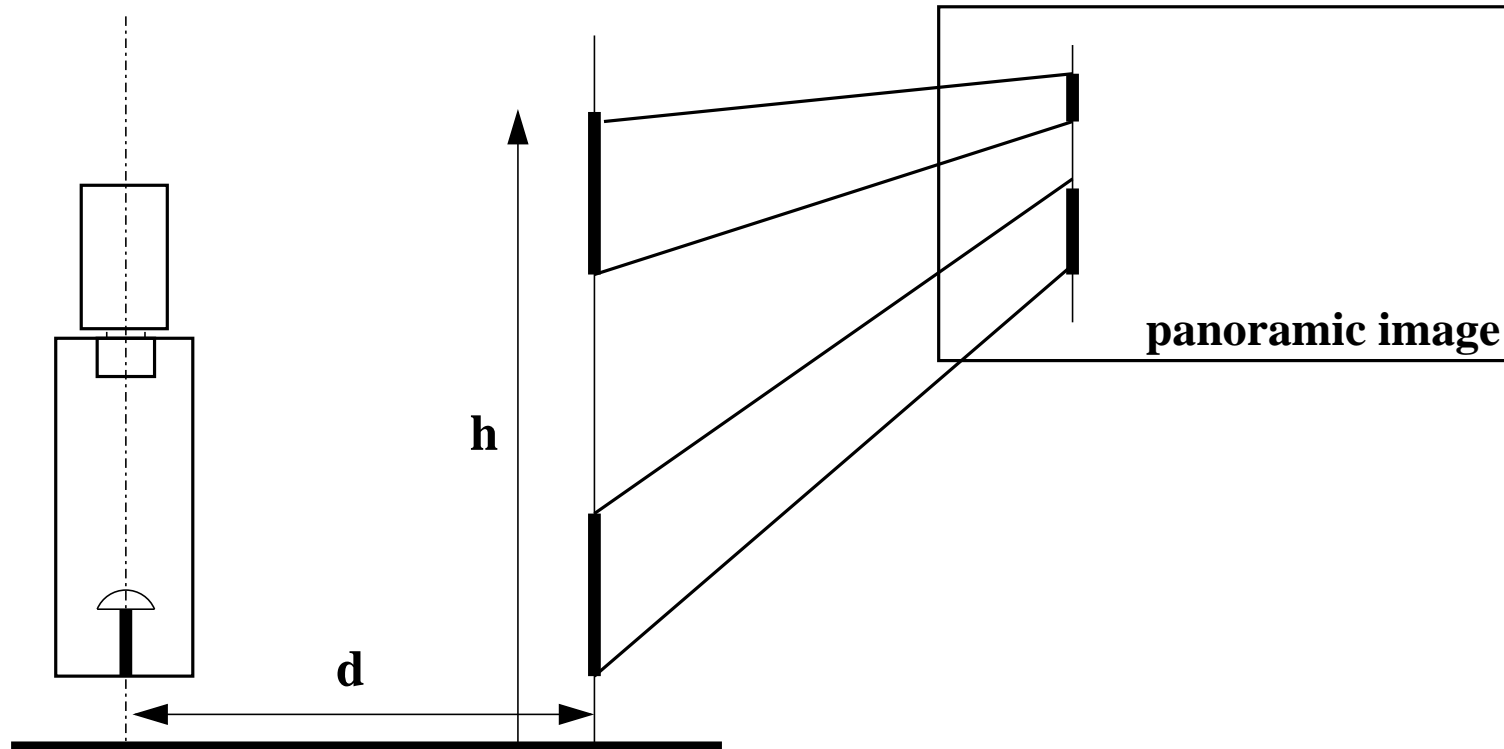
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Non-uniform sampling



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Size of an object in the panoramic image will also depend on its position above ground level:



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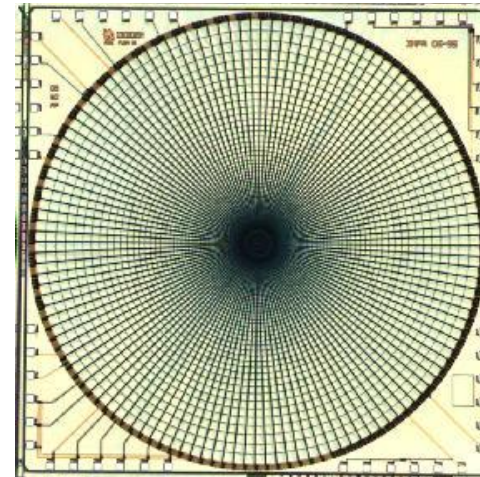
Main results



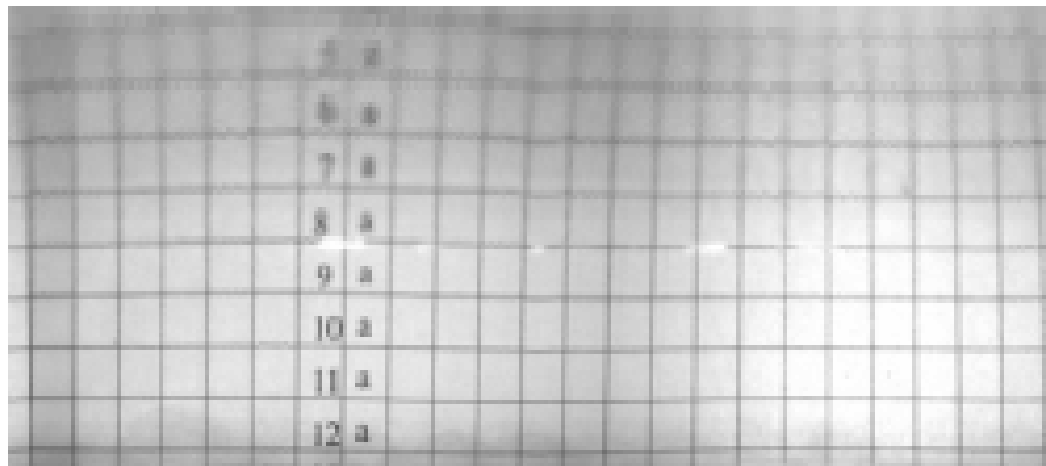
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Designed mirror



SVAVISCA Sensor



Uniform sampling

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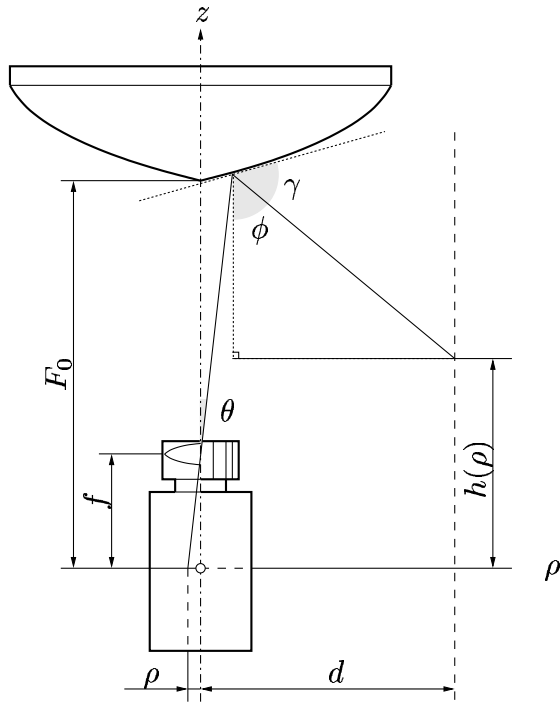
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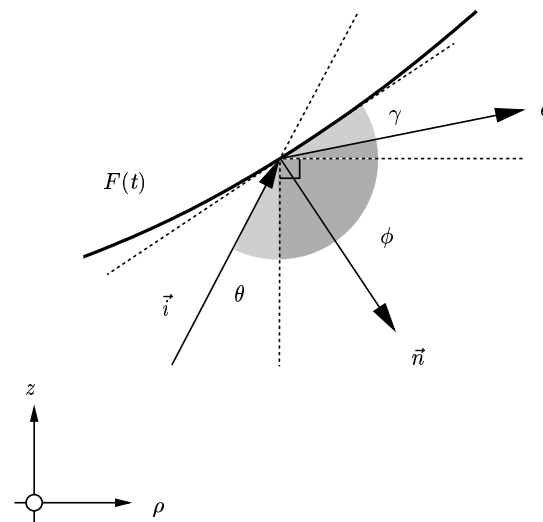
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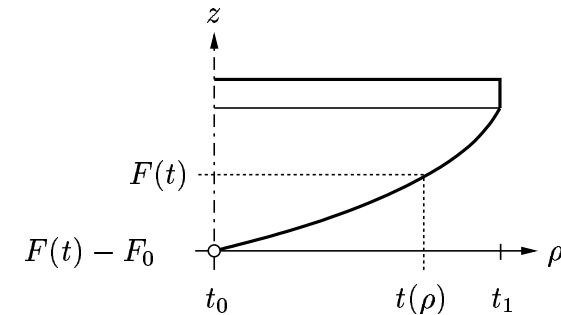
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Schematic diagram



Reflection of a ray



Cross section function

Non-linear differential equation:

$$F'(t) + \frac{t(d-t) + (F(t)-f)(F(t)-h(t))}{(F(t)-f)(d-t) - t(F(t)-h(t))} - \sqrt{\left(\frac{t(d-t) + (F(t)-f)(F(t)-h(t))}{(F(t)-f)(d-t) - t(F(t)-h(t))}\right)^2 + 1} = 0$$

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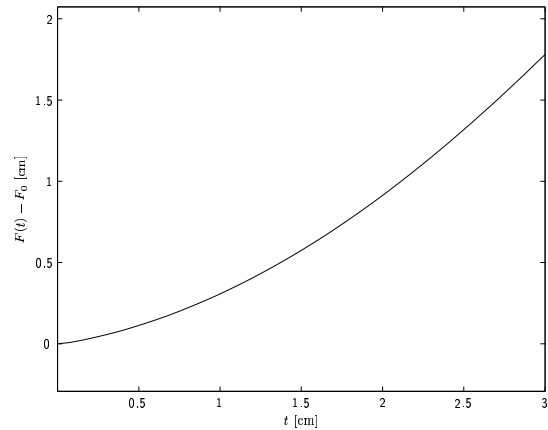
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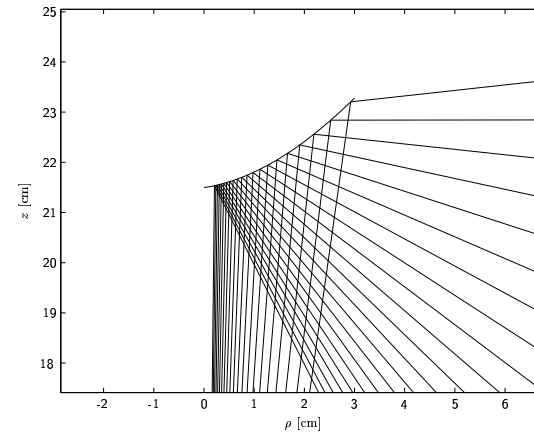
Mirror design - numerical solution



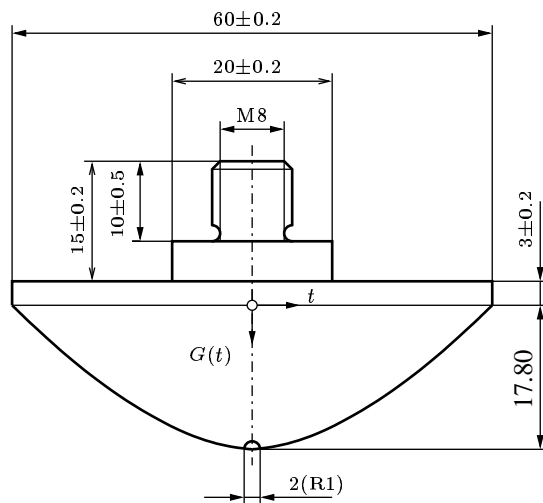
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Cross section function



Rays reflection



Technical drawing



Manufactured mirror

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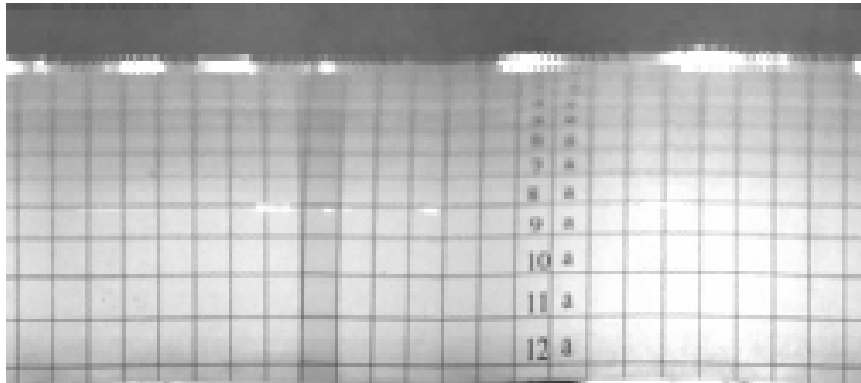
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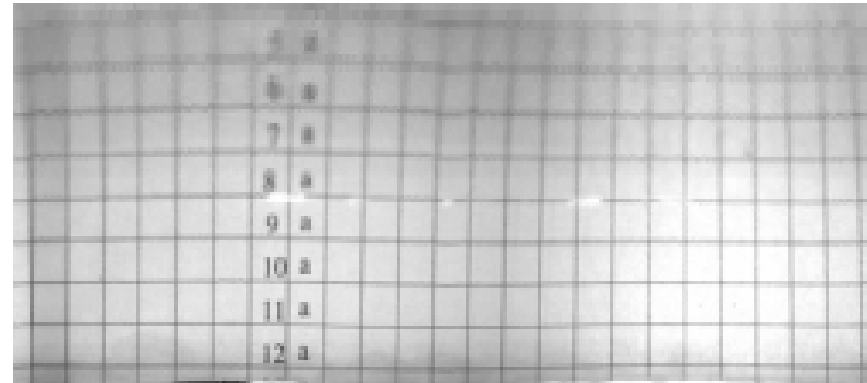
Results



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Hyperbolic mirror



SVAVISCA mirror



ratio = 0.44



ratio = 1.02

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Conclusions



- Uniform resolution mirror shape designed
- Mirror manufactured
- Any shape can be designed and manufactured

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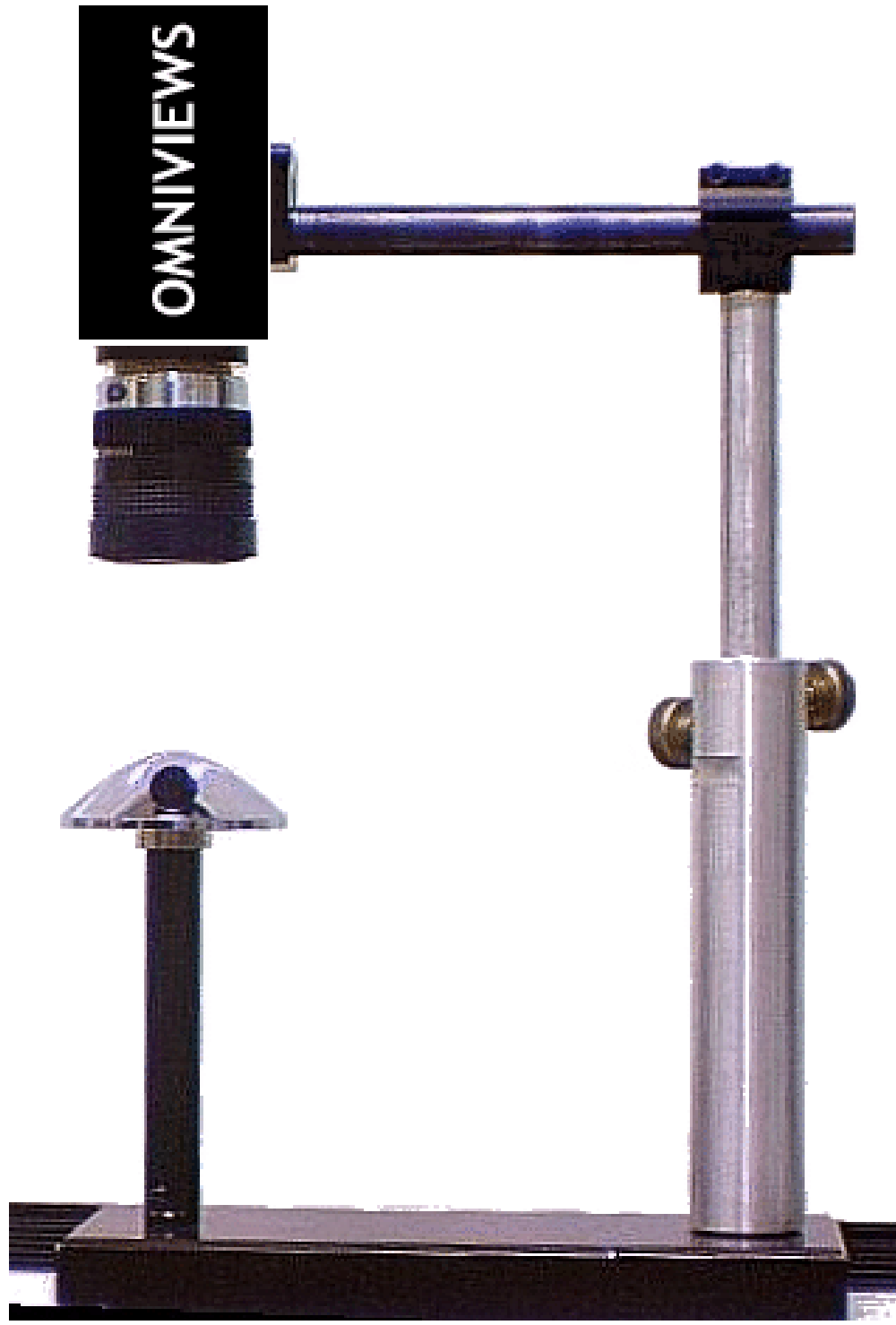
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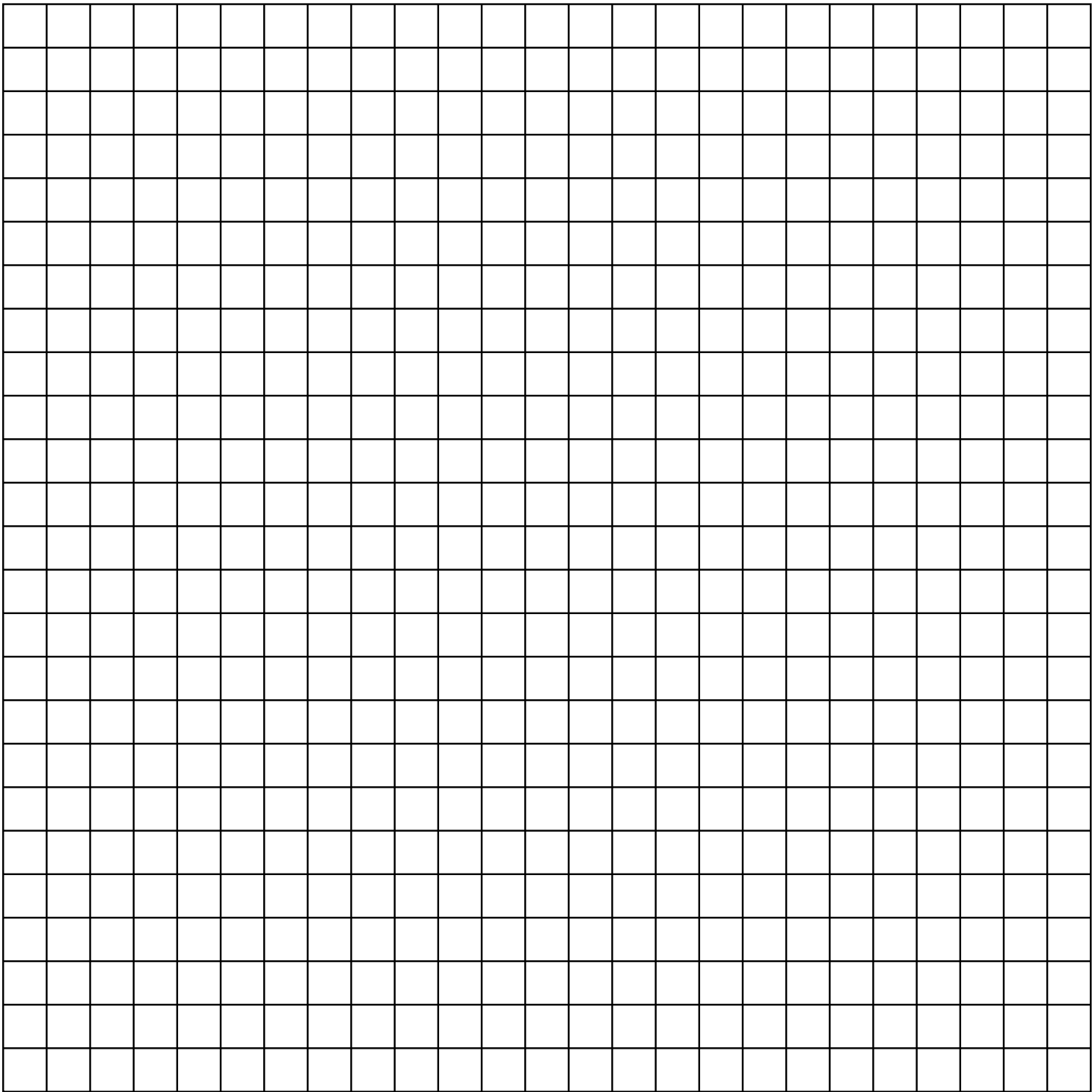
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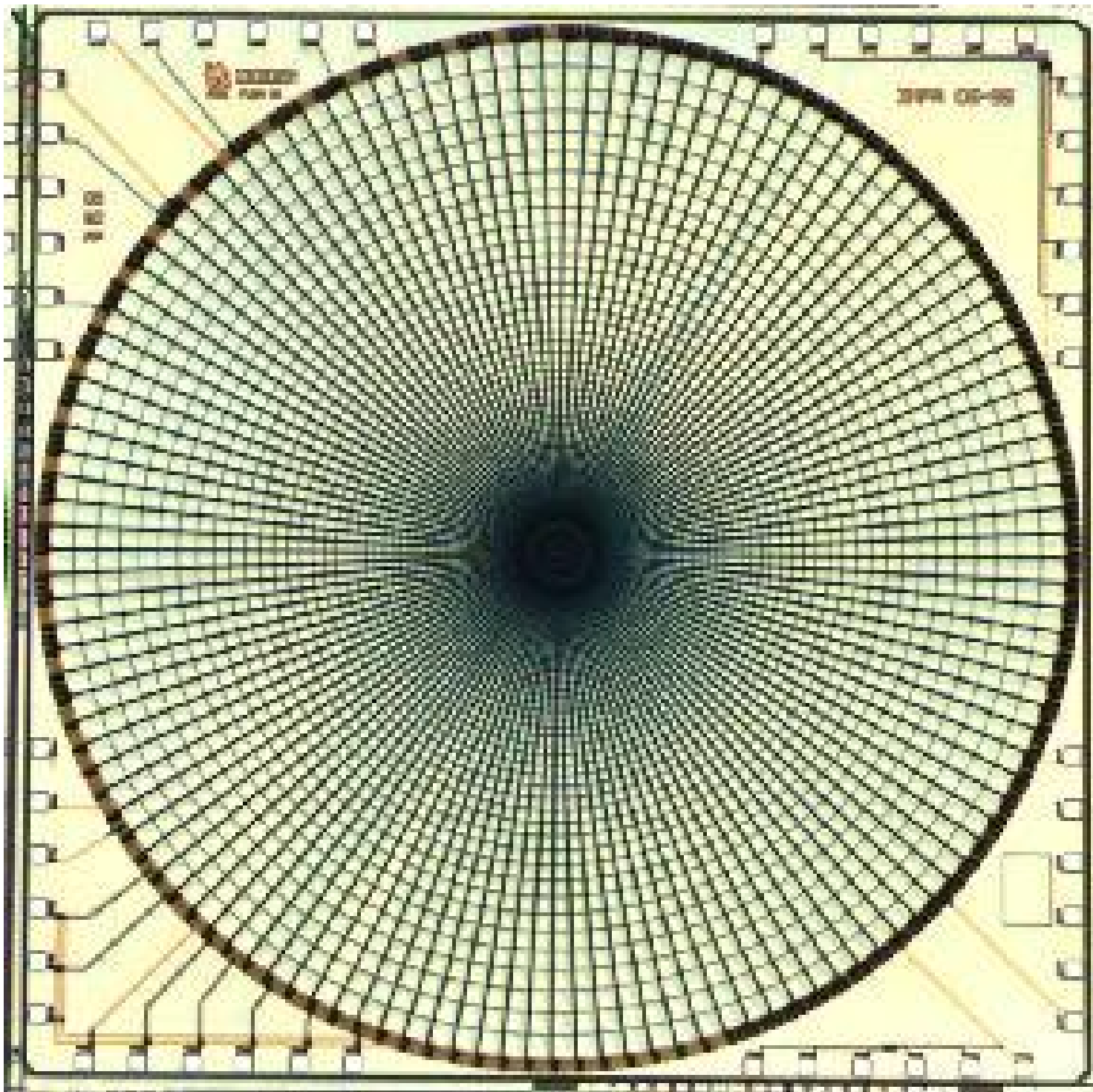


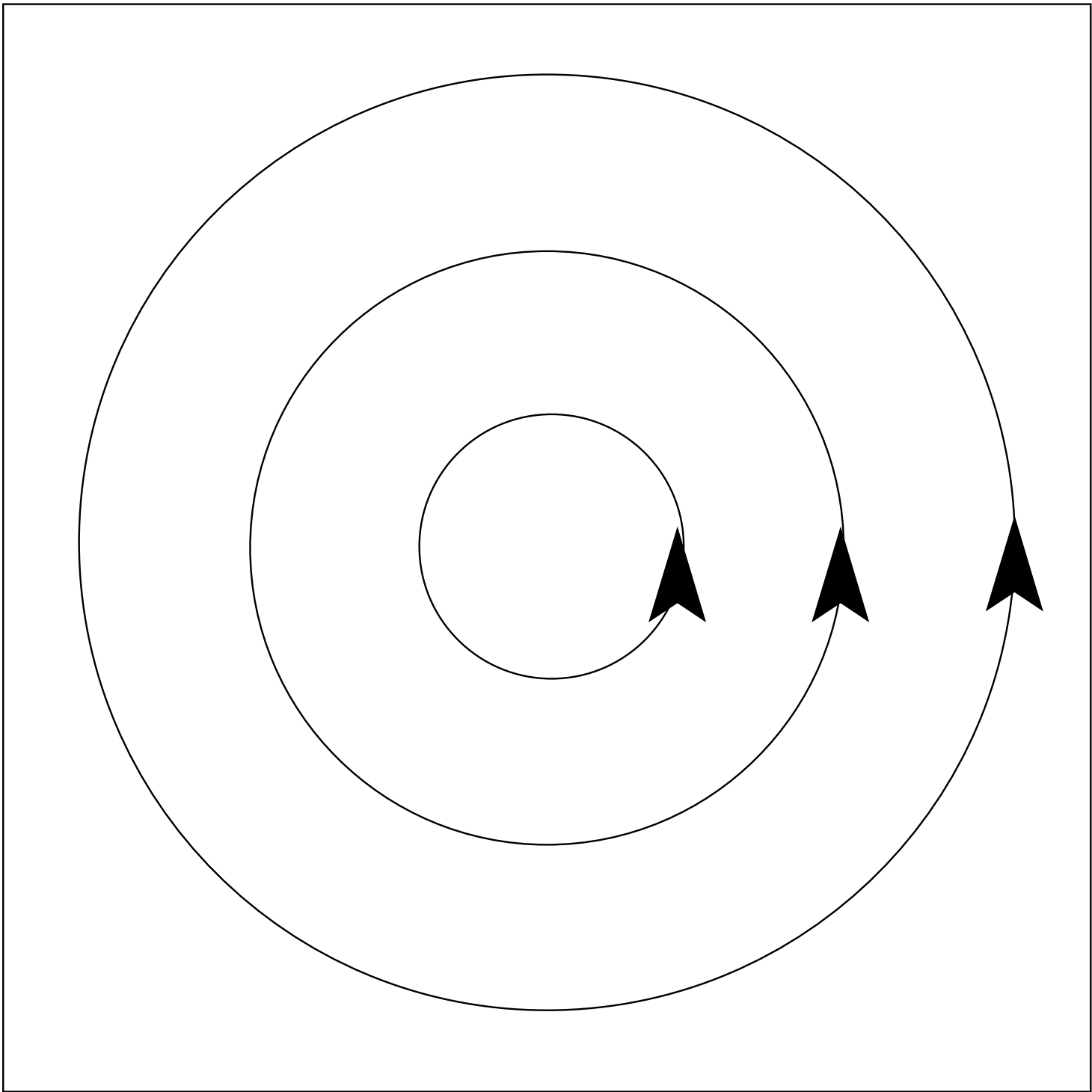
OMNIVIEWS

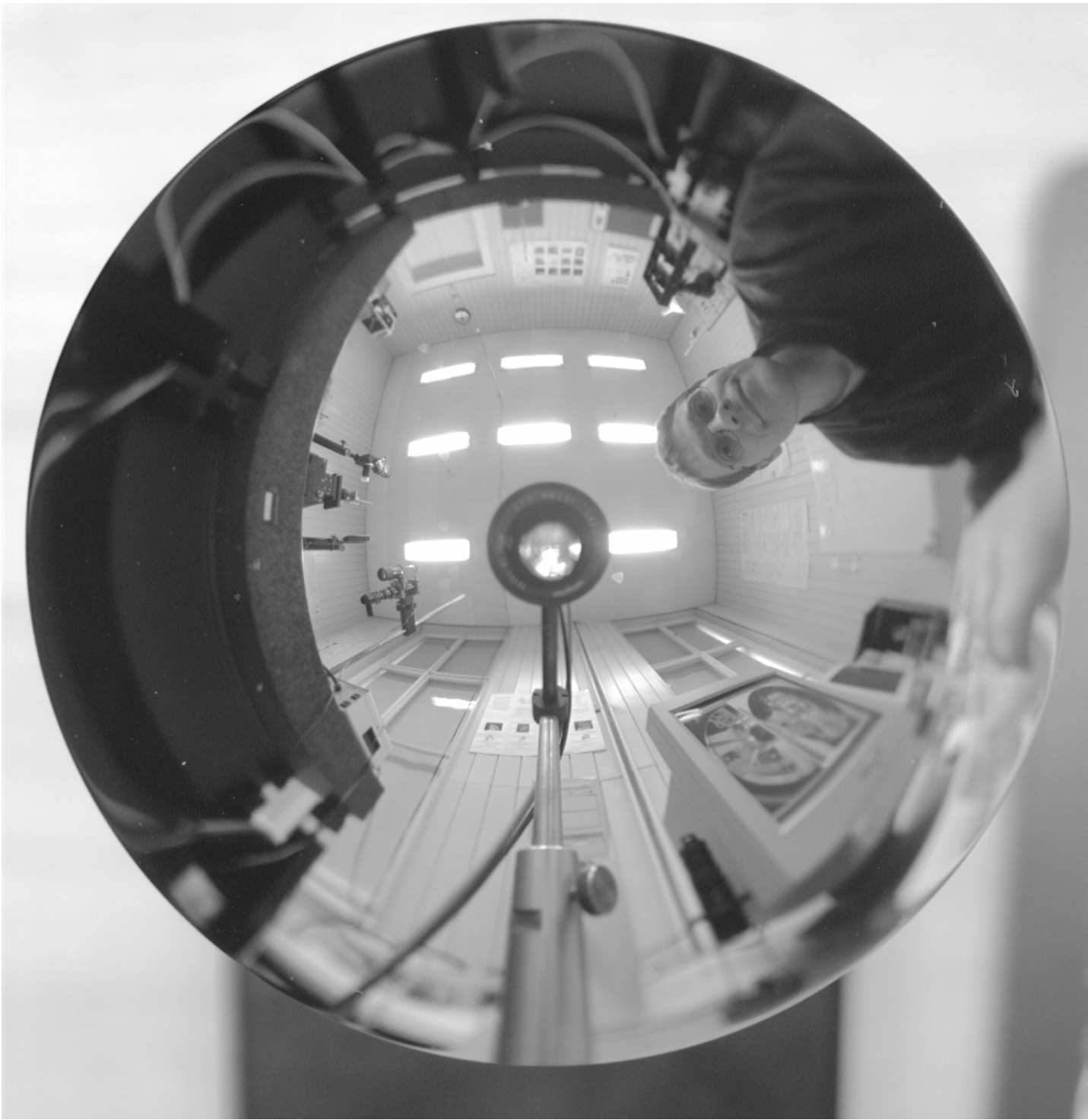


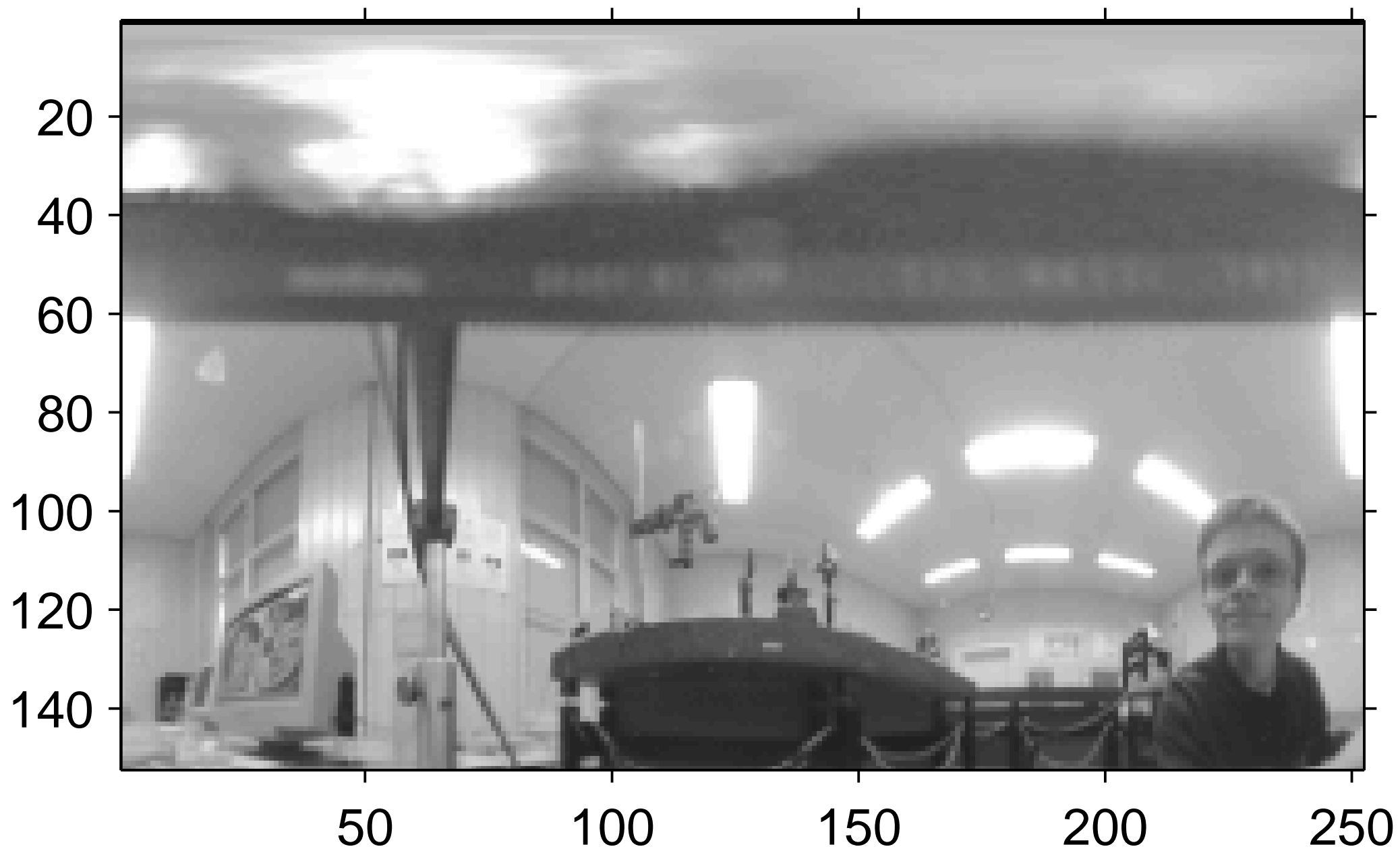








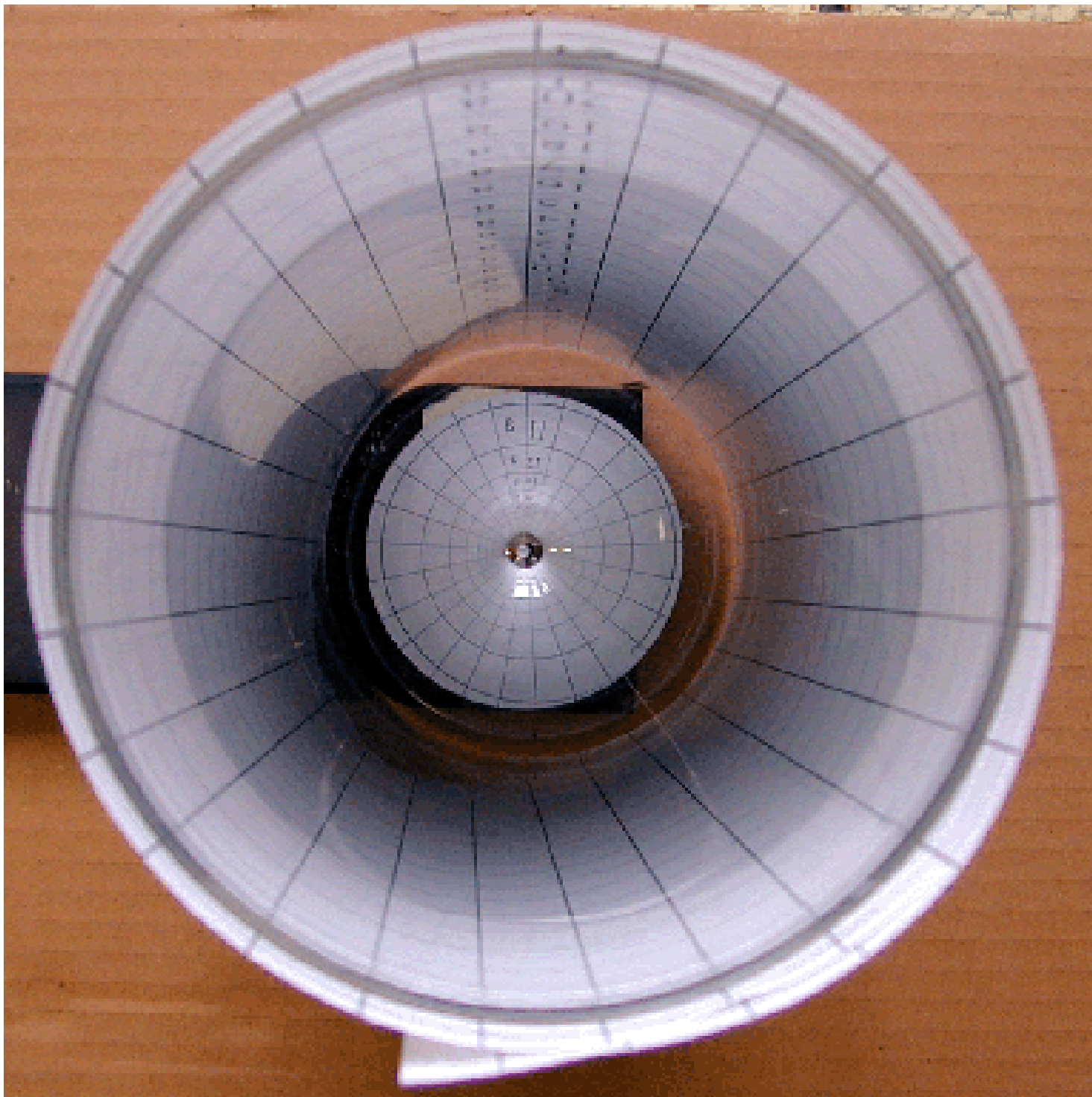


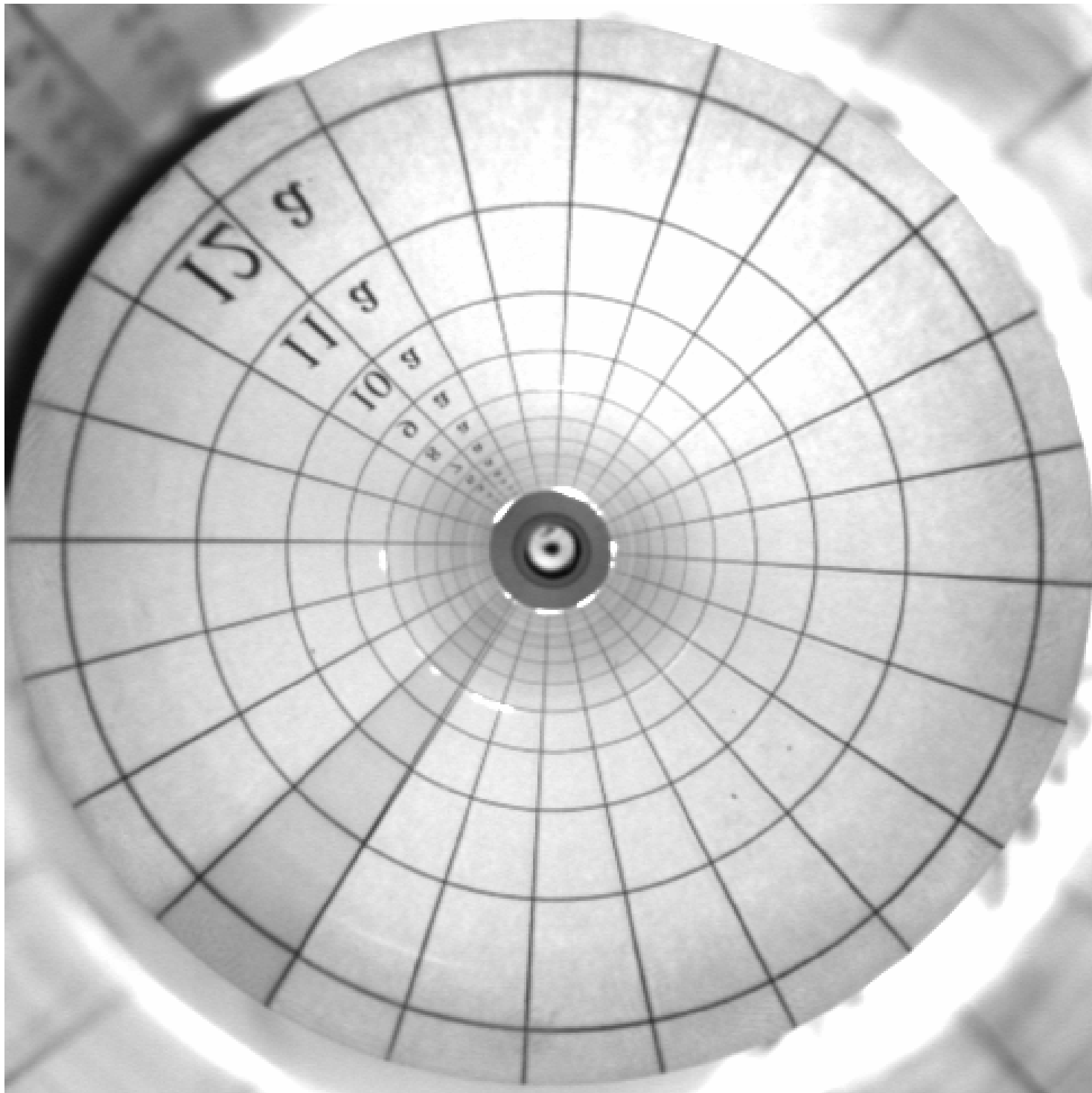


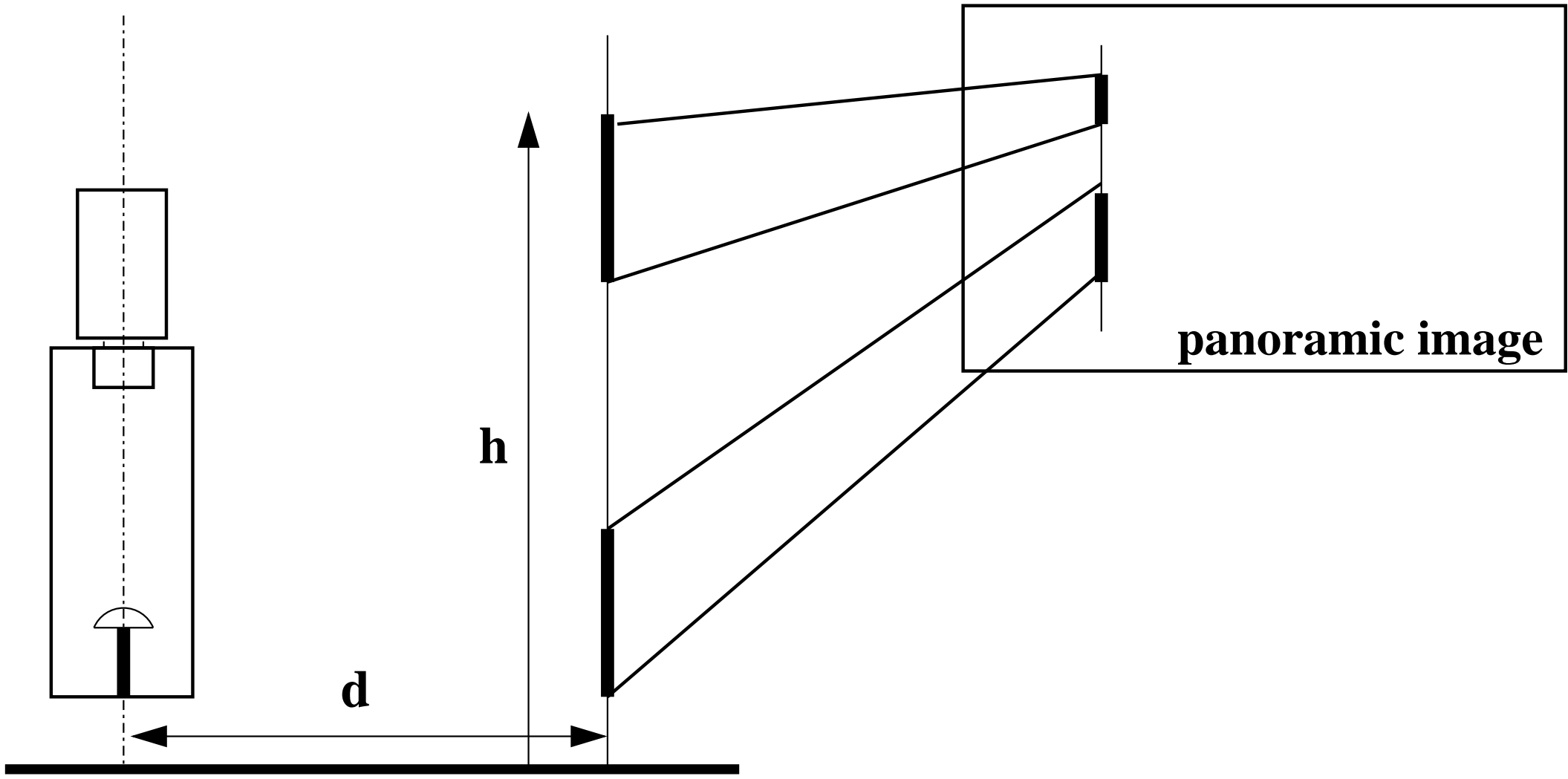




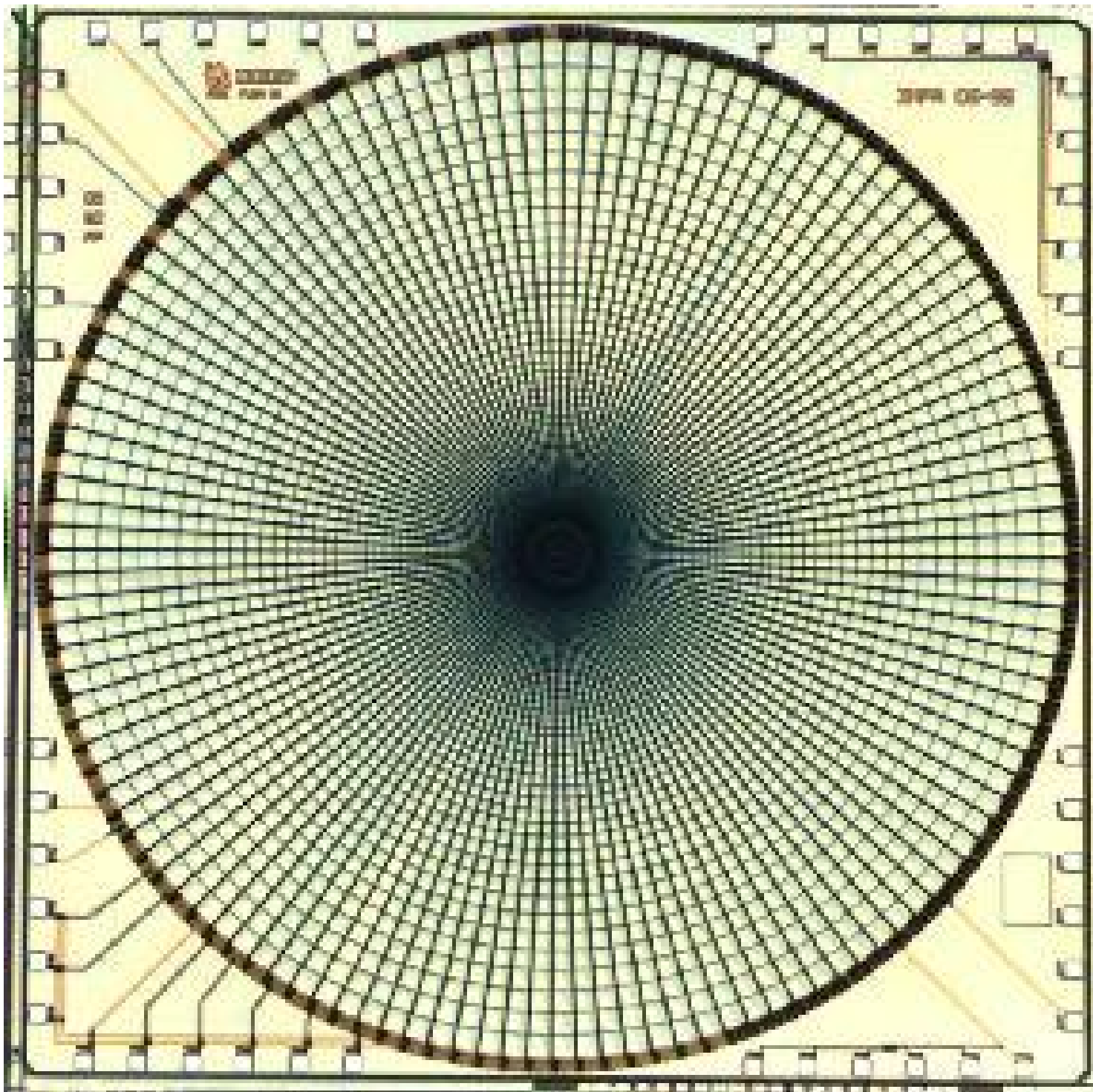












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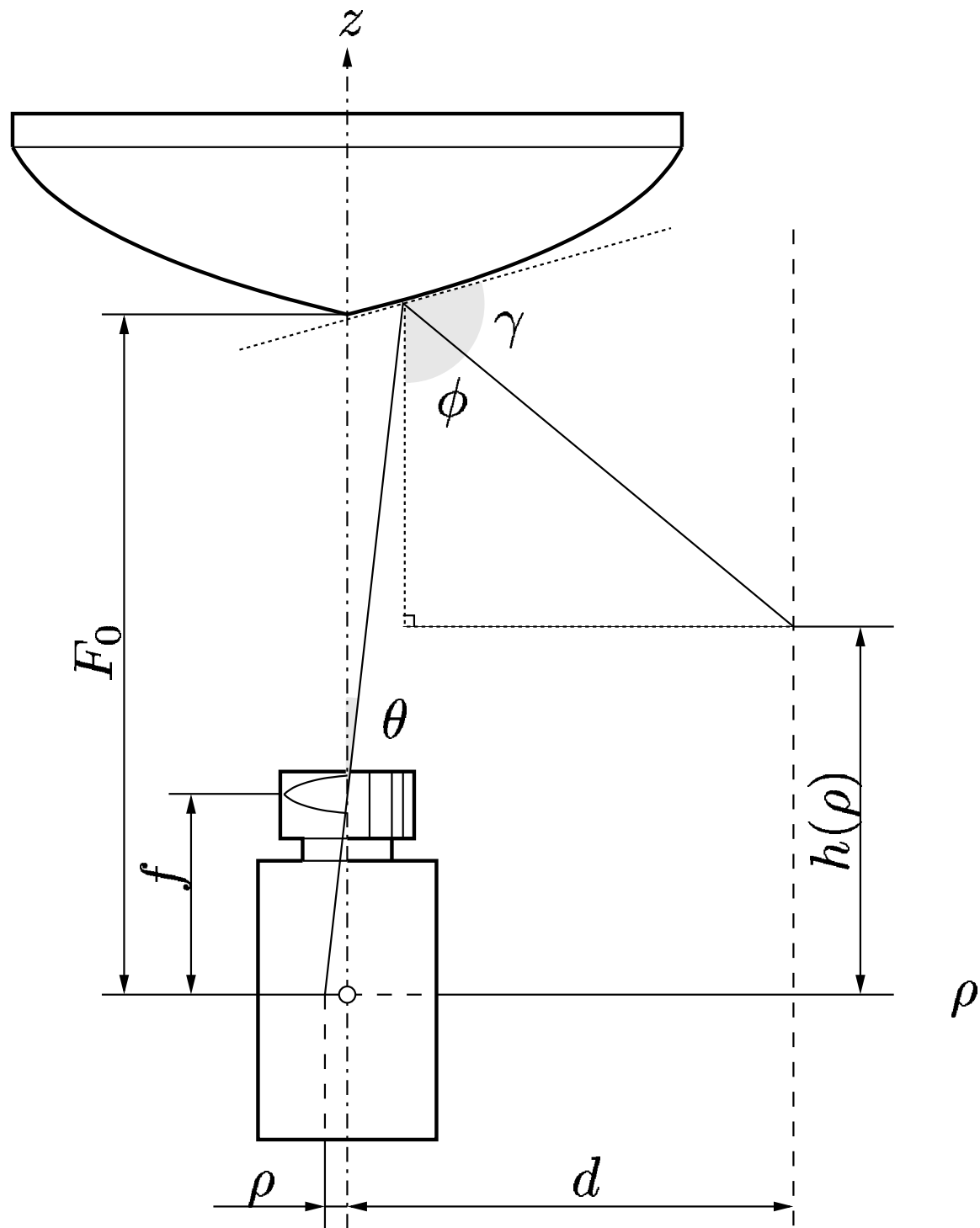
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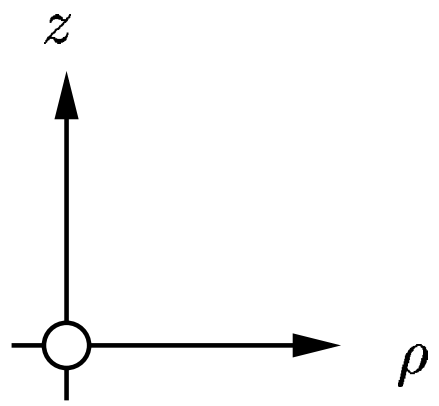
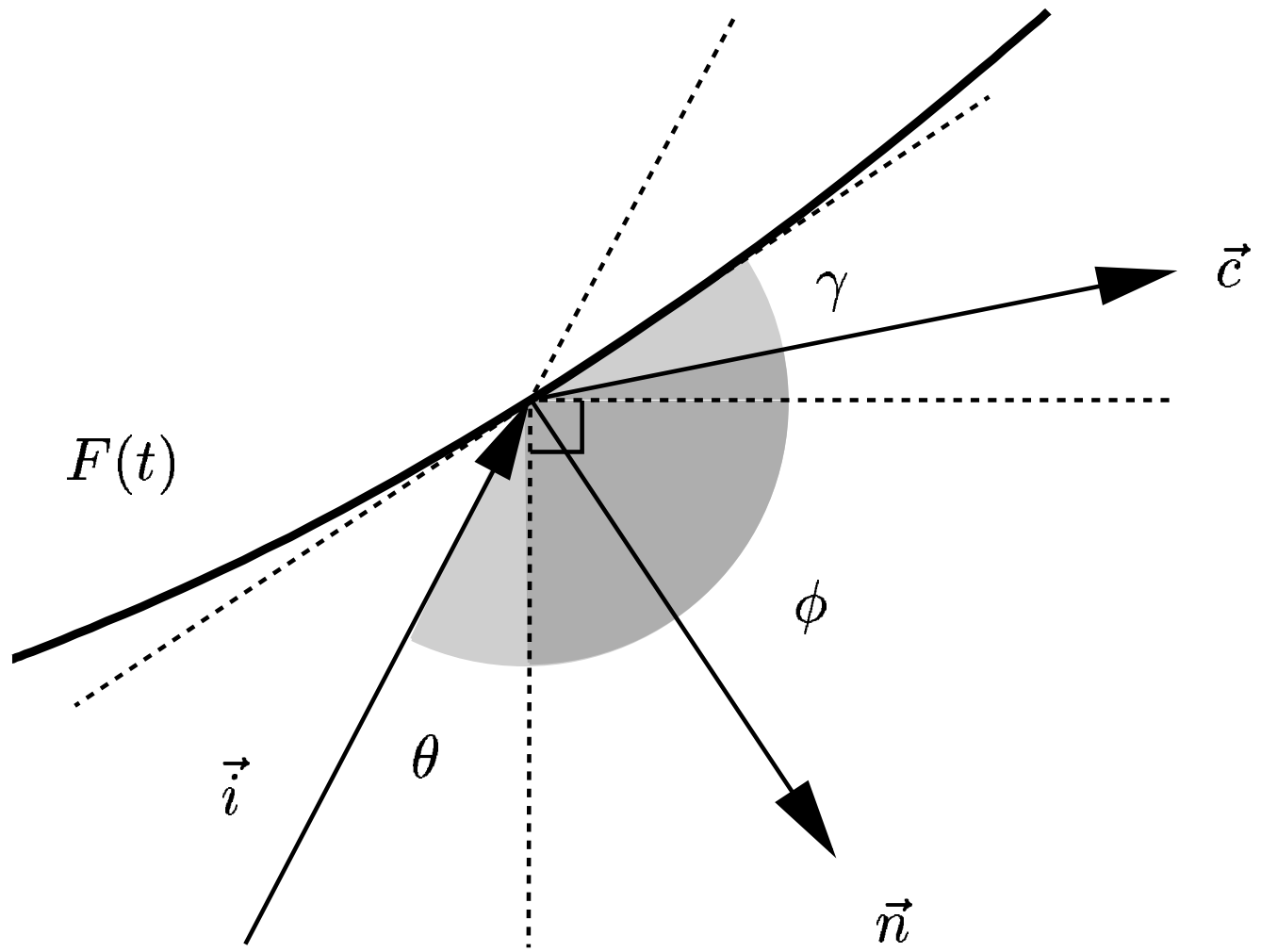
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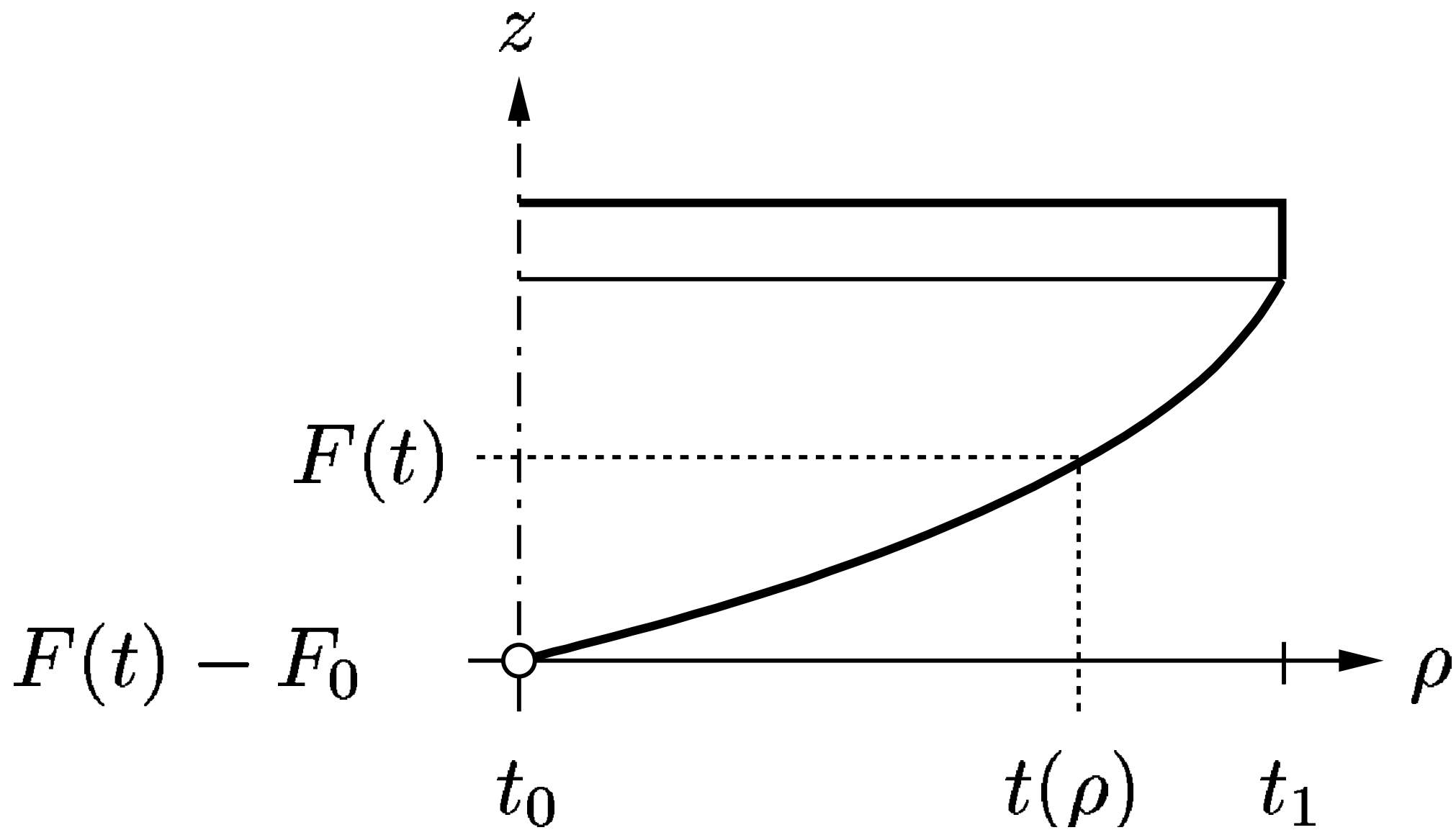
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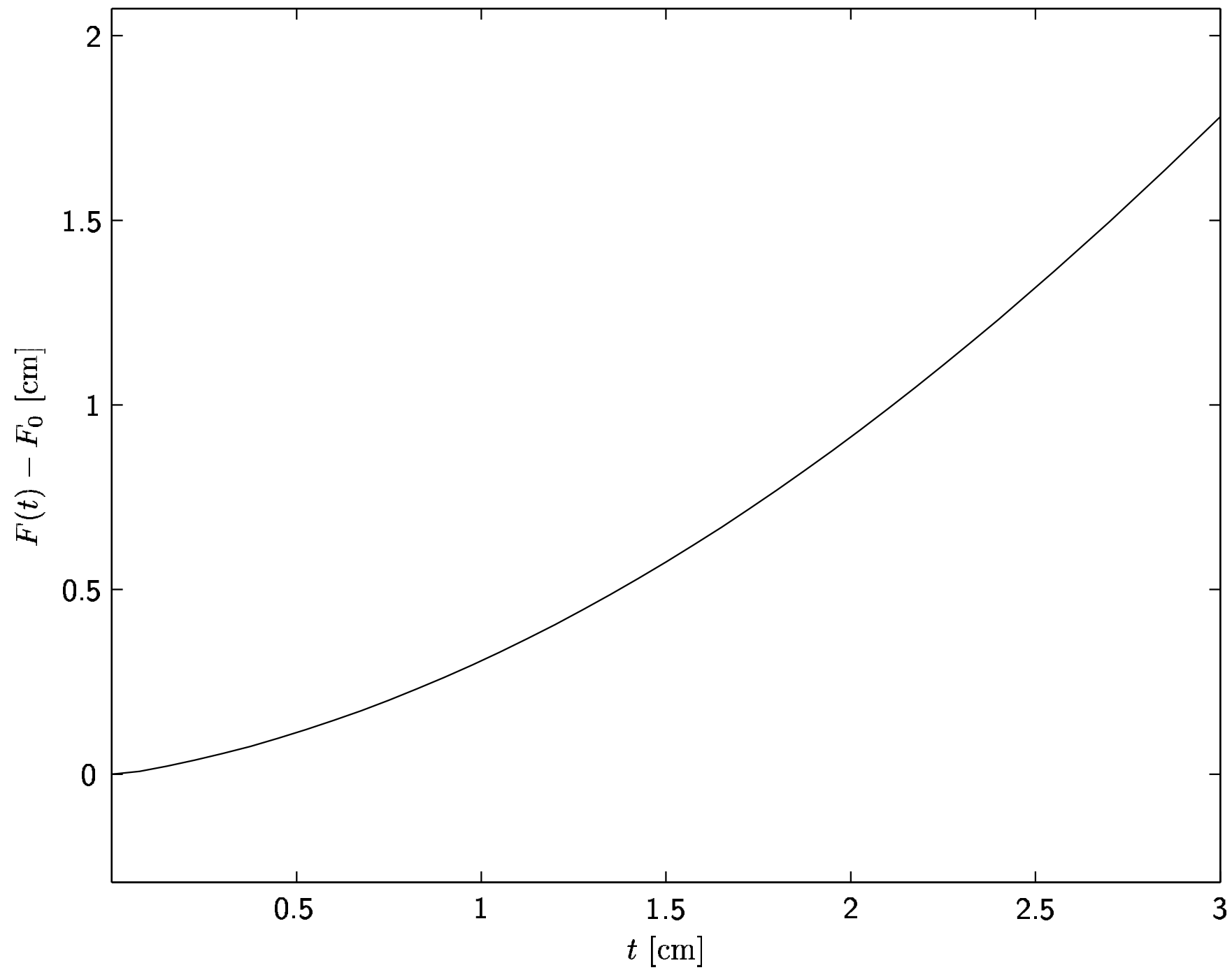
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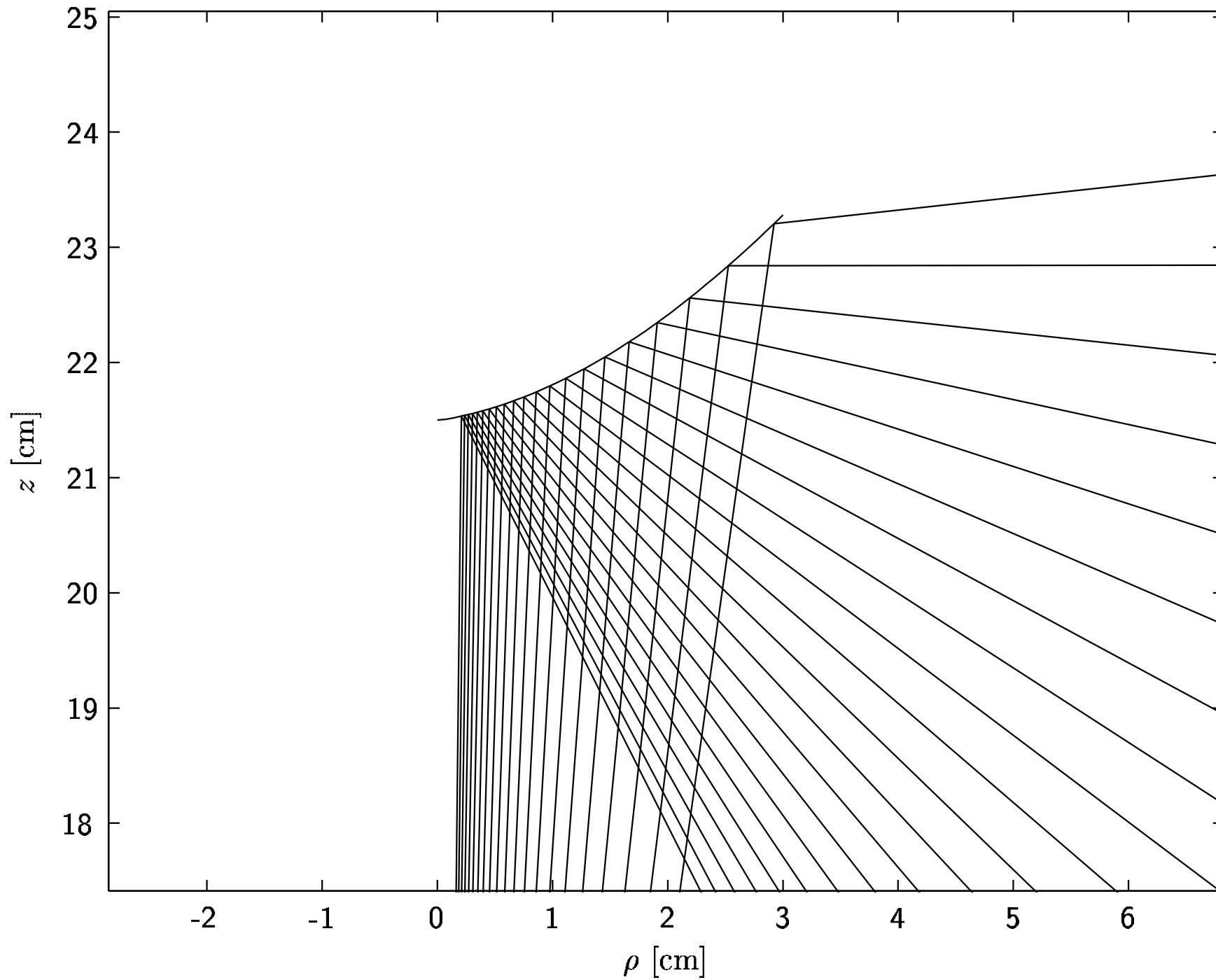
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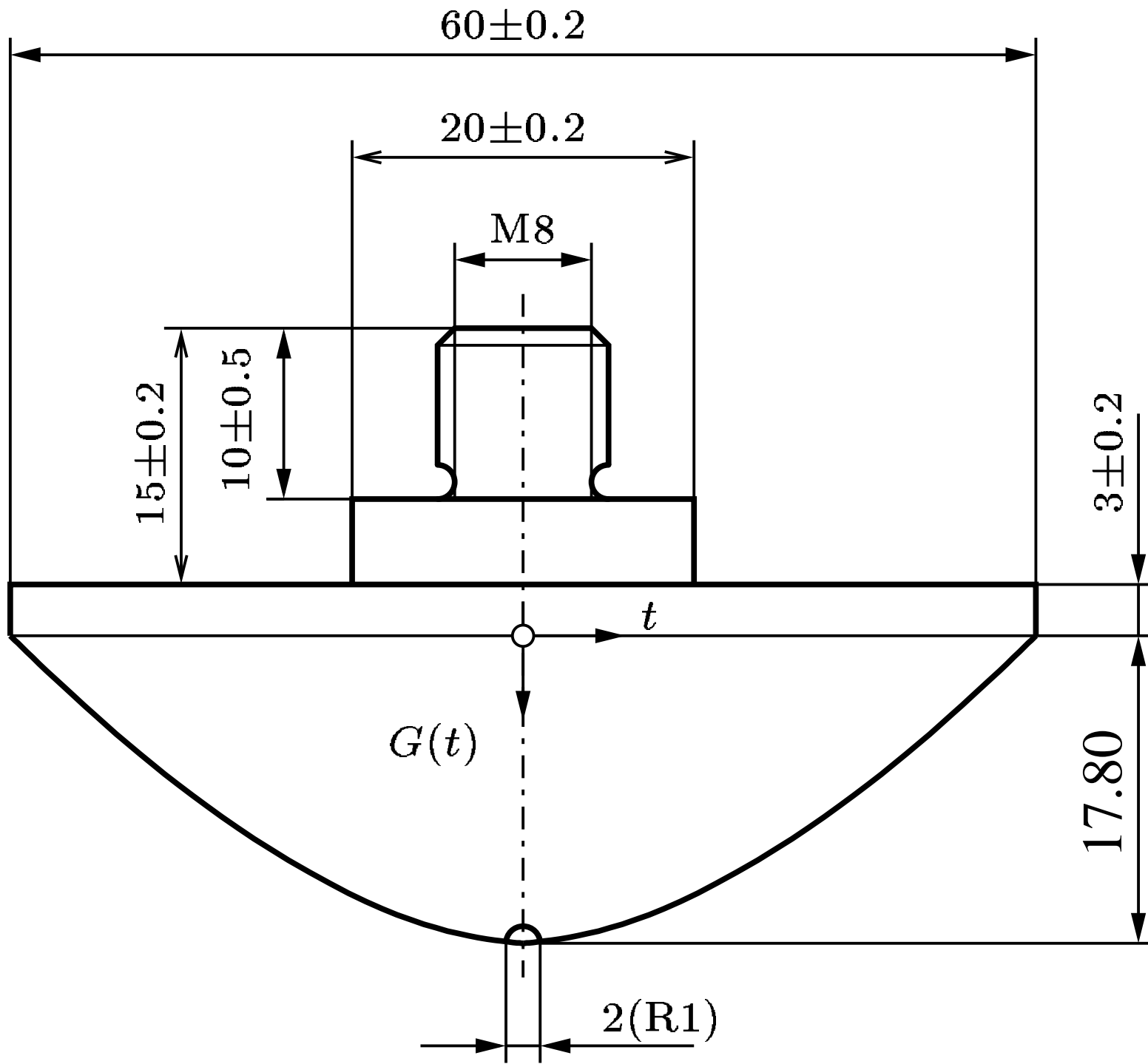














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