



**Abbe diffraction demonstration
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International Centre for Theoretical Physics**

**Preparatory School to the Winter College on Optics: Advanced Optical Techniques for Bio-
imaging**

The Abbe diffraction experiment



Ernst Abbe
(1840-1905)

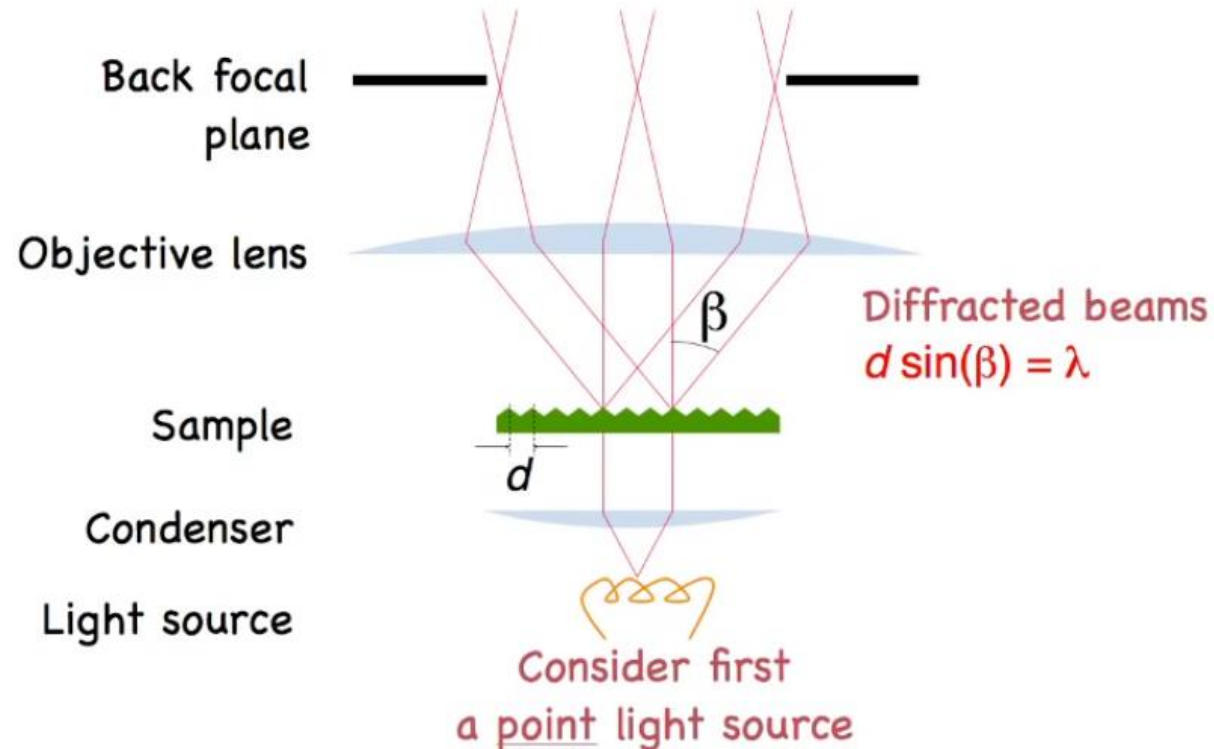


The Abbe diffraction experiment

Resolution

Ernst Abbe's argument (1873)

Consider a striped sample \approx a diffraction grating

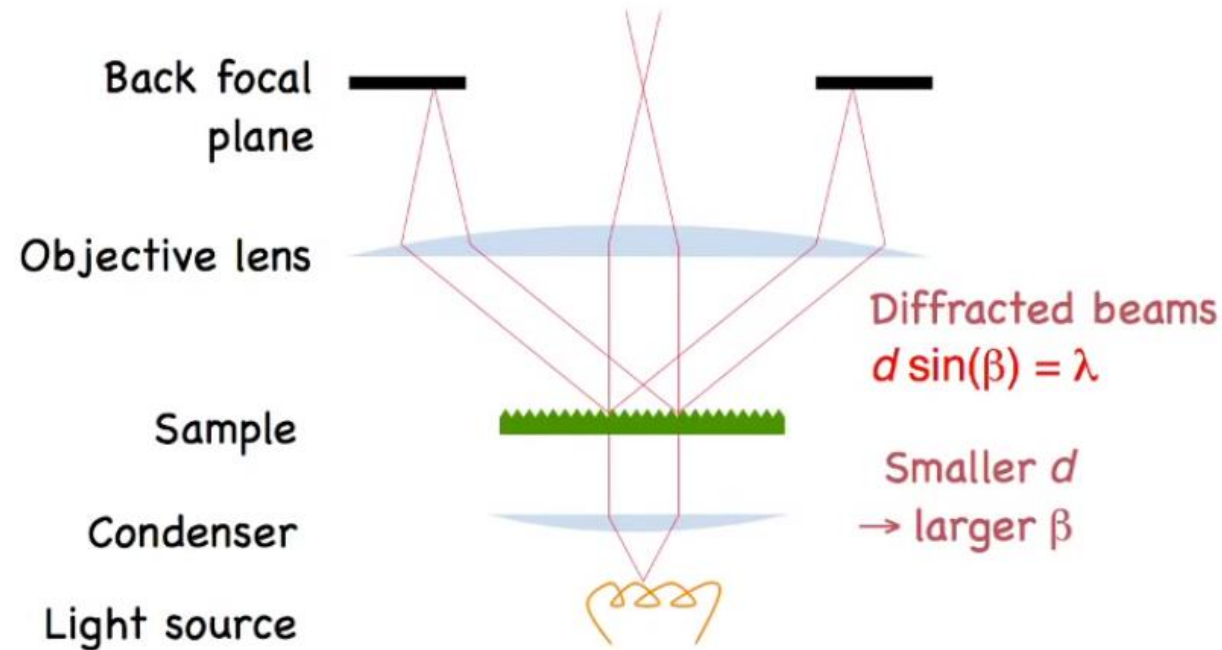


The Abbe diffraction experiment

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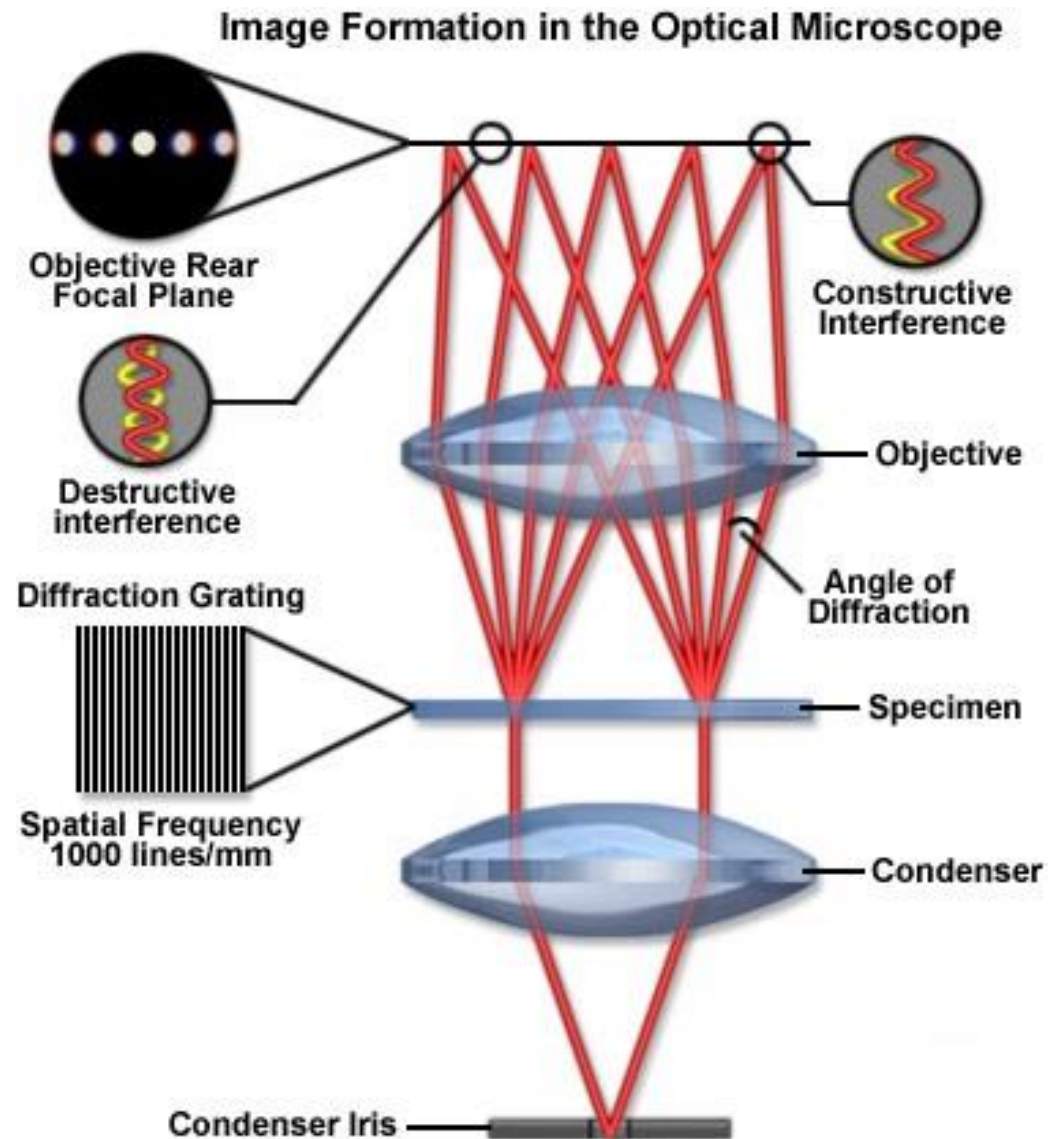
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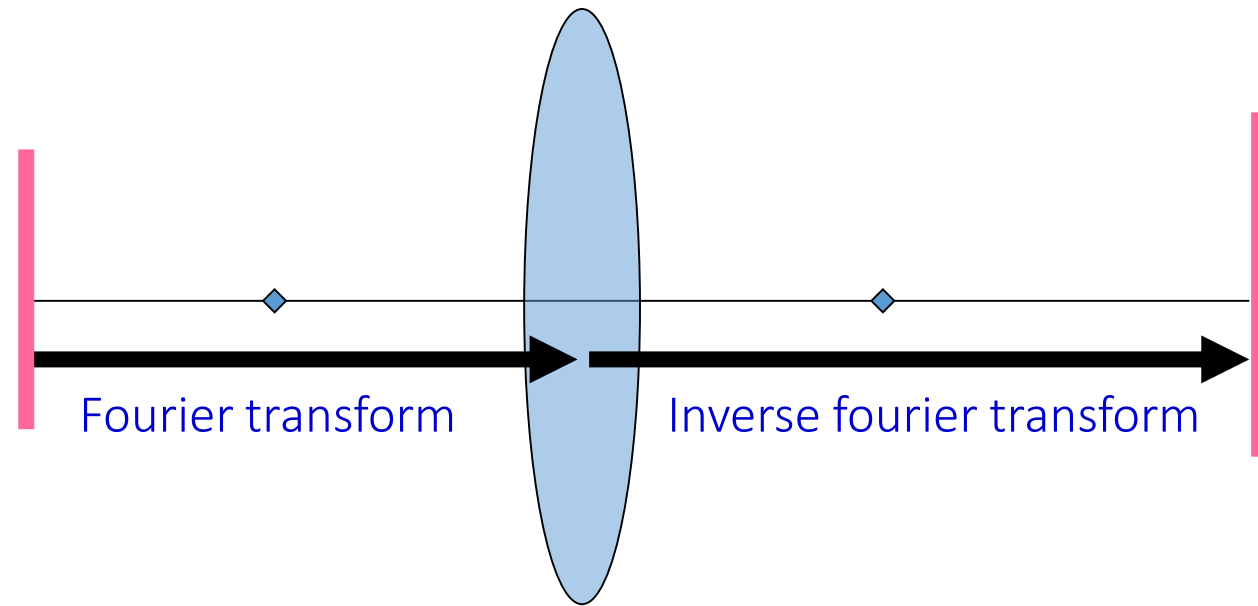


If $\beta > \alpha$, only one spot makes it through
 \Rightarrow no interference \Rightarrow no image formed

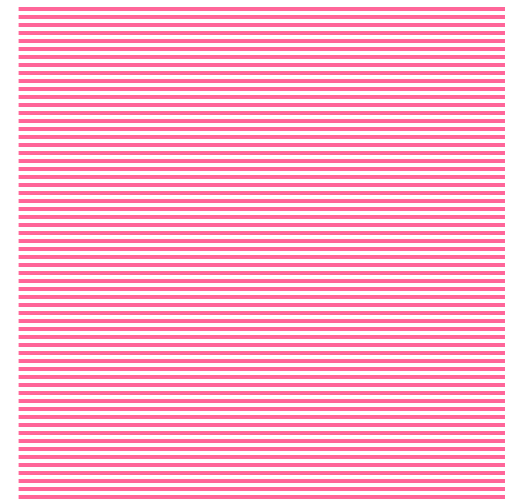
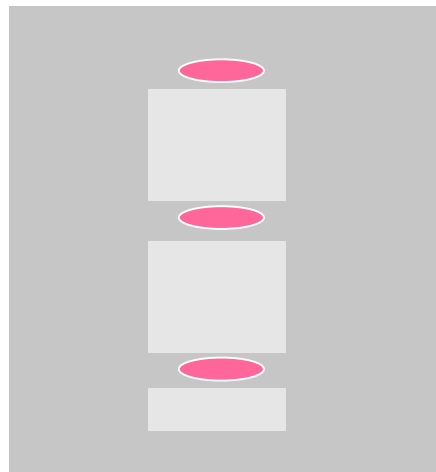
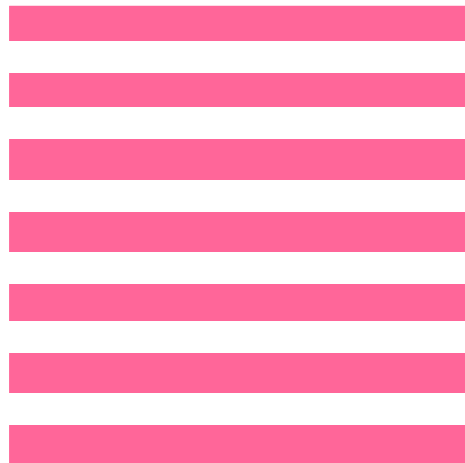
Resolution limit:
 $\lambda/n \sin(\alpha) = \lambda/NA$

The Abbe diffraction experiment





The image results from the number, position and orientation of the diffracted spots



What would happen if blocked some of the spots?

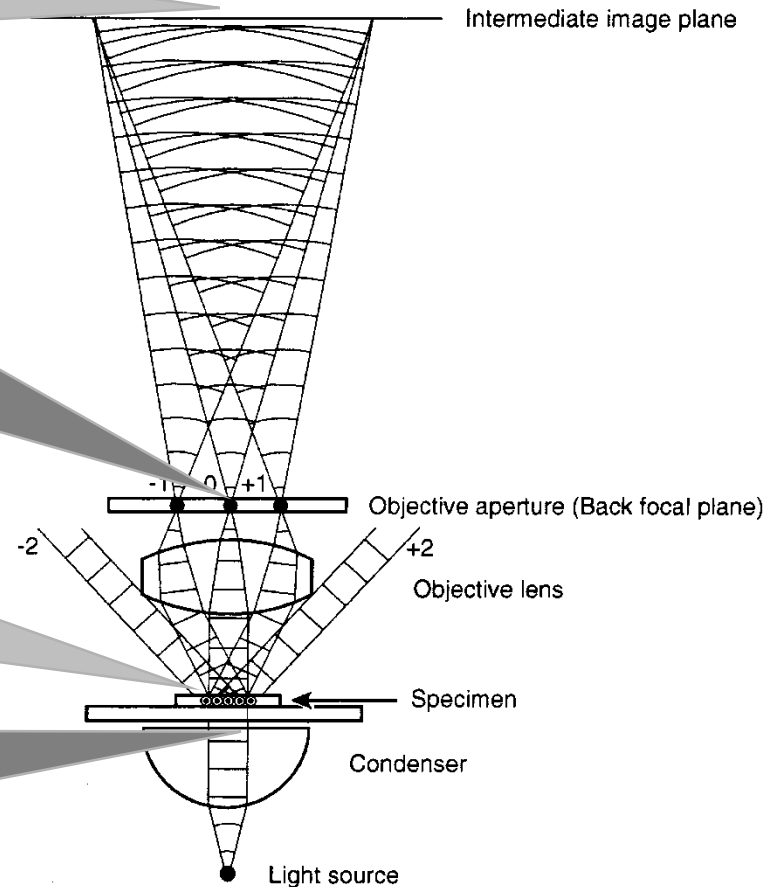
Imaging a linear grating

Intermediate Image: Formed by interfering waves from $-1, 0, +1$ orders

Back Focal Plane: Diffraction pattern, formed by objective (multiple images of the source as a result of line spacing)

Specimen: Slide with periodic lines. Spacing determines diffraction angles.

Condenser: Produces parallel wave front at 0° (aperture is closed down to a pinhole).



“Illumination Path”

Abbe:

“the microscope image is the interference effect of a diffraction phenomenon”

Thanks