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Fakultät für Naturwissenschaften, Fachbereich Physik

Announcement

Origin, effects and correction of the aberrations of optical lenses

Prof. Rose

Description

Optical lenses suffer from imperfections which produce aberrations in the image of an object taken by a microscope, photographic camera, or a telescope. Perfect imaging is obtained within the frame of Gaussian optics which is only valid for narrow beams confined to the region near the straight optic axis which represents the central axis of the optical system. However, narrow beams yield poor image resolution. In order to increase the resolution, broad pencils of rays must be employed such that the origin of each outgoing pencil is transferred in a conjugate image point by the lens system. Real lenses produce aberrations owing to the inaccuracies of their geometry and/or their index of refraction. The aberrations reduce contrast and resolution caused by the broadening of the image points. The size of the image spots depends on the lateral position of the object point and the initial opening angle of the pencil of rays emanating from this point. The aberrations are classified by their order which is a measure of their impact on the image quality. In most cases the size of an aberration is the smaller the higher its order is.

The lecture will start with the principles and properties of Gaussian optics. Subsequently, the origin, the classification and the impact of the aberrations on the form of the image points are outlined. It will be shown that the performance of light-optical lenses and electron lenses differ considerably. As a consequence, light-optical methods for correcting the fundamental chromatic and spherical aberrations cannot be applied in electron optics. Feasible correction methods for compensating these aberrations will be discussed in detail for both light optics and electron optics.

The lectures will be complemented with a practical course. The first part will consist of experiments on light optics. During the second part, the students will learn how to simulate the effect of aberrations in a transmission electron microscope (TEM).

Prerequisites

Undergraduate physics and mathematics, some experience in programming would be helpful

Additional information

Lecture with lab

3 ECTS credits

Registration

Registration via Moodle: https://moodle.uni-ulm.de/course/view.php?id=7325

Dates

First meeting:	Thu, 20.7.2017, 15:00, N27/glass box
Lecture:	7. - 11.8.2017, N24/251
Lab course:	tba

Assessment

written exam

Lecturer

Prof. Rose, Electron Microscopy Group of Materials Science