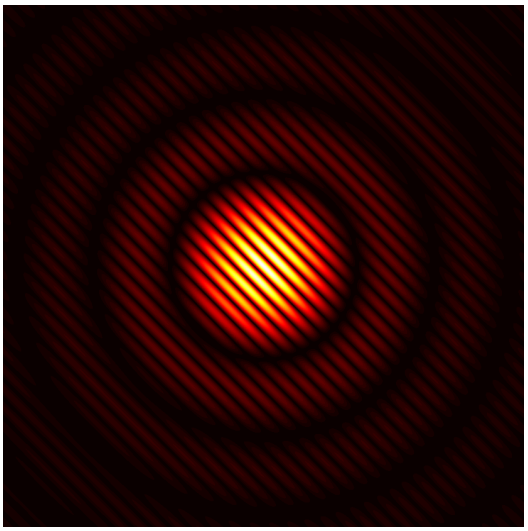
SMUFOP00 Fourier Optics



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Objectives

The aim of this course is to provide the basics of Fourier optics for astronomers. The theory of diffraction and image formation makes an extensive use of tools related to Fourier analysis and signal processing, such as the Fourier transform, convolution and frequency filtering. During this course we present the mathematical formalism as well as applications to image formation, long baseline interferometry, Abbe-Porter optical filtering and Lyot coronography. The course is completed by laboratory sessions, using optical benches with lasers, lenses and cameras. We also give a small introduction to a scientific computing language (python) and use it for numerical exercises and processing of data obtained during lab sessions.

Prerequisites

Mathematical knowledge: Integrals, Fourier transform and convolution
Basic knowledge in wave optics (plane waves, interferences, coherence, diffraction)

Evaluation

Type of examinations: Exam (1/3), oral presentation based on article synthesis (1/3), lab reports (1/3)

Main progression steps

- Weeks 1-3 : theoretical courses and exercises (5 courses).
- Weeks 4-5 : lab sessions and theoretical courses.
- Weeks 6-7 : theoretical courses and exercises
- Week 3 - end : scientific project based on article synthesis
- Last week : final exam and oral presentation of the project

Bibliography & Resources

Aristidi, E., “Fourier optics course” - https://www-n.oca.eu/aristidi/Cours/FourierOptics_Course.pdf
Goodman, J.W., “Introduction To Fourier Optics”
Cours d’optique ondulatoire, L3 (in French) - http://sites.unice.fr/site/aristidi/optique/
Modern optics (university of Edinburgh) - http://www2.ph.ed.ac.uk/ wjh/teaching/mo/
Roddier, F., “Distributions et transformation de Fourier” (in french)
Bracewell, R.N., “The Fourier Transform and Its Applications”

Contents

Theory (19h)

1. Reminders on Fourier analysis
2. Fraunhofer diffraction
3. Fourier properties of lenses
4. Optical coherent filtering.
5. Image formation in incoherent light.

Lab experiments (6h)

1. Fraunhofer diffraction
2. Optical filtering