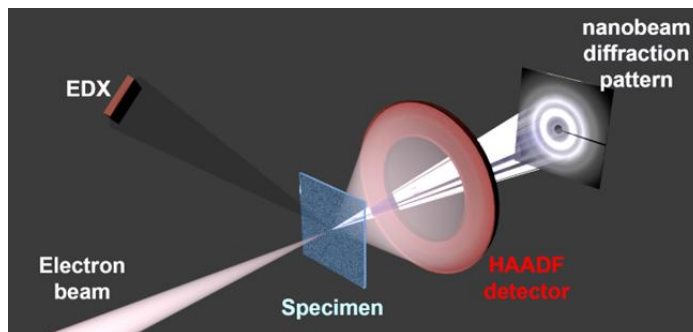# Masterthesis

4D-STEM workflow to study atomistic structures

Motivation

Modern microscopy and related detectors can produce very large datasets, impossible to collect, inspect and analyze manually. In material science the acquisition and evaluation of such big data can be used to e.g. deduce information on the structure and stability of matter.

In the present work, big data sets will be collected using a high-end Transmission-Electron Microscope (TEM). For that, a technically so called 4D-STEM approach will be used were a small electron probe scans across a thin sample and for every beam position a diffraction pattern is stored.

Additional signals, as e.g. high-angle annular dark-fields (HAADF) or energy dispersive X-rays (EDX) can also be acquired to add up into a multidimensional data set.

The goal of the work is, to establish a workflow on experimental setup from the TEM scan and detector, to the data analysis workflow. This includes handling of big data and scripting abilities. Starting from a technical approach, stepwise materials physics questions can be tackled.

Tasks

- Familiarization with electron microscope (TEM) and particular with data collection of technically called 4D-STEM data
- Microstructural characterization and parameter extraction
- Data analysis and evaluation (Python based)

Timeline

- 1st-2nd month: literature review and basic TEM handling
- 3rd-9th month: experimental setup and data extraction, evaluation
- 9th-12th month: analyzing results and thesis writing

Research area:
Microstructural characterization, method developement

What you will learn:
Transmission Electron Microscopy (TEM), Data handling and scripting

What you bring:
Master student in materials science or bachelor/master student in physics, basic knowledge in solid state physics and scripting is desireable

Starting date:
After March 2026

Language:
English or German

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