Module Name
3D Cryo Electron Microscopy

Type of Module	**Module Code**
o Advanced Module	3D Cryo Electron Microscopy

Identification Number	**Workload**	**Credit Points**	**Term**	**Offered Every**	**Start**	**Duration**
MN-B-SM (GA 3)	360 h	12 CP	2nd term of studying	Summer term, 1st half	Summer term only	7 weeks

1	**Course Types**	**Contact Time**	**Private Study**
	a) Lectures	24 h	48 h
	b) Practical/Lab	150 h	106 h
	c) Seminar	8 h	24 h

2 Module Objectives and Skills to be Acquired

Students who successfully completed this module

- have acquired fundamental knowledge about the principles of electron microscopy (EM) as a tool in structural biology, including the physical background of electron optics, and about the computational methods required to reconstruct 3D objects from 2D images.
- are able to prepare sample grids for negative-stain EM, operate a transmission electron microscope, assess protein quality by EM, and use computational tools to process EM datasets to determine the 3D structures of proteins.
- are familiar with the use of high-performance computing resources for advanced computational tasks, and are able to write simple computer scripts to automate repetitive tasks.
- have learned how to present research results in oral and written form, and to critically discuss scientific publications related to the topic of the module on a professional level.
- are able to transfer skills acquired in this module to other fields of biochemistry.

3 Module Content

- Imaging with electrons: theory and practical aspects
- Sample preparation for EM: negative-staining and vitrification of biological macromolecules
- Data collection using electron microscopes, routine operations on electron microscopes, and strategies for automated data collection and quality assessment
- Basic introduction into using high-performance computing resources in structural biology
- Reconstruction of 3D structures from 2D EM images using single-particle refinement strategies

4 Teaching Methods

- Lectures; Practical/Lab; Seminar; Computer exercises; Guidance to independent research; Training on presentation techniques in oral and written form

5 Prerequisites (for the Module)

Enrollment in the Master's of Science degree course "Genetics and Biology of Aging and Regeneration" or in the Master's degree course "Biochemistry and Molecular Medicine"

Additional academic requirements

Previous attendance of the lecture module Principles of Molecular Genetics, Development and Aging

6	**Type of Examination** The final examination consists of two parts: Oral examination on topics of lectures, seminars and the practical/lab part (20-30 min; 50 % of the total module mark), written report (50 % of the total module mark)
7	**Credits Awarded** Regular and active participation; Each examination part at least "sufficient" (see appendix of the examination regulations for details)
8	**Compatibility with other Curricula*** Optional compulsory module in the Master's degree course "Biochemistry and Molecular Medicine"
9	**Proportion of Final Grade** 12.0 %
10	**Module Coordinator** Prof. Dr. Elmar Behrmann, phone 470 76300, e-mail: elmar.behrmann@uni-koeln.de
11	**Further Information** **Participating faculty:** Prof. Dr. E. Behrmann, Dr. M. Gunkel, Dr. S. Pöpsel **Literature** • Frank, J. (2006) Three-Dimensional Electron Microscopy of Macromolecular Assemblies: Visualization of Biological Molecules in Their Native State. Oxford University Press • Jensen, G. Getting Started in Cryo-EM. Online course [https://em-learning.com/] • Additional material and subject specific literature will be provided *ad hoc* via Ilias **Note:** the module contains hand-on laboratory work conducted by small groups of students and is taught in course rooms and research laboratories. The module also contains computer-based research/practicals as an important component. **Location:** The course will take place at the Institute of Biochemistry, Zülpicher Str. 47, 50674 Cologne. **General time schedule:** Week 1-5 (Mon.-Fri.): mixed lectures experimental/computational work 9:00 to 17:00 (Mon: 13:00 to 17:00) including a lunch break five times a week. Exact times can vary according to the laboratory needs; Week 6 (Mon.-Fri.): Preparation and presentation of the seminar talk and the poster, respective of the written report; Week 7 (Mon.-Fri.): Preparation for the oral examination **Introduction to the module**: No prior introduction is required. All required study material will be made available by Ilias in advance to the course. The course starts on Monday April 13, 2026 at 13:00 in Room 465, 4th floor of the Institute of Biochemistry. **Oral examination:** June 3, 2026, second/supplementary examination July 3, 2026; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.