Module Name 3D Cryo Electron Microscopy

Identification Number	Workload	Credit Points	Term	Offered Every	Start	Duration
MN-BC-BSM07	360h	12 CP	1st or 2nd term of studying	Summer term	Summer term only	7 weeks

1	Course Types	Contact Time	Private Study	Group Size*
	a) Lecture	24 h	48 h	max. 12
	b) Practical/lab	150 h	106 h	max. 12
	c) Seminar	8 h	24 h	max. 12

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

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

6 Type of Examination

M.Sc. Biochemistry and Molecular Medicine (Type BC4): The final examination consists of two parts: 20-30 min oral examination about topics of the lectures and seminar presentations (50% of the total module mark), and written report on the experimental results (50% of the total module mark).

7 Credits Awarded

Regular and active participation; completed homework
Each examination part at least "sufficient" (see appendix of the examination regulations for details)

8	**Compatibility with other Curricula** Biochemical subject module in the master's degree course "Genetics and Biology of Aging and Regeneration" and in the master´s degree course "Chemistry"
9	**Proportion of Final Grade** 10%
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 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**: The course starts on Monday April 8th, 2024 at 13:00 in Room 465, 4th floor of the Institute of Biochemistry. **Oral examination:** May 31st, 2024, second/supplementary examination August 23th, 2024; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.

* 4 students from the Master´s degree course "Genetics and Biology of Ageing and Regeneration", 7 students from Master´s degree course "Biochemistry and Molecular Medicine", and 1 from the Master´s degree course "Chemistry".