

<b>Module Name</b> 3D Cryo Electron Microscopy						
<b>Identification Number</b>	<b>Workload</b>	<b>Credit Points</b>	<b>Term</b>	<b>Offered Every</b>	<b>Start</b>	<b>Duration</b>
MN-BC-BSM07	360h	12 CP	1 <sup>st</sup> or 2 <sup>nd</sup> term of studying	Summer term	Summer term only	7 weeks
<b>1</b>	<b>Course Types</b> a) Lecture b) Practical/lab c) Seminar		<b>Contact Time</b> 24 h 150 h 8 h	<b>Private Study</b> 48 h 106 h 24 h		<b>Group Size*</b> max. 12 max. 12 max. 12
<b>2</b>	<b>Module Objectives and Skills to be Acquired</b> Students who successfully completed this module... <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• are able to transfer skills acquired in this module to other fields of biochemistry.</li> </ul>					
<b>3</b>	<b>Module Content</b> <ul style="list-style-type: none"> <li>• Imaging with electrons: theory and practical aspects</li> <li>• Sample preparation for EM: negative-staining and vitrification of biological macromolecules</li> <li>• Data collection using electron microscopes, routine operations on electron microscopes, and strategies for automated data collection and quality assessment</li> <li>• Basic introduction into using high-performance computing resources in structural biology</li> <li>• Reconstruction of 3D structures from 2D EM images using single-particle refinement strategies</li> </ul>					
<b>4</b>	<b>Teaching Methods</b> Lectures; Practical/Lab; Seminar; Computer exercises; Guidance to independent research; Training on presentation techniques in oral and written form					
<b>5</b>	<b>Prerequisites</b> 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".					
<b>6</b>	<b>Type of Examination</b> 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).					
<b>7</b>	<b>Credits Awarded</b> Regular and active participation; completed homework Each examination part at least "sufficient" (see appendix of the examination regulations for details)					

8	<p><b>Compatibility with other Curricula</b></p> <p>Biochemical subject module in the master's degree course "Genetics and Biology of Aging and Regeneration" and in the master's degree course "Chemistry"</p>
9	<p><b>Proportion of Final Grade</b></p> <p>10%</p>
10	<p><b>Module Coordinator</b></p> <p>Prof. Dr. Elmar Behrmann, phone 470 76300, e-mail: <a href="mailto:elmar.behrmann@uni-koeln.de">elmar.behrmann@uni-koeln.de</a></p>
11	<p><b>Further Information</b></p> <p><b>Participating faculty:</b> Prof. Dr. E. Behrmann, Dr. M. Gunkel, Dr. S. Pöpsel</p> <p><b>Literature</b></p> <ul style="list-style-type: none"> <li>• Frank, J. (2006) Three-Dimensional Electron Microscopy of Macromolecular Assemblies: Visualization of Biological Molecules in Their Native State. Oxford University Press</li> <li>• Jensen, G. Getting Started in Cryo-EM. Online course <a href="https://em-learning.com/">[https://em-learning.com/]</a></li> <li>• Additional material and subject specific literature will be provided <i>ad hoc</i> via Ilias</li> </ul> <p><b>Note:</b> 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.</p> <p><b>Location:</b> The course will take place at the Institute of Biochemistry, Zùlpicher Str. 47, 50674 Cologne.</p> <p><b>General time schedule:</b> 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</p>

\* 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".