Module Name
Introduction to Protein Crystallography

Type of Module	**Module Code**
o Advanced Module	Crystallography

Identification Number	**Workload**	**Credit Points**	**Term**	**Offered Every**	**Start**	**Duration**
MN-B-SM (GA 4)	360 h	12 CP	2nd term of studying	Summer term, 2nd half	Summer term only	7 weeks

1	**Course Types**	**Contact Time**	**Private Study**
	a) Lectures	24 h	45 h
	b) Practical/Lab	154 h	108 h
	c) Seminar	8 h	21 h

2 Module Objectives and Skills to be Acquired

Students who successfully completed this module

- are able to set up crystallization screens, analyse crystals by X-ray diffraction, and determine crystal structures by the application of the relevant computer programs
- have acquired a thorough knowledge of the principles of macromolecular crystallography and can use it to judge crystal structures generated by other scientists regarding their quality
- are familiar with different methods for 3D structure determination and can compare them with respect to their results and limits
- are able to set up crystallization screens, analyse crystals by X-ray diffraction, and determine crystal structures by the application of the relevant computer programs.
- can predict protein structure using state-of-the-art algorithms and judge their quality and usefulness
- are able to recognize different protein folds, analyze and visualize biological macromolecular 3D structures using molecular viewers and other programs
- can independently carry out small scientific projects related to the topic of the module
- 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 the acquired skills of this module to other fields of biochemistry and biology

3 Module Content

- Visualisation and analysis of protein structures
- Crystallographic foundations: crystal geometry, symmetries, theory and practice of X-ray diffraction
- Crystallization experiments on biological macromolecules
- Crystallographic data collection and analysis
- Approaches for solving the phase problem
- Structure building and refinement
- Validation and quality assessment
- Protein modelling
- Critical reading of publications in the field of Structural Biology
- Software used: ChimeraX, AlphaFold, Phenix, CCP4, Coot and other

4	**Teaching Methods** Lectures; 4 week practical work [wet lab (30%), computer lab (60%) and guided excercises (10%)], 1 week project work ("Solve your *own* structure"); Seminar "Journal Club"; 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: One hour written examination about topics of the lectures and the practical/lab part (50 % of the total module mark) and an oral presentation of a self-chosen structural biology paper (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. Ulrich Baumann, phone 470-3208, e-mail: ubaumann@uni-koeln.de

11	**Further Information** **Participating faculty:** Prof. Dr. U. Baumann, Dr. J. Gebauer **Literature** • Rupp, B. (2010) Biomolecular Crystallography. Garland Science • Blow, D. (2002) Outline of Protein Crystallography for Biologists. Oxford University Press • Branden, C.I., Tooze, J. (1998) Introduction to Protein Structure. 2nd edition, Taylor and Francis • Liljas, A., Liljas, L., Piskur, J., Lindblom, G., Nissen, P., Kjeldgaard, M. (2009) Textbook on Structural Biology. World Scientific • ChimeraX (https://www.rbvi.ucsf.edu/chimerax/) • 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. Further information can be found online: https://px.uni-koeln.de/teaching/proteincrystallography **Location:** The course will take place at the Institute of Biochemistry, Zülpicher Str. 47, 50674 Cologne. **General time schedule:** Week 1-4: (Mo-Fr) Lectures at approx. 9:00-10:30 a.m. (three times a week), following experimental/computational work till 5 p.m. (including lunch break, the exact times of lectures and practical work may vary according to the laboratory needs). Week 5*:* self-organised project work (best performed in the computer lab of the institute). Week 6*:* Preparation and presentation of seminar talk; Week 7: Preparation for the written examination **Introduction to the module**: May 27, 2024 at 10:15 a.m., Zülpicher Str. 47, Room 465 (further information/link will be sent to your Smail-Account) **Written examination:** July 19, 2024, second/supplementary examination August 30, 2024; the latter date may vary if students and module coordinator agree. More details will be given at the beginning of the module.