Faculty of Mathematics and Natural Sciences (FMNS)

Profile report: Biomolecular X-ray Crystallography/Biomoleculaire Röntgenkristallografie

- Discipline: Structural Biology
- Level: tenure-track Assistant Professor
- Fte: Full time (1,0)

1. Scientific discipline
X-ray crystallography is a technique used to determine atomic structures of biological macromolecules such as proteins, nucleic acids, and complexes thereof. The technique has been used since the mid-20th century, and has since established itself at the core of structural biology, with currently over 120,000 crystal structures determined and deposited in the Protein Data Bank (rcsb.org).

2. Vacancy
This position is opened by the Board of the Faculty of Mathematics and Natural Sciences (EMK/gl/16/00968) of the University of Groningen and will be embedded in the Groningen Biomolecular Sciences and Biotechnology Institute (GBB), an institute with 12 vibrant research groups, targeting challenging biological questions in the focal areas ‘Molecular Mechanisms of Biological Processes’ and ‘Physiology and Systems Biology’. The position falls within the framework of ‘Career Paths in Science 3’ (‘Bèta’s in Banen 3’). Please use link for criteria and conditions.

3. Selection committee (BAC)
- Prof. dr. B. Poolman (Scientific Director GBB), chair
- Prof. dr. D.J. Slotboom (Head research group Membrane Enzymology; Deputy Director of the educational programmes in Chemistry)
- Prof. dr. S.J. Marrink (Head research group Molecular Dynamics)
- Prof. dr. T. Sixma (Head X-ray crystallography group, Netherlands Cancer Institute)
- Prof. dr. M.W. Fraaije (Staff member Biotransformation and Biocatalysis)
- Prof. dr. A.K.H. Hirsch (Staff member Chemical Biology)
- N. van der Veer (Student member)

Additional advisors:
- External consultants: Profs. G. Schertler (Paul Scherrer Institute, CH), A. Pearson (University of Hamburg, DE), E. Pebay-Perouilla (Institute for Structural Biology, Grenoble, FR)
- Dr. A.M.W.H. Thunnissen (staff member Protein Crystallography)
- Dr. C. Paulino (staff member Electron Microscopy)
- HR advisor: Mrs. Y. Folkers (FMNS)
4. Research area

X-ray crystallography has been one of the most influential techniques in shaping our insight in the molecular basis of life, which for instance is reflected in the large number of Nobel prizes awarded for breakthroughs obtained using macromolecular X-ray crystallography (Nobel prizes in Chemistry 2012, 2009, 2006, 2003, 1997, 1988, 1982, 1972, 1962, and Nobel prize in Physiology and Medicine in 1962). In addition, without X-ray crystallography other prominent fields, such as Molecular Dynamics, would not have developed to their current advanced levels. Not only fundamental discoveries have been made possible by the technique, but also applications are developed on the basis of macromolecular structures. Most prominent of these are the rational design of novel therapeutics and the engineering of enzymes with new or improved activity for biotechnological applications. About 100 articles with results from X-ray crystallography are published annually in *Nature, Science* and *Cell*. Over the past few decades the technique has become easier to use, also for non-specialists, owing to the development of user-friendly software, availability of synchrotron resources, and commercialization of (robotics) equipment. By and large two types of crystallographers can currently be discerned: those who use the technique for routine purposes, similar to any commercialized technique, and those who push the techniques to the next level. The former work can be done in a facility-type set-up, and is often related to applications in drug design and biotechnology (operated by current staff scientist). The latter requires highly specialized fundamentally driven scientists, ideally pursuing their own independent lines of research. At the moment, ground-breaking advances include the development of X-ray-free electron lasers, serial crystallography, and time-resolved methods, as well as the elucidation of ever-larger complexes of macromolecules. The latter development leads to convergence towards single-particle cryo-Transmission Electron Microscopy (cryo-TEM), which now allows resolving biomacromolecular complexes at relatively high resolution. The X-ray and EM techniques are fully complementary, and their combined use results in a synergy that is likely to culminate in to new fundamental insights in the molecular mechanisms important for life. The candidate will use state-of-the-art methods to determine the high-resolution structures of biological macromolecules such as proteins, nucleic acids, and complexes thereof, and use the information to elucidate molecular mechanisms of biomolecular action.

5. Embedding: institute (and base unit)

The position will be embedded in the newly formed GBB research unit Structural Biology, which will combine the research groups Biomolecular X-ray Crystallography and Electron Microscopy. The current X-ray Crystallography group exists of a tenured staff scientist (dr. Andy-Mark Thunnissen) specialized in X-ray crystallography and two support staff members, who focus on structural biocatalysis and facility-type research, and who are involved in collaborative projects within GBB, between the GBB and other institutes, and with companies. The new faculty member is expected to develop an independent research line on an important biological topic, to exploit the rapid new
developments in methodology and to integrate X-ray crystallography with complementary structural biology techniques. The envisioned Biomolecular X-ray Crystallography group will combine an independent research line at the forefront of the field (led by the new faculty member) and facility-type activities operated by the current staff members (dr. Thunnissen). As such the organization of the new group will mirror the organization of the Electron Microscopy group, which also includes an independent line of research (dr. Cristina Paulino) and facility-type research (dr. Marc Stuart).

6. Local and (inter)national position
The research institute GBB has been one of the pioneering institutes both in the development of new methodology and in the tackling of fundamental biological questions using X-ray crystallography. The structure of papain published in 1968 by the group of Jan Drenth was one of the first ever protein structures; Drenth also is author of a widely acknowledged textbook in this field. The University of Groningen has a strong track record in using X-ray crystallography to tackle basic questions in the fields of enzymology, biocatalysis and membrane transport. X-ray crystallography is a core activity of GBB (i.e. work of profs. Dick Janssen, Marco Fraaije, Dirk Slotboom, Arnold Driessen, Oscar Kuipers, Arjan Kortholt, Bert Poolman), while successful collaborations exist with groups from other research institutes in Groningen (i.e. the Stratingh Institute for Chemistry, the Zernike Institute for Advanced Materials, the Groningen Research Institute for Pharmacy, and the European Research Institute for the Biology of Ageing), as well as with the University Medical Centre Groningen.

X-ray crystallography is being used worldwide, with many science departments having one or more groups using the technique. The Netherlands hosts dedicated crystallography groups at the Universities of Groningen, Utrecht, Leiden, and Eindhoven, and at the National Cancer Institute (NKI) in Amsterdam, while many other groups collaborate with crystallographers in the Netherlands or abroad. The Dutch groups focus primarily on specific unresolved biological questions, rather than method development. Much of the current developments in methodologies occur in large global consortia, and at synchrotron and XFEL sites (XFEL in Hamburg, SwissFEL in Villigen).

7. Expected contributions to research
The research activities should result in the strengthening of the international position of GBB in structural biology. The research line should become independent and be centred on solving challenging biological topics in structural biology. The research should lead to international recognition, as demonstrated by publications in prominent international journals and contributions to major international scientific conferences in the field. External fund raising is essential to accomplishing the aforementioned tasks.
8. Expected contributions to teaching
Development of excellent teaching skills and a strong commitment to participating in the teaching programmes of the Undergraduate and Graduate School of Science are expected. Particularly, teaching is affiliated to Life Sciences (e.g. the BSc Biology, BSc Life Science and Technology, MSc Molecular Biology and Biotechnology) and Chemistry (BSc and MSc levels). Supervision of (under)graduate students during BSc/MSc/PhD research and thesis projects should also be undertaken. Generally, the tasks comprise developing and implementing courses and teaching in structural biology and biophysical chemistry.

9. Expected contributions to the organization
An active input is expected in order to provide a valuable contribution to the management and organizational tasks of the institute. At the level of the FMNS, the candidate will contribute to the organization of the faculty, for example by participating in working groups and committees in the fields of teaching, research and management, and establishing overarching activities within the FMNS themes (i.e. Molecular Life and Health and Advanced Materials). The candidate will participate in relevant national and international organizations.

10. Supportive information
- The job announcement and online application: [http://www.rug.nl/about-us/work-withus/job-opportunities/overview](http://www.rug.nl/about-us/work-withus/job-opportunities/overview)

- The university and the institutes:
  i. University of Groningen: [www.rug.nl](http://www.rug.nl)
  ii. Groningen Biomolecular Science and Biotechnology Institute: [www.rug.nl/gbb](http://www.rug.nl/gbb)
  iii. Stratingh Institute for Chemistry: [http://www.rug.nl/research/stratingh/](http://www.rug.nl/research/stratingh/)
  vi. University Medical Centre Groningen / Faculty of Medical Sciences: [http://www.rug.nl/umcg/research/](http://www.rug.nl/umcg/research/)

- Promotion conditions defined in the Career Paths in Science: [www.rug.nl/fwn/careerpathsinscience](http://www.rug.nl/fwn/careerpathsinscience)

- Standard salary levels according to Union of Dutch Universities (VSNU): [http://www.vsnu.nl/cla](http://www.vsnu.nl/cla)