PhD Program between the Freie Universität Berlin (FUB) and the China Scholarship Council (CSC)

Open PhD Position at Freie Universität Berlin, offered only to Chinese CSC scholarship candidates 2020

Please Note: this PhD position is only offered to Chinese PhD candidates for the application in the framework of the FUB-CSC PhD Program.

Department/Institute: Department of Biology, Chemistry, Pharmacy / Institute of Chemistry and Biochemistry

Subject area: Gene Regulation, Transcription, Structural Biochemistry

Name of Supervisor: Prof. Markus C. WAHL, PhD (Mr.)

Number of open PhD positions: 2

Type of the PhD Study: Fulltime

Project title: Molecular mechanisms of co-transcriptional rRNA folding and processing in bacteria

PhD Project description:

The growth rates of bacteria and of several eukaryotic microorganisms, including yeast, scale with the concentration of cellular ribosomes1,2. In bacteria, the synthesis of ribosomal (r)RNA sets the pace for ribosome biogenesis3,4, while the synthesis of r-proteins is adjusted depending on the rRNA levels by transcriptional and, predominantly, translational feedback loops5. In fast-growing Escherichia coli, more than two thirds of the actively transcribing RNA polymerases (RNAPs) are engaged in rRNA synthesis, and rRNA accounts for about three quarters of the total RNA in these cells2,6. While efficient rRNA synthesis is, thus, of paramount importance for bacteria to take maximum advantage of favorable nutritional conditions and warrants the expenditure of a large fraction of the cellular resources, it presents formidable challenges to the transcriptional machinery. Bacterial ribosomal RNAs are synthesized by a dedicated transcription complex, minimally comprising RNA polymerase, DNA, RNA bearing an N-utilization site-like anti-termination element, Nus factors A, B, E, and G, inositol mono-phosphatase SuhB and ribosomal protein S4. This complex transcribes at high rates, shields RNA polymerase from premature termination and supports co-transcriptional rRNA folding, modification, processing and r-subunit assembly by presently unknown mechanisms 7,8. The ability to support co-transcriptional rRNA folding, modification, processing and r-subunit assembly is specific to the endogenous transcription machinery, as rRNA synthesis by the highly efficient RNAP from phage T7 predominantly leads to inactive ribosomes in E. coli9.

Bacterial rRNAs are synthesized as precursors of concatenated 16S, 23S and 5S rRNAs with additional intervening tRNAs, from which mature rRNAs/tRNAs are excised7,8. Co-transcriptional rRNA processing has been directly visualized by electron microscopy10 and is inter-linked with co-transcriptional rRNA folding11. In the course of the proposed PhD...
projects, we will investigate the molecular mechanisms underlying co-transcriptional rRNA folding and processing in bacteria.

Our group uses advanced preparative Biochemistry, integrative structural biochemical approaches (including X-ray crystallography, single-particle electron cryo-microscopy and chemical cross-linking/mass spectrometry) and structure-guided mutational analyses to elucidate the functional organization of intact bacterial transcription complexes as well as of individual components and sub-complexes. Recently, for example, we have worked out the functional architecture of a processive transcription antitermination complex, comprising RNA polymerase, DNA, RNA bearing a specific regulatory sequence, host transcription factors NusA, NusB, NusE and NusG and the phage protein λN, revealing how the λN protein can launch a multi-pronged strategy to convert RNA polymerase into a termination-resistant form.

References
### Academic requirements:

English is the working language in our lab. The doctoral thesis can be written in English or German. Proficiency in German is neither required in the lab nor for the thesis. English requirements: IELTS 6.5 or TOEFL 95 ibt

### Information of the professor or research group leader (website, awards etc.):

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### Please Note:

In a first step, the complete application should be submitted to [csc@international.fu-berlin.de](mailto:csc@international.fu-berlin.de) for evaluation by January 4th, 2020. Please do not contact the professor before. He/she will get in contact with you after having received the complete application via the International Office of Freie Universität Berlin in January.