The junior research group “Biological Algorithms” headed by Benjamin Friedrich within the Cluster of Excellence ‘Center for Advancing Electronics Dresden’ (cfaed) offers a position as

**Research Associate / PhD Position in Theoretical Biological Physics**
(subject to personal qualification employees are remunerated according to salary group E 13 TV-L)

**Research area:** Muscle building in silico: Mathematical modeling of myofibrillogenesis

**cfaed Investigators:** PD Dr. Benjamin Friedrich

**cfaed research path:** Biological Systems Path

**Terms:** The position will start as soon as possible, entails 65% of the fulltime weekly hours, and is fixed-term until June 30, 2021 with the possibility of extension. The period of employment is governed by the Fixed-Term Research Contracts Act (Wissenschaftszeitvertragsgesetz – WissZeitVG). The position offers the chance to obtain further academic qualification (e.g. PhD).

About the “Biological Algorithms group”
How do structures form in cells and tissues? The mission of our “Biological Algorithms group” is to understand physical principles of self-assembly and self-organization in living matter. Topics include the spontaneous formation of pattern in the cytoskeleton of cells, in tissues, and organisms. In our theoretical research, we combine nonlinear dynamics, statistical physics, and computational physics to understand physical mechanisms of biological function, and its robustness in the presence of noise and perturbations, while closely collaborating with experimental partners.

More information on current research can be found at [https://cfaed.tu-dresden.de/friedrich-home](https://cfaed.tu-dresden.de/friedrich-home). Our small group consists of enthusiastic students from different countries. All group meetings are held in English.

About the project
We are hiring a PhD student for a project in Theoretical Biophysics, to understand how microscopic force-generating units in our muscles self-assemble during development: Every muscle cell in your body contains highly regular myofibrils, which produce active muscle forces. Each myofibril is built by a chain of sarcomeres, composed of actin filaments and myosin molecular motors, linked together by gigantic titin springs. The myofibrils are active “biological crystals” and any alterations of their regular architecture are linked to disease states. Yet how these myofibrils assemble during development is poorly understood in terms of physical mechanisms.

In this project, physical mechanisms of myofibril self-assembly shall be investigated, with a focus the role of active tension and filament elasticity for sarcomere self-assembly. We will formulate alternative physical mechanisms in terms of mathematical models, study these numerically and analytically, and test these by comparison to experimental data. Specifically, we plan agent-based simulations of initially unordered acto-myosin bundles, with specific interaction rules for the different filaments. In addition to computer simulations, we will develop a mean-field theory of sarcomeric pattern formation that coarse-grains the interaction model. We will compute phase-diagram of liquid crystal order in nascent myofibrils. We will derive testable predictions that will be compared to quantitative experimental data (time-lapse fluorescence microscopy, electron microscopy, molecular force sensor data).
Previously, our group proposed a first mechanism how actin and myosin filaments self-assemble into regular sarcomeric patterns by a combination of active forces and passive crosslinking (Friedrich et al. PLoS Computational Biology, 2012), which will provide a starting point for the project. This PhD thesis will constitute the theory part of a theory-experiment collaboration with the laboratories of Frank Schorrer (IBDM, Marseilles) and Olivier Pourquie (HMSB, Boston). You will participate in regular international project meetings. The experimental partners will provide high-resolution time-lapse microscopy data of developing myofibrils, as well as molecular force-sensor data for live force measurements in developing muscle fibers. Based on this data, we will quantify the gradual emergence of sarcomeric patterns using concepts from Soft Condensed Matter Physics (nematic and smectic order parameters) to link theory and experiment. Full funding including travel funds is available from the prestigious Human Frontier Science Program. More information on the project can be found here: https://cfaed.tu-dresden.de/press-releases-201/muscle-growth-in-the-computer-international-team-wants-to-unravel-the-formation-of-myo-fibrils

Requirements: We are looking for a theoretical physicist (or applied mathematician), who is intrigued to discover algorithms of life, and meets the following requirements: excellent university degree (diploma or Master) in Biological Physics, Mathematical Biology, or related field; experience in statistical physics, nonlinear dynamics, stochastic processes; experience in Computational Physics (Monte-Carlo and agent-based simulations, ODEs, PDEs), and programming skills (e.g. Matlab, Python, C); strong interest in applying physics to understand life, willingness to learn some biology en route; strong analytic and problem-solving skills, creativity; strong communication skills, especially in cross-disciplinary communication; fluency in English – oral and written.

What we offer:
Dresden is a European hub for Biological Physics that unites excellence in information and life sciences. You will be embedded in the Cluster of Excellence cfaed, where we contribute bio-inspired algorithms of molecular self-assembly and self-organization. Additionally, we enjoy the close proximity of collaboration partners at the Max-Planck Institute of Molecular Cell Biology and Genetics, the Biotechnology Centre, and the new Center for Systems Biology Dresden. For informal enquiries, please contact Dr. Benjamin Friedrich at benjamin.m.friedrich@tu-dresden.de.

Applications from women are particularly welcome. The same applies to people with disabilities. Dresden is a medium-sized city (5-10^5 inhabitants) with a rich cultural life, baroque architecture, and affordable rents. Berlin and Prague are only a hop away (2h by train).

Application Procedure
Your application (in English only) should include: a motivation letter, your CV with publication list, the names and contact details of two references, copy of degree certificate, and transcript of grades (i.e. the official list of coursework including your grades). Please include also a link to your Master’s or PhD thesis. Complete applications should be submitted preferably via the TU Dresden SecureMail Portal https://securemail.tu-dresden.de by sending it as a single pdf document quoting the reference number PhD-Bio-w517 in the subject header to recruiting.cfaed@tu-dresden.de or alternatively by post to: TU Dresden, cfaed, Frau Dr. P. Grünberg, Helmholtzstr. 10, 01069 Dresden, Germany. The closing date for applications is 07.01.2019 (stamped arrival date of the university central mail service applies). Please submit copies only, as your application will not be returned to you.

Reference to data protection: Your data protection rights, the purpose for which your data will be processed, as well as further information about data protection is available to you on the website: https://tu-dresden.de/karriere/datenschutzhinweis
About cfaed

cfaed is a cluster of excellence within the German Excellence Initiative. As a central scientific unit of TU Dresden, it brings together 300 researchers from the university and 10 other research institutes in the areas of Electrical and Computer Engineering, Computer Science, Materials Science, Physics, Chemistry, Biology, and Mathematics. cfaed addresses the advancement of electronic information processing systems through exploring new technologies which overcome the limits of today's predominant CMOS technology. For more information please see https://cfaed.tu-dresden.de/

Additionally, our research group is part of the new Cluster of Excellence “Physics of Life” and affiliated with the “Center for Systems Biology Dresden”.

About TU Dresden

The TU Dresden is among the top universities in Germany and Europe and one of the eleven German universities that were identified as an ‘elite university’ in June 2012. As a modern full-status university with 14 departments it offers a wide academic range making it one of a very few in Germany.