European School of Molecular Medicine

2025 summer call PhD selections

AVAILABLE POSITIONS

Principal Investigator	Philipp S Erdmann
Affiliation	Human Technopole
Title of the proposed project	Genetically Encoded Shape Tags for the Localization of Ciliary Proteins
Short description of the project	We seek to develop and validate genetically encoded shape tags called "GeoTags" optimized for the localization and structural analysis of small proteins within larger cellular structures, in particular, primary cilia. The GeoTags will be designed using coiled-coil protein origamis as shape module, a fluorescent protein to allow detection by confocal microscopy, and a localization module enabling precise recruitment of the tag to the protein of interest. Combining these modules will allow direct visualization of proteins in their location by cryo-electron tomography (cryo-ET) without disrupting cilia function or other cellular processes. The ultimate goal is to provide researchers with a powerful, high-resolution-capable toolset for studying the structure, dynamics, and organization of subcellular targets such as primary cilia proteins, which are critical for numerous signaling pathways and cellular functions in health and disease.
Main research area for the project	Structural biology
Second research area for the project	
3 key words for project	synapse, neurotransmission
Main topic/s of the lab	Cryo-electron tomography, cryo-electron microscopy, membrane-less organelles, phase separation, neuro
Short description of the lab activity	In short, our goal is to enable "A Biopsy at the Nanoscale". This means making medically relevant samples accessible to high-resolution cryo-electron tomography (cryo-ET). For this goal, we develop pipelines and new sample preparation strategies for cryo-electron microscopy (cryo-EM). By enabling cryo-ET in organoids and tissue, we can follow cellular processes as they happen at high resolution — one day ideally without the need of model systems directly in patient-derived samples. Biologically, we are interested in phenomena related to liquid phase separation (LLPS) or biomolecular condensation in the setting of human diseases. Here, we seek to answer both basic questions, i.e., how they form and what are their biomechanical properties, but also how biomolecular condensates (BMCs) interact with their surroundings and shape cellular pathways. As these liquid-like compartments are involved in many normal but also disease-related cellular processes, understanding their composition and internal organization may be critical to revealing primary cellular function as well as developing new treatment strategies. With a goal of gaining molecular-level insights from organoids and tissue, our work at HT has so far been focused on creating robust workfl ows for making large samples such as organoids and tissue compatible with high-pressure freezing (HPF) and in situ cryo-ET. For this, we recently developed Serialized On-grid Lift-In

	Sectioning for Tomography (SOLIST), signifi cantly improving stability and throughput of cryo-lift out. We will continue developing techniques to address technological needs of the "biopsy at the nanoscale", such as markers or a "GFP" for cryo-EM. BMCs have a prominent role for my group since they are involved in many human diseases, including cancer and neurological disorders. At HT there are ample opportunities to dive deeply into these topics thanks to the organoids facility (ASCOF) and other research groups. And we think that understanding the molecular mechanisms that govern formation of BMCs with a unique, high-resolution perspective, can only be provided by cryo-ET. With this, we hope to give a unique "spin" to this fi eld of research, collaborating with groups and facilities at HT, integrating also other cutting-edge methods such expansion microscopy (ExM) and cross-linking mass spectrometry (MS).
Recent bibliography	1.Beyond Dimerization: Harnessing Tetrameric Coiled-Coils for Nanostructure Assembly R Jerala, S Vidmar, T Šmidlehner, J Aupič, Ž Strmšek, A Ljubetič, F Xiao, Angewandte Chemie International Edition2025 2.TOMOMAN: a software package for large-scale cryo-electron tomography data preprocessing, community data sharing and collaborative computing S Khavnekar, PS Erdmann, W Wan Applied Crystallography 57 (6) 2024 3.Serialized on-grid lift-in sectioning for tomography (SOLIST) enables a biopsy at the nanoscale HTD Nguyen, G Perone, N Klena, R Vazzana, F Kaluthantrige Don, Nature Methods 21 (9), 1693-1701 2024 4.In Situ Cryo-Electron Tomography and Advanced Micromanipulator Techniques S Klumpe, PS Erdmann Cryo-Electron Tomography: Structural Biology in situ, 151-165 2024 5.Beyond Dimerization: Harnessing Tetrameric Coiled-Coils for Nanostructure Assembly S Vidmar, T Šmidlehner, J Aupič, Ž Strmšek, A Ljubetič, F Xiao, G Hu, Angewandte Chemie International Edition, e202422075 2024 Full Bibliography: https://scholar.google.com/citations?hl=de&user=pCHFZzQAAAAJ&view_op=list_works&sortby=pubdate
Group composition	4 x PhD, 1 x Postdoc, 1x technician, 2 x undergrad (current state March 2025; 2 PhD will be replaced this year)
Institutional page link	https://humantechnopole.it/en/
Lab website link	https://humantechnopole.it/en/research-groups/erdmann-group/
Social media links	https://x.com/3P1L