			''Basic Principles and Practical Aspects of CryoEM''	
	Time		4.9.2023 - 15.9.2023	
	Modul		CHE 485	
	Speakers		Multi-User CryoEM Facility and Users	
	Organized by the CryoEM Facility		Carolin Seuring, Ulrike Laugks, Cornelia Cazey, Kay Grünewald https://www.cssb-hamburg.de/facilities/cryo_em/index_eng.html	
	Contact		carolin.seuring@cssb-hamburg.de	
	Register for Course		https://lists.cssb-hamburg.de/sympa/info/cryoemcourse2023	
	Rooms		CSSB Lecture hall, Harbor Lecture Hall, IT Rooms	
	Format		Hybrid Talks, Live Demos (Microscope, Data Analysis)	
	Zoom		Meeting ID: 687 5046 4138; pw: cryoem2023	
	Practicals		16 students	
	Course Material (ID_Title_speaker)		https://syncandshare.desy.de/index.php/s/37rE46ZBJH5p97d	
			Week 1	
ID	CSSB Lecture Hall	Time Slot	Day 1, Monday, 4.9.2023: Introduction to Cryo-EM	Course Introduction
1.1	Welcome	9:00 - 9:30	Welcome and Introduction to the Course	Carolin Seuring + Kay Grünewald
1.2	Talk	9:30 - 10:15	From proteins to cells to cellular movies: Introduction to electron cryo-microscopy	Kay Grünewald
		10:15 - 10:30	Coffee Break	
1.3	CryoEM Facility	10:30 - 11:15	Tour through the Multi-User CryoEM Facility and CSSB	Cornelia Cazey, Ulrike Laugks, Carolin Seuring
1.4	Talk	11:15 - 12:00	Basic Introduction to TEM	Cornelia Cazey
		12:00 - 13:00	Lunch Break	
1.5	Talk	13:00 - 13:30	Talk Sample Prep Overview: neg. stain - vitrification	Cornelia Cazey
1.6	Workshop	13:30 - 16:00	Hands on sample preparation in 4 groups: neg. stain, vitrobot, Leica GP2, manual plunger	Cornelia Cazey, Ulrike Laugks, Yuliia Mironova, Carolin Seuring
ID	CSSB Lecture Hall		Day 2, Tuesday, 5.09.2023: Physical	CryoSPA Workflow
	Free morning	9:30 - 11:00	LIV - Seminar : no lecture and enjoy your morning!	
2.1	Talk + Interactive	11:00 - 12:00	Image Formation Basics 1: Phase Contrast, Amplitude Contrast, Plane Waves	Carolin Seuring
2.2	Talk + Interactive	12:00 - 13:00	Image Formation Basics 2: Raydiagrams, CTF and Defocus, Aberrations	Carolin Seuring
		13:00 - 13:30	Free Time	
2.3	Demonstration	13:30 - 14:00	Sample loading at Titan Krios (4 groups a 4 pax)	Ulrike Laugks, Cornelia Cazey
2.4	Demonstration	14:00 - 14:30	Explanation: Atlas Acquisition, Finding the best grid	Cornelia Cazey
2.5	Demonstration	14:30 - 15:30	Sample screening and setting up your data acquisition presets	Carolin Seuring
		15:30 - 16:00	Coffee Break	
2.6	Demonstration	16:00 - 17:30	Acquiring high-resolution data set of a protein on a Titan Krios with EPU	Carolin Seuring
2.7	Demonstration	17:30 - 18:00	Monitoring incoming data with CryoSPARC live	Wolfgang Lugmayr
ID	CSSB Lecture Hall		Day 3, Wednesday, 6.9.2023	cryoSPARC Workflow
		9:00 - 10:00	CSSB Health and Safety Lecture : lecture hall not available	CSSB lecture hall not available
	CSSB Foyer	9:30 - 10:00	Student Accounts will be distributed	Lena Beyer
3.1	Talk	10:15 - 11:15	An overview to single particle analysis: from 2D projection images to 3D model	Haaris Safdari
3.2	Talk	11:15 - 11:30	Overview Webinterface cryoSPARC: from motion correction to 3D model	Carolin Seuring
3.3	Demo	11:30 - 12:00	Theory Motion Correction + Theory CTF Correction	Emil Gustavson
	Science Talk CSSB	12:00 - 13:30	Axel Brunger, Stanford University, "Molecular mechanisms of calcium-triggered exocytosis"	hosted by Tom Marlovits in CSSB lecture hall
3.5	cryoSPARC Demo	13:30 - 14:00	Parameters to "Curate Exposures"	Carolin Seuring
3.6	Practicals in Groups of 4	14:00 - 15:30	Curate Exposures "Apoferritin" and "Ribosome"	Emil Gustavson, Fabio Strati, Andrea Dallapè, Carolin Seuring
ID	CSSB Lecture Hall		Day 4, Thursday, 7.9.2023	cryoSPARCWorkflow
4.1	Talk	9:30 - 10:00	Particle Picking Approaches Theory & Quality of picks	Edu Mullapudi
4.2	Talk	10:00 - 11:15	The Theory behind 2D classification, 3D classification, Fourier Slice Theorem + Euler Angles	Haaris Safdari
		11:15 - 13:15	Free Time	
4.3	Practicals in Groups of 4	13:15 - 16:00	Particle Picking to 2D classification in cryoSPARC "Apoferritin" and "Ribosome"	Emil Gustavson, Fabio Strati, Andrea Dallapè, Carolin Seuring
ID	CSSB Lecture Hall		Day 5, Friday, 8.9.2023	CryoSPARC Workflow
5.1	cryoSPARC Demo	9:30 - 10:00	Particle Cleaning From 2D classes to 3D	Florian Gabriel
5.2	Lecture	10:00 - 11:00	Ab-initio modelling: different approaches, same principle - different perspectives	Andrea Dallapè
5.3	cryoSPARC Demo	11:00 - 12:00	3D homogeneous and heterogeneous refinement in cryoSPARC	Fabio Strati
		12:00 - 13:00	Free Time	CSSB lecture hall not available
5.4	Practicals in groups of 4	13:00 - 16:00	From 2D class averages to cryoEM densities "Apoferritin" and "Ribosome"	Emil Gustavson, Fabio Strati, Andrea Dallapè, Carolin Seuring
			Week 2	
ID	CSSB Lecture Hall		Day 6, Monday, 11.09.2023	CryoET workflow part 1
6.1	Q & A	8:30 - 9:00	Recap: CryoSPARC results	Carolin Seuring and Speakers
6.2	Talk	9:00 - 10:00	Introduction to cryoET - workflow overview	Ulrike Laugks
		10:00 - 10:15	Coffee Break	
6.3	Talk	10:15 - 10:30	Complexity of sample preparation: Overview and History	Christoph Hagen
6.4	Talk	10:30 - 11:00	Sample freezing expanded: plunge freezing of cells/high-pressure freezing	Christoph Hagen
6.5	Talk	11:00 - 11:15	Sample thinning 1 "CEMOVIS"	Christoph Hagen
6.6	Talk	11:15 - 11:45	Sample thinning 2 "Lamella": FIB-SEM Theory and CLEM	Simon Corroyer-Dulmont
		11:45 - 13:00	Free Time	
6.7	cryoEM Facility	13:00 - 13:15	Meeting at the facility and dividing the groups	Tim Laugks, Ulrike Laugks, Carolin Seuring
6.8	cryoEM Facility	13:15 - 14:45	Live Demos: cryo-CLEM, cryoFIB-SEM, cryoET data acquisition with Tomo	Tim Laugks, Ulrike Laugks, Carolin Seuring
		14:45 - 15:00	Coffee Break	
6.9	cryoEM Facility	15:00 - 16:30	Live Demos: cryo-CLEM, cryoFIB-SEM, cryoET data acquisition with Tomo	Tim Laugks, Ulrike Laugks, Carolin Seuring
ID	CSSB Lecture Hall		Day 7, Tuesday, 12.09.2023	CryoET workflow part 2
7.1	Q & A	09:00 - 09:30	Re-cap, Q & A	Ulrike Laugks and Speakers
7.2	Talk / location EMBL 48	09:30 - 10:00	Tomogram reconstruction theory and software overview	Lindsay Baker
		10:00 - 10:15	Have a coffee	
7.3	Talk / location EMBL 48	10:15 - 11:15	Sub-volume averaging	Daven Vasishtan

7.4	Bring your Laptop mouse (middle mouse button is needed for picking)	11:15 - 12:00	Follow along: STA of ribosomes with aretomo, imod, peet, cryolo	Yuliia Mironova and Ulrike Laugks
		12:00 - 13:00	Free Time	
7.5	Bring your Laptop and mouse (middle mouse button is needed for picking)	13:30 - 17:00	Follow along: STA of ribosomes with aretomo, imod, peet, cryolo	Ulrike Laugks, Emily Machala, Yuliia Mironova, Clara Feldmann, Jan Hellert
ID	CSSB Lecture Hall		Day 8, Wednesday, 13.09.2023	Model Building
8.1	Talk	9:00 - 10:00	Wrap-up Session for STA of ribosomes	Yuliia Mironova, Ulrike Laugks
8.2	Lecture	10:00 - 10:45	Introduction to cryoEM density fitting	Guendalina Marini
		10:45 - 11:00	Coffee break	Guendalina Marini
8.3	Demo	11:00 - 11:30	Visualizing proteins in 3D - ChimeraX	Tom Mulvaney, Guendalina Marini
8.4	Follow-along	11:30 - 12:30	Flexible fitting of atomic models in cryoEM maps - RibFind and iTEMPy	Tom Mulvaney, Guendalina Marini
		12:30 - 13:30	Free Time	
8.5	Bring your Laptop	13:30 - 15:30	Interactive TEMPy in ChimeraX + Validation	Tom Mulvaney, Guendalina Marini
ID	CSSB Lecture Hall		Day 9, Thursday, 14.9.2023, Journal Club by Students and Science Talks	
9.1	Science Talk	09:00 - 09:20	**"CryoET of Bunyavirus Infection"**	**Jan Hellert (AG Grünewald)**
			It is all about the specimen	
9.2	Paper Presentation	09:20 - 09:40	Kelley K et al. (2022) "Waffle Method: A general and flexible approach for improving throughput in FIB-milling." Nat Commun 13: 1857 http://dx.doi.org/10.1038/s41467-022-29501-3	Student 1
9.3	Paper Presentation	09:40 - 10:00	Li S et al. (2023) Near-Atomic Resolution Cryo-EM Image Reconstruction of RNA. Methods Mol Biol 2568: 179-192 http://dx.doi.org/10.1007/978-1-0716-2687-0_12	Student 2
9.4	Paper Presentation	10:00 - 10:20	Toro-Nahuelpan, M. et al. "Tailoring cryo-electron microscopy grids by photo-micropatterning for in-cell structural studies." Nat Methods 17, 50-54 (2020). http://dx.doi.org/10.1038/s41592-019-0630-5	Student 3
9.5	Research Talk	10:20 - 10:40	**"Jetfreezing - a novel approach to time-resolved freezing of biomolecules"**	**Amir Banari (assoc. with CryoEM Facility)**
			Electron Diffraction	
9.6	Special Guest	10:40 - 11:10	**"Enhancing Electron Diffraction Detection and Data Acquisition in Continuous Diffraction Tomography"**	**Saleh Gorji (Gatan-Ametek)**
		11:15 - 13:00	CSSB Seminar	
			Cryo electron tomography in Cell Biology	
9.7	Review Presentation	13:10 - 13:30	Young LN, Villa E (2023) Bringing Structure to Cell Biology with Cryo-Electron Tomography. Annu Rev Biophys 52: 573-595 http://dx.doi.org/annurev-biophys-111622-091327	Student 4
9.8	Paper Presentation	13:30 - 13:50	Papantoniou C. et al. (2023). "Munc13- and SNAP25-dependent molecular bridges play a key role in synaptic vesicle priming." Sci Adv 9: eadf6222 http://dx.doi.org/10.1126/sciadv.adf6222	Student 5
9.9	Paper Presentation	13:50 - 14:10	Kaplan M. et al. (2023). "Bdellovibrio predation cycle characterized at nanometre-scale resolution with cryo-electron tomography." Nat Microbiol http://dx.doi.org/10.1038/s41564-023-01401-2	Student 6
9.10	Research Talk	14:10 - 14:30	**“Re-discovering Giardia lamblia s intracellular morphology with cryo-ET”**	**Lenka Cernikova (AG Kosinski, CSSB)**
		14:30 - 14:50	Coffee Break	
			Recent Technical Advances of cryo tomography	
9.11	Review Presentation	14:50 - 15:10	Theveny et al. (2022). "Parasitology meets cryo-electron tomography-exciting prospects await." Trends Parasitol. 38(5): 365-378. http://dx.doi.org/10.1016/j.pt.2022.01.006	Student 7
9.12	Paper Presentation	15:10 - 15:30	Eisenstein F et al. (2023) "Parallel cryo electron tomography on in situ lamellae." Nat Methods 20: 131-138 http://dx.doi.org/10.1038/s41592-022-01690-1	Student 8
9.13	Paper Presentation	15:30 - 15:50	Sagar Khavnekar et al. (2023). "Towards the Visual Proteomics of C. reinhardtii using High-throughput Collaborative in situ Cryo-ET." Microscopy and Microanalysis 29(1):961–963, https://doi.org/10.1093/micmic/ozad067.480	Student 9
	Happy Hour and BBQ	**16.00 - 19.00**	**Happy Hour and BBQ sponsored by Mitigen and Gatan-Ametek, all speakers and students invited**	
ID	CSSB Lecture Hall		Day 10, Friday 15.9.23, Journal Club by Students and Science Talks II	
			Correlative light and electron microscopy	
10.1	Review Presentation	09:00 - 09:20	Lovatt et al. (2022). "Bridging length scales from molecules to the whole organism by cryoCLEM and cryoET". https://pubs.rsc.org/en/content/articlepdf/2022/fd/d2fd00081d?page=search	Student 10
10.2	Paper Presentation	09:20 - 09:40	Sexton et al. (2022) Super-resolution confocal cryo-CLEM with cryo-FIB milling for in situ imaging of Deinococcus radiodurans. Curr Res Struct Biol 4: 1-9 http://dx.doi.org/10.1016/j.crstbi.2021.12.001	Student 11
10.3	Paper Presentation	09:40 - 10:00	Li WX (2023). Integrated multimodality microscope for accurate and efficient target-guided cryo-lamellae preparation. Nature Methods 20: 268-+ http://dx.doi.org/10.1038/s41592-022-01749-z	Student 12
10.4	Research Talk	10:00 - 10:20	**"Correlative microscopy studies on Shigella T3SS"**	**Fereshta Hafizi (AG Kolbe)**
		10:00 - 10:30	Coffee Break	

			Heterogeneous cryoEM Data: approaches to interprete what is real?	
10.5	Paper Presentation	10:30 - 10:50	Edich et al. (2022). "The impact of AlphaFold2 on experimental structure solution." Faraday Discuss. http://dx.doi.org/10.1039/D2FD00072E	Student 13
10.6	Paper Presentation	10:50 - 11:10	Zeng et al. (2023) High-throughput cryo-ET structural pattern mining by unsupervised deep iterative subtomogram clustering. PNAS: e2213149120 http://dx.doi.org/10.1073/pnas.2213149120	Student 14
10.7	Paper Presentation	11:10 - 11:30	Punjani A et al. (2020) Non-uniform refinement: adaptive regularization improves single-particle cryo-EM reconstruction. Nat Methods 17: 1214-+ http://dx.doi.org/10.1038/s41592-020-00990-8	Student 15
10.8	Paper Presentation	11:30 - 11:50	Janson K et al. (2022) Cryo-Electron Microscopy Snapshots of Eukaryotic Membrane Proteins in Native Lipid-Bilayer Nanodiscs. Biomacromolecules 23: 5084-5094 http://dx.doi.org/10.1021/acs.biomac.2c00935	Student 16
10.9	Research Talk	11:50 - 12:10	**"Plasmofraction: A Bottom-up structural biology approach towards the P. falciparum gametocyte membrane proteome"**	**Siavash Mostafavi (AG Löw)**
10.10	Feedback Form	12:10 - 12:30	Questionnaire / Feedback Online Form	Carolin Seuring, Ulrike Laugks, Cornelia Cazey, Kay Grünewald
	Feedback Discussion	12:30 - 13:30	Lunch Break Discussion	all speakers
			Challenges in cryoEM	
10.11	Special Guest	13:30 - 13:50	**T.B.D.**	**Ben Apker (Mitigen)**
10.12	Research Talk	13:50 - 14:10	**"My challenges in solving the structure of a "small" membrane protein complex"**	**Katharina Jungnickel (AG Löw)**
10.13	Famous last words	14:10 - 14:30	**"AI-based structure prediction empowers integrative structural analysis of human nuclear pores"**	Jan Kosinski
	Socializing	14:30 - 16:00	Cake and Coffee for all	

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