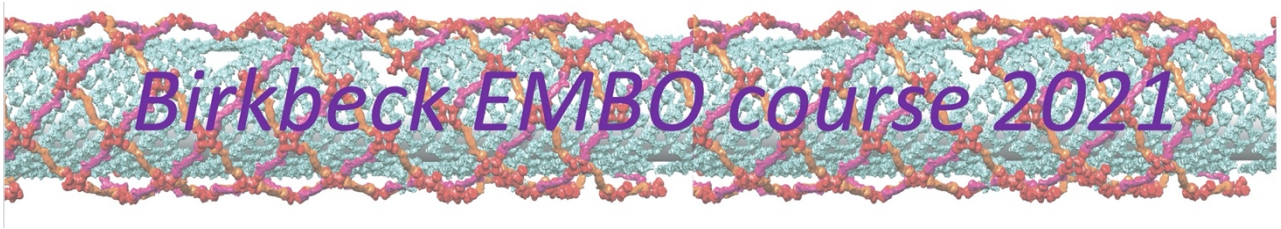

List of lectures (2-17 will be pre-recorded and given to the students in advance):

1 EM preparation methods, **Carolyn Moores**, Birkbeck College London - LIVE
2 Basic concepts of Fourier analysis, **Giulia Zanetti**, Birkbeck College London
3 Concepts of convolution, point spread, and cross-correlation, **Elena Orlova**, Birkbeck College London
4 Principles of TEM image formation, **Chris Russo**, MRC-LMB Cambridge
5 Contrast transfer, CTF correction, phase contrast, **Dan Clare** eBic/Diamond, Didcot
6 Detectors, noise, frame alignment principles, particle detection, **Helen Saibil**, Birkbeck College London
7 Single particle analysis, reconstruction principles, **Gabe Lander**, SCRIPPS San Diego
8 Single particle (Bayesian methods, particle classification), **Sjors Sheres**, MRC-LMB Cambridge
9 Using symmetry, viruses, helices, extracting asymmetric parts, **Juha Huiskonen**, HiLIFE Helsinki
10 Tomography, **Bertram Daum**, Living Systems Institute, Exeter
11 CLEM and FIB milling, **Julia Mahamid**, EMBL Heidelberg
12 Subtomogram averaging, 3D CTF correction, **Tanmay Bharat**, University of Oxford
13 Running an EM lab, **Natasha Lukoyanova**, Birkbeck College London
14 Validation of 3D EM reconstructions, post processing, **Peter Rosenthal**, Crick Institute London
15 Interpretation of maps, docking of atomic structures, **Maya Topf**, Birkbeck College London and CSSB Hamburg
16 High resolution refinement, model assessment, **Arjen Jakobi**, University of Delft
17 Automation, **Bridget Carragher**, NYSBC, New York
18 Data deposition, data sharing, open software: discussion, **Janet Thornton**, EBI Hinxton - LIVE
19 Future prospects for cryo EM, **Richard Henderson**, MRC LMB Cambridge - LIVE

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	12.30-13.00	13.00-13.30	13.30-14.00	14.00-14.30	14.30 - onwards	Remo meeting sessions will be open during and after the practicals for people who want to have 1:1 or small group chats.
6 Mon	Course overview and introductions **(H Saibil, M Topf, G Zanetti, C Moores, E Orlova, P Rosenthal, N Lukoyanova)**	Lecture 1 LIVE: EM preparation methods (**Carolyn Moores**)		Students' introductions	Intro to Remo sessions	
7 Tues	Q&A on Lectures 2 and 3: Basic concepts of Fourier analysis (**Giulia Zanetti**) and Concepts of convolution, point spread, and cross-correlation (**Elena Orlova**)			Practical 1: Images and transforms, filtering, CTF, diffraction, filter design, EMAN2 Initial steps in processing, Scipion/motion corr/dose fractionation **(Helen Saibil, BBK; Jose Miguel de la Rosa Trevin, Marta Carroni, Stockholm, other BBK internals)**		
8 Wed	Q&A on Lectures 4 and 5: Principles of TEM image formation (**Chris Russo**) and Contrast transfer, CTF correction, phase contrast (**Dan Clare**)		Students' Flash talks	Practical 2: Scipion preprocessing pipeline cont'd: CTF find4, phase contrast, Gautomatch, particle picking, examples of good and bad images, effects of dose and filtering (**Jose Miguel de la Rosa Trevin, Marta Carroni, Stockholm, Dan Clare, Diamond)**		
9 Thurs	Q&A on Lectures 6 and 7: Detectors, noise, frame alignment principles, particle detection (**Helen Saibil**) and Single			Practical 3: Single particle analysis: cryosparc: initial model by SGD, 2D & 3D classification, refinement. Map inspection		

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	particle analysis, reconstruction principles (**Gabe Lander**)			with Chimera **(Ali Punjani, Jose Miguel de la Rosa Trevin; BBK internals)**	
10 Fri	Q&A on Lecture 9: Using symmetry, viruses, helices, extracting asymmetric parts (**Juha Huiskonen**)	Extended lunch break with sponsors links		Q&A on lecture 8: Single particle: Bayesian methods, particle classification (**Sjors Scheres**)	Practical 4: Relion advanced topics in single particle analysis: 3D refinement with focussed classification, signal subtraction, postprocessing, sharpening, local filtering **(Sjors Scheres, Dari Kimanius, Kat Toropova)**
11 Sat	Q&A on lecture 10 and 11: Tomography (**Bertram Daum**) and CLEM and FIB milling (**Julia Mahamid**)			Practical 5: Tomography and segmentation/dynamo **(Giulia Zanetti, Daniel Castaño-Diez, Carlos Fernández Rodriguez, Alister Burt, Stefano Scaramuzza)**	
12 Sun					
13 Mon	Q&A on lecture 12: Subtomogram averaging, 3D CTF correction (**Tanmay Bharat**)	Q&A on lecture 13: Running an EM lab (**Natasha Lukoyanova**)	Students' Flash talks	Practical 6: Subtomogram averaging, Dynamo **(Giulia Zanetti, Daniel Castaño-Diez, Carlos Fernández Rodriguez, Alister Burt, Stefano Scaramuzza)**	
14 Tues	Q&A on lecture 14 and 15: Validation of 3D EM reconstructions, post processing (**Peter Rosenthal**) and Interpretation of maps, docking of atomic structures (**Maya Topf**)			Practical 7: Fitting of structures, flexible fitting (Flex-EM), model validation (TEMPy) (**Tom Burnley, Maya Topf, Agnel Joseph, Colin Palmer)**	
15 Wed	Q&A on lecture 17: Automation (**Bridget Carragher**)		Q&A on lecture 16: High resolution refinement, model assessment (**Arjen Jakobi**)	Practical 8: local sharpening (LocScale), de novo structure building (CCP-EM, REFMAC) **(Arjen Jakobi, Tom Burnley, Agnel Joseph, Colin Palmer)**	
16 Thurs	Lecture 18 LIVE: Data deposition, data sharing, open software: discussion. (**Janet Thornton**)			lecture 19 LIVE: Future prospects for cryo EM (**Richard Henderson**) Course review and conclusion	

Schedule in plain format:

Monday 6th September
12.30 - 13.00: Course overview and introductions (**H Saibil, M Topf, G Zanetti, C Moores, E Orlova, P Rosenthal, N Lukoyanova)**
13.00 - 14.00: Lecture 1 LIVE: EM preparation methods (**Carolyn Moores**)
14.00 - 14.30: Students' introductions
14.30 – 17.00: Optional Remo session for small group and 1:1 interactions

Tuesday 7th September
12.30 – 13.30: Q&A on Lectures 2 and 3: Basic concepts of Fourier analysis (**Giulia Zanetti**) and Concepts of convolution, point spread, and cross-correlation (**Elena Orlova**)
13.30 – 14.00: break
14.00 – 18.00: Practical 1: Images and transforms, filtering, CTF, diffraction spacings, filter design, EMAN 2
Initial steps in processing, Scipion/motion corr/dose fractionation (**Helen Saibil, BBK; Jose Miguel de la Rosa Trevin, Marta Carroni, Stockholm; other BBK internals)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Wednesday 8th September
12.30 – 13.30: Q&A on Lectures 4 and 5: Principles of TEM image formation (**Chris Russo**) and Contrast transfer, CTF correction, phase contrast (**Dan Clare**)
13.30 – 14.00: Students' Flash talks
14.00 – 18.00: Practical 2: Scipion preprocessing pipeline cont'd: CTF find4, phase contrast, Gautomatch, particle picking, examples of good and bad images, effects of dose and filtering (**Jose Miguel de la Rosa Trevin, Marta Carroni, Stockholm, Dan Clare, Diamond)**

18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Thursday 9th September
12.30 – 13.30: Q&A on Lectures 6 and 7: Detectors, noise, frame alignment principles, particle detection (**Helen Saibil**) and Single particle analysis, reconstruction principles (**Gabe Lander**)
13.30 – 14.00: break
14.00 – 18.00: Practical 3: Single particle analysis: cryosparc: initial model by SGD, 2D & 3D classification, refinement. Map inspection with Chimera **(Ali Punjani, Jose Miguel de la Rosa Trevin; BBK internals)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Friday 10th September
12.30 – 13.00: Q&A on Lecture 9: Using symmetry, viruses, helices, extracting asymmetric parts (**Juha Huiskonen**)
13.00 – 14.00: extended lunch break with sponsors
14.00 – 14.30: Q&A on lecture 8: Single particle: Bayesian methods, particle classification (**Sjors Scheres**)
14.30 – 18.30: Practical 4: Relion advanced topics in single particle analysis: 3D refinement with focussed classification, signal subtraction, postprocessing, sharpening, local filtering **(Sjors Scheres, Kat Toropova)**
18.30 – 20.00: Optional Remo session for small group and 1:1 interactions

Saturday 11th September
12.30 – 13.30: Q&A on lecture 10 and 11: Tomography (**Bertram Daum**) and CLEM and FIB milling (**Julia Mahamid**)
13.30 – 14.00: break
14.00 – 18.00: Practical 5: Tomography and segmentation/dynamo **(Giulia Zanetti, Daniel Castaño-Diez, Carlos Fernández Rodriguez, Alister Burt)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Monday 13th September
12.30 – 13.00: Q&A on lecture 12: Subtomogram averaging, 3D CTF correction (**Tanmay Bharat**)
13.00 – 13.30: Q&A on lecture 13: Running an EM lab (**Natasha Lukoyanova**)
13.30 – 14.00: Students' Flash talks
14.00 – 18.00: Practical 6: Subtomogram averaging, Dynamo **(Giulia Zanetti, Daniel Castaño-Diez, Carlos Fernández Rodriguez, Alister Burt)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Tuesday 14th September
12.30 – 13.30: Q&A on lecture 14 and 15: Validation of 3D EM reconstructions, post processing (**Peter Rosenthal**) and Interpretation of maps, docking of atomic structures (**Maya Topf**)
13.30 – 14.00: break
14.00 – 18.00: Practical 7: Fitting of structures, flexible fitting (Flex-EM), model validation (TEMPy) (**Tom Burnley, Maya Topf)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Wednesday 15th September
12.30 – 13.00: Q&A on lecture 17: Automation (**Bridget Carragher**)
13.00 – 13.30: break
13.30 – 14.00: Q&A on lecture 16: High resolution refinement, model assessment (**Arjen Jakobi**)
14.00 – 18.00: Practical 8: local sharpening (LocScale), de novo structure building (CCP-EM, REFMAC) **(Arjen Jakobi, Tom Burnley)**
18.00 – 20.00: Optional Remo session for small group and 1:1 interactions

Thursday 16th September
12.30 – 14.00: Lecture 18 LIVE: Data deposition, data sharing, open software: discussion (**Janet Thornton**)
14.00 – 15.30: lecture 19 LIVE: Future prospects for cryo EM (**Richard Henderson**)

15.30 – 16.30: Course review and conclusion