

EMBO | FEBS  
Lecture Course

# MITOCHONDRIA IN LIFE, DEATH AND DISEASE

24 – 28 SEPTEMBER 2019  
HERCEG NOVI, MONTENEGRO

PROGRAMME



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## About the EMBO-FEBS Lecture Course

Mitochondria are prominent in every textbook of biochemistry and cell biology. The classical view to mitochondria is that they are sausage-shape power plants of the cell, that possess their own DNA (mitochondrial DNA-mtDNA), which encodes essential subunits of the oxidative phosphorylation system and is maternally inherited. This unique feature of mitochondria is a reminiscence of their bacterial origin which occurred two billion years ago through an endosymbiotic event.

Although this textbook knowledge of mitochondria is very important, it does not give justice to the enormous progress and conceptual advances that have been made in the field of mitochondrial biology in the last decade. This results in a wealth of novel information regarding their basic function, but it also revealed many novel roles these organelles play in the context of cellular physiology in both unicellular and complex multicellular systems. For instance, mitochondria interact and communicate with other organelles and they are involved in complex metabolic networks mediating cell survival, apoptosis, redox control, calcium homeostasis and many metabolic and biosynthetic pathways.

This EMBO|FEBS lecture course will deal with a number of research areas that have a great impact on the understanding of mitochondrial biology general. It will be organized in five sessions that include:

1. Mitochondrial protein import and biogenesis
2. Organelle signaling and control of metabolism
3. Mitochondrial DNA maintenance and gene expression
4. Mitochondrial diseases and development of treatments
5. Mitochondrial dynamics and quality control

## SPEAKERS

**EMBO | FEBS**  
*Lecture Course*

### **Alexey Amunts**

Arrhenius Laboratories for Natural Sciences,  
University Stockholm, SE

### **Nenad Ban**

Institute of Molecular Biology  
and Biophysics, ETH Zurich, CH

### **Nika Danial**

Department of Cell Biology,  
Harvard Medical School, US

### **Anil Sukru Dogan**

Department of Molecular Biology  
and Genetics, Boğaziçi University, TR

### **José Antonio Enríquez**

The Carlos III National Centre for  
Cardiovascular Research, ES

### **Aleksandra Filipovska**

Harry Perkins Institute of Medical Research,  
University of Western Australia, AU

### **Claes Gustafsson**

Department of Medical Biochemistry and  
Cell Biology, University of Gothenburg, SE

### **Maria Falkenberg**

Institute of Biomedicine,  
University of Gothenburg, SE

### **Thomas Langer**

Max Planck Institute for Biology of Ageing  
Cologne, DE

## SPEAKERS

### **Nils-Göran Larsson**

Department of Medical Biochemistry and Biophysics, Karolinska Institute, SE

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### **Roland Lill**

Institut für Zytobiologie und Zytopathologie, Philipps University of Marburg, DE

### **Laurence Maréchal-Drouard**

Institut de biologie moléculaire des plantes, CNRS, Université de Strasbourg, FR

### **Chris Meisinger**

Institute of Biochemistry and Molecular Biology, University of Freiburg, DE

### **Michal Minczuk**

MRC Mitochondrial Biology Unit, University of Cambridge, UK

### **Carlos Moraes**

Department of Neurology, University of Miami, US

### **Peter Rehling**

Department of Cellular Biochemistry, University Medical Centre Göttingen, DE

### **Claire Remacle**

InBioS - Genetics and Physiology of Microalgae, University of Liège, BE

### **Jan Riemer**

Institute for Biochemistry, University of Cologne, DE

## SPEAKERS

**EMBO | FEBS**  
*Lecture Course*

### **Elena Rugarli**

CECAD Research Center,  
University of Cologne, DE

### **Christian Schmitz-Linneweber**

Institute of Biology, Humboldt University  
of Berlin, DE

### **André Schneider**

Department of Chemistry and Biochemistry,  
University of Berne, CH

### **Luca Scorrano**

Venetian Institute of Molecular Medicine,  
University of Padua, IT

### **Anu Suomalainen**

Biomedicum, University of Helsinki, FI

### **Zofia Chrzanowska-Lightowlers**

Trust Centre for Mitochondrial Research,  
Newcastle University, UK

### **Massimo Zeviani**

MRC Mitochondrial Biology Unit,  
University of Cambridge, UK

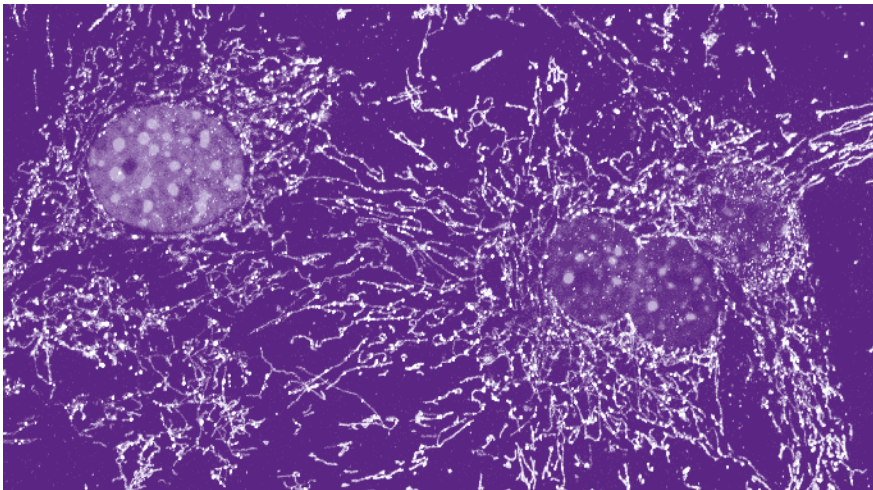
Day 1

## PROGRAMME

Tuesday | 24 September 2019

Chair: Aleksandra Trifunovic

- 14:00 - 18:00 Arrival and Registration
- 18:00 - 18:10 **Opening and Welcome**  
Aleksandra Trifunovic
- 18:10 - 18:20 **Welcome by FEBS Member-in-Charge**  
Winnie Eskild
- 18:20 - 19:20 **Keynote Science & Society Lecture:**  
New insights into iron-sulfur protein biogenesis  
in mitochondria  
Roland Lill
- 19:20 - 22:00 **Welcome Cocktail and Dinner**



07:30 - 9:00

**Breakfast**

**SESSION 1:**

**Mitochondrial protein import and biogenesis**

Chair: Kostas Tokalidis

09:00-09:10

Introduction

Kostas Tokalidis

09:10-09:40

Mitochondrial Biogenesis in *Trypanosoma brucei* -  
Variations on a theme or fundamentally different?

André Schneider

09:40-10:10

Metabolic- and cell cycle-dependent signal switches  
at the mitochondrial import machinery

Chris Meisinger

10:10-10:40

Mitochondria in green microalgae: genome manipulation,  
respiratory chain analysis and retrograde signaling

Claire Remacle

10:40-10:55

Multiple pathways coordinate human mitochondrial  
complex IV assembly and the stability of respiratory  
supercomplexes

Cristina Ugalde

10:55-11:20

**Coffee break**

11:20-11:50

Protein synthesis: from ribosome assembly to targeting  
of membrane proteins

Nenad Ban

11:50-12:20

How cryo-EM revolutionizes our understanding of  
protein synthesis and bioenergetics in mitochondria

Alexey Amunts

12:20-12:50

Cytosolic quality control in mitochondrial biogenesis

Jan Riemer

12:50-13:05

Ribosome biogenesis in human mitochondria

Ricarda Richter-Dennerlein

13:05-14:00

**Lunch**

14:00-15:30

Free Time

15:30-16:30

Meet the PI/Meet the Editor



**SESSION 2:    **Organelle signaling and control of metabolism****

Chair: Robert Lightowlers

- 16:30-16:40    Introduction  
Robert Lightowlers
- 16:40-17:10    Regulation of translation is required for coordinated  
respiratory complex assembly  
Aleksandra Filipovska
- 17:10-17:40    Mitochondrial pyruvate handling and cellular responses  
to inflammation  
Nika Danial
- 17:40-18:10    Peculiar features of mitochondrial gene expression in  
Chlorophyta and Glaucophyta  
Laurence Maréchal-Drouard
- 18:10-18:30    **Coffee break**
- 18:30-19:00    Post-transcriptional regulation of mitochondrial function  
Elena Rugarli
- 19:00-19:15    Cardiac specific deletion of MTP18 induces heart failure  
in mice  
Timothy Wai
- 19:15-19:30    Disentangling the role of CHOP in mitochondrial  
dysfunction  
Sophie Kaspar
- 19:30-20:30    **Dinner**

- 07:30-09:00 **Breakfast**
- SESSION 3: Mitochondrial DNA maintenance and gene expression**  
**Chair: Howy Jacobs**
- 09:00-09:10 Introduction  
Howy Jacobs
- 09:10-09:40 Plasticity of mitochondrial translation  
Peter Rehling
- 09:40-10:10 Mitochondrial DNA double-strand breaks: Consequences and therapeutic uses.  
Carlos Moraes
- 10:10-10:25 Investigating the role of G-quadruplexes in mtDNA deletions formation  
Mara Doimo
- 10:25-10:40 Spatial and temporal organization of mitochondrial gene expression  
Roger Salvatori
- 10:40-10:55 A stressTFAM required for mitochondrial proteostasis and cellular survival upon mitoUPreR  
Nora Vögtle
- 10:55-11:20 **Coffee break**
- 11:20-11:50 Essential RNA Binding Proteins in Mitochondria of Plasmodium  
Christian Schmitz-Linneweber
- 11:50-12:20 Molecular basis of mtDNA replication  
Maria Falkenberg
- 12:20-12:35 Selection on Somatic mtDNA Mutations in the Tissues of mtDNA Mutator Mice  
Jim Stewart

- 12:35-13:05 Mammalian mitochondrial translation: So much we still don't know!  
*Zofia Chrzanowska-Lightowlers*
- 13:05-14:10 **Lunch**
- 14:10-15:30 Free Time
- 15:30-16:30 Meet the PI/Meet the Editor
- 16:30-17:30 **Embo Lecture:** Inhibition of mtDNA gene expression to treat cancer  
*Nils-Göran Larsson*
- 17:30-18:00 **Installation Grantee Lecture:** ROS-mediated control of mitochondrial biogenesis  
*Anil Sukru Dogan*
- 18:00-18:30 **Coffee break**
- 18:30-19:30 **Round Table Discussion**  
The Hottest Questions in Mitochondrial Research
- 19:30-20:30 **Dinner**
- 20:30-22:30 Poster Presentation with Drinks  
*Poster numbers 43-85*

07:30-09:00	<b>Breakfast</b>
<b>SESSION 4:</b>	<b>Mitochondrial diseases and development of treatment</b>
	<b>Chair: Palmiro Cantatore</b>
09:00-09:10	Introduction Palmiro Cantatore
09:10-10:10	Women in Science Lecture: Mitochondrial disease pathophysiology in and outside the organelle Anu Suomalainen
10:10-10:40	Mitochondrial transcription and its regulation in health and disease Claes Gustafsson
10:40-10:55	Mitochondrial RNA Granules in cancer. Vanessa Xavier
10:55-11:20	<b>Coffee break</b>
11:20-11:50	Mitochondrial disorders: From gene discovery to pathomechanisms and experimental therapy Massimo Zeviani
11:50-12:20	Targeting the mitochondrial genome with programmable nucleases Michal Minczuk
12:20-12:35	The Involvement of Mitochondrial Proteins CHCHD2 and CHCHD10 in Neurodegenerative Disease Isabella Straub
12:35-12:50	Poster Prizes announcement
12:50-14:00	<b>Lunch</b>
14:00-22:00	Sightseeing & Dinner

07:30-09:00

**Breakfast**

**SESSION 5:**

**Mitochondrial dynamics and quality control**

**Chair: Philippe Giege**

09:00-09:10

Introduction

Philippe Giege

09:10-09:40

Keeping mitochondria in shape: a matter of life and death

Luca Scorrano

09:40-10:10

Mitochondria, mtDNA, OXPHOS where are we going?

José Antonio Enríquez

10:10-10:25

The ER membrane insertase Get1/2 is required for efficient mitophagy in yeast

Mashun Onishi

10:25-10:40

USP14 inhibition corrects an in vivo model of impaired mitophagy

Elena Ziviani

10:40-11:10

**Coffee Break**

11:10-11:40

Metabolic repurposing of mitochondria by proteolysis

Thomas Langer

11:40-11:55

Mitochondrial clustering in perivascular astrocytic end-feet coordinates local metabolic domains to promote vascular repair

Matteo Bergami

11:55-12:10

Oxidative phosphorylation provides stress resistance in quiescent cells

Silvia Novais

12:10-12:30

Closing Remarks

Aleksandra Trifunovic

12:30-13:30

**Lunch**

13:30

Departure

## Posters

Posters are arranged in numerical and alphabetical order (1-85) and are divided in 2 days. Poster presenters are expected to dismantle their posters straight after the session.

## Poster Sessions

DAY 2, Wed, 25 Sept, 20:30-22:30  
poster number 1-42

Set up  
Wed, 25 Sept: 20:00

Dismantle  
Wed, 25 Sept: after the session

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DAY 3, Thurs, 26 Sept, 20:30-22:30  
poster number 43-85

Set up  
Thurs, 26 Sept: 20:00

Dismantle  
Thurs, 26 Sept: after the session

Please find your poster number in the following list of Poster Presentations.

## List of Poster Presentations

- |   |                 |   |
|---|-----------------|---|
| 1 | Andric, Silvana | Insulin resistance disturbed mitochondrial biogenesis and morphology in steroidogenic cells of prepubertal testis, but not ovary      |
| 2 | Antonicka, Hana | Characterization of mitochondrial proteins using BioID.   |
| 3 | Babayemi, David | Comparative disruption of signal biomolecules and energy metabolising system in the brain of male albino rats by inorganic arsenicals |
| 4 | Bailey, Peter   | Whole genome pooled CRISPR/Cas9 forward genetic screens for regulators of mitochondrial 2-oxoglutarate metabolism                     |
| 5 | Bergami, Matteo | Mitochondrial clustering in perivascular astrocytic end-feet coordinates local metabolic domains to promote vascular repair           |

6	Borankova, Karolin	Inhibition of Mitochondrial Fission and Protein Synthesis Efficiently Induces Apoptosis in Stem-Like Drug-Resistant Neuroblastoma Cells
7	Branco Fonseca, Tiago Alexandre	Unravelling the roles of Fission Protein 1: a forgotten mitochondrial fission factor with pleiotropic functions
8	Cantatore, Palmiro	Elucidating the molecular mechanisms underlying the biological activity of rescuing peptides in MELAS mitochondrial disease
9	Čunátová, Kristýna	Mechanisms of interdependency in biogenesis of OXPHOS enzyme complexes I and IV.
10	Danhelovska, Tereza	The relevance of ACBD3 protein in mitochondrial energy metabolism in HEK293 and HeLa cell lines
11	Dawod, Phepy	Analysis of mitochondrial DNA in Serbian patients with Leigh syndrome phenotype
12	Doimo, Mara	Investigating the role of G-quadruplexes in mtDNA deletions formation
13	Donati, Giulio	Combinatorial treatment of aggressive B-cell lymphoma with mitochondrial complex I and BCL2 inhibitors
14	Erdinc, Direnis	BioID identifies novel proteins involved in mitochondrial transcription termination
15	Fernandez-Vizarra, Erika	Respiratory supercomplexes as the platform for complex III-mediated maturation of complexes I and IV
16	Francisco, Annelise	Aged mouse devoid of mitochondrial NAD(P)-transhydrogenase shows behavioral changes associated with impaired 5-hydroxytryptamine and nitric oxide neurotransmitters signaling
17	Gleisinger, Elisabeth	Mitochondrial dysfunction in intestinal epithelial cells influences regenerative and neoplastic processes
18	Gonçalves, Filipa B.	Is PINK1 dictating mitochondrial functions in PD?
19	Herbers, Elena	The effect of obesity and weight loss on mitochondrial function in adipocytes
20	Herholz, Marija	Deciphering the molecular machinery regulating mitochondrial biogenesis in <i>C. elegans</i>
21	Ho, Dieu Hien	The role of LONP1 in mammalian mitochondrial physiology

## List of Poster Presentations

- |    |                       |   |
|----|-----------------------|---|
| 22 | Hock, Daniella        | From disease to biology: how quantitative proteomics can resolve the molecular diagnosis of mitochondrial disease patients and provide insights into mitochondrial biology      |
| 23 | Indrieri, Alessia     | miR-181a and miR-181b downregulation ameliorates mitochondrial-associated neurodegeneration by enhancing mitochondrial biogenesis and mitophagy                                 |
| 24 | ION, Ana              | Characterization of C12orf65, a mitochondria translation release factor family member   |
| 25 | Irazoki, Andrea       | Bnip3-dependent mitophagy controls inflammation in skeletal muscle cells  |
| 26 | Izquierdo, Ismael     | A new non-canonical Gαq pathway regulates axonal mitochondrial motility   |
| 27 | Kaspar, Sophie        | Disentangling the role of CHOP in the context of mitochondrial dysfunction  |
| 28 | Kock Flygaard, Rasmus | ATP synthase in <i>Toxoplasma</i> shapes the mitochondria through previously unseen high oligomeric states.   |
| 29 | Kostic, Tatjana       | Age-related changes of mitochondrial function and dynamics in testosterone-producing Leydig cells from aged rats are improved by long-term sildenafil treatment                 |
| 30 | Küçüköke, Cansu       | Functional coupling of presequence processing and peptide turnover in human mitochondria  |
| 31 | Lasarzewski, Yvonne   | Dissecting the function of the mitochondrial m-AAA protease in health and disease   |
| 32 | Lavdovskaia, Elena    | Role of GTPases in mitochondrial ribosome biogenesis  |
| 33 | Li, Xin               | Redox modulation on muscular dystrophy of deregulation in endoplasmic reticulum-mitochondria tethering complex  |
| 34 | Lindau, Caroline      | Structural Basis of Membrane Protein Chaperoning through the Mitochondrial Intermembrane Space  |
| 35 | Magri, Andrea         | Inactivation of mitochondrial porin VDAC1 in <i>Saccharomyces cerevisiae</i> promotes a metabolic rewiring and reveals a new regulatory function of the pore in cell metabolism |
| 36 | Maiti, Priyanka       | Elucidating the role of GTPase OBGH1 in mammalian mitoribosome assembly   |



37	Manchanda, Mansi	Mitochondria in chronic wounds: experimental and translational studies
38	Martins Garcia, Bruna	Mitofusin 2 regulates cholesterol homeostasis
39	Míguez Amil, Samuel	Macromolecular complexes in mtDNA repair and replication processes: Molecular and structural mechanisms by cryo_EM
40	Moschandrea, Chrysanthi	Role of DARS2 in the regulation of intestinal epithelial homeostasis
41	Motori, Elisa	Anaplerosis induced by mitochondrial dysfunction is a metabolic hallmark of degenerating neurons
42	Mujeeb ur Rehman, Pirzada	CLUH binds to the 3' UTR of target mRNAs
43	Muñoz-Sánchez, Jorge	The Heme oxygenase isoforms present differential traffic to the nucleus and mitochondria in PC12 cells in response to hypoxia
44	Niftullayev, Sadig	Autophagy balances mtDNA synthesis and degradation by DNA polymerase POLG during starvation
45	Magalhaes-Novais, Silvia	Oxidative phosphorylation provides stress resistance in quiescent cells
46	Novak, Ivana	Regulation of receptor-mediated mitophagy
47	Onishi, Mashun	The ER membrane insertase Get1/2 is required for efficient mitophagy in yeast
48	Oyebode, Olubukola	Mitochondrial-mediated apoptosis in liver but not in testis of galactose-induced aging rats
49	Palenikova, Petra	Identifying genetic interactions in mitochondrial gene expression machinery
50	Pardo Hernández, Carlos	Structure and degradation mechanism of the human mitochondrial protease Lon
51	Pernas, Lena	Elucidating the role of mitochondria in cellular defense against a parasite
52	Pinheiro, Pedro	Characterization of mouse models for POLG-related diseases
53	Poerschke, Sabine	CIP12 facilitates early steps of complex III biogenesis
54	Potter, Alisa	Mass Spectrometric analysis of human mitochondrial nucleoid-associated proteome

## List of Poster Presentations

- |    |                             |  |
|----|-----------------------------|--|
| 55 | Rackham, Oliver             | The importance of fidelity in mitochondrial gene expression for cell and organ function                      |
| 56 | Rebello, Paula              | High-throughput screen: Looking for chemical MERCs modulators.   |
| 57 | Reljić, Boris               | Multi-omic approaches for elucidating the assembly and function of mitochondrial respiratory chain complexes |
| 58 | Rey, Timo                   | Biophysics of Mitochondrial RNA Granules: membraneless organisation of gene expression.                      |
| 59 | Richter-Dennerlein, Ricarda | Ribosome biogenesis in human mitochondria  |
| 60 | Rorbach, Joanna             | C6orf203 is an RNA-binding protein involved in mitochondrial protein synthesis                               |
| 61 | Rzepka, Magdalena           | A mitochondrially encoded reporter to study dynamics of translation regulation in mitochondria               |
| 62 | Salvatori, Roger            | Spatial and temporal organization of mitochondrial gene expression   |
| 63 | Savic Azoulay, Ivana        | Lactate as a novel metabolic mediator between asic1a and mitochondria  |
| 64 | Schuettpelz, Jana           | The role of SLC25A46 in ER-mitochondrial contact homeostasis and implication                                 |
| 65 | Sendon, Pamela Marie        | Development and Characterization of A Novel Mouse Model Carrying Specific Mitochondrial DNA Mutations        |
| 66 | Shaw, Abhirup               | Investigation of the role of mitophagy regulation in primary human white and browning adipocytes             |
| 67 | Singh, Vivek                | Atomic model of human mitoribosome   |
| 68 | Soares, Rita                | Mitochondrial Dynamics: a target that modulates adult neural stem cell fate                                  |
| 69 | Spier, Anna                 | Role of mitochondrial energy metabolism in bacterial infection   |
| 70 | Stewart, Jim                | Selection on Somatic mtDNA Mutations in the Tissues of mtDNA Mutator Mice                                    |
| 71 | Stoker, Megan               | The off target effects of antiviral and chemotherapeutic agents on mitochondrial function in vitro.          |
| 72 | Stout, Roisin               | Mitochondrial dysfunction in facial appearance and ageing  |

73	Straub, Isabella	The Involvement of Mitochondrial Proteins CHCHD2 and CHCHD10 in Neurodegenerative Disease
74	Szczepanowska, Karolina	ClpXP maintains complex I integrity through turnover of N-module.
75	Ugalde, Cristina	Multiple pathways coordinate human mitochondrial complex IV assembly and the stability of respiratory supercomplexes
76	Vega, Montserrat	Imbalance in mitochondrial homeostasis alters cell longevity
77	Verbeke, Jeremy	Study of the mechanisms leading to mitochondrial fragmentation in Brucella-infected cells: analysis of the impact on mitofusin 1 and 2
78	Vögtle, Nora	A stressTFAM required for mitochondrial proteostasis and cellular survival upon mitoUPreR
79	Wai, Timothy	Cardiac specific deletion of MTP18 induces heart failure in mice
80	Wanrooij, Sjoerd	The presence of rNTPs decreases the speed of mitochondrial DNA replication.
81	Wasner, Kobi	Investigating novel roles for parkin in mitochondrial DNA maintenance in Parkinson's disease
82	Xavier, Vanessa	Mitochondrial RNA Granules in cancer.
83	Zamberlan, Margherita	The Epac1/Rap1 pathway retrogradely signals changes in mitochondrial morphology
84	Ziviani, Elena	USP14 inhibition corrects an in vivo model of impaired mitophagy
85	Zorkau, Matthew	Utilising a click chemistry method for in situ visualisation of mitochondrial protein synthesis



## ACCOMMODATION

All events of the EMBO/FEBS Course Mito2019, including lunches and dinners for the participants, will be held in Iberostar Herceg Novi Hotel. The hotel is located at the village of Njivice, in the Herceg Novi district, approximately 25 km from Dubrovnik Airport (Croatia) and 30 km from Tivat Airport (Montenegro).

### **Hotel Iberostar Herceg Novi**

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## ABOUT THE AREA

### Montenegro

One of the smallest countries in Europe, Montenegro encloses majestic mountains, breathtaking beaches, colorful food and friendly locals. Set in the south of the Adriatic Sea with a coast of not even 300km from tip to toe, that, nevertheless, crams in some of Europe's most spectacular seaside scenery.

### The Bay of Kotor or Boka Kotorska

The Bay of Kotor known simply as Boka ("the Bay"), is the name of the winding bay of the Adriatic Sea in southwestern Montenegro. Boka has been inhabited since antiquity. Its well-preserved medieval towns of Kotor, Risan, Tivat, Perast and Herceg Novi, along with their natural surroundings, are major tourist attractions. The Natural and Culturo-Historical Region of Kotor has been a World Heritage Site since 1979. Kotor is the old coastal and cultural centre. For centuries, it has been a crossroads of commercial roads under the strong influence of Venice. It is protected by mountains with a strong defense structure built during the time of the Byzantine Empire.





The bay is naturally divided into four smaller parts - Herceg Novi bay, Risan bay, Kotor bay and Tivat bay. The small towns, as treasuries of history, art and beauty, are strung like pearls on its coastline.

Herceg Novi is a town situated at the end of the bay. Its appearance is an illustration of its turbulent history. The town is a fine combination of romantic, Byzantine and oriental styles interweaved in the Mediterranean appearance of this town. Today, Herceg Novi is the town of flowers with all its windows faced toward the sun and the sea. It is one of the warmest towns on the Adriatic coast. One should visit the City Museum and the Archives, the Modern Arts Gallery, and the Old town with Tower clock.

## CONTACT

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## ORGANIZER

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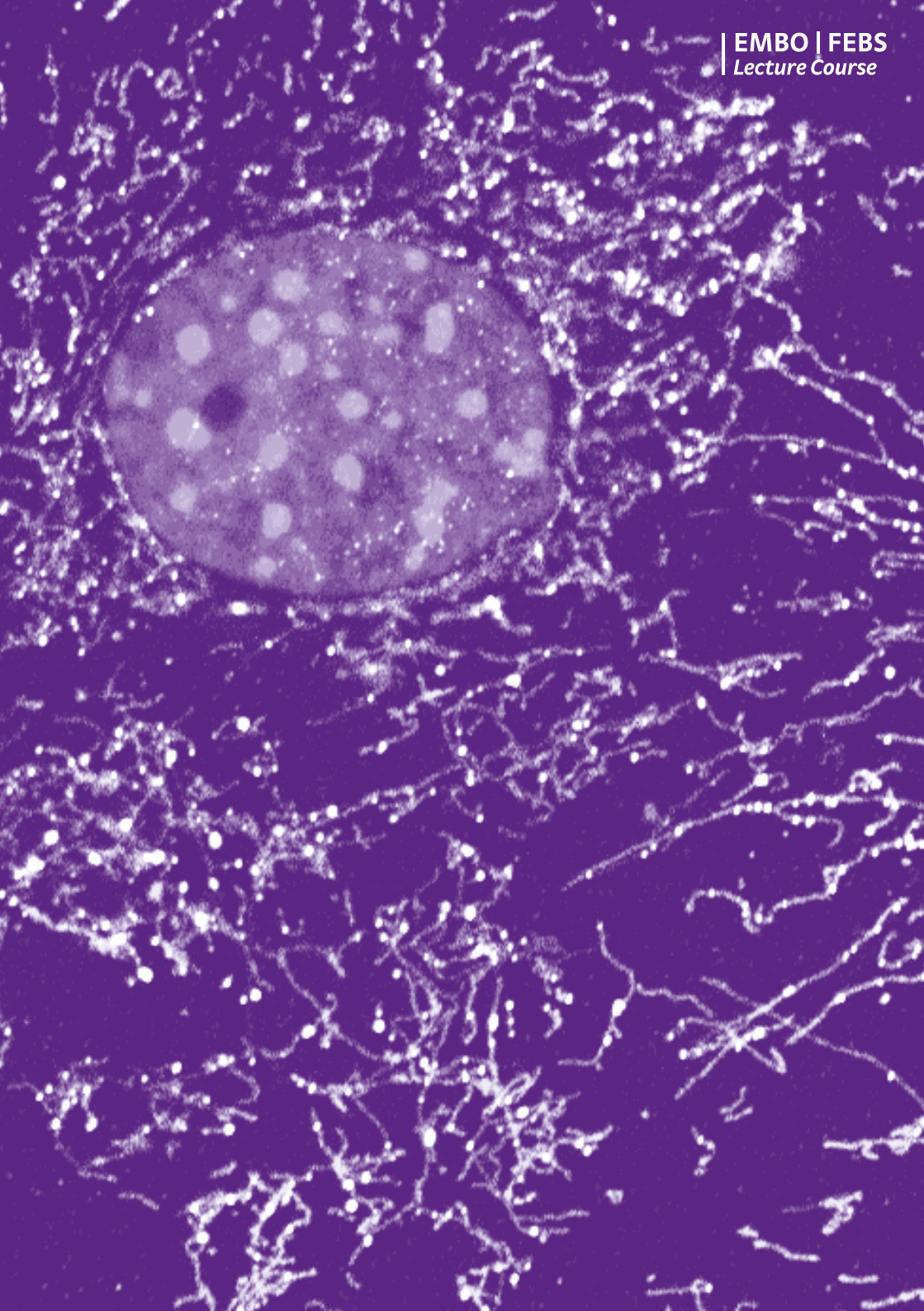
e-mail: aleksandra.trifunovic@uk-koeln.de

## Co-Organizer

**Palmiro Cantatore**

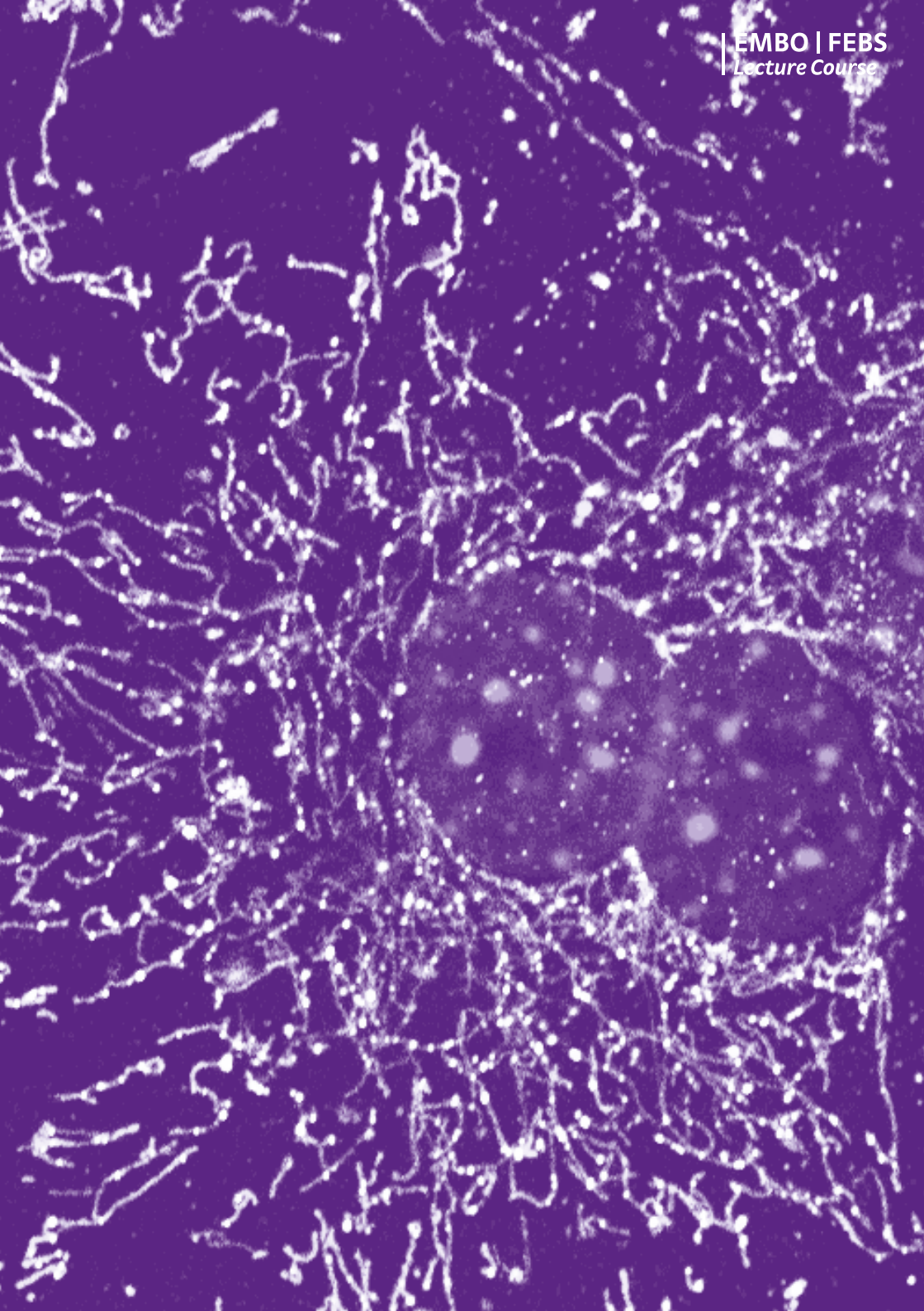
University of Bari, IT





A high-magnification electron micrograph of a cell. A large, dark, circular nucleus is visible on the left side, containing a prominent nucleolus. The cytoplasm is filled with a complex, interconnected network of mitochondria, which appear as thin, wavy lines with numerous small, dark, circular cristae. The overall image has a high-contrast, grainy texture characteristic of electron microscopy.

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