

## Mesoscopic Physics school timetable

*2D materials, superconductivity and superconducting circuits, quantum transport and hybrid systems: theories and experiments*

**Arrival:** Monday 30<sup>th</sup> September 2024

**Departure:** Saturday 12<sup>th</sup> October 2024

### 1st week

|               | Tuesday 1 <sup>st</sup>               | Wednesday 2 <sup>nd</sup>            | Thursday 3 <sup>rd</sup>              | Friday 4 <sup>th</sup>               | Saturday 5 <sup>th</sup>             |
|---------------|---------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|
| 08:50 – 09:00 | Opening                               |                                      |                                       |                                      |                                      |
| 09:00 – 10:30 | <b>Course 4A:</b><br>Samuel Deleglise | <b>Course 4B:</b><br>Sophie Gueron   | <b>Course 4A:</b><br>Samuel Deleglise | <b>Course 4B:</b><br>Sophie Gueron   | <b>Course 3B:</b><br>Leni Bascones   |
| 10:30 - 11:00 | <b>Coffee break</b>                   |                                      |                                       |                                      |                                      |
| 11:00 – 12:00 | <b>Course 2A:</b><br>Landry Bretheau  | <b>Course 2A:</b><br>Landry Bretheau | <b>Course 2B:</b><br>Quentin Ficheux  | <b>Course 2A:</b><br>Landry Bretheau | <b>Course 2B:</b><br>Quentin Ficheux |
| 12:00 - 15:00 | <b>Lunch</b>                          |                                      |                                       |                                      |                                      |
| 15:00 - 16:00 | Discussion<br>Courses 4-2             | Discussion<br>Courses 4-2            | Discussion<br>Courses 4-2             | Discussion<br>Courses 4-2            | Discussion<br>Courses 4-2            |
| 16:00 – 16:30 | <b>Coffee</b>                         |                                      |                                       |                                      |                                      |
| 16:30 – 18:00 | <b>Focus 2:</b><br>Alexia Auffèves    | <b>Focus 2:</b><br>Alexia Auffèves   | <b>Focus 4:</b><br>Andrea Hofmann     | <b>Focus 4:</b><br>Andrea Hofmann    | <b>Course 3A:</b><br>Eva Andrei      |
| 18:00 - 19:00 | <b>Posters - A</b>                    | <b>Course 2B:</b><br>Quentin Ficheux | <b>Posters – B</b>                    | Start-Up<br>session                  | Recap week 1                         |
| 19:00         | Welcome Drinks                        |                                      |                                       |                                      |                                      |

### 2<sup>nd</sup> week

|               | Monday 7 <sup>th</sup>             | Tuesday 8 <sup>th</sup>              | Wednesday 9 <sup>th</sup>            | Thursday 10 <sup>th</sup>              | Friday 11 <sup>th</sup>                |
|---------------|------------------------------------|--------------------------------------|--------------------------------------|--|--|
| 09:00 – 10:30 | <b>Course 3A:</b><br>Eva Andrei    | <b>Course 1A:</b><br>Geraldine Haack | <b>Course 1A:</b><br>Geraldine Haack | <b>Links A:</b><br>François Parmentier | <b>Links A:</b><br>François Parmentier |
| 10:30 - 11:00 | <b>Coffee break</b>                |                                      |                                      |  |  |
| 11:00 – 12:00 | <b>Focus 3:</b><br>Adolfo Grushin  | <b>Course 1B:</b><br>Xavier Waintal  | <b>Focus 3:</b><br>Adolfo Grushin    | <b>Course 1B:</b><br>Xavier Waintal    | <b>Course 1B:</b><br>Xavier Waintal    |
| 12:00 - 15:00 | <b>Lunch</b>                       |                                      |                                      |  |  |
| 15:00 - 16:00 | Discussion<br>Courses 1-3          | Discussion<br>Courses 1-3            | Discussion<br>Courses 1-3            | Discussion<br>Courses 1-3              | Discussion<br>Courses 1-3              |
| 16:00 – 16:30 | <b>Coffee</b>                      |                                      |                                      |  |  |
| 16:30 – 18:00 | <b>Course 3B:</b><br>Leni Bascones | <b>Focus 1:</b><br>Gwendal Fève      | <b>Focus 1:</b><br>Gwendal Fève      | <b>Links B:</b><br>Carmen Rubio        | <b>Links B:</b><br>Carmen Rubio        |
| 18:00 - 19:00 | <b>Posters - A</b>                 |                                      | <b>Posters - B</b>                   | <b>Focus 3:</b><br>Adolfo Grushin      | Recap week 2 and<br>Closing            |
| 19:00         |                                    |                                      |                                      | IESC Dinner                            |  |

## Invited lecturers and speakers and keywords:

### Course 1: Quantum Transport

Geraldine Haack (A) and Xavier Waintal (B)

- Diffusive and ballistic transport
- Landauer-Buttiker formalism
- Conductance and noise measurements
- Coulomb blockade
- Quantum Hall effect
- Heat transport
- **Focus 1:** Gwendal Fève - Anyons in mesoscopic conductors

### Course 2: Mesoscopic Superconductivity and Quantum Circuits

Landry Bretheau (A) and Quentin Ficheux (B)

- London formalism
- BCS theory
- Andreev states
- Josephson effect and junctions
- Superconducting circuits
- Quantum Electrodynamics
- Qubits
- **Focus 2:** Alexia Auffèves – Quantum energy

### Course 3: 2D Systems

Eva Andrei (A) and Leni Bascones (B)

- Electronic properties of graphene and 2D materials
- Twistronics
- Berry phase and topology
- Correlated states in 2D materials
- **Focus 3:** Adolfo Grushin – Weyl semimetals and topological insulators

### Course 4: Hybrid Systems

Samuel Deleglise (A) and Sophie Gueron (B)

- Opto-mechanical coupling
- Coupling to superconducting circuits
- Quantification of mechanical motion
- Quantum transport in nanowires and nanotubes
- Hybrid Josephson junctions and Andreev states in nanowires
- **Focus 4:** Andrea Hofmann – Semiconductor-superconductor devices

### Links:

- François Parmentier (A) – Heat transport in graphene
- Carmen Rubio-Verdú (B) – STM measurements in twisted 2D materials