S3 : **Gaël Grissonnanche** (Laboratoire des Solides Irradiés, École Polytechnique, Palaiseau)

"The secrets of strange metals: A Comprehensive Introduction"

Strange metals defy the standard theory of electron transport, exhibiting a *T*-linear temperature resistivity in contrast to the T^2 dependence found in conventional metals. This simple yet anomalous behavior is found in a rich diversity of quantum materials. It seems closely tied to the emergence of unconventional superconductivity, suggesting a profound link between electron scattering and pairing. In addition, strange metals surprisingly share the exact same scattering rate, regardless of microscopic details of materials, known as the 'Planckian limit'. It can be stated by a surprisingly simple relation: $1/\tau = k_B T/\hbar$, where $1/\tau$ is the electron scattering rate, $\hbar$ is Planck's constant, k_B is Boltzmann's constant and *T* is the temperature. This could be a new fundamental limit for quantum mechanics, but there is as yet no theoretical basis for Planck's limit in solids. In this lecture, we will explore the differences between conventional and strange metals, delve into their connection with superconductivity, and investigate how the Planckian limit shapes their behavior. We will introduce key experimental techniques—magnetoresistance, angle-dependent magnetoresistance (ADMR), and the Seebeck effect—as well as the numerical approach of Boltzmann transport theory to model electron dynamics. Through these tools, we aim to uncover the mechanisms driving the peculiar transport properties of strange metals, providing attendees with a comprehensive foundation to further study these complex systems.