Searching for transformative materials and quantum systems: The rise of two-dimensional indium selenide

Speaker: Professor Amalia Patane
Nottingham University

Date: Tuesday 12th November at 13:00

Room: MAS2.06

The progressive miniaturization of materials in the 21st century has enabled important discoveries and access to a wide range of phenomena of fundamental and applied interest. But future progress and innovation require a shift towards transformative material systems and integration technologies. The search for such materials beyond traditional covalent semiconductors, such as Si, has led to fast growing activities on atomically thin layers of van der Waals (vdW) crystals and the exciting growing development of the metal chalcogenide indium selenide, InSe. This vdW crystal has a band gap energy that increases markedly with decreasing layer thickness down to a single layer and a high, broad photoresponsivity that extends from the ultra-violet (UV) to the infrared (IR) range. It has a relatively low mass conduction band electrons even in atomically thin films, and a high electron mobility, larger than in Si-based field effect transistors. The science of InSe is now a rapidly developing and vibrant field and more breakthroughs are expected as new concepts emerge from experiment and theory. For example, InSe exhibits a unique valence band with an inverted Mexican hat-like shape and van Hove singularities in the density of states that could give access to strong electron-electron correlation phenomena, such as new forms of charge/spin ordering; different types of heterobilayers can also be created by combining InSe with other material systems, leading to new phenomena, such as a giant quantum Hall plateau.

Here, I will review my recent research on this new system and discuss emerging activities and prospects for fundamental and applied research.