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COLLOQUIA – HILARY TERM 2020

VENUE: **Hume Rothery Lecture Theatre**

Refreshments will be served in the Hume Rothery Building Reception Foyer from 3:30 p.m.

Week	*Date*	*Colloquium Title and Abstract*	*Host:*
1	Thursday, 23 January	**Dr Vasu S Kalangi**, Marie Curie Research Fellow, Ecole Normale Superieure (Paris) **Graphene based membranes: tunable ion sieving and smart membrane applications** Graphene based membranes continue to attract intense interest due to their unique molecular sieving and fast permeation properties. In this talk, tunable ion sieving and controlled transport of water molecules through graphene-based membranes with sub-nm interolayer spacing will be discussed. I will report experiments exploring the ionic transport through graphene nanocapillaries with interlayer spacing, comparable to, or smaller than, the diameter of hydrated ions (9.8 Å to 6.4 Å). Further, the electrically controlled water permeation, from ultrafast permeation to complete blocking, through micrometre-thick graphene oxide membranes will be discussed with a prospect for developing smart membranes. Finally, I will complete my presentation by describing a controlled experimental methodology that I have recently developed to measure the flow rate of dilute ionic solutions through 2D nanocapillaries. These studies allow to envision the design of graphene and other 2D materials-based next generation membranes for separation and purification technologies.	S Siddarama
3	Thursday, 6 February	**Dr Samuli Autti**, University of Lancaster **Pushing the Boundaries of Quantum Vacuum in the Superfluid ^{3}He Universe** Moving an object in superfluid ^{3}He in the zero-temperature limit resembles moving it in the vacuum of the Standard Model: within a region bounded by a characteristic scale, speed, frequency etc, the object moves as if the superfluid is not there in the first place. According to the textbook picture the vacuum vanishes beyond these bounds. For example, if the object's velocity exceeds the critical Landau value, the vacuum is expected to break along its trajectory, producing pairs of quasiparticles and quasiholes.	N Ares

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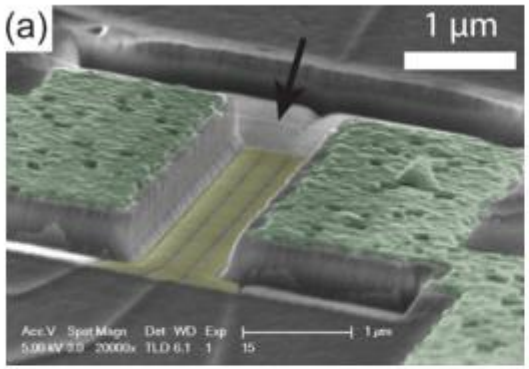
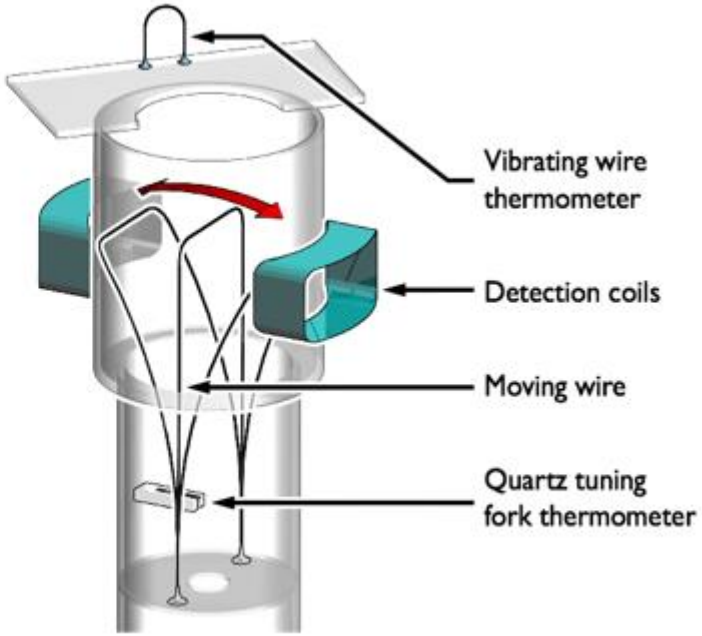
		The object can in principle be made smaller than the grain size of the vacuum itself. In superfluid ^{3}He this scale is the size of a Cooper pair (~100nm), in the Universe this could be as small as the Planck length. Neither have been accessed experimentally. In this presentation we explore and push these boundaries in the superfluid universe making use of two experimental examples: First, the speed limit can be broken by a large moving wire with, remarkably, very minor consequences (Nature Physics **12**, 1017–1021 (2016)). Second, nano-sized probes smaller than the Cooper pairs seem to interact even less with the superfluid vacuum than large objects.  	

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5	Thursday, 20 February	**Dr Thomas Slater**, Diamond **3D Imaging of Nanoparticles using Scanning Transmission Electron Microscopy** The precise 3D structure of nanoparticles is important for their applications in drug delivery, optical sensing and in particular in catalysis, where their surface structure plays a fundamental role. Scanning transmission electron microscopy is able to image nanoparticles in three dimensions, with reconstructions at atomic resolution in some cases. In this talk, I will review methods for performing three dimensional reconstruction of inorganic nanoparticles. I will particularly focus on using energy dispersive X-ray spectroscopy to determine the 3D distribution of elements within nanoparticles, highlighting some of my contributions in developing these techniques. I will also present recent and future work on automating 3D imaging of nanoparticles without tilting the microscope stage.	J Kim
8	Thursday, 12 March	**Professor Anne Young**, UCL Eastman Dental Institute **Development of SMART composites for minimally invasive tooth repair: from bench to clinic** Currently 25% of 5-year old children in the UK suffer from dental caries. Their young age combined with the 2018 ban on use of silver amalgam fillings, however, makes treatment extremely difficult. The aim of this talk will therefore be to describe the development of a new SMART dental composite material that can be placed without drill or anaesthetic. It is designed to be placed directly on disease affected dentine following painless minimal excavation of just the surface highly infected tooth structure. Studies have shown the new SMART composite paste can penetrate into and stabilise the underlying disease affected dentine. Following blue light exposure for 20s, the paste sets solid providing a material with comparable shape, colour and mechanical properties to that of the original sound tooth. This talk will cover material development and optimisation including assessment of paste setting reaction kinetics, tooth bonding mechanisms, mechanical, antibacterial and eukaryotic cell compatibility studies. It will also demonstrate how the material can prevent enzyme activated continuing tooth destruction and might encourage greater natural tooth self-repair. Finally, studies required for CE marking and results from a First-in-Human clinical trial will be described in addition to how the formulations are being modified for bone repair.	B Gabrys