South West Nuclear Hub

Incorporating the **Bristol-Oxford Nuclear Research Centre**

Nuclear Seminar Series

Upcoming Talks

Tues 17th Feb, 2pm
3.21, Physics

David Smith
Interface Analysis Centre
School of Physics

Photophoretic resonance absorption for the sorting single-walled carbon nanotubes (SWCNTs) and heavy isotopes: A new method for high purity, low energy separation.

Tues 3rd March, 2pm
3.21, Physics

Aleksej Popel
UK Spent Fuel Research Group
University of Cambridge
Title TBC

David Tanner
Solid Mechanics Research Group
Faculty of Engineering
Addressing Key Structural Integrity Challenges in the UK Nuclear Industry

Tues 17th March, 2pm
Mott LT, Physics

Prof James Marrow
James Martin Professor of Energy Materials
University of Oxford
Title TBC

Tues 31st March, 2pm
3.21, Physics

Rick Bradford
EDF Energy
RAEng visiting Professor

Lessons from Past Plant Failures in UK Commercial Reactors

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University of Bristol

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This Week…

Tues 17th Feb, 2-3pm, Physics 3.21

David Smith

Interface Analysis Centre, School of Physics

Photophoretic resonance absorption for the sorting single-walled carbon nanotubes (SWCNTs) and heavy isotopes: A new method for high purity, low energy separation.

Photophoresis is an emerging technology for processing sub-micron particles. It utilises particles differing interactions with light as mechanism for separation. These differing interactions may arise due to difference in the particles photothermal characteristics or varying degrees of photoelectric absorption. This talk will focus on photophoretic phenomena arising from photoelectric absorption. Specifically, photophoresis as an avenue for the selective chiral sorting of single-walled carbon nanotubes (SWCNTs) and heavy isotope separation.

High purity mono-chiral SWCNT samples are essential for the commercial realisation of high-speed SWCNT electronics. Current sorting techniques utilise secondary properties such as specific gravity or nucleotide affinity as recognition/separation avenues. Such techniques do not necessarily guarantee high quality electronic properties. We present a novel approach for selective chiral separation based upon innate electronic properties. Using the resonant transfer of photonic momentum as a direct method of separation it is possible selectively impose excess optical force to specific chiralities. The relevant theory is developed and potential experiments (and the associated challenges) are discussed. Computer simulations have been developed for the BlueCrystai HPC facility here at the University of Bristol. The simulations modelled the evolution of large ensembles of SWCNT due Brownian, optical and hydrodynamic forces. Subsequent results show the feasibility of potential photophoretic, opto-fluidic and optical counter propagating sorting devices. These results include investigations into optimum temperature, optical intensity flow regimes and flow velocities for fast separation. We find that an optical sorting system would be ~100x faster than the current 'Gold Standard'.

Finally, the prospect of whether a photophoretic approach could be applied to heavy isotope separation is considered. Atomic vapour laser isotope separation (ALVLIS), Molecular laser isotope separation (MLIS) and more recently Separation of isotopes by laser excitation (SILEX) utilise resonance optical absorption. However, these technologies are still relatively energy intensify as the vapour has to be maintained in an ionised state. By taking advantage of the transfer of photonic momentum it should be possible to to achieve high purity separation without the currently required cascade configurations.

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