Physics Postgraduate Conference

Tuesday 16th August 2022

JA 317

Time	Student	Primary Supervisor
10:00 - 10:15	**Jason Mill**	**Jaroszynski**
	Combined Very High Energy Electron Beam Radiotherapy and Imaging Studies Despite the increasing success of radiotherapy techniques, there are still obstacles which cause problems such as normal tissue toxicity, and the cost and size of machinery. One way in which these may be better controlled is with the use of laser-driven plasma accelerators. These can deliver GeV electron beams on a much smaller and more affordable scale. These beams can have femtosecond durations, making their dose rates extremely high. This is beneficial for the study of the novel FLASH effect, but makes it harder to accurately measure their dose. They can also have applications in non-intrusive imaging techniques.	
10:15 – 10:30	**Apostolos Minopetras**	**Martin**
	WDS, CL and ToF-SIMS analysis of GeSn and Ge doped AlGaN samples. The Electron Probe Microanalyzer (EPMA) is a machine capable of providing imaging similar to an SEM while also being able to provide elemental analysis of samples using Wavelength dispersive spectroscopy (WDS) which provides high resolution characteristic x-ray analysis. Additionally, optoelectronic property information can be obtained using cathodoluminescence (CL). GeSN and Ge-doped ALGaN samples were analysed for elemental composition using WDS. One of the GeSN samples was multi-layered and ToF-SIMS had to be used as WDS is unsittable for multi-layered materials. For the Ge-doped AlGaN samples CL was used to analyse optoelectronic properties. WDS and CL maps are planned for all samples to test uniformity.	

10:30 – 10:45	**Maia Peat**	**McKenna**
	Stabilisation and optimisation of laser-driven ion acceleration mechanisms High-power laser-driven ion acceleration mechanisms, such as target normal sheath acceleration (TNSA), have a wide range of potential applications. The stabilisation and optimisation of these mechanisms continues to pose a challenge in the field of laser-plasma interactions. Variations in the contrast and energy of the laser prepulse, which produces the preplasma, can lead to non-linear instabilities in energy coupling, which can cause variations in ion production [1]. It is essential to characterise these instabilities. A novel design for a transverse optical probe to measure preplasma scale lengths of the front surface of a solid density target in Bunker B at SCAPA is presented. The optimisation of TNSA depends strongly on the temperature of the fast electrons heated directly by the laser. The fast electron temperature scales with laser intensity [2][3]. A parameter scan of electron temperature, varying laser energy and pulse duration, is presented, in preparation for an experiment at Astra-Gemini in October 2022. [1] P. McKenna et al., "Effects of front surface plasma expansion on proton acceleration in ultra-intense laser irradiation of foil targets," Laser Part Beam 26 (2008) [2] S. C. Wilks, W. L. Kruer, M. Tabak, and A. B. Langdon, "Absorption of ultra-intense laser pulses," Phys. Rev. Lett. 69, 1383–1386 (1992) [3] M. G. Haines, M. S. Wei, F. N. Beg, and R. B. Stephens, "Hot-electron temperature and laser-light absorption in fast ignition," Phys. Rev. Lett. 102, 045008 (2009)	
10:45 – 11:00	**Sebastian Schmid**	**Daley**
	Emulating baths via closed quantum dynamics A quantum system emitting energy into its environment is the basis of measurement. The modelling of this can typically be facilitated by the theory of open quantum systems, which requires modelling baths of particular shapes and typically infinite sizes. Is it possible to emulate the behaviour of infinite size baths by finite, exactly treated quantum environments in that information leaving a system returns to said system only after an exponential amount of time spent in the environment?	
Break 11:00-11:30		

11:30 - 11:45	**Lily Berman**	**Hidding**
	A plasma-driven x-ray free-electron laser using ultrahigh brightness beams X-ray free-electron lasers (XFELs) are sources of extremely bright, coherent x-rays that have wide-ranging research applications. Unlike a 'normal' laser, they use the interaction of a high energy electron beam and light in an undulator magnet to achieve light amplification. The electron beam is provided by a km-scale linear accelerator which makes these facilities large, costly and scarce. Plasma wakefield acceleration (PWFA) is a novel acceleration method that uses a plasma to generate extremely high accelerating gradients capable of achieving multi GeV electron energies in less than a metre. Here, we present efforts to develop schemes for a PWFA-driven XFEL by using a plasma photocathode to generate ultralow emittance, ultrahigh brightness electron beams.	
11:45 - 12:00	**Sridevi Kuriyattil**	**Daley**
	Quantum Information Scrambling and Emergent Geometries in Quantum Circuits Quantum Information scrambling describes a phenomenon in which a localized bit of quantum information is delocalized by many-body dynamics and gets encoded into a many-body entangled state. This process cannot take place instantaneously. However, according to fast scrambling conjecture, if scrambling takes place at times that scale logarithmically with system size N, the system is called a "fast scrambler". Various quantifiers can be used to track the phenomenon of information scrambling and characterize fast scrambling regime. We have used two primary tools that do the same: Entanglement entropy and Tripartite mutual information (TMI) to do the entanglement analysis in our toy model of Clifford circuit with tunable long-range interactions.	
12:00 - 12:15	**Jesel Patel**	**McKenna**
	The SciFi Stack: A high repetition diagnostic of laser driven proton beams *High power lasers (HPL) incident to thin foil solid targets produce energetic proton beams with applications in science, industry and medicine. Underlying physics determine the acceleration mechanism driving these beams, and result in different features in the spatial and spectral profile. Conventionally, passive detector media such as the radio-chromic film stack have been used to monitor these features and diagnose interactions. However, these methods are unsuitable in the high repetition environments of new HPL facilities. We present first results with a scintillating fiber based beam profile monitor and propose a fully spectro-spatial diagnostic capable of operating at high repetition rates.*	

12:15-12:30	**Ewen Lawrence**	**Kirton**
	Thermalisation of open quantum systems beyond the Markov approximation Quantum systems are inevitably connected to their surrounding environment, theoretically described by the theory of open quantum systems. Approximations tend to be used to reduce the complexity, such as the Markov approximation which states that the system can only be affected by its current state, excluding possible memory effects. Whilst this works well for small couplings, fully exact numerical methods have been developed to allow simulation beyond this. We seek to understand how this extension affects the thermalisation of quantum systems, a fundamental step in many thermodynamic processes like heat engines.	

Lunch 12:30-14:00

14:00 - 14:15	**Zinuo Li**	**Chen**
	Fluorescent gold nanoprobes for cancer biomarker detection We aim to develop a fluorescent nanoprobe consists with small gold nanorod functionalized with fluorophore labelled hairpin DNA, which can be used to detect lncRNA biomarker in prostate cancer. It has been found that the fluorescence intensity and lifetime of nanoprobes will have obvious changes after hybridizing with cDNA in solution phase. In addition, the performance of nanoprobes was further investigated by incubating with cancer/non-cancer cells and exosomes.	
14:15 - 14:30	**Lenard Arpad**	**Hidding**
	Laser-Wakefield Accelerators for Radiotherapy and Space Radiation Studies Space radiation is encountered by every satellite and consists of particles with broad energy ranges and pose a major hazard to onboard electronics, they degrade instruments and eventually cause them to fail. Current facilities cannot create these broad energy particles. It is ideal to test the satellites for the same radiation conditions they will encounter in space, we propose using laser-wakefield accelerators to produce electrons with broad energy range instead that can mimic the space radiation environment. These electrons with broad energy range can also have beneficial applications in radiotherapy.	

14:30 - 14.45	**Daniel Doveiko**	**Rolinski**
	Sodium Silicate Particle Size Measurements using Time -Resolved Fluorescence Anisotropy During the talk a method for determining the particle sizes in sodium silicate liquors at high pH based on the measurements of time-resolved fluorescence anisotropy of two fluorescent labels will be presented. Rotational times of the non-binding rhodamine B and electrostatically binding rhodamine 6G are used to determine the medium microviscosity and the silicate particle radius, respectively. The anisotropy measurements were performed on the range of samples prepared by diluting the stock solution of silicate to the concentrations ranging between 0.2M and 2M of NaOH and on the stock solution at different temperatures. The recovered particle size was 7.0±1.2Å.	
14:45 - 15.00	**Mark Higgins**	**Eliasson**
	Electron Bernstein Current Drive in Spherical Tokamaks Spherical tokamaks (STs) provide an attractive solution to future fusion power plants due to their increased confinement and stability over conventional torus designs. However the over-dense nature of ST plasmas means well established methods of driving current such as the electron-cyclotron resonance are not possible in this configuration. Electron Bernstein Wave (EBW) absorption appears to be a promising method for both current drive and solenoid free start-up. The accessibility of ST plasma to EBWs is therefore modelled using ray tracing and finite-difference Fokker-Planck codes to find the optimum conditions for EBW current drive.	