International Student Research Project Opportunities (Summer 2021)

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Supervisor(s)	Project Description
Prof Amihay Hanany Theoretical Physics Group (a.hanany@imperial.ac.uk)	**Quiver Gauge Theories** There is a collection of projects in string theory research under the general topic of "quiver gauge theories". Past projects were done in the study of "brane tilings" and "orbifolds", but a general study in string theory is also possible. The work may involve theoretical, analytical, and/or computational studies, depending on the taste and choice of the student. Some of the projects involve combinatorial techniques as well as methods taken from number theory. Some other projects involve methods from representations of Lie algebras and algebraic geometry. The interested student needs to have a strong background in theoretical physics, but the projects are not restricted to a given year of study. The expectation from the student is to be well motivated and ready to solve problems which were not seen before, but using the tools acquired so far in their degree.
Prof Roland A. Smith Plasma Physics Group (r.a.smith@imperial.ac.uk)	**Optical levitation of microtargets for ultra-high power laser experiments.** The interaction of ultra-intense lasers with a microtarget of order the laser wavelength (a micron or so) is a field pioneered by Imperial College. These targets are exciting for several reasons, their geometry results in large boosts to the laser electric field which enhances hot electron and x-ray generation and their perfectly isolated geometry creates a unique micro-laboratory to study ultra-high intensity laser physics. Our most recent experiments and simulations also show that we can use them to generate much more energetic MeV ion beams than "traditional" laser targets, and we are investigation how to harness this to underpin future ion-beam cancer therapy techniques. To enable these experiments we develop new optical levitation traps which work under vacuum and balance the force of gravity against photon momentum transfer from a continuous laser beam. This project could involve either experimental work to characterise and refine our trap systems, or numerical modelling in Python to better understand trap dynamics and help design new trap systems able to capture "exotic" objects such as microbubbles and chiral liquids, depending on the interests of the student.
Prof. Ken Long Centre for the Clinical Application of Particles k.long@imperial.ac.uk	**New approaches in radiotherapy** Cancer is responsible for one out of four deaths in Europe alone. Radiotherapy has a key role in cancer treatment; roughly half of all cancer patients will receive RT at some point during their illness. The treatment of radioresistant tumours, tumours close to a sensitive structure, such as the central nervous system (CNS) and paediatric cancers, is compromised by the radiation tolerance of normal tissue. We in the Centre for the Clinical Application of Particles seek to drive a change in current practice by exploiting the wealth of biological knowledge to devise new approaches that decrease the toxic effect of radiation on normal tissue while maintaining, or even enhancing, the tumour-kill probability. Exploiting the close bond between physics and biology we propose to identify techniques by which to activate and/or modulate the aforementioned effects by tuning the physical parameters of irradiation. An IROP student joining this programme will contribute to the development of novel techniques to simulate the microbiophysical processes that underpin the impact of ionising radiations on tissue. As the work progresses, increasing emphasis will be placed on the comparison of simulations with measurement.