GravityCam - A novel high-speed and wide-field instrument for a large astronomical telescope, detecting exoplanets and dark matter

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Description: GravityCam is a new high-speed optical instrument proposed for the 3.6 New Technology Telescope at the La Silla Observatory in Chile. The instrument will capable of delivering significantly sharper images from the ground than is normally possible without adaptive optics. Advances in optical and near infrared imaging technologies allow images to be acquired at high speed without significant noise penalty. Aligning these images before they are combined can yield a 3–5 fold improvement in image resolution. By using arrays of such detectors, survey fields may be as wide as the telescope optics allows. GravityCam will be able to greatly accelerate the rate of detection of Earth size planets by gravitational microlensing and will substantially improve the quality of weak shear studies of dark matter distribution in distant clusters of galaxies. An extensive microlensing survey will also provide a vast dataset for asteroseismology studies, and GravityCam promises to generate a unique data set on the population of the Kuiper belt and possibly the Oort cloud.

At the moment two competing night vision technologies are proposed as detectors for GravityCam; Electron Multiplying CCDs (EMCCDs) or CMOS devices. While EMCCDs has been used for high-precision astronomy for a number of years and is a well tested technology, CMOS devices are only approaching a level good enough for astronomy, and more research into their performance is therefore needed.

From an in-depth comparison of the performance of an EMCCD against a CMOS device on a number of parameters, such as noise, photoresponse, gain uniformity, point spread function, the successful candidate would be able to study how detector performance compares with the requirements on the astronomical observations needed for GravityCam to fulfil its scientific goals. This would provide a basis for a decision for which detector would be best for GravityCam and would also be useful for other applications in a wide range of applications, both ground and space-based.

The data for this study would come from lab testing, existing instrumentation, and a planned new test instrument designed specifically for this purpose, for which the student would be able to be a major driver. This means that the project will advance from lab based test to actual observations at a astronomical telescope.

References:

Qualifications required: A first class or upper second class MSc/BSc degree in Physics, Astronomy, Electronic Engineering or a related discipline.