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Investigation of Detectability of Orbital Objects/Debris in Geostationary Earth Orbit by Microwave Kinetic Inductance Detectors

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Abstract : Microwave Kinetic Inductance Detectors (MKIDs) are considered as one of the most promising photon detectors of the future in many Astronomical applications such as exoplanet detections. The MKID advantages stem from their single photon sensitivity (ranging from UV to optical and near infrared), photon energy resolution and high temporal capability (~microseconds). There has been substantial progress in the development of these detectors and MKIDs with Megapixel arrays is now possible. The unique capability of recording an incident photon and its energy (or wavelength) while also registering its time of arrival to within a microsecond enables an array of MKIDs to produce a four-dimensional data block of x, y, z and t comprising x, y spatial, z axis per pixel spectral and t axis per pixel which is temporal. This offers the possibility that the spectrum and brightness variation for any detected piece of space debris as a function of time might offer a unique identifier or fingerprint. Such a fingerprint signal from any object identified in multiple detections by different observers has the potential to determine the orbital features of the object and be used for their tracking. Modelling performed so far shows that with a 20 cm telescope located at an Astronomical observatory (e.g. La Palma, Canary Islands) we could detect sub cm objects at GEO. By considering a Lambertian sphere with a 10 % reflectivity (albedo of the Moon) we anticipate the following for a GEO object: 10 cm object imaged in a 1 second image capture; 1.2 cm object for a 70 second image integration or 0.65 cm object for a 4 minute image integration. We present details of our modelling and the potential instrument for a dedicated GEO surveillance system.

Keywords : space debris, orbital debris, detection system, observation, microwave kinetic inductance detectors, MKID
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