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## Firmware development of a compact Compton telescope for flight on a high-altitude balloon.

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Gamma-ray bursts are amongst the most luminous transients in the universe, yet the processes which drive these highly energetic objects are still poorly understood. Measurement of gamma-ray polarisation, when combined with spectroscopic and temporal measurements, may be one of the keys to unlocking the mystery behind these processes and the central engine which drives them. Polarimetry measurements can also allow for a more complete understanding of other gamma-ray sources, such as pulsars and blazars.

A compact Compton Telescope (COMCUBE) is being developed to perform these measurements in the keV range, with a view to being deployed as a payload on a 6U CubeSat. A scaled-down prototype detector is currently under development for flight on a high-altitude balloon in Q3 of this year.

This compact instrument combines two sets of double-sided silicon strip detectors (DSSSDs) with scintillator calorimeter modules. These calorimeter modules are read out by arrays of silicon photomultipliers (SiPMs) interfaced with a readout ASIC. All of the detector electronics are interfaced with a ARM-based FPGA-SoC module, for which a custom firmware has been developed. This firmware performs interfacing and time-stamping on the incoming science data, and identifies coincident events between detector modules. These time-tagged events are then further processed before being streamed to the SoC cores for downlinking. Here, this firmware along with its design drivers are described. An in-depth description of the techniques used to optimise its data throughput and resource efficiency, and on the data chain of one of the calorimeter modules, is also given.

### Eligibility for "Best presentation for young researcher" prize

Yes

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