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The C1XS X-ray Spectrometer on Chandrayaan-1

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The Chandrayaan-1 X-ray Spectrometer (C1XS) is a compact X-ray spectrometer for the Indian Space Research Organisation (ISRO) Chandrayaan-1 lunar mission It exploits heritage from the D-CIXS instrument (Grande et al 2003, 2007) on ESA's SMART1 mission. However, by comparison with SMART-1, Chandrayaan-1 is intended as a science rather than a technology mission, leading to far more favourable conditions for science measurements. C1XS is designed to measure absolute and relative abundances of major rock-forming elements (principally Mg, Al, Si, Ti, Ca and Fe) in the lunar crust with spatial resolution ˜25 km. C1XS is currently in production, and will be delivered in Feb 2008, with the launch of Chandrayaan-1 expected in late spring 2008.

The CIXS instrument hardware is built by an international team led from the Rutherford Appleton Laboratory. The Principal Investigator is Prof M. Grande at the University of Wales, Aberystwyth, and there is also a major science and design contribution from ISAC, ISRO, Bangalore, India; CESR, Toulouse, France provide amplifiers. The Science team is led by Dr I A Crawford of Birkbeck College London. In order to record the incident solar X-ray flux at the Moon, a good measure of which is essential to derive absolute lunar elemental surface abundances, CIXS carries an X-ray Solar Monitor (XSM) provided by the University of Helsinki, Finland.

The baseline design consists of 24 nadir pointing Swept Charge Device detectors, each filtered with 400nm of Al on 400nm of polymer substrate, which provide high detection efficiency in the 1 to 7 keV range, which contains the X-ray fluorescence lines of interest. Micro-machined collimators provide a 14 degree FWHM FOV, equivalent to 25 km from 100km altitude. A deployable door protects the instrument during launch and cruise, and also provides a Fe55 calibration X-ray sources for each of the detectors.

Careful thought has been given to the radiation shielding, in what is already a comparatively low radiation environment orbit. Additional refinements to the electronics, onboard software and thermal design will also greatly increase detector stability and signal to noise ratio. This will result in a significantly improved energy resolution which should therefore be better than 200eV throughout the lifetime of the mission. In comparison to D-CIXS, C1XS and XSM will be far better calibrated. C1XS will arrive at the Moon in the run up to the maximum of the solar cycle, and the high incident X-ray flux coupled to an orbit optimized for science, means that we will obtain composition data accurate to better than 10% of major elemental abundances over the entire surface. Hence C1XS will be well-placed to make significant contributions to lunar science. In addition, the ˜25 km spatial resolution enables C1XS to address a number of smaller-scale geological issues which also refine our understanding of lunar geological evolution.

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