RAL
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RUTHERFORD APPLETON LABORATORY
SCIENCE AND ENGINEERING RESEARCH COUNCIL

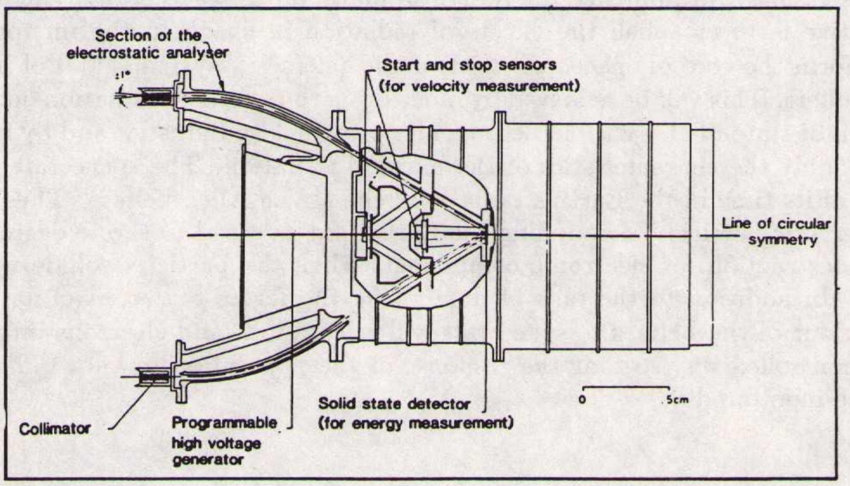
CRRES

The Combined Release and Radiation Effects Spacecraft (CRRES) is a mission whose results will influence the design of many future spacecraft. The over-riding objective is to establish the effects of radiation in space on the microelectronics that form the core of spacecraft control and telemetry systems, and of instrument controllers. This will be achieved by monitoring the effects of radiation on a vast collection of state-of-the-art microelectronics provided by Industry, and by monitoring thoroughly the characteristics of the harmful radiation. The spacecraft will spend most of its time in the Earth's radiation belts ("Van Allen belts"). These are belts of energetic particles surrounding the Earth that can lead to severe degradation, or even destruction, of electronic components when the particles collide with spacecraft. In addition to the task of monitoring the forces that control naturally the behaviour of the belts, the spacecraft will release ions and electrons into the belts in a controlled way so that the response of the population to known disturbances can be monitored.

The mission involves predominantly teams from the USA. However, the University of Sussex, the Mullard Space Science Laboratory of University College, London, and the Space Plasmas Group at RAL have helped to construct instruments for the spacecraft. Launch was due in July 9 of this year. RAL has helped to construct a Magnetospheric Ion Composition Spectrometer (see overleaf), one of the instruments that will establish the nature and dynamics of the ions that form a major part of the radiation belts. Altogether four groups were involved in the design and construction - the Max Planck Institute for Aeronomy in Germany, who led the team, the Rutherford-Appleton Laboratory, the University of Sussex, and the University of Bergen in Norway. The spectrometer measures positive ions and identifies the ion mass, charge state, energy and the direction in which they are travelling. RAL's contribution has been to construct the collimator and electrostatic analyser which enables the energy per charge of the ion to be measured. RAL have also produced two of the high voltage (15 kV and 25 kV) supplies needed to power the instrument.

MAGNETOSPHERIC ION COMPOSITION SPECTROMETER

An ion intercepted by the spectrometer first passes through a collimator and an electrostatic analyser. For a specific voltage applied to the analyser only ions of a particular energy per charge can traverse the full length. The applied voltage is changed regularly so that a range of energy per charges can be measured. An ion that has the correct energy per charge to pass through the analyser next enters a section which measures the time taken for it to traverse the distance between two secondary emitting surfaces, firstly, a foil at the exit of the analyser, secondly, the surface of a solid state detector. The first cloud of secondary electrons strikes a microchannel plate whose output pulse starts a clock, the second cloud stops the clock. The solid state detector records the total energy of the ion. Combining knowledge of the path length, total energy, and energy per charge, enables full identification of the ion characteristics.



Sketch of the Magnetospheric Ion Composition Spectrometer for CRRES

The Laboratory will also take part in data analysis and interpretation. In addition to the crucial task of identifying the nature of the ion population within the magnetosphere, Laboratory scientists will study how the ion population is formed and its dynamic behaviour under various solar conditions. The ultimate aim will be to understand the population of the radiation belts sufficiently well that its state and dynamical development can be predicted, and, also, sufficiently well that realistic tests of the effects of radiation on microelectronics can be carried out during spacecraft development phases.

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