## Magnetosphere

# First success for a space mission and a comet for Christmas

*from D.J. Southwood and D.A. Bryant*

THE first active phase of the Active Magneto-spheric Particle Tracer Explorers (AMPTE) space mission is successfully accomplished. On 11 September 1984 and again on 20 September, lithium ions were released in the solar wind immediately upstream from the terrestrial magnetosphere, some 110,000 km from the Earth's surface. At a meeting of the AMPTE science team on 25–27 October at the Applied Physics Laboratory in Laurel, Maryland, the data from the releases were assimilated and cross comparisons were made between the three spacecraft involved in the mission.

AMPTE is a joint project of the United States, West Germany and Britain. Each national team has provided a spacecraft. The US Charge Composition Explorer (CCE) carries a comprehensive set of instrumentation to detect the mass and charge composition of the terrestrial ionized environment, the magnetosphere. Its task is to monitor whether test ions released by the German Ion Release Module (IRM) can penetrate to its orbit. The IRM is also fully instrumented to make plasma and field measurements. The third spacecraft is the British subsatellite, UKS, added to the programme at the behest of the German team, who recognized that the actual pick-up of the release ions by the surrounding plasma posed a significant scientific problem in its own right. The UKS orbits close to the IRM so that both spacecraft are able to monitor the local effects of the ion releases.

The first result of the release experiment in the solar wind is a null one; the team are convinced that no lithium ions made their way from the release site to the CCE, deep in the magnetosphere. However, no disappointment was evident in the team, in part because of their exhilaration at the unique measurements made by IRM and UKS as the ions were created. In any case, the null result provides an important constraint on our understanding of solar ion access. Furthermore, the quality of the data from the passive measurements made routinely in the mission is so good that inevitably major gains will be made in our knowledge of the Earth's ionized environment and in its interaction with the solar wind.

The lithium releases produced artificial cometary effects. Comparison of IRM and UKS data show that the clouds initially formed a cavity in the solar wind from which the magnetic field was excluded. The scale of the cavity must have been well constrained because in both cases it contained IRM, whereas UKS saw no cavity in one case, and in the other only partial exclusion of the field. The solar wind was slowed and diverted by the obstacle; in the process, the solar wind magnetic field was amplified. Magnetic forces led to the cloud being blown away from the vicinity of the spacecraft. Electron heating accompanied the field compression and the ion detectors recorded the signatures of classic cycloidal motion of the lithium ions as the solar wind picked them up and accelerated them. Further detailed plasma diagnostics were provided by plasma wave instruments. Beam instabilities, attributable to the interaction of lithium ions and solar wind protons, were detected but, during the passage over the spacecraft of the most intense electrical current sheets, no 'anomalous' (wave-induced) electrical resistivity seems to have been present.

Between the active ion-releasing phases of the mission, the three spacecraft make passive measurements of the Earth's ionized outer atmosphere. The measurements made during the magnetic storm of 4 September provide a high point of the mission so far; CCE monitored the build up and decay of a hot plasma 'ring current' about the Earth, and IRM and UKS detected extreme solar wind, bow shock and magnetopause conditions.

The next ion release from IRM is due to take place on 25 December at 12.18 UT. The date was chosen for scientific reasons; the ideal configuration of the spacecraft and the ambient flow, combined with the requirements imposed by the position of viewing sites, constrained the team to two dates, of which Christmas Day is preferred to 27 December. The release will be of barium, which ionizes much faster than lithium, and will be made on the dawn flank of the magnetosphere, just outside the magnetopause. A longer-lasting and more substantial cavity is expected. The prime purpose is to create an artificial 'comet' which will be visible from North America and the eastern Pacific. The comet may be visible to ground observers (and other wise men) on the dawn side of earth for about twenty minutes.

Further releases of barium and lithium are planned for late March 1985. The ions will be released into the tail of the magnetosphere and CCE will be tracing the access of the ions to regions closer to Earth. □

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## Gene regulation

# Repression of activators

*from Anna Velcich and Edward Ziff*

SINCE their first discovery in 1981, gene enhancers have increasingly been recognized as potent activators of transcription of a wide range of viral and cellular genes[1]. A challenging report by Borrelli, Hen and Chambon on page 608 of this issue presents evidence of a mechanism of negative regulation of a viral enhancer[2]. The finding is even more provocative because the proteins that Borrelli *et al.* show to repress enhancer activity are best known for their ability to activate genes. They are the E1a proteins of adenovirus-2, which are known to stimulate the transcription of both adenoviral and cellular genes in cells infected by the virus.

Enhancers are short segments of DNA that indirectly stimulate the transcription of nearby genes, perhaps by providing access for the transcribing enzyme, RNA polymerase II, to the genes. By contrast, the E1a proteins are direct activators of gene transcription[3,4] by mechanisms that are unknown.

Chambon and his colleagues have studied the effect of E1a proteins on transcription of a plasmid containing a rabbit $\beta$-globin gene linked to the enhancer of polyoma virus. They show that when HeLa cells are transfected with this plasmid, the polyoma enhancer stimulates transcription of the $\beta$-globin gene, but transcription is repressed if the cells are co-transfected with a plasmid that expresses E1a proteins. Unlike activation, the repression is independently effected by either of the E1a proteins. In competition experiments, additional enhancer DNA relieves repression by E1a, presumably by directly and competitively binding repressor. The E1a gene's own enhancer is active in this competition assay, suggesting that it may itself be repressed by E1a proteins and so be autoregulated. Chambon *et al.* show that the enhancer of simian virus 40 too is a target of repression, a result that is also indicated by data from our laboratory and which suggests that the repression of enhancers by E1a could be quite general.

Because, as the data show, activation and repression can be exerted under the same conditions, the E1a gene may command a complex control over transcription. With increasing production of E1a protein, a gene stimulated by it would be expressed and a gene dependent upon enhancers would be repressed. As the quantity of E1a protein falls, the activity of the E1a-dependent gene would dwindle, and the enhancer would regain its activity. The