ROSAT

How to rescue a satellite

London

JUST a week short of completing an all-sky survey of X-ray sources, the multinational Röntgen X-ray observatory ROSAT span out of control on 25 January with damage to two instruments in its scientific payload. British researchers connected with the project report that power and communications have now been restored, but the satellite has yet to resume its scientific operations. On Monday, project scientists were still undecided about whether to re-start operations using back-up instuments or spend valuable time devising extra safety precautions.

A collaboration between Germany, Britain and the United States, ROSAT was launched last year (see *Nature* **345**, 465; 1990) aboard a Delta II rocket from Cape Canaveral, and has so far been very successful. The satellite passes over the ground station at Weilheim, near Munich, for bursts of eight in every 96 minutes over a period of eight hours. For the remaining 16 hours each day, the satellite is effectively on its own.

When ROSAT was detected in its first pass over Weilheim at 02:32 GMT on Friday, 25 January after just such a gap, it was clear that it was in difficulties. Onboard batteries were running dangerously low and no telemetry was being received, indicating that something was wrong with the attitude control system — the antenna was not pointing at the ground station and the solar panels were not oriented properly, so that the solar batteries could not recharge. "Housekeeping" signals from the distressed spacecraft showed that onboard voltage had dropped below the 1·1-volt safety threshold and was falling towards 0·5 volts — the "point of no return", according to UK project leader Professor Ken Pounds of the University of Leicester.

Engineers from the manufacturer, Dornier, were summoned from their beds at 06:19, when an emergency was declared. Mission Control at the German Space Operations Centre at Oberpfaffenhofen, 25 km from Munich, was able to harness the satellite by 09:12, less than seven hours after the problem was reported. The NASA Deep Space Network (DSN) had by that time been called in to help, and the DSN station at Goldstone, California, began to track the satellite at 10:39 GMT.

Alan Harris, one of the British ROSAT researchers based with their German colleagues at the Max Planck Centre for Extraterrestrial Physics in Garching, north of Munich, says that the onboard computer had lost touch with the attitude control system, possibly due to a software error. As the spacecraft tumbled, its sensitive X-ray detectors pointed directly at the Sun, and were damaged when their emergency 'sunshades' failed to engage in time.

The German X-ray telescope has four instruments in the focal plane, arranged as two redundant pairs. Damage occurred to one of the pair of position-sensitive proportional counters (PSPCs) as sunlight punctured its protective shield, allowing some gas to escape before a safety valve managed to save the duplicate instrument. The first PSPC is now permanently 'blind', but researchers are working on the duplicate which should be "all set to go", says Pounds, after calibration tests. The instruments are a duplicate pair of high-resolution imagers, designed for detailed study of isolated X-ray sources. These were not in use at the time and escaped damage.

The British instrument, the wide-field camera, lost one out of its eight filters, one of a pair used in the all-sky survey. The damaged filter has a back-up, like everything on board ROSAT. "We've lost very little", says Harris.

The cause of the initial failure is still unknown, but Pounds suspects that it might have been connected with a very large solar flare and an associated surge of protons on the same night. Harris says that there is no firm idea about the cause. Meanwhile, scientists are deciding whether to risk resuming operations or to wait for a time — possibly a period of weeks — for new software protocols to be designed and tested. ROSAT's viewing timetables are scripted to the second, so compromise is unlikely: either it works fully or not at all. The DSN could be used to cover the 16-hour gap as a safety measure, but even with the help of Goldstone and the DSN's Canberra antenna, there would still be a gap of 8 hours that Harris says is "too long for comfort".

Pounds echoes the mood of caution that has descended on Garching. "It's absolutely right that the Germans are taking a cautious approach", he says, in case the problem strikes again. As it was, luck and prompt action saved the DM560-million satellite: just hours later, the batteries would have expired, bringing the mission to an irrevocable close. **Henry Gee**

■ Next week (14 February), *Nature* will publish the first X-ray pictures of the Moon, taken by ROSAT.

RADIOACTIVE MATERIALS

New UK road rules

London

BRITISH controls over the road transport of radioactive materials will be overhauled if a private member's bill, now being debated by a House of Commons committee,

becomes law. The bill's sponsor, Conservative Member of Parliament Dudley Fishburn, says the movement on Britain's roads of some 500,000 shipments of radioactive isotopes each year (mostly used in medicine and non-nuclear industries) is effectively unregulated, relying on an outmoded 1948 Act of Parliament.

Strict regulations on the packaging, labelling and handling of radioactive substances will follow if the bill is passed, to bring UK law in line with standards laid down by the International Atomic Energy Agency. Britain agreed to enforce these standards by 1990, but an attempt last year to introduce a law failed, after argument over whether the bill applied to Northern Ireland. Fishburn expects no similar problems this time around. Peter Aldhous

GENE THERAPY

Cancer trial starts

Washington

THE first clinical trial to use gene therapy to treat cancer began last week at the US National Institutes of Health (NIH) with the treatment of two patients, a 29-year-old woman and a 42-year-old man. The team of NIH researchers, led by Steven Rosenberg of the National Cancer Institute, plans to treat up to 50 terminally ill cancer patients who have malignant melanoma, an advanced form of skin cancer.

This latest trial builds on Rosenberg's earlier gene transfer experiments in which he showed that tumour infiltrating lymphocytes (TILs) — cells with anti-tumour activity — that were isolated from the patient's tumour, marked with a gene for neomycin resistance and readministered to the patient, 'homed' to the tumour site. About half the patients with advanced melanoma that were treated with gene-modified TILs showed some improvement after therapy.

Now, Rosenberg is attempting to use TILs as vehicles to deliver to the tumour site molecules that may enhance their anti-tumour activity. By inserting the gene coding for tumour necrosis factor (TNF) — a potent protein molecule that has been shown to cause the shrinkage of tumours in mice — into TILs, it is hoped to spark localized production of TNF at the tumour site at levels that will cause tumour regression.

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