articles

Simulating experiments for Spacelab

In June this year a number of flights were made in a NASA CV990 aircraft to evaluate designs for experiments to be carried aboard Spacelab from 1980 onwards. Here five of the groups involved describe what they achieved. NASA and the European Space Agency recently decided to carry out another similar mission next year.

Measurements of ozone and minor atmospheric constituents

THE instrument flown was an absolute spectrometric radiometer for the spectral range 3–40 cm^{-1}. Such an instrument on a space platform would be used to measure the cosmic background spectrum and to monitor atmospheric constituents. At aircraft altitudes the atmospheric emission prevents the first, and the scientific objectives set for the flights were therefore to explore the spectral assignments and concentrations of ozone and minor constituents of the atmosphere and in so doing to test developments of technique. Previous experiments had shown the need for improved techniques that would give a resolution of at least 0.01 cm^{-1} unapodised so that overlapping emission lines from different constituents are resolved, that would allow an interferogram to be recorded in no more than a few minutes because significant changes can occur in atmospheric conditions in such time intervals, and that would give measurements of emission in absolute terms in order to make possible quantitative estimates of constituents. The changes required in the instrumentation[1] to give these improvements were the introduction of a fast data acquisition system, the adoption of the polarised interferometric method both to suppress the effects of signal fluctuations and to allow continuous reference to a cooled black-body calibration source[2,3], and the incorporation of greatly improved germanium bolometric detectors (P. A. R. Ade and S. El-Atawy, personal communication).

At the altitude of the aircraft (up to about 39,000 feet) there was appreciable atmospheric water vapour. Nevertheless, most of the spectra were recorded at an elevation of no more than 14° to give a long path for the minor constituents. The aircraft was, during most flights, close to the tropopause (high at that time of the year) and it would have been unproductive to take measurements over a range of elevation angles so as to give limb-scanning information on the vertical structure of the atmosphere (though a suitable input mirror system had been incorporated for this purpose). It was, however, essential to have a servo-controlled input mirror, taking its drive from the aircraft's intertial guidance system to maintain constant elevation during the recording of an interferogram.

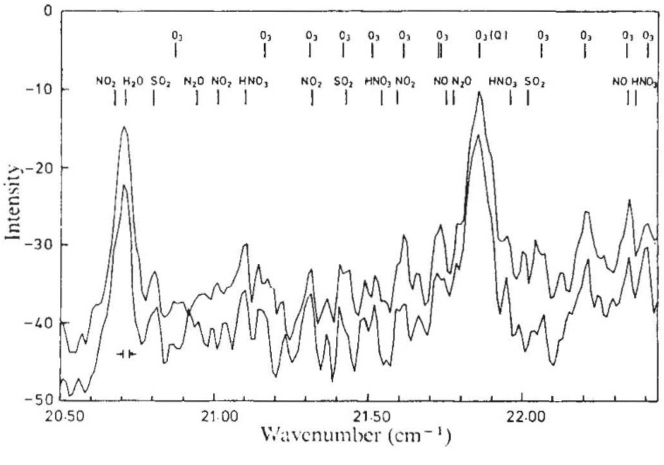

Fig. 1 Parts of two of the emission spectra.

The emission was continuously compared with that from a black-body cavity; to give absolute calibration two black-body cavities were used, one at ice temperature and the other at liquid-nitrogen temperature. More than 100 interferograms were recorded, and even though the analysis is not yet complete it is clear that the new techniques were successful. To illustrate this, Fig. 1 shows small parts of two of the emission spectra, relative to the ice black body. The interferogram for each was recorded in 8 min and the spectrum obtained covers the range 3–40 cm^{-1}, of which only the part from 20.5 to 22.5 cm^{-1} is shown. The Fourier transform was linearly apodised to give a resolution of 0.02 cm^{-1}. One of the spectra is displaced upwards to avoid overlapping. Both were obtained at an altitude of 33,000 feet and at an elevation angle of 14°; they were recorded successively. It can be seen that most features are reproduced in the two spectra. The positions of lines of possible constituents of the atmosphere are marked at the top of Fig. 1, as derived from theoretical calculations and laboratory measurements (J. W. Fleming, private communication).

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1 Beckman, J. E., and Harries, J. E., *Appl. Opt.*, **14**, 470 (1975).
2 Martin, D. H., in *Infrared Detection Techniques for Space Research* (edit. by Manno, V., and Ring, J.), (Reidel, Dordrecht, 1972).
3 Carli, B., *IEEE Trans. MTT*, **22**, 1094 (1974).

Photography and photometry of the near infrared OH airglow

WE are able[1] to photograph the near infrared OH airglow, and the ASSESS mission allowed us to carry out: (1) horizontal parallax measurements of airglow features over a wide geographic range, using the plane's motion to generate a baseline; (2) photometry over a wide range in latitude and longitude to