NEAR INFRARED SPECTRA OF THE MARTIAN SURFACE

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Abstract
Near Infrared images and spectra were obtained using the United Kingdom Infrared Telescope (UKIRT), Mauna Kea. The data were obtained in August and September 2003 during the Martian opposition. Preliminary results are shown here.

Introduction
The near infrared spectra of Mars contain distinctive absorption features due to atmospheric gases, ices and surface minerals. By looking at Mars through appropriate wavelength ranges, global distributions of these component substances can be extracted for a variety of applications. A ground-based telescope whilst achieving a much lower spatial resolution than orbiting satellites, has instruments capable of obtaining a much higher spectral resolution at the wavelengths required.

Observations
Both spectra and narrow band images were obtained using the United Kingdom Infrared Telescope (UKIRT) and the UKIRT Imaging Spectrometer (UIST). Near-infrared narrow band images were obtained as a series of short exposures (to maximise seeing conditions) in 4 different filters (fig 2). The spectral scans were obtained between 1.4 - 2.5 μm with a spectral resolution of 960. Spectra were taken with the spectrometer slit oriented north-south and stepped in increments of 0.25 arcseconds along the east-west horizontal. The spectral data were stored as a *data cube* (Fig 1), which has two spatial (x,y) axes and one spectral (z) axis. Spectra can then be obtained from any spatial location on the Martian disk or an image can be produced from any wavelength range (fig 3-5).
Data was obtained on 5 nights between August 16th and September 5th 2003 (data shown here is from August 17th). The time lapse between the first observations and the last allowed for Mars to rotate with respect to Earth so that most of the Martian surface was mapped. During the observations the seeing conditions were excellent (about 0.35 arcseconds) allowing for a spatial resolution of down to 96.4km for spectral images (fig 3-5) and somewhat better for the narrow band images (fig 2).

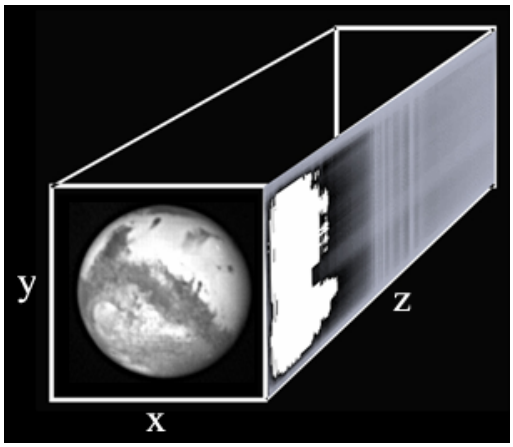

Fig 1

Fig 1: is the data cube configuration where y is the length and orientation of the spectrometer slit, x is the scan direction across the Martian disk and z is the near-infrared spectra from each slit position.

Results

Narrow Band Images

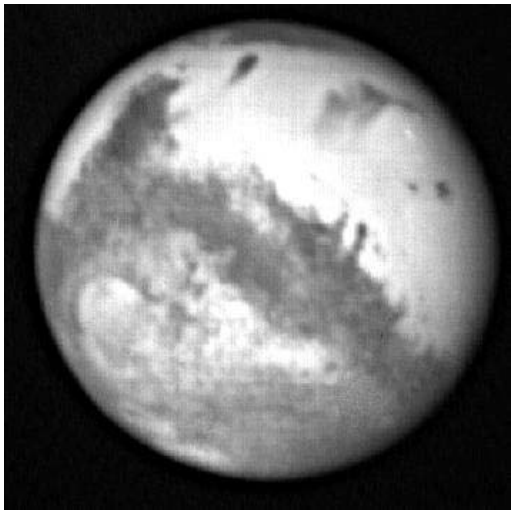
Fig 2

Fig 2: is a narrow band image at a wavelength of 2.12 μm. The image had an exposure time of 0.09 seconds and has been processed by unsharp masking to enhance low contrast features. Due to the excellent observing conditions on the night this image was obtained

and with the Martian disk being greater than 25 arcseconds due to our close approach, this may be the sharpest image of Mars yet taken from a ground-based telescope.

Spectral Images

The following images have been extracted from the spectral cube described previously.

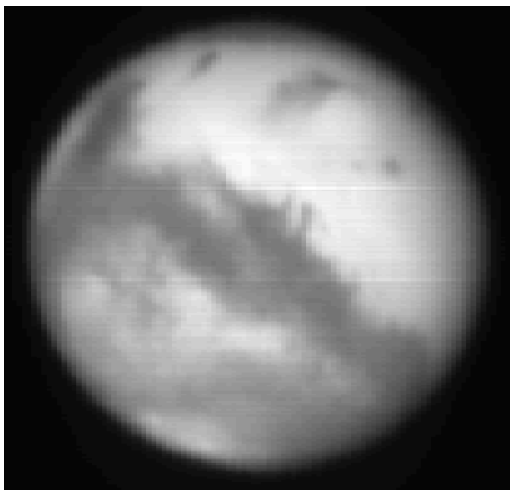

Fig 3

Fig 3: An image in the wavelength region 2.2-2.3 μm shows similar albedo marking as seen in visible light and narrow band images.

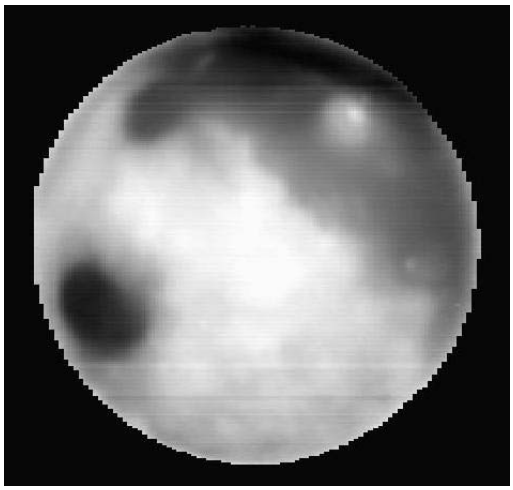

Fig 4

CO_2 Index Images (Fig 4): This image was created from the 2 μm CO_2 absorption line, and so show excess CO_2 absorption. Since the Martian atmosphere is 95% CO_2 the absorption strength of the line will depend on the amount of atmosphere it has travelled through. This image therefore, outlines the topography (higher regions are seen through less CO_2). The Hellas impact basin and Isidis Planitia are shown here as dark low-lying regions cutting into the bright southern highlands. Also Elysium Mons and associated uplift is visible as a bright region in the dark northern lowlands. Smaller features are also recognisable such as Apollinaris Patera as a bright spot in the East, just north of the highland/lowland boundary, this volcano was first discovered by a visiting spacecraft, yet it is clearly visible in the 2003 ground-based observations.

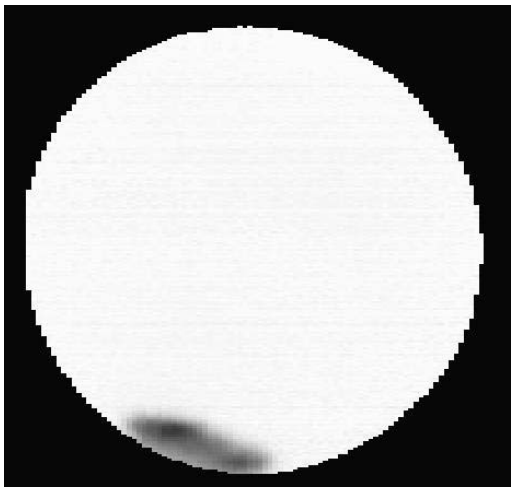

Fig 5

CO_2 Ice Absorption Image (Fig 5): This image was taken from the narrow CO_2 ice absorption band at 2.29 μm and shows a large concentration at the south pole (The north pole can not be seen with this orientation of Mars). When compared with a similar image obtained in September, polar icecap shrinkage due to the Martian southern spring is visible.

For further images see "Ground-Based IR Imaging Spectroscopy of Mars", Bailey J. *et al* also in these proceedings.

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