1971 MARINER MARS INTERFEROMETER SPECTROMETER (IRIS). R. A. Hanel, Goddard Space Flight Center (retired), Ann Arbor, MI., 734-913-2015, <rhanel@cwix.com>.

The success of identifying a mineral (Quartz) in the desert areas on Earth by an IRIS on the meteorological spacecraft Nimbus had raised our hope to do the same on Mars. However, as Mariner 9 arrived at Mars, a global dust storm was near its peak. The whole planet was engulfed by a dust cloud. The Martian spectra, although covering a wider spectral range than the Nimbus spectra, showed signatures of CO_2, water vapor and a wide, but relatively smooth feature of the dust suspended in the atmosphere. This feature appeared in emission in the south-polar and in absorption in the mid-latitude spectra. In the beginning, it was not even clear in what spectral range and to what extent emission from the surface emerged.

The dust features did not resemble the familiar quartz characteristic, nor that of any of the laboratory spectra of powdered minerals available to us. At that time, all we could say was that the feature had a broad maximum at about 1100 cm^{-1}. Available mineral spectra showed a general pattern of shifting the absorption maxima towards higher wavenumbers with increasing silicon content. Using this relationship, we concluded that the silicon content of the dust cloud was relatively high (about 60%). This indicated that Mars had differentiated into a core and a mantle. Before that time, this was not known.

The absence of sharp features in the dust spectrum indicated also the likelihood that several minerals were involved, each one filling transmission gaps of the others. Subsequently, many suggestions were made concerning the dust composition, but none seems to fit the data very well. The ideal solution would require the application of the Mie-Theory, but, as far as I know, this has not yet been accomplished. The main reason is probably the lack of information on the complex refractive index as a function of wavenumber for many possible candidates for the dust.

As time progressed, the atmospheric dust settled more and more to the ground and the surface was exposed, although it remained unclear to what degree residual dust still was in the atmosphere and to what degree the dust now on the surface obscured genuine mineral signatures. The spectra taken late in the life of Mariner 9 resembled more and more the shape of a blackbody. Strong emissivity signatures have not been apparent. The relatively large field of view of IRIS, combined with the highly elliptical orbit of Mariner 9, resulted in spectra averaging over large areas, often several thousand square kilometers. This may have further reduced the chance of seeing pronounced emissivity features.

An exception to this is the appearance of a hematite feature, first seen by TES, but also found later in IRIS spectra. This shows that further examination of the IRIS spectra, specifically of those in the latter part of the mission, may still be worthwhile.

A south polar-spectrum showed a mixture of dark and bright areas. Ignoring the gaseous CO_2 and water bands as well as the dust signature, one could fit the spectrum well with a superposition of two blackbodies, one with a temperature of about 140 K and a second one with 235 K. The relative strength of the blackbody spectra was in agreement with the areas of bright and dark surfaces observed simultaneously by the Imaging System for the IRIS field of view, suggesting the colder surface to be CO_2 ice and the warmer exposed soil after the ice had

evaporated. This was clear evidence that the south-polar cap was CO_2 and not water ice. Spectra of the north-polar cap led to the same conclusion.

IRIS also identified the so called W-cloud to be water ice. Vertical profiles of atmospheric temperatures lead to east-west profiles of wind speed, indicating a strong circumpolar jet in the southern hemisphere. The general trade-off between spectral and spatial resolution and Signal-to-Noise ratio will be discussed too.

IRIS instrument parameters:

Spectral Range	200 - 2000 cm^{-1} (5 - 50 μm)
Spectral Resolution	2.4 cm^{-1}
Field of view	circular, 4.5 degrees full angle
NESR	3 to 5 x 10^{-8} $W/(cm^2\ sr\ cm^{-1})$