11.05

Synoptic Observations of Mars using the Hubble Space Telescope: Second Year

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Hubble Space Telescope observations of Mars during 1993-1993 commenced on May 30, 1992 (L_s = 259) and continued until June 16, 1993 (L_s = 93). Most of the sequences were designed specifically to repeat coverage at the identical seasonal dates observed during the first year of HST observations (James et al., 1993) in order to document interannual variations in atmospheric and surface features.
The period of observations includes the summer dust storm season in the south (reported at 1992 DPS), the winter north polar hood, and the north cap recession and orographic cloud development of northern spring. These phenomena will be discussed in the context of the 1992-1993 observations. Interannual variability will be investigated through comparison of these phenomena during the two years. The background dust opacity history, deduced from modeling with a radiative transfer code, will be compared to that previously determined for 1990-1991.

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11.06

Mars Apparition of 1992–93: CCD Imaging from HST and Ground-Based Telescopes

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CCD cameras have become standard imaging tools for Mars observations, not only from the Hubble Space Telescope (HST), but also from many telescopes that remain Earthbound. These include some sophisticated, although moderately priced, CCD systems obtained by serious amateur observers. Although the results do not have resolutions that are comparable to Mars orbiting spacecraft, this data does afford whole-hemisphere formats during each single exposure, giving us complete views of major weather systems. This data can also provide monitoring of weather and albedo changes during periods, like the present, when no working spacecraft is at Mars.

The HST images are superior to the best ground-based images, and the best ground-based images are obtained less than 1% of the available time. On the other hand, time on HST for Mars observations has naturally been limited. Earlier HST observations of Mars have shown that useful images can be aquired even when its apparent diameter is at its smallest size. The only physical limitation on observations is the HST restriction that Mars must be at least 50 degrees from the sun. This covers roughly one-half of a Martian year.

At Lowell Observatory, a telescope and CCD system were dedicated to these Mars observations. Bad weather was a major problem, eliminating any chance for contiguous observations and allowing for only a handful of reasonably useful images. On nights that were clear, the atmospheric turbulence was usually extreme. During this period, Flagstaff experienced several times its normal precipitation for the season.

In Miami, Beish and Parker were still recovering from Hurricane Andrew. Although their telescopes were not damaged, their "domes" required extensive rebuilding. Nevertheless, Parker intermittently obtained good Mars images, beginning in July 1992.

Using the above sources, together with data gathered by Beish of the International Mars Patrol (ALPO) and by R. McKim of the British Astronomical Association, we can piece together much of the activity of the apparition. This is still not as complete as data from the International Planetary Patrol network of 1969 through 1978.

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11.07

First Observations of the Martian Atmosphere from the Mars Observer Thermal Emission Spectrometer Experiment.

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The Mars Observer Thermal Emission Spectrometer (TES) experiment will study the surface and atmosphere of Mars. The instrument has three 2x3 arrays of detectors: broadband solar (0.3-2.7 μm), broadband thermal (5.5-100 μm), and spectrometric (200-1600 cm^{-1}, at selectable 5 and 10 cm^{-1} resolution). Full disk measurements of the planet will be made in early August, 1993. At this time L_s=115°, near the time of maximum water vapor abundance in the north polar region. The signatures of atmospheric H_2O, CO_2, and dust are expected to dominate the spectrum. The data will be discussed in the context of atmospheric science.

11.08

Mariner 9 IRIS Revisited: Mars Observer or Bust

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In preparation for the Mars Observer mission and the return of tens of thousands of infrared spectra per day from the Thermal Emission Spectrometer (TES), we have developed a fast inversion algorithm to retrieve temperature structure and aerosol opacity from Martian infrared spectra. As a test of our algorithm we are undertaking a systematic analysis of the entire Mariner 9 Infrared Interferometric Spectrometer (IRIS) dataset of 21,000+ spectra. While portions of the IRIS dataset have been previously analyzed, the lack of a speedy and robust algorithm to invert the IRIS spectra to retrieve temperature profiles and aerosol opacities has been a major impediment to a truly comprehensive analysis.

Independent temperature profiles are obtained by separately inverting the two sides of the 15 μm (667 cm^{-1}) band (P and R branches). In the absence of any other atmospheric opacity, these profiles should be identical to within the rms error resulting from measurement noise propagation (1-2K) and uncertainties in the CO_2 absorption properties. However, in practice, additional wavenumber dependent extinction due to absorption and scattering by atmospheric aerosols causes the retrieved P and R branch profiles to differ. These differences are exploited to assist in deriving information on opacity resulting from the presence of the particulates. Additionally, the simultaneous analysis of IRIS spectra of the same geographic location, but different viewing geometries, is used in the characterization of the optical properties of airborne particulates. Preliminary results for temperature profiles and aerosol opacities will be presented.

11.09

Ground-Based Monitoring of Martian Atmospheric Opacity

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The amount of dust in the Martian atmosphere is variable in both space and time, and complicates quantitative analysis of Martian surface properties. Dust storms have been observed telescopically for almost 200 years, and are known to have major effects upon the structure and