# Meridional Mapping of Mesospheric Temperatures from $CO_2$ Emission along the MGS Ground Track

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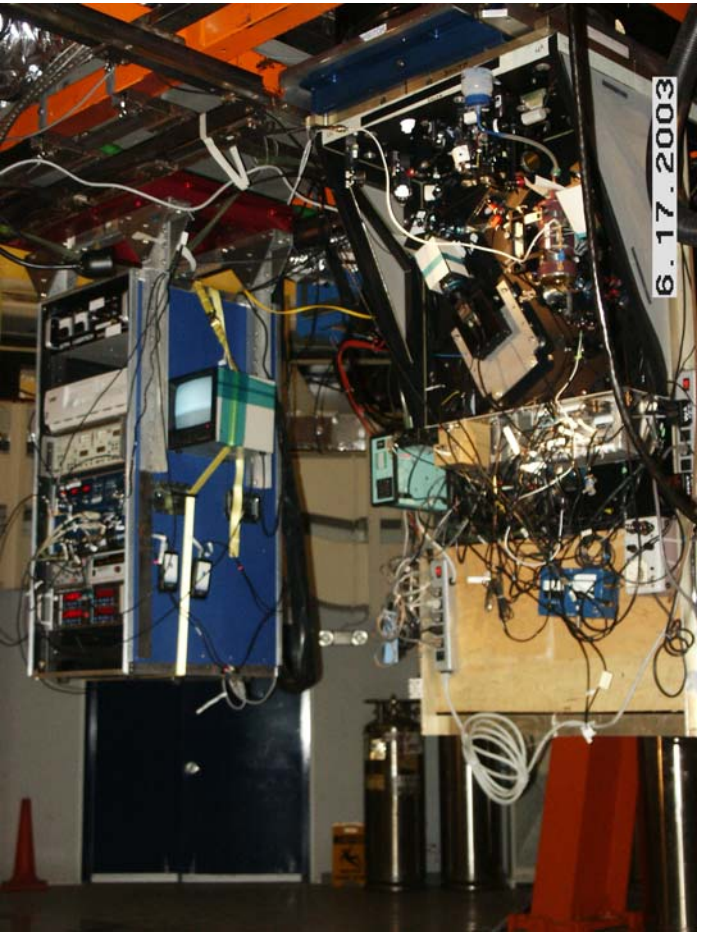


HIPWAC on the IRTF

Observations were made with the Heterodyne Instrument for Planetary Wind And Composition (HIPWAC), an instrument built at the Goddard Space Flight Center. This instrument uniquely provides a resolving power of $10^6$ at 10 microns.

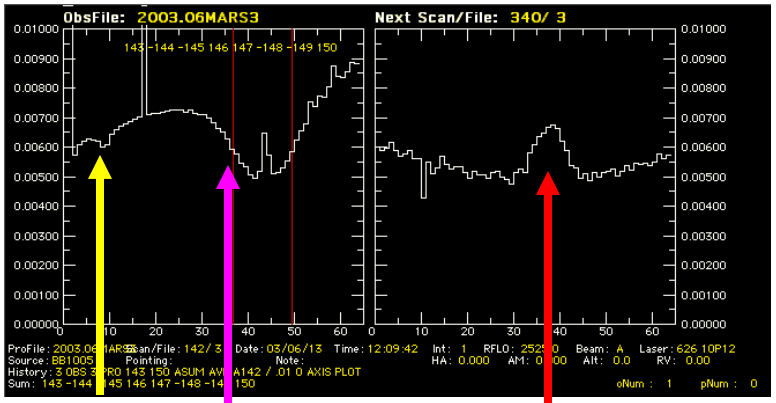
This allows:

- Measurement of gas velocities (winds) to ~2 m/sec from Doppler shifts of emitted spectral lines.

- Retrieval of atmospheric temperature and molecular abundance from true line shapes.

The observations presented here were obtained on 4 nights in June 2003. $CO_2$ hot band and non-thermal (lasing) transitions were observed. This provided constraints on tropospheric temperature profile. Observations were also obtained along the Mars Global Surveyor ground track, allowing for direct comparison of the ground-based and spacecraft measurements.

951.192 $cm^{-1}$ P12 $CO_2$ at 30° S

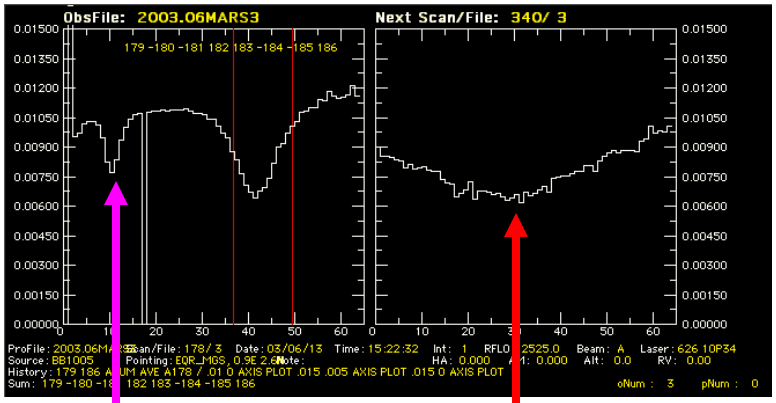



$^{16}O^{12}C^{18}O$

Non-Thermal Emission Core

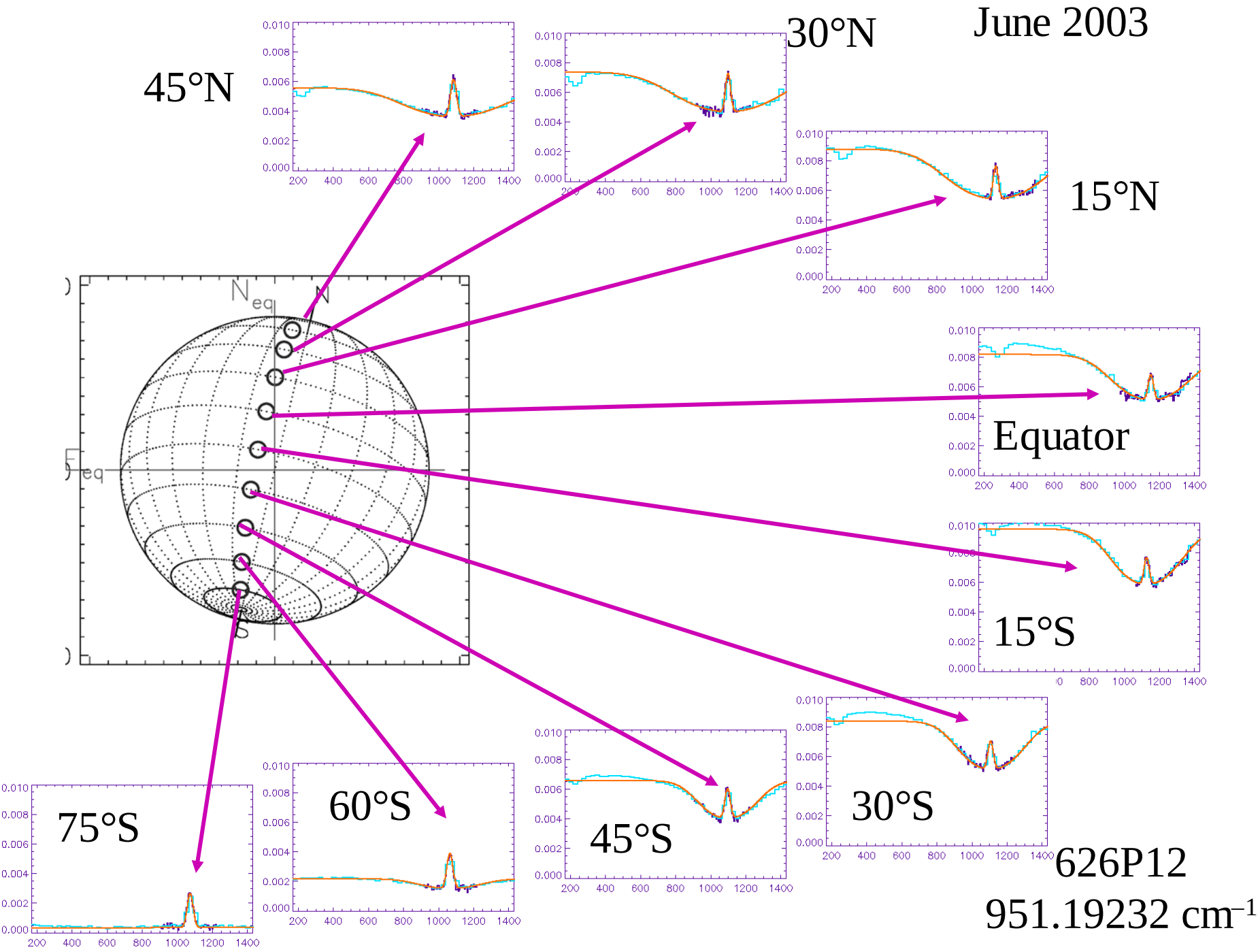
Tropospheric Absorption Feature —
flat-bottomed due to stratospheric self-emission

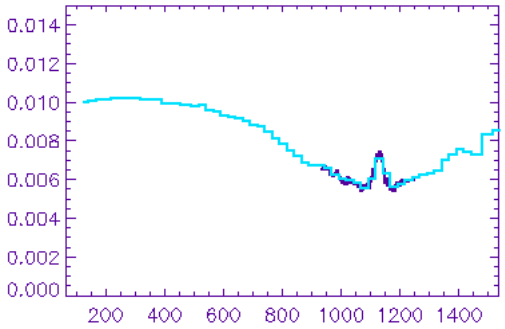
931.001 $cm^{-1}$ P34 $CO_2$ at Equator




No Emission Core

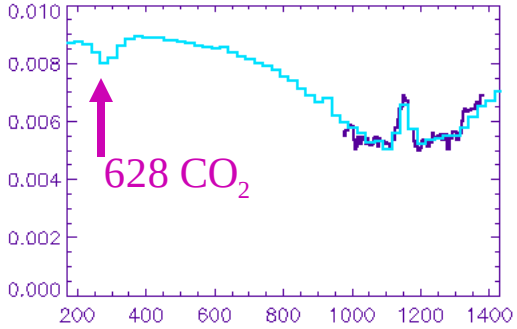
Tropospheric Absorption Feature —
$CO_2$ Hot Band Transition


June 2003
45°N
30°N
15°N
Equator
15°S
30°S
45°S
60°S
75°S
626P12
951.19232 cm⁻¹



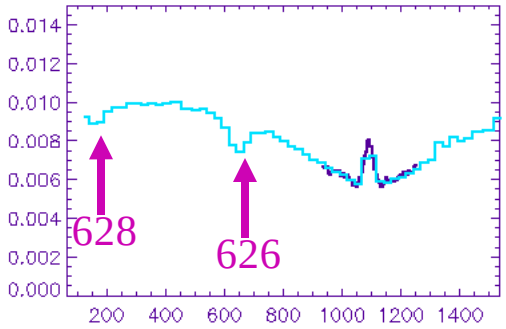

626P8

954.54498 $cm^{-1}$




626P12

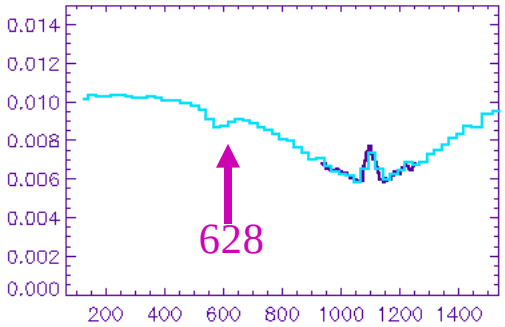
951.19232 $cm^{-1}$




626P14

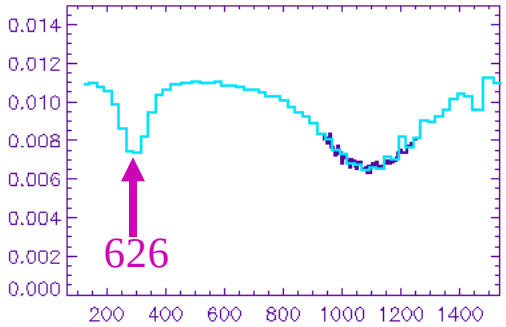
949.47900 $cm^{-1}$

# Hot-Band and Isotopic $CO_2$ Transitions at the Equator



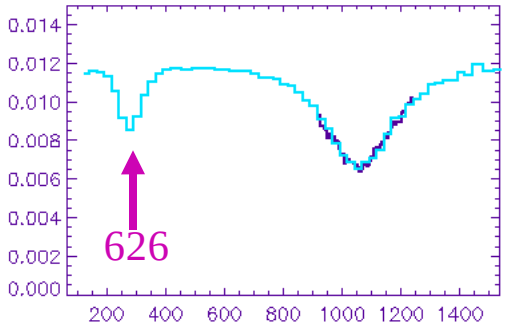

626P16

947.74200 $cm^{-1}$




626P28

936.80402 $cm^{-1}$




626P34

931.00098 $cm^{-1}$

Note: 626 = $^{16}O^{12}C^{16}O$, 628 = $^{16}O^{12}C^{18}O$

## *Relevance to current research on Mars:*

1. Mission support. IR heterodyne spectroscopy of Mars supports the Mars Global Surveyor, Mars Odyssey, and Mars Exploration Rover missions that currently are exploring Mars. The flight missions do not support high spectral resolution, so HIPWAC provides an important test of atmospheric properties inferred from flight instrumentation.

2. Mesospheric probe. The non-thermal emission by $CO_2$ in Mars' mesosphere (~65 km and higher) provides information on temperature and energy balance in this region. An understanding of the physical processes in the mesosphere is important in deducing how the atmosphere of Mars evolved from its primordial condition to the present.

3. Unique phenomena. Non-thermal emission by carbon dioxide in the upper atmosphere is a property unique to the Earth-like terrestrial planets in our solar system. (Whether the Earth itself exhibits similar phenomena is unknown.) Non-thermal emission from extrasolar planets may be a useful tool in the future.