Understanding the martian upper atmosphere with the MGS Accelerometer

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The structure and dynamics of the martian upper atmosphere are not well understood. Analyis of recent MGS data will improve our understanding of them. This improved understanding can then be applied to other atmospheres. It is also critical for the success of future missions using aerobraking.

MGS aerobraking data, collected primarily for operational reasons, will soon be available for general scientific use via the PDS. Data was collected near the periapsis of each aerobraking pass. Periapses occurred at a range of altitudes, latitudes, longitudes, seasons, and local solar times. Each aerobraking pass returned a few hundred seconds of data, revealing upper atmospheric densities along a track which extended 10s of degrees south and north of periapsis and from approximately 160 km down to 110 km at periapsis, then back up to 160 km. Changes in longitude, season, and local solar time were negligible during any individual aerobraking pass as the spacecraft was in a near-sunsynchronous orbit.

Preliminary data analysis reveals that zonal mean densities are not well predicted by current models and that densities measured at essentially fixed latitude, local solar time, and season vary by factors of a few with longitude. This zonal variation is stable from orbit to orbit (timescales of a few hours) and on timescales of a few weeks. Changes with altitude, latitude, season, and local solar time could be studied in a perfect data set. This zonal variation is believed to be caused by atmospheric tides. Tidal modes exist in the martian atmosphere with a variety of temporal and spatial frequencies. Many alias to a longitudinally-fixed structure when viewed by a sun-synchronous observer like MGS.

We will discuss:

Observations of day-to-day variability, or weather, which is unpredictable and uncharacterizable in current and near-future models.
Stability and vertical propagation characteristics of the various harmonics making up the zonal structure.
Seasonal and latitudinal variations in the zonal structure.
Variations with time of day in the zonal structure and in its day-to-day variability.
The underlying tidal oscillations of the atmosphere.
LPL involvement in Mars Odyssey aerobraking in autumn 2001.