

EARTH-BASED RADIO OBSERVATIONS OF THE PLANET MERCURY

M.J. Ledlow¹, J.O. Burns¹, J.H. Zhao¹, G. Gisler², M. Zeilik¹,
D. Baker³

¹Institute for Astrophysics, Department of Physics and
Astronomy, The University of New Mexico, Albuquerque,
New Mexico 87131

²Los Alamos National Laboratory, Los Alamos, N.M. 87545

³NASA, Goddard Space Flight Center, Greenbelt, Maryland
20771

Mercury is the least studied of the terrestrial planets and very little is known of the interior properties. Mercury has an average day-side surface temperature of 630 K and a night-side surface temperature of 100 K. It's eccentric orbit ($e=0.2$) is constrained in a 3/2 spin-orbit resonance. Local noon occurs at longitudes 0 and 180 degrees at perihelion passage. Because the sidereal rotation rate is constant but the orbital speed is a maximum, the sun appears to hover overhead at these longitudes. This results in excessive heating along the equator in the form of hot poles. Our current observations are the first to map these poles.

We observed Mercury on July 6th 1986 and on February 2nd and 23rd of 1988 at the Very Large Array (VLA) Radio Telescope near Socorro, New Mexico. Observations on both dates were made at wavelengths of 2 and 6 centimeters. In observing Mercury at radio wavelengths, one is able to probe the long-term heating at subsurface layers corresponding to the electric skin depth at the frequency of observation. We estimate skin depths of 20 and 70 centimeters for the wavelengths 2 and 6 centimeters respectively.

Figures 1 and 2 are the final VLA maps and theoretical models for the two dates of observations in 1988. The resolutions of the maps in figure 1 are 0.4 arcsec and 1.0 arcsec for 2 and 6 centimeters respectively. In figure 2, the resolutions are 1.0 arcsec and 2.5 arcsec respectively. The model assumes simple blackbody reradiation from subsurface layers. Based on the insolation history of the planet, observed temperatures are calculated from equilibrium values at a subsurface depth at which the temperature ceases to vary with time. We assume that this depth is close to the skin depth at radio wavelengths. We note the close general agreement between model and observations for the February 2nd maps. However, the generated model for February 23rd fails to accurately predict the relative intensities of the two hot poles, thus showing a considerable departure from the simple blackbody treatment. We suggest this as evidence for thermal inertia in the subsurface material. This may also explain the edge-brightening seen on the primary hot pole. Further modeling and investigation of the mottling structure on the high-resolution 2cm map is in progress.

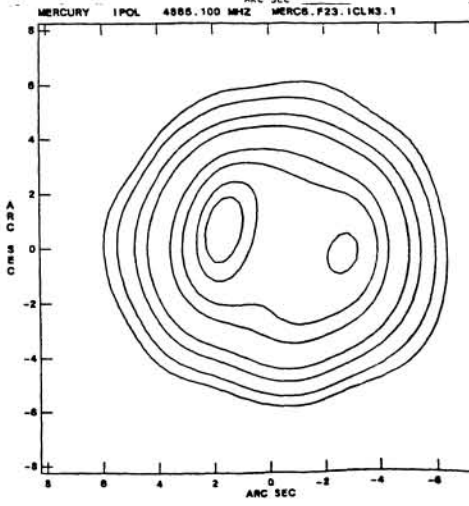
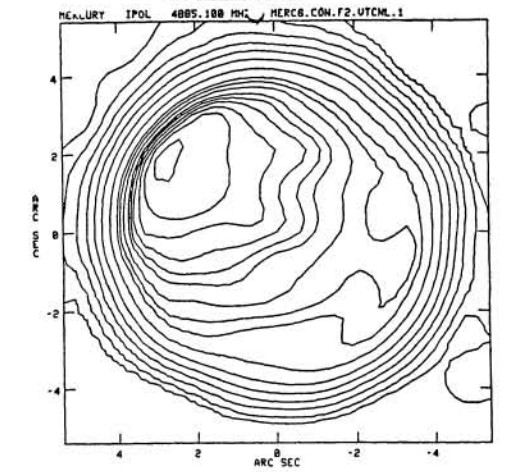
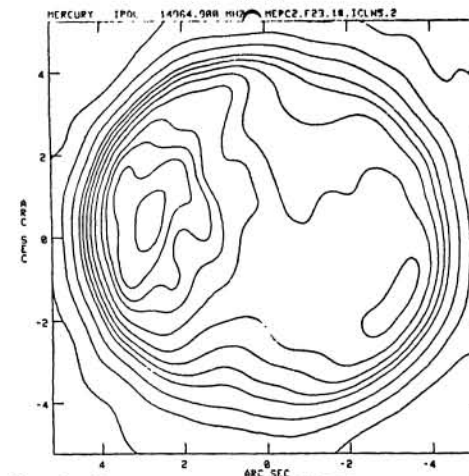
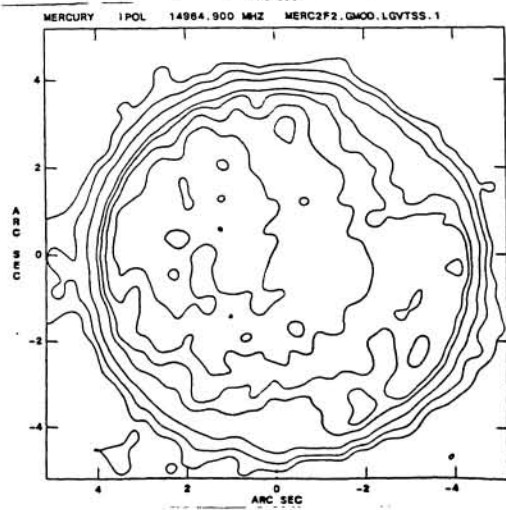
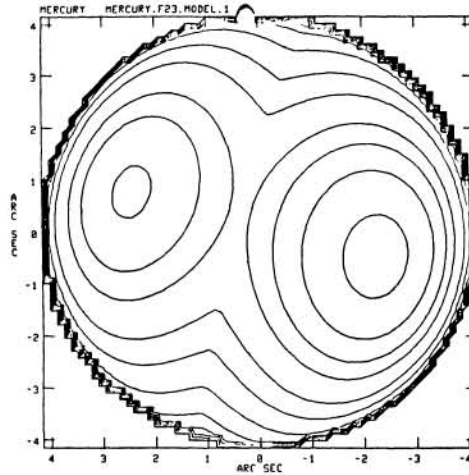
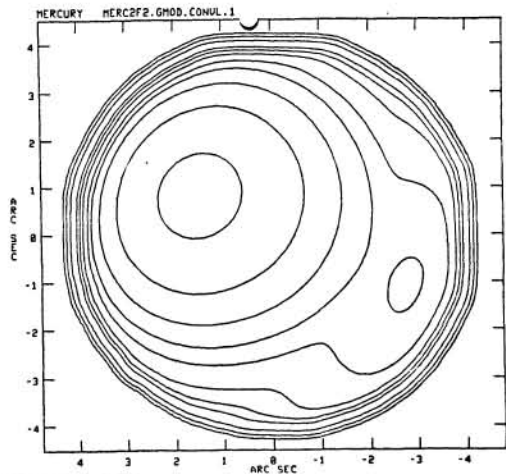


Figure 1 February 2nd maps.
From top; model, 2cm map,
6cm map.

Figure 2 February 23rd maps.
From top; model, 2cm map,
6cm map.