Using Cassini UVIS Data to Constrain Enceladus’ Libration State
T.A. Hurford, P. Helfenstein, C. Hansen

Given the non-spherical shape of Enceladus, the satellite may experience gravitational
torques that will cause it to physically librate as it orbits Saturn. Physical libration would
produce a diurnal oscillation in the longitude of Enceladus’ tidal bulge, which could have
a profound effect on the diurnal stresses experienced by the surface of the satellite.
Although Cassini ISS has placed an observational upper limit on Enceladus’ libration
amplitude, small amplitude librations may have geologically significant consequences.
For example, a physical libration will affect heat production along the tiger stripes as
produced by tidal shear heating and a previous study has explored possible libration
states that provided better matches to Cassini CIRS observations of heat along the tiger
stripes.

Cassini UVIS stellar occultations provided measurements of the column density of the
Enceladus plume at two different points in Enceladus’ orbit and find comparable column
density values. This column density may be a reflection of the amount of the tiger stripe
rifts in tension and able to vent volatiles and a physical libration will also affect the
fraction of tiger stripe in tension at different points in the orbit. We have modeled the
expected fraction of tiger stripes in tension under different libration conditions. Without
libration the amount of tiger stripe rifts in tension at both points in the orbit would not be
comparable and therefore may not allow comparable amounts of volatiles to escape.
However, we identify libration conditions that do allow comparable amounts of the tiger
stripes to be in tension at each point in the orbit, which might lead to comparable column
densities. The librations identified coincide with possible librations states identified in
the earlier study, which used Cassini CIRS observations.