Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS03-02 Room:202 Time:May 20 14:30-14:45

Determination of the normal modes of the Moon's libration

Nicolas Rambaux[1*], James Williams[2], Dale Boggs[2]

[1]University Paris 06, IMCCE, Observatory of Paris, [2]Jet Propulsion Laboratory, California Institute of Technology

The Lunar Laser Ranging experiment has been active since 1969 when Apollo astronauts placed the first retroreflector on the Moon. The data accuracy of a few centimeters, over a time-span of several decades, along with the numerically integrated ephemeris, DE421, encourages analysis of the lunar physical librations, and especially the detection of three modes of free physical librations (longitude, latitude, and wobble modes). This analysis was performed by using iteratively a frequency analysis and linear least-squares fit of the wide spectrum of DE421 Moon's physical librations. From this analysis we identified and estimated about 130 terms in the angular series for latitude librations and about 70 terms in the longitude angle and polar coordinates. In this determination, we found the non-negligible amplitude of the three modes of free physical libration. The determined amplitudes become 1.296" in longitude (after correction of two close forcing terms), 0.032" in latitude and 8.196" X 3.312" for the wobble, with the respective periods of 1056.13 days, 8822.88 days (referred to the moving node), and 27257.27 days. The presence of such terms, despite short damping times of 104 to 106 yr, suggests the existence of some source of stimulation acting in geologically recent times.

Keywords: Libration, Moon