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Lunar ranging experiment ephemerides and the reduction of observations (summary only)

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The generation of a lunar laser ranging ephemeris uses numerical integrations of the lunar orbit and physical librations and a data fitting procedure. The relativistic equations of motion for the nine planets and the Moon are simultaneously integrated with perturbations on the lunar orbit from zonal harmonics of the Earth through degree four, lunar tesseral harmonics through degree and order three, and a tidal bulge on the Earth. The integration of the lunar rotation follows from the torques of the Earth and Sun on a solid body Moon with gravitational harmonics through degree and order three. The fitting program utilizes the integrations of the orbit and physical librations, nominal values of U.T. 1 and polar motion from the Bureau International de l'Heure, and includes corrections for atmospheric delays, nutations of the Earth's pole taken to the body axis, solid body Earth tides, monthly and bimonthly tidal corrections in U.T. 1, and relativistic clock transformations. Not only do the fits give new starting conditions for the orbit and libration integrations but improved observatory and retroreflector coordinates, the mass ratio Sun/(Earth + Moon), and harmonics of the lunar gravity field.