GENERAL DISCUSSION

Shelus : There has been a great deal of discussion about the
   comparison of new analytical models of the lunar orbit with one
   another and with numerical integrations. Is there any progress
   towards comparing them with observations, as Eckhardt has done
   for the librations ?

Henrard : Are the libration comparisons made with the observations
   themselves, or with numerical integrations ?

Eckhardt : They are made with numerical integrations that have been
   fit to the data.

Chapront : If we compare to observation, we have to introduce the
   motion of the Earth, the librations, etc. It is probably too early
   to fit analytical solutions directly to the data.

Yatskiv : Dr. King has tried to explain the low Q of the Moon with a
   linear oscillator model, and I do not believe that this is a valid
   method. What is Q ? It is the ratio of energy dissipated to all
   energy, and by analogy with the Chandler wobble, it includes
   processes at the core-mantle boundary and within the mantle. Such
   a simple model will surely give a Q that is too low. There must
   be an analysis of spectra. The Chandler motion gives a Q of 60
   for Earth, but core-mantle dissipation gives Q = 1000.

Eckhardt : King's value applies only to 1-month periods. If you want
   to apply it to other modes, such as the free libration, then you
   must find some way to extrapolate it. The work is based on Q being
   inversely proportional to frequency, so that implies higher values
   at longer periods. Also, the free libration Q is not quite as you
   defined it. It is the ratio of the energy dissipated in one cycle
   to the total energy in the elastic modes only, the elastic oscillation
   towards and away from the Earth. The physical librational energy
   is another big fountain of energy, about 1000 times greater than
   the elastic energy, and so the Q for free and physical librations
   should differ by something like this factor.

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Shelus : Those who were here on Friday will recall that there were
   several presentations of Universal Time results from lunar laser
   ranging, and Martine Feissel wanted to see what they looked like
   on a common graph. A group of us tried that evening to do exactly
   that, without realising the problems in the task. The scales were
   different, the time spans also, and different groups had used or not
   used various sets of corrections, the most important being the UT
   tidal term. We produced a graph which we agreed be shown informally
   only, but it is of interest. The four sets of results have been
   put on the same basis, with one of them offset vertically by a
   fixed amount. The match is very good, despite the fact that there
   were four different lunar orbits and four different libration models
   used. If there had been only a two-way match, the chances of its

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being accidental would be very great, but having four fit so nicely
together surprised us. Later Martine Feissel plotted the
astrometric data on the same scale, and it also is in fairly
reasonable agreement. In fact, the matches are so good that some
of us are skeptical and we will return home to study the question
some more, before publishing any conclusion.

The participants in this comparison were Calame, Feissel, Fliegel,
Langley, Mulholland and Shelus.