# LLR/Interplanetary Session Summary

Jürgen Müller
Tom Murphy

# LLR/Interplanetary Session

- 1 talk in Canberra, 9 talks and 2 posters this year!

- Sergei Kopeikin: LLR Formulation
  - SSB frame ordinarily used in LLR analysis
  - any frame could be used (e.g., geocenter)
  - must be careful not to misinterpret gauge-dependent terms as unambiguous physical effects
- Tom Murphy: APOLLO
  - 2 years into campaign
  - LLR firmly in multi-photon regime
  - 1-mm level error estimates; no sign of excess scatter
  - fit to model imperfect, but APOLLO addressing lunar orientation to new degree of precision

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- Liliane Biskupek: LLR analysis
  - using 38-year LLR data to investigate earth orientation parameters (EOP)
  - some differences in nutation compared to MHB2000 (also seen by Jim Williams)
  - also looked at daily earth orientation to study UT1 and VOL
- Simone Dell'Agnello (for Currie): NG LLR reflectors
  - plans for sparse lunar reflector array, using large cubes
  - test new gravity paradigms (e.g., Dvali et al.)
  - 100 mm cube: careful control of thermal paths
  - anchor 1m into ground
  - testing cube at SCF in Frascati

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- Jan McGarry: LRO ranging
  - 28 Hz, sync to PPS, 8 ms earth gate each cycle
  - 1–10 fJ/cm$^2$ energy density limit
  - 10–30 sec “real-time” web confirmation of hits
  - ranging by arrangement, starting June 2009
- Anthony Mallama: LRO requirements
  - pointing, priority, software mods, timing capability
  - methods for verifying pointing (~3 arcsec demonstrated)
- Chris Clarke: Logistics
  - predictions (including point-ahead) in CPF format
  - plan to have weekly schedules

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- Jerrry Wiant: MLRS prep for LRO
  - achieve 1–2 arcsec pointing offset from crater
  - use Glonass to scan beam and understand divergence
  - no real hardware changes; almost all software
    - Randy's done that
- Maria Zuber: interplanetary ranging
  - can use to understand orbits, rotations, precession, asteroids, $J_2$ of sun, etc.
  - MESSENGER demo: 24 Mkm 2-way
  - MOLA 80 Mkm Earth to Mars 1-way
  - LRO is first planetary S/C with CCR array

# LLR/Interplanetary Posters

- Wasilla Zerhouni: LLR→celestial pole determination
- Tomasz Niedzielski: minimum duration for sea level rise determination

- And: Ukrainian frogs (not ducks) say: Quack