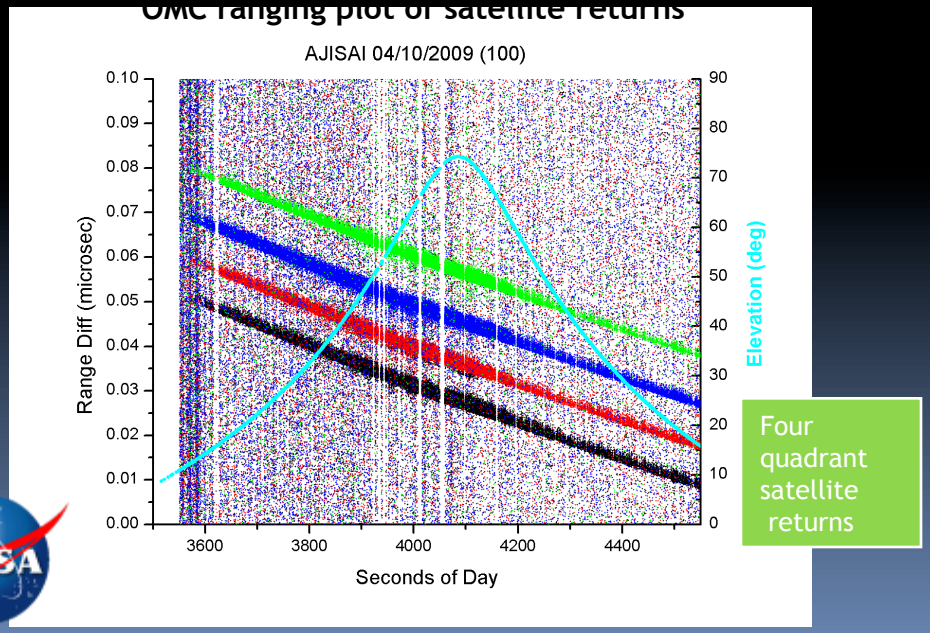
NASA's Next Generation Satellite Laser Ranging System (NGSLR)

Jan McGarry/NASA/GSFC/694

NGSLR is a high repetition rate single photon detection laser ranging system capable of tracking cube corner reflector (CCR) equipped satellites in Earth orbit. The concept of NGSLR was developed by J. Degnan (GSFC, retired) in the 1990s. Technical development continues at Goddard. The system has demonstrated tracking of Earth orbit satellites with altitudes from 300 km to 20000 km both day and night. Completion of the NGSLR prototype is occurring under the Space Geodesy Project.



System Features:

- 1 to 2 arcsecond pointing/tracking accuracy
- Track CCR equipped satellites to 20,000 km altitude, 24/7 operation
- Reduced ocular, chemical, electrical hazards
- Semi automated tracking features
- Small, compact, low maintenance, increased reliability
- Lower operating/replication costs

NGSLR achieves daylight ranging to GNSS with NASA mJ laser & high QE (40%) detector

- First successful daylight ranging to a GNSS satellite (GLONASS-109) from NGSLR on April 2, 2012 at approximately 7pm EDT:
  - Starting getting satellite returns immediately after laser turn-on
  - Pass started approx 30 minutes before sunset
  - Tracked for an hour – down below 35 degrees elevation
  - Strong enough pass for real-time signal processing to find much of the signal
  - System characteristics: daylight filter used, ~500 μJ/pulse transmit energy, ~6 arcsec laser divergence, 11 arcsec receiver field of view

- Second daylight GNSS (GLONASS-115) April 3, 2012 at ~ 2pm EDT:
  - Same system characteristics as above
  - Not as robust as first pass, but clearly visible satellite returns

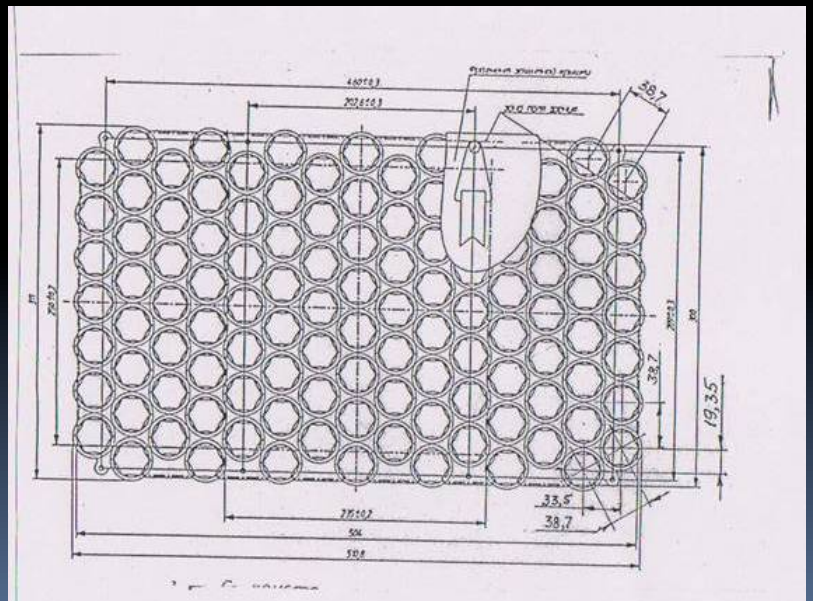
GLONASS Retro-Reflector Arrays

- GLONASS is Russian GNSS satellite.

- GLONASS-109 has 112 cube array with lower cross section (response) than recommendation from the International Laser Ranging Service (ILRS) for that satellite altitude.

- GLONASS-115 has same number of cubes, but uncoated, which provides for a somewhat higher response. Although also lower response than ILRS recommendation.

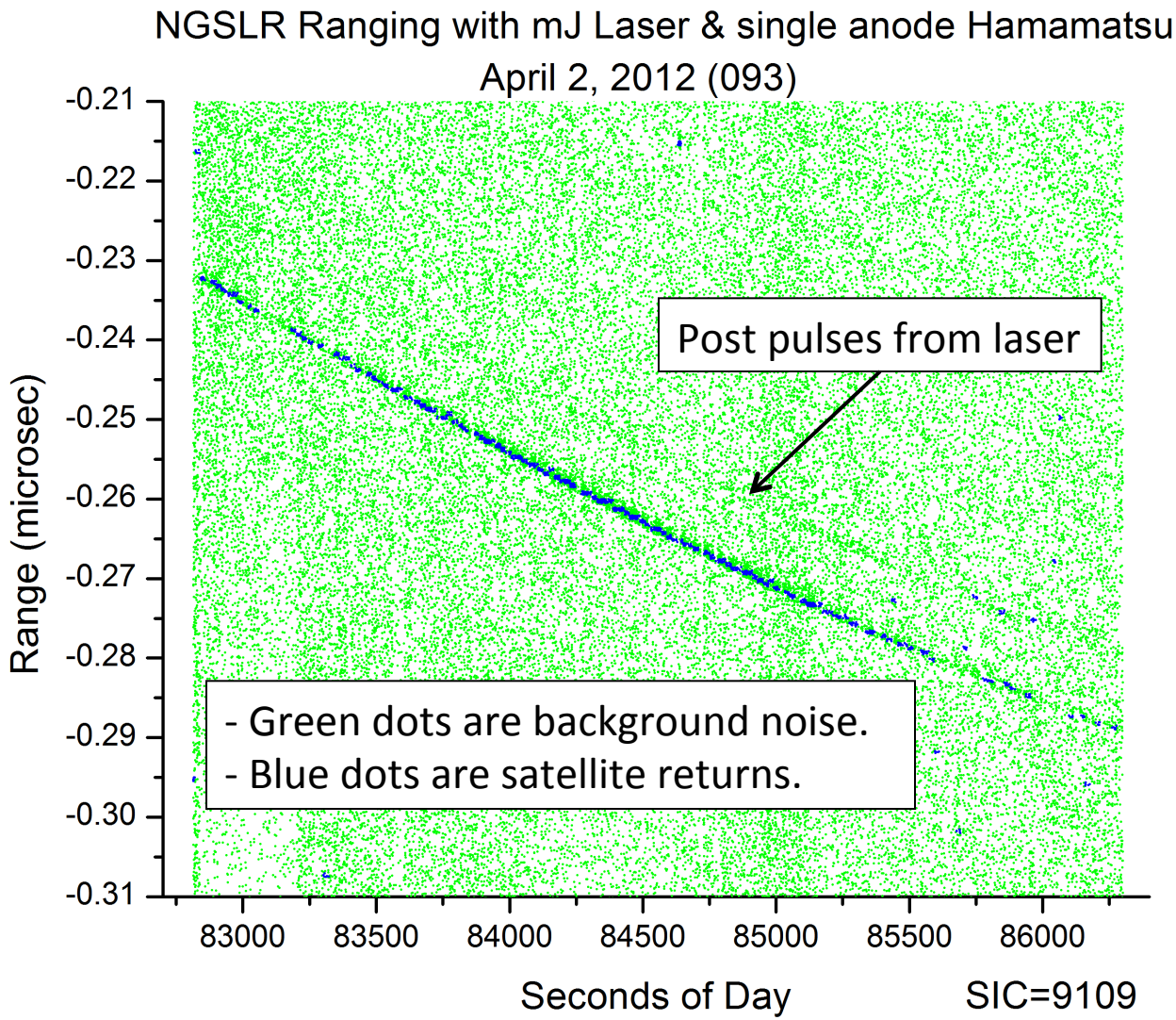
- GNSS satellites are difficult to track during daylight for most ILRS stations due to high altitude (> 20,000 km), modest retro-reflector response, and high background noise during day.



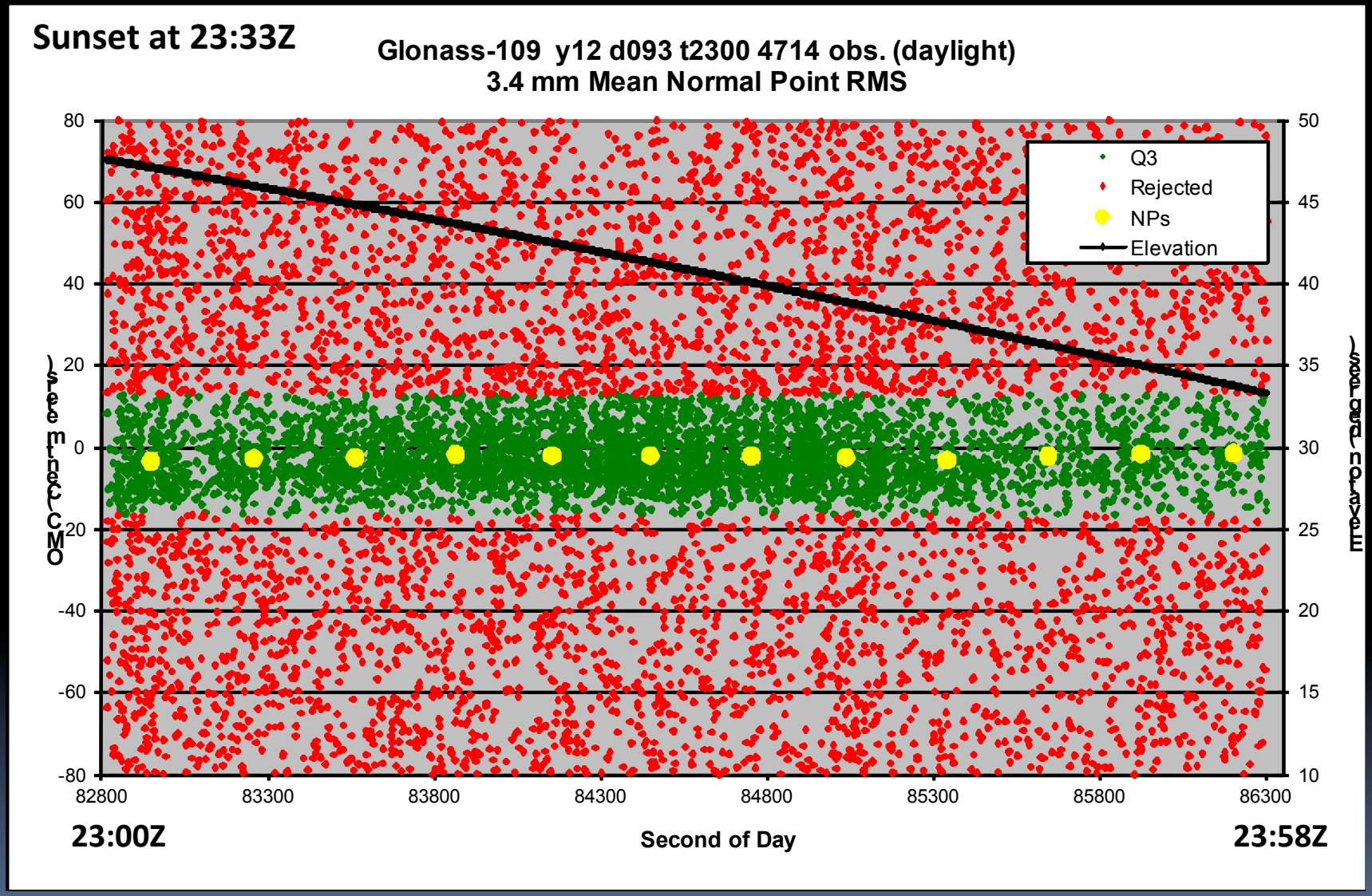
GLONASS retro-reflector array

Daylight Ranging to GNSS

Measured Minus Station Predicted Ranges



Daylight Ranging to GNSS: Normal Pts



NASA mJ laser and Hamamatsu (40% QE) detector