# Dawn Mission
# Mars Gravity Assist
# Preliminary Report for GRaND, v1.1

Prepared by Tom Prettyman

3-Mar-2009

# Overview

- GRaND acquired neutron and gamma ray counting data during Mars Gravity Assist
  - Data acquired up to S/C entry into safe-mode (occurred after MCA at an altitude of 3000 km)
- GRaND got close enough to Mars to see neutrons and gamma rays:
  - Mars closest approach (MCA) was about 550 km
  - About 16 min were spent below 1000 km during which time the S/C was nadir-pointing to within about 10°
- The space background environment was quiet, ideal for science data acquisition
- GRaND was nominal during the encounter
- Preliminary results with comparisons to the Odyssey NS are presented

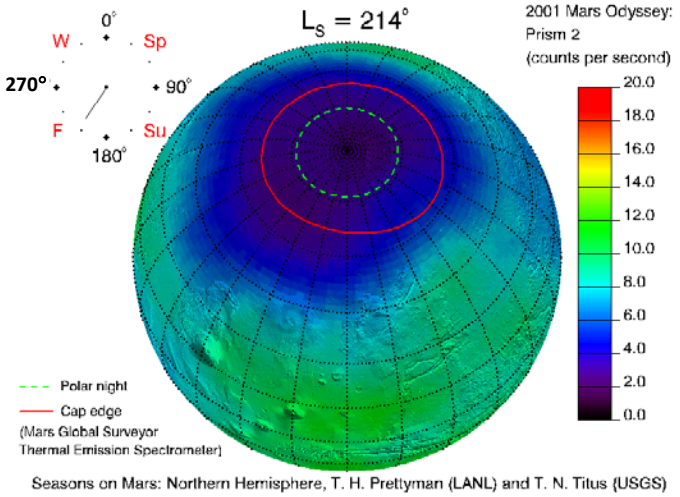
# Operations and Data Analysis

- Instrument settings
  - 35s measurement intervals below 16000 km
  - Timestamp regression was not observed
- Data Volume
  - 295 science data records
- Level 1a data delivered to DSC
- Higher order data products under development
- Instrument was powered on successfully following MGA yesterday (2-Mar-09)
  - Continued data acquisition followed by power-off in DC024
  - Anneal operations deferred
  - Lessons learned (Should HV sequence be separate from Power ON and parameter set?)

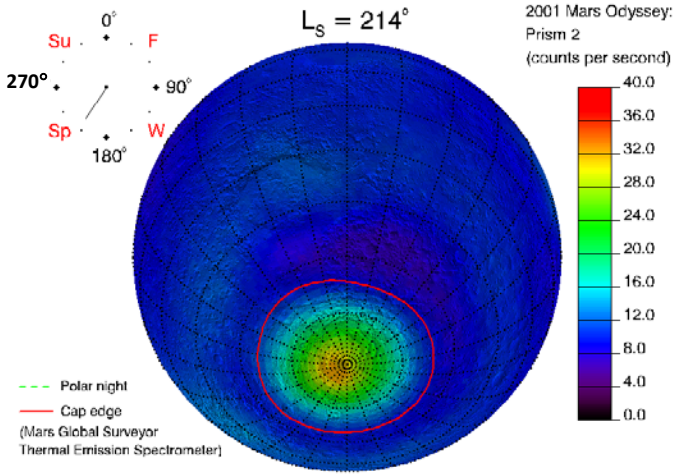
# Mars Closest Approach

18-Feb-2008, $L_S$=212˚ Mid Autumn in the Northern Hemisphere

## Thermal

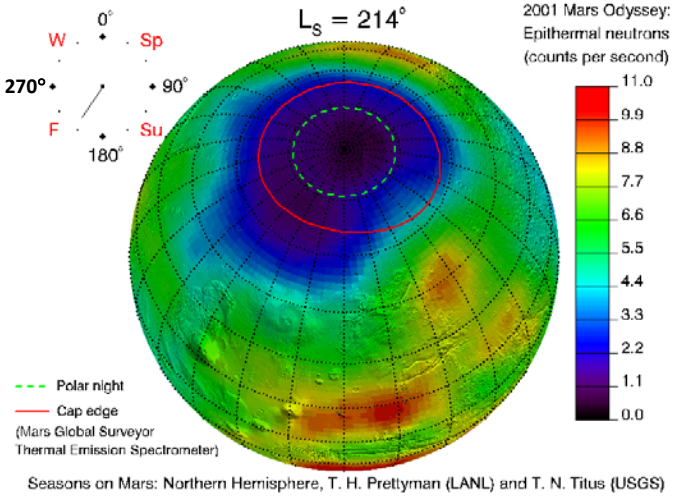



Seasons on Mars: Northern Hemisphere, T. H. Prettyman (LANL) and T. N. Titus (USGS)

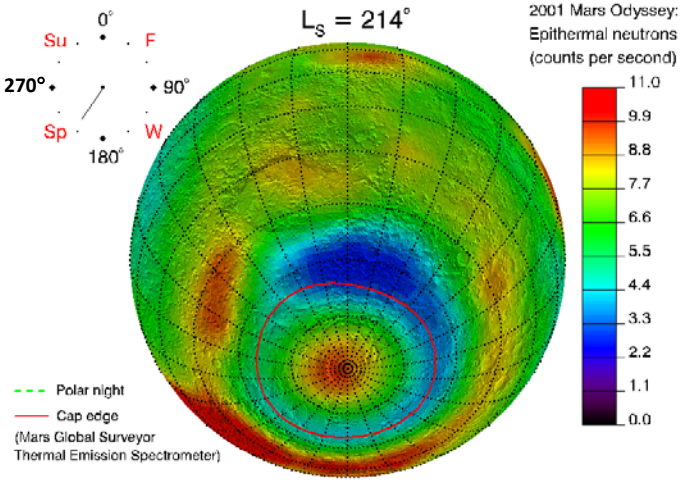



Seasons on Mars: Southern Hemisphere, T. H. Prettyman (LANL) and T. N. Titus (USGS)

## Epithermal




Seasons on Mars: Northern Hemisphere, T. H. Prettyman (LANL) and T. N. Titus (USGS)

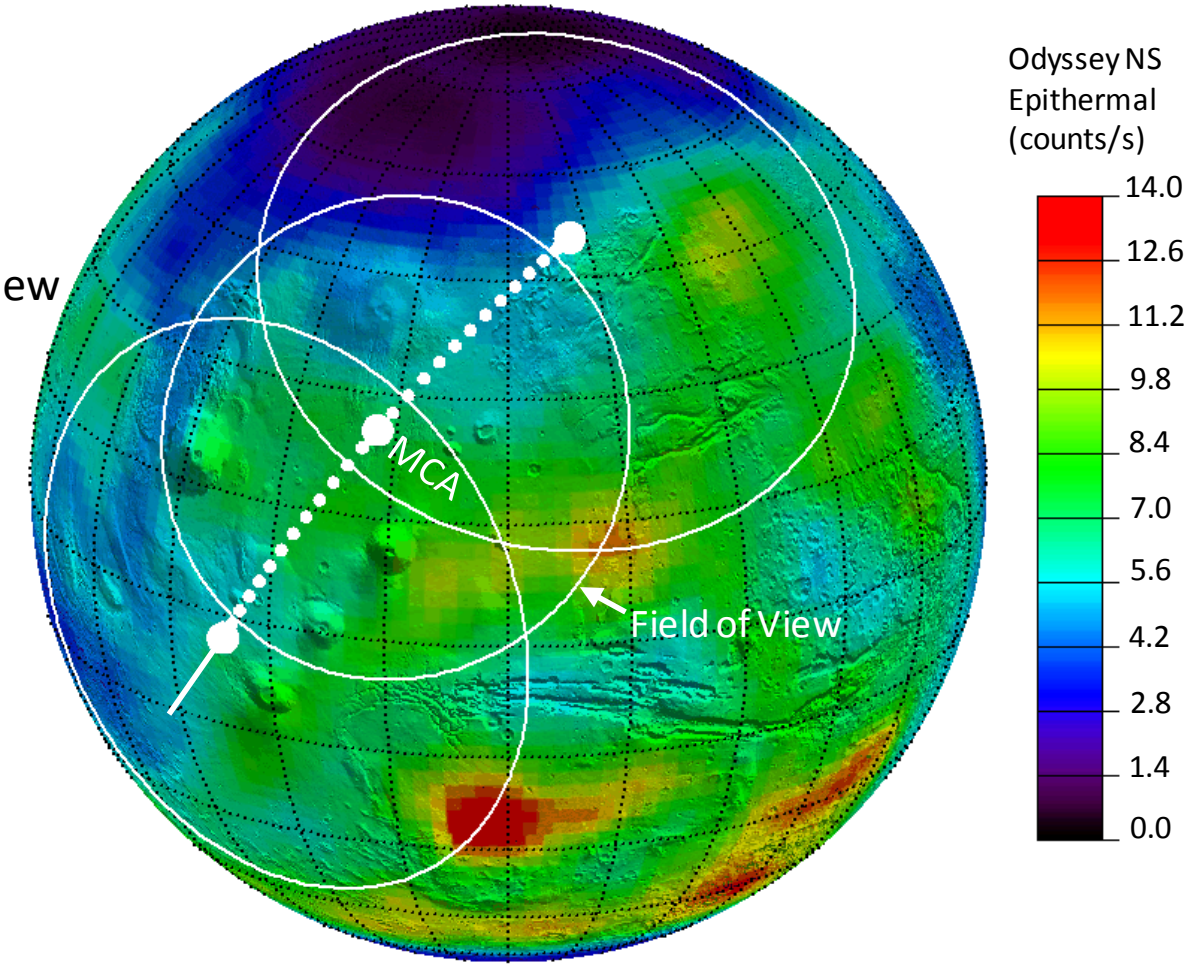



Seasons on Mars: Southern Hemisphere

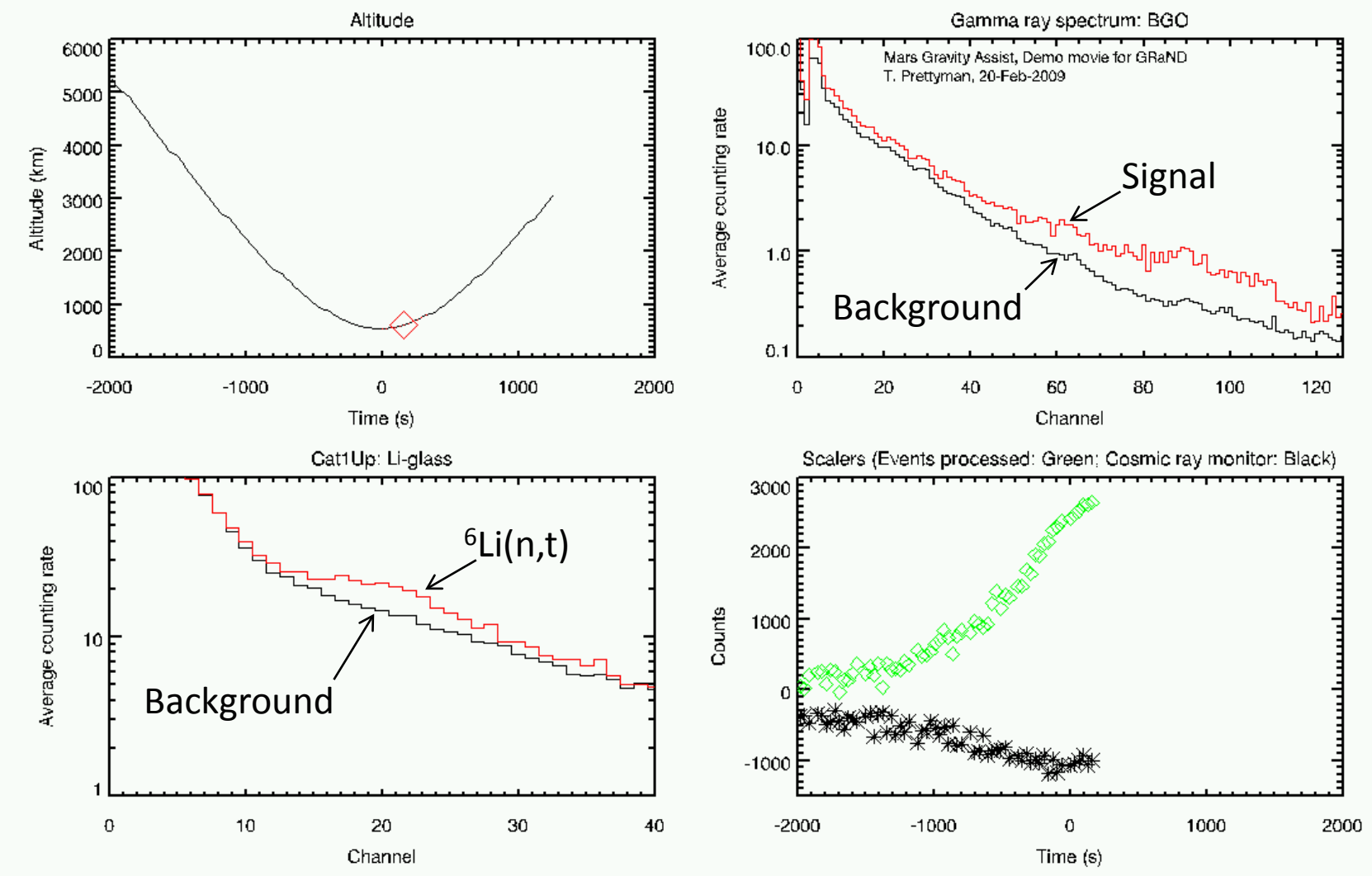
# Trajectory (below 1000 km)

The seasonal cap in the northern hemisphere was thin. At high northern latitudes, the neutron spectrometer was primarily sensitive to the water-rich regolith.

GRaND subsatellite points and Field of View



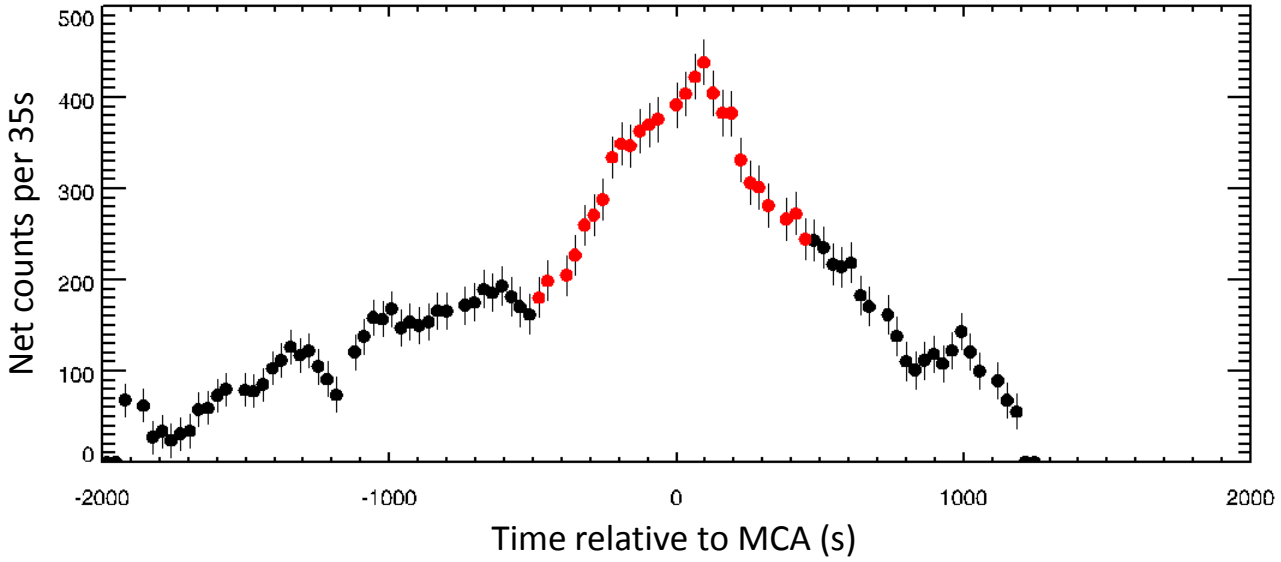
# Counting Data



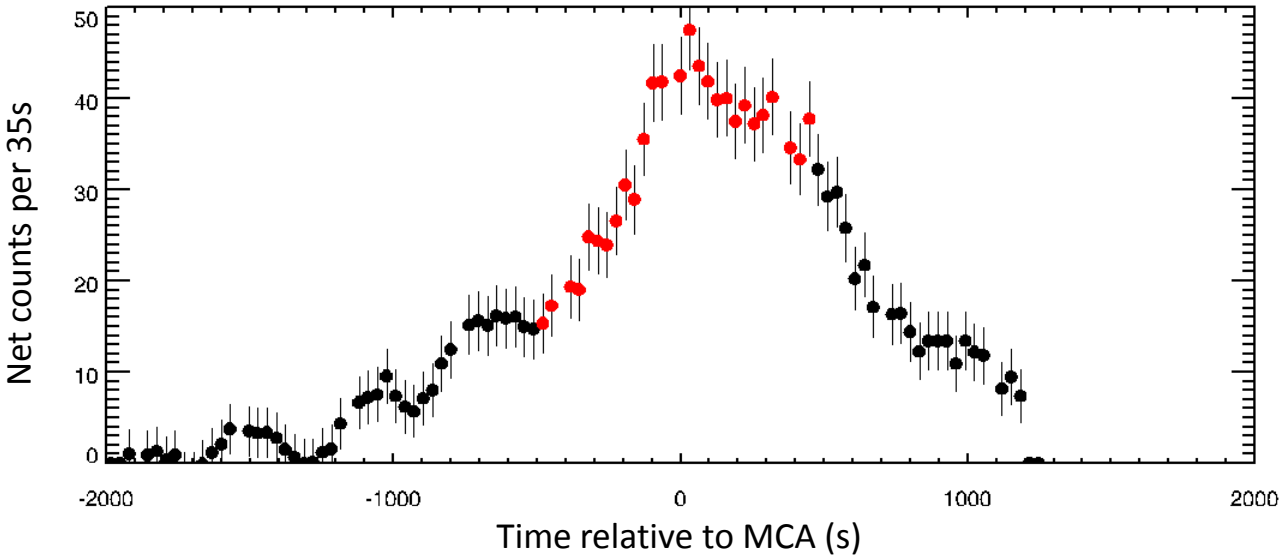

Frame from QuickTime movie: GRaND Data MCA.mov

# Neutron Counting Data

Nadir-pointing Li-glass
CAT1, $^{6}$Li(n,t) peak




Fast neutrons
CAT4, nadir+sides



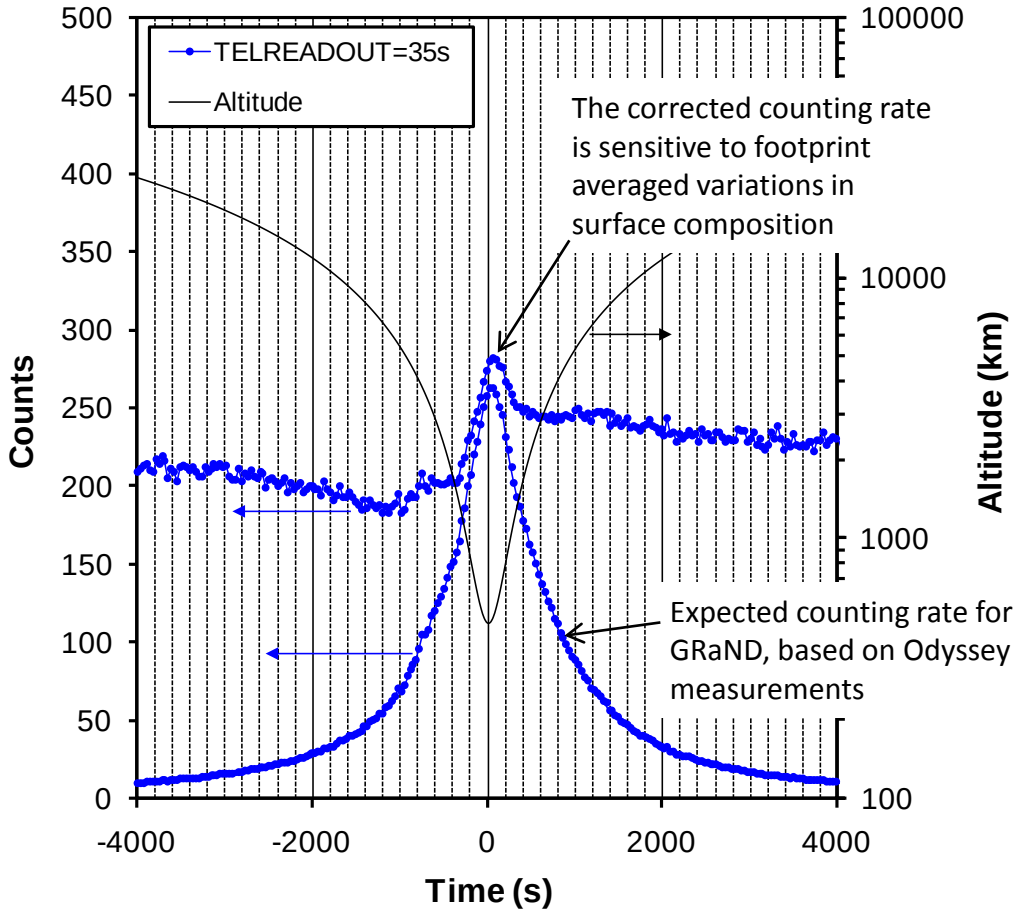

The counting data were averaged using a 5-point sliding window

# Analysis Method: Simple Approach

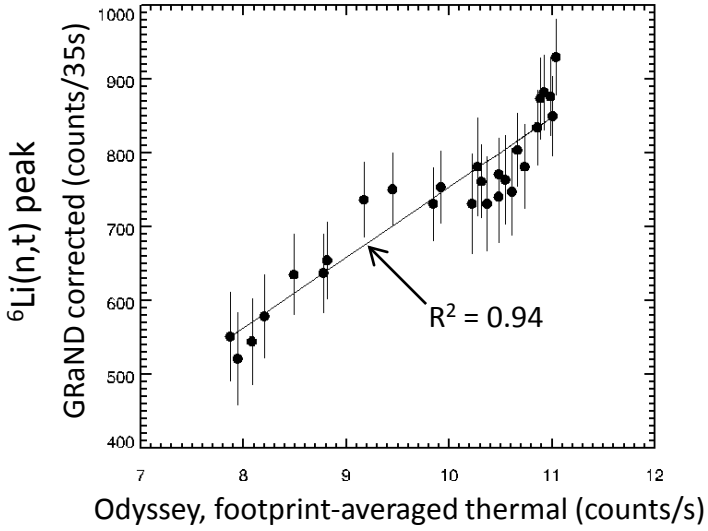
Procedure:

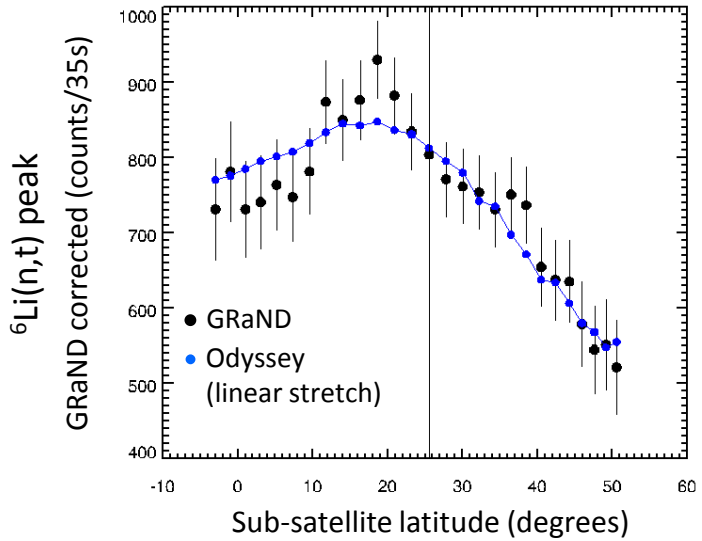
- Correct GRaND time series data for altitude and S/C orientation
  - Divide by the solid angle subtended by Mars at the S/C
  - Divide by the cosine of the S/C angle relative to nadir
- Compare the corrected GRaND counting rate for each measurement to the Odyssey counting rate averaged over GRaND's footprint

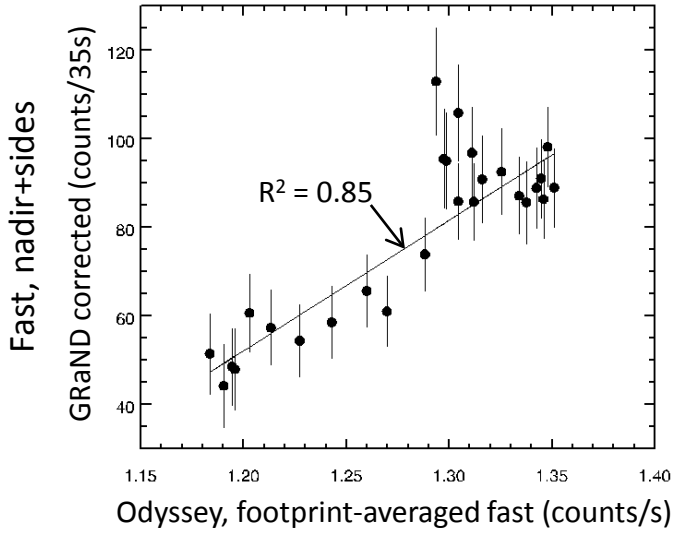
Simulated, footprint-averaged Odyssey data prepared prior to Dawn/MGA

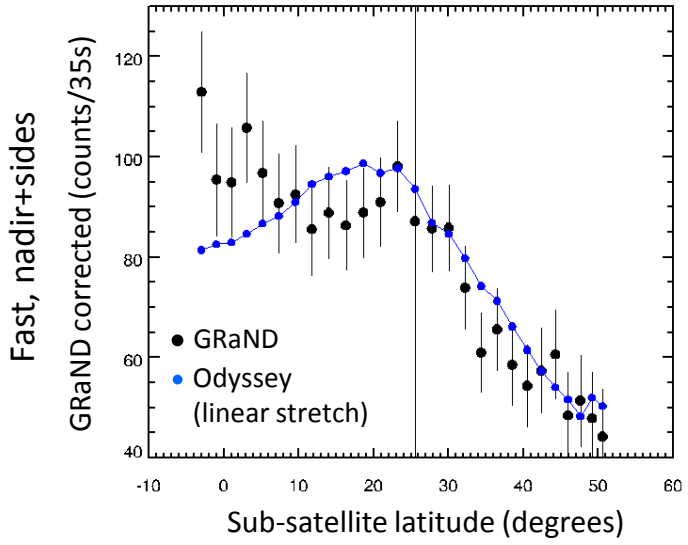


# Comparison Measured GRaND counting data to Odyssey



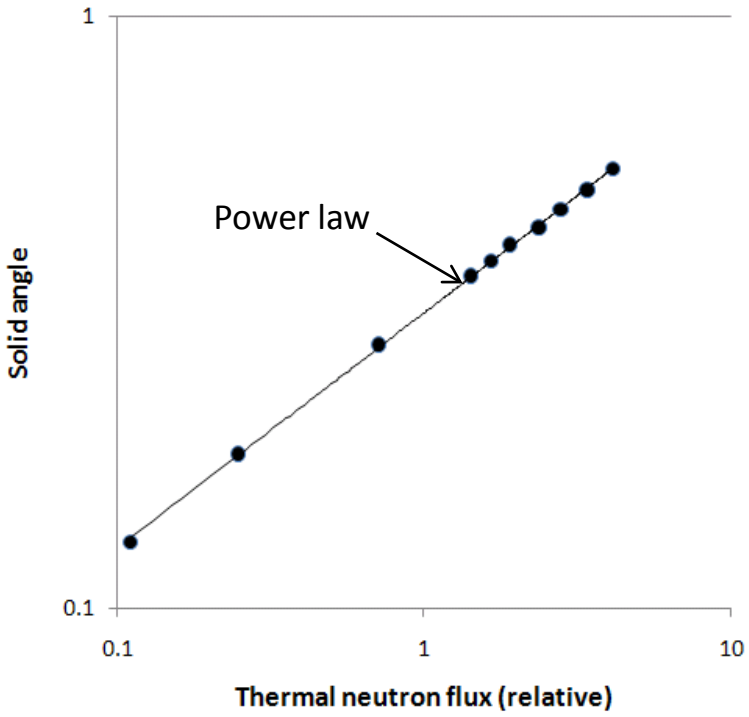



# Detailed Analysis

- Neutrons
  - Compare modeled counting rates based on neutron leakage spectra to GRaND data
  - Accounts for neutron decay, ballistic trajectories and relative motion of the S/C (ram effect)
- Gamma rays
  - Compare O and Fe counting rates to mapped ODY/GRS data available in the PDS
- Analysis will include implications for science at Vesta and Ceres
- Results to be presented at EGU
- Manuscript on GRaND performance during cruise and MGA in preparation



# Conclusions

- Mars Gravity Assist was a tremendous success from the standpoint of acquiring useful GRaND data
- GRaND measured gamma rays and neutrons originating from Mars
- GRaND neutron counting rates are strongly correlated with footprint-averaged Odyssey data
- The GRaND data will be useful for calibration and mission planning
- Results presented here should be regarded as preliminary - addition work on data reduction and analysis methods is needed in order to provide accurate comparisons to Odyssey