GSICS MW-SubGroup

A Check of Lunar Brightness Temperature Models With MHS

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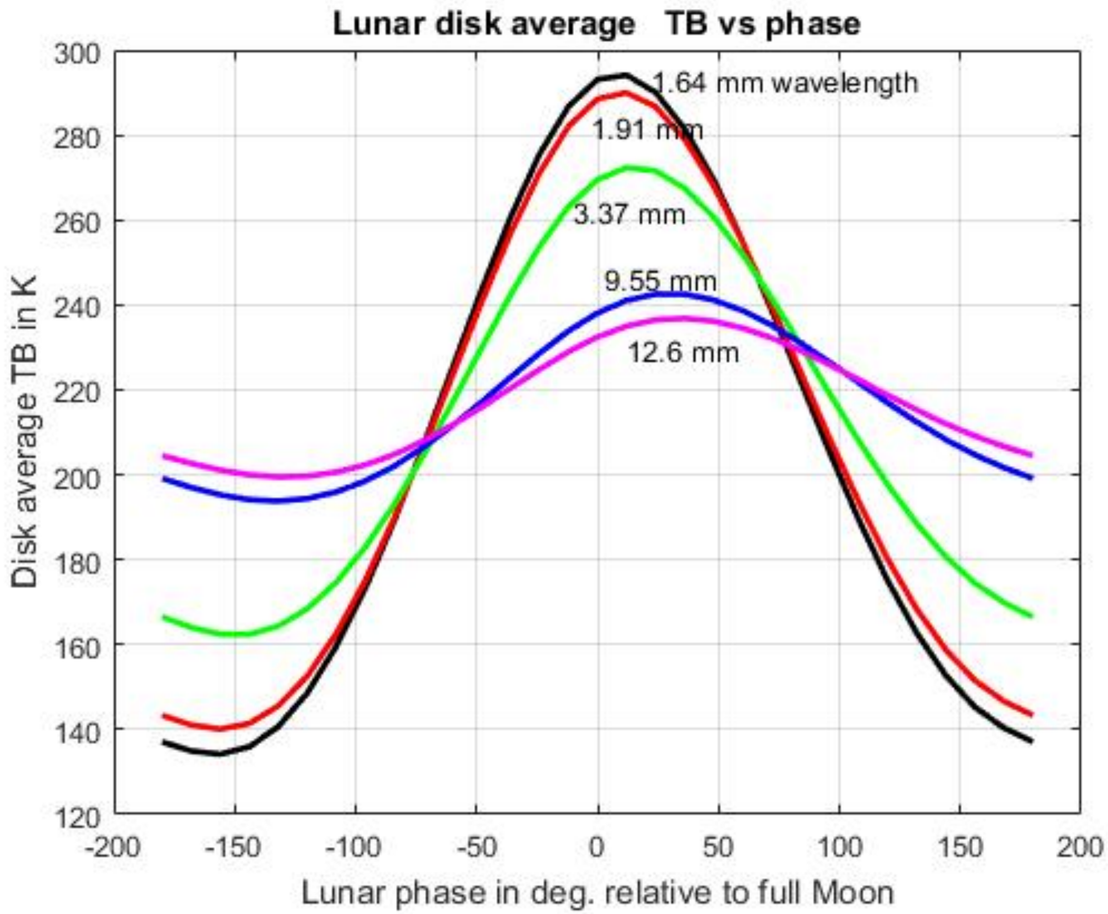
Presentation Outline

- Necessary condition for using the Moon as flux reference: $T_B = f(\varphi)$
- Observations of the Moon at different phase angles with MHS
- A comparison of different relationships $T_B = f(\varphi)$ with the measurements

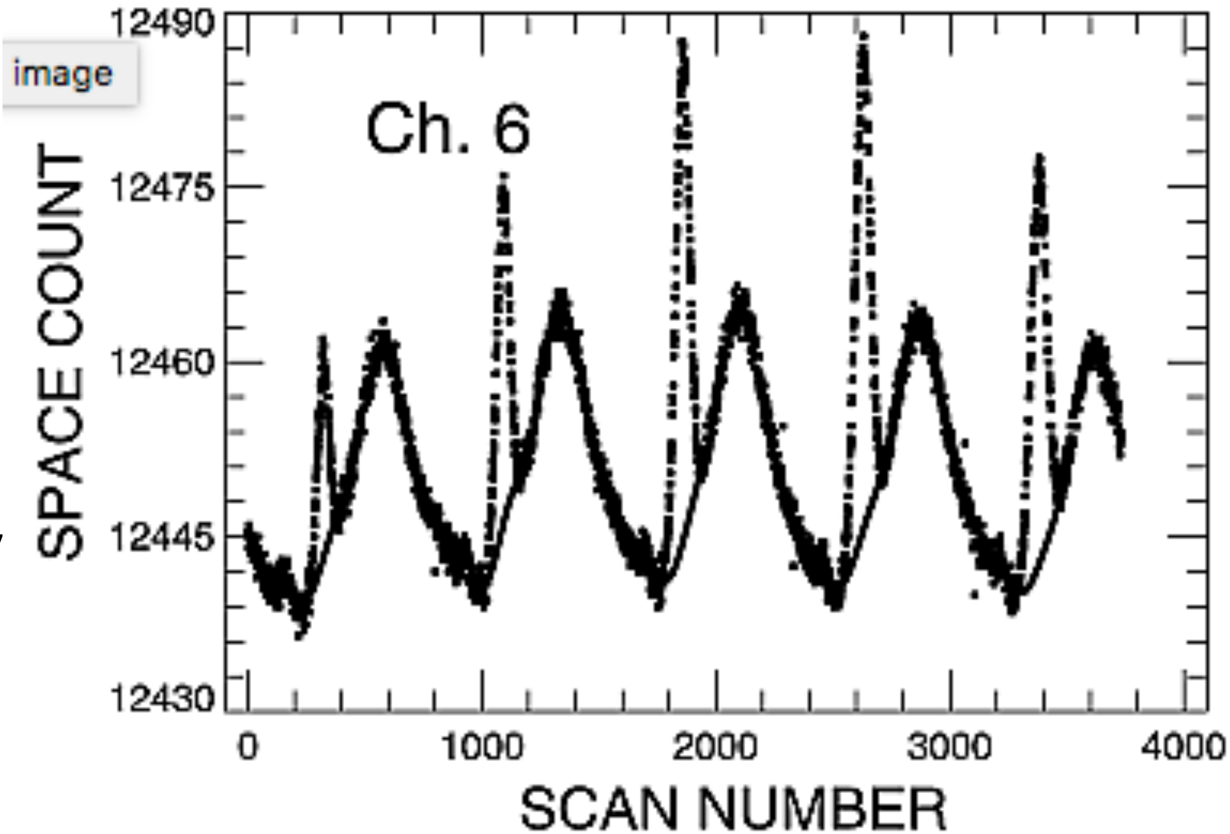
T_B = f(φ) According to Keihm (1984)

- Lunar regolith property model based on Apollo 15 and 17 experiments and measurements of returned samples
- Absolute accuracy ±5%
- Was used as calibration reference for
  - NASA's DSN
  - COBE
  - µwave limb sounder
  - Odin and Steam-R
- Available on web page



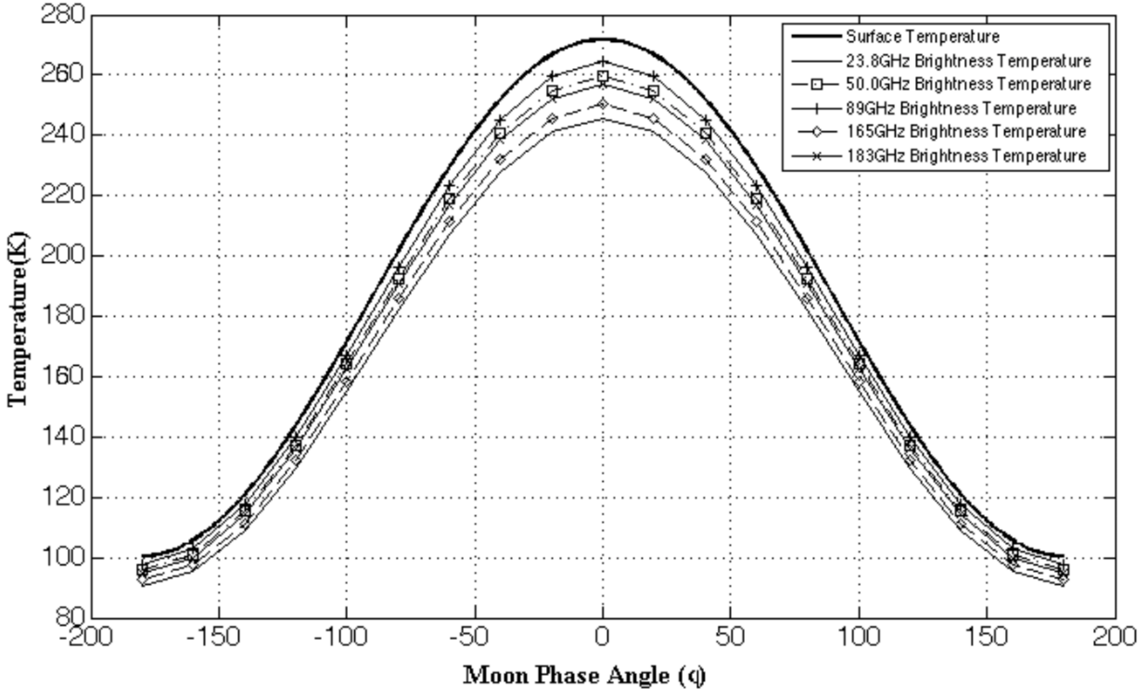
T_B = f(φ) According to Mo & Kigawa (2007)

- Parametrical expression for effective Moon brightness temperature
- Second order polynomial in cos φ
- Brightness temperature independent of frequency and sign of phase angle
- Was used for correction of lunar contamination in AMSU-A on NOAA-18



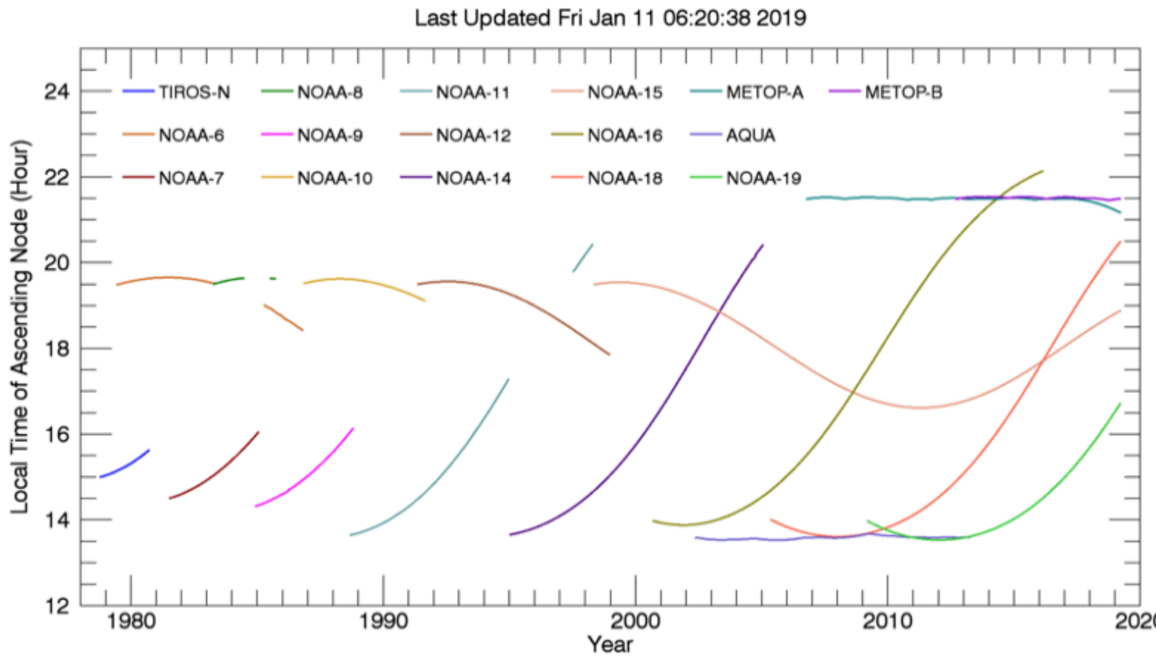
T_B = f(φ) According to Yang et al. (2018)

- Parametrical expression for effective Moon brightness temperature
- Second order polynomial in cos φ
- Brightness temperature independent of sign of phase angle, emissivity changes with channel number
- Was used for monitoring the stability of ATMS



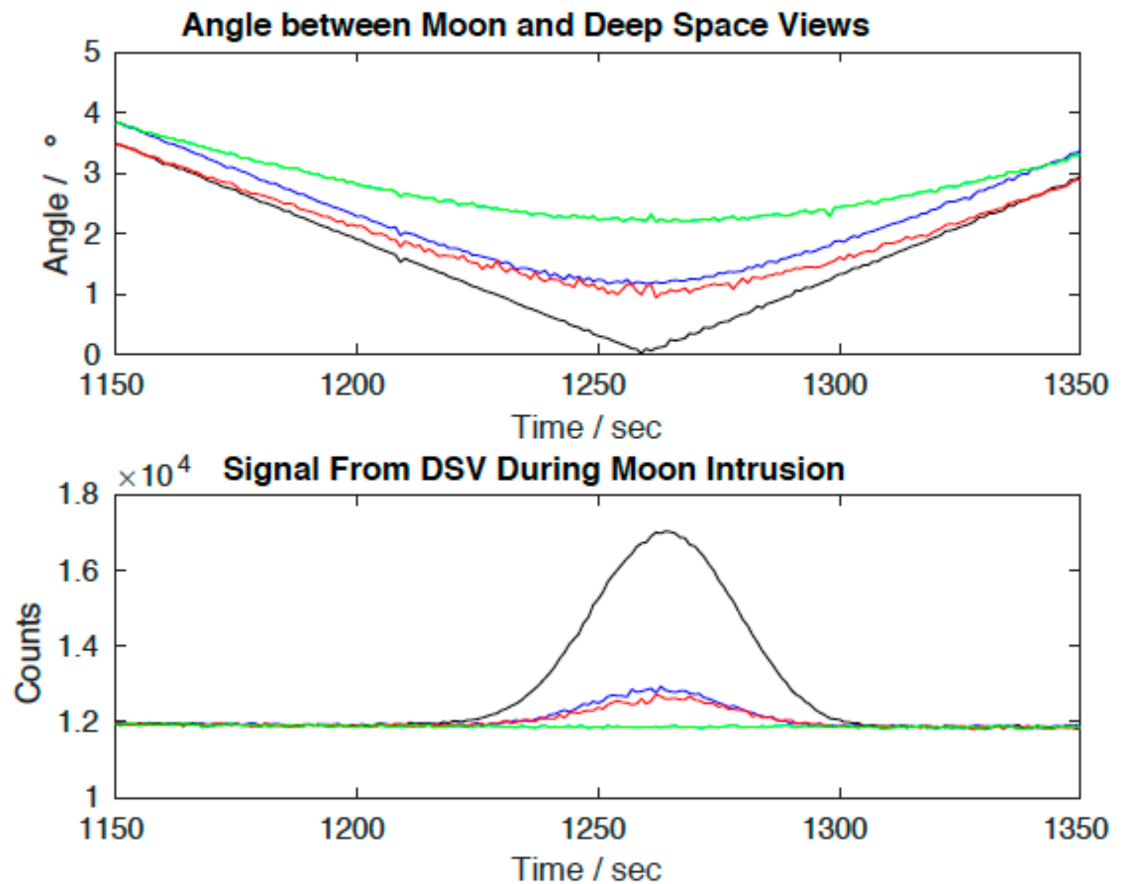
Drifting Orbit of NOAA-18

- NOAA-18 turned from morning to afternoon satellite
- Equator crossing time constrains phase angle of Moon during intrusion in DSV
- 39 Moon appearances in the DSV between 2006 and 2018 were analyzed
- Unique set of $T_B - \varphi -$ pairs



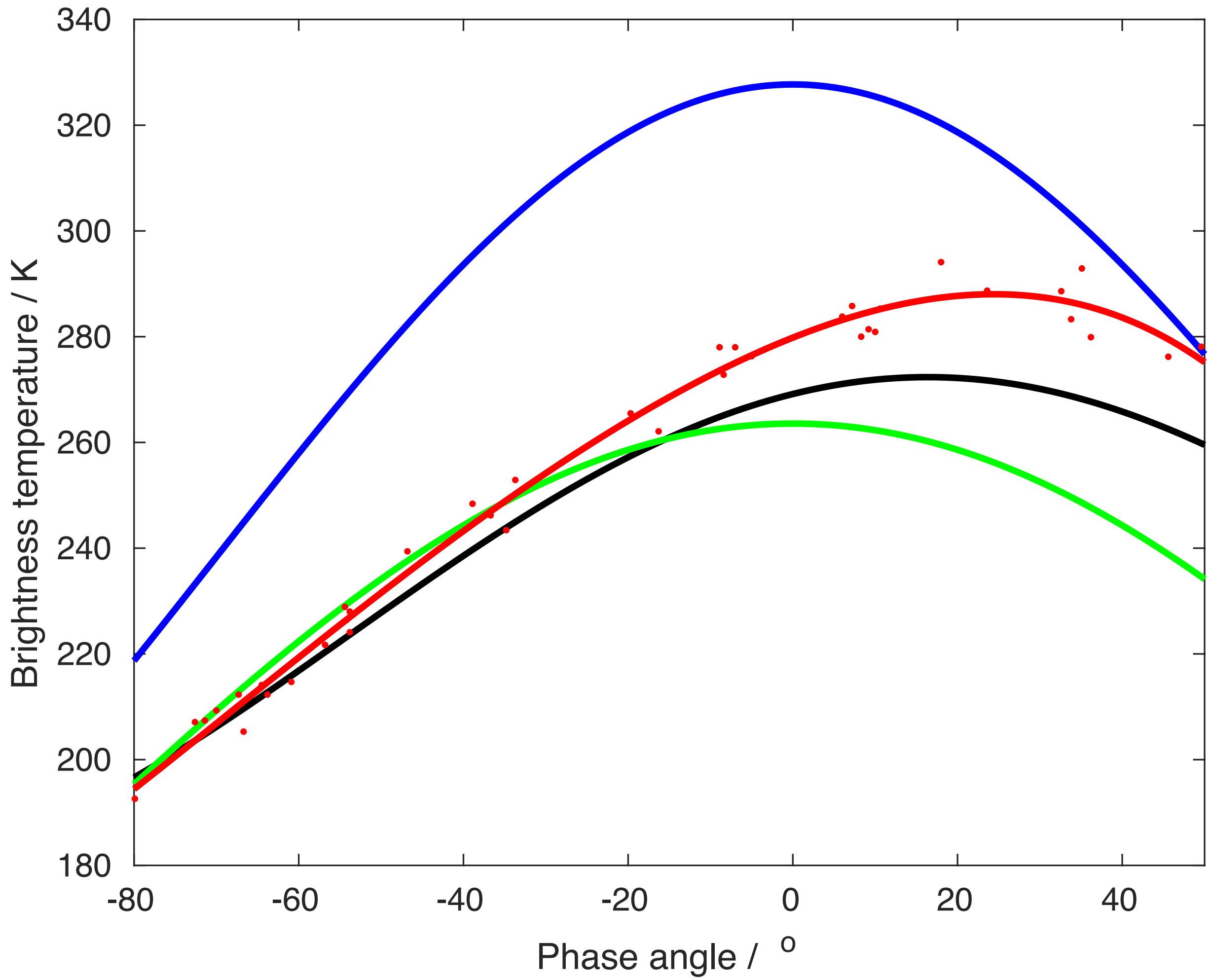
Problem: Beam Size of MHS on NOAA-18

- Calibration sources fill the beam, Moon does not
- Moon must be in center of Field of View, beam size must be known
- Both requirements can be fulfilled with data from Moon intrusions themselves
- *Θ* 3dB of MHS on NOAA-18 disagrees with plots on EUM web page for sounding channels



Comparison Between Models and Observations at 89 GHz

- Red: Moon Intrusions MHS on NOAA-18
- Black: Keihm (1984)
- Green: Yang et al. (2018)
- Blue: Mo & Kigawa (2007)
- Agreement only for waxing Moon



Next Steps

- Results obtained from 39 Moon intrusions, overall there are 1600 with MHS on NOAA-18 alone. AMSU-B has similar Moon intrusions.
- Determine channel alignment and beam sizes with high accuracy
- Check channel uniformity, in particular for sounding channels
- Check stability of flux calibration with an accuracy of 0.1 K per decade for satellites on stable orbits
- Analyse Moon intrusions with HIRS
  - Time and date of Moon intrusions conveniently displayed with STAR ICVS
  - Daily Status only available after 12/31, 2015
  - **Earlier dates very useful because Moon appears rarely in DSV of HIRS**

Back Up Slides