CHECKING BEAM PERFORMANCE OF HIRS AND MHS WITH THE MOON

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

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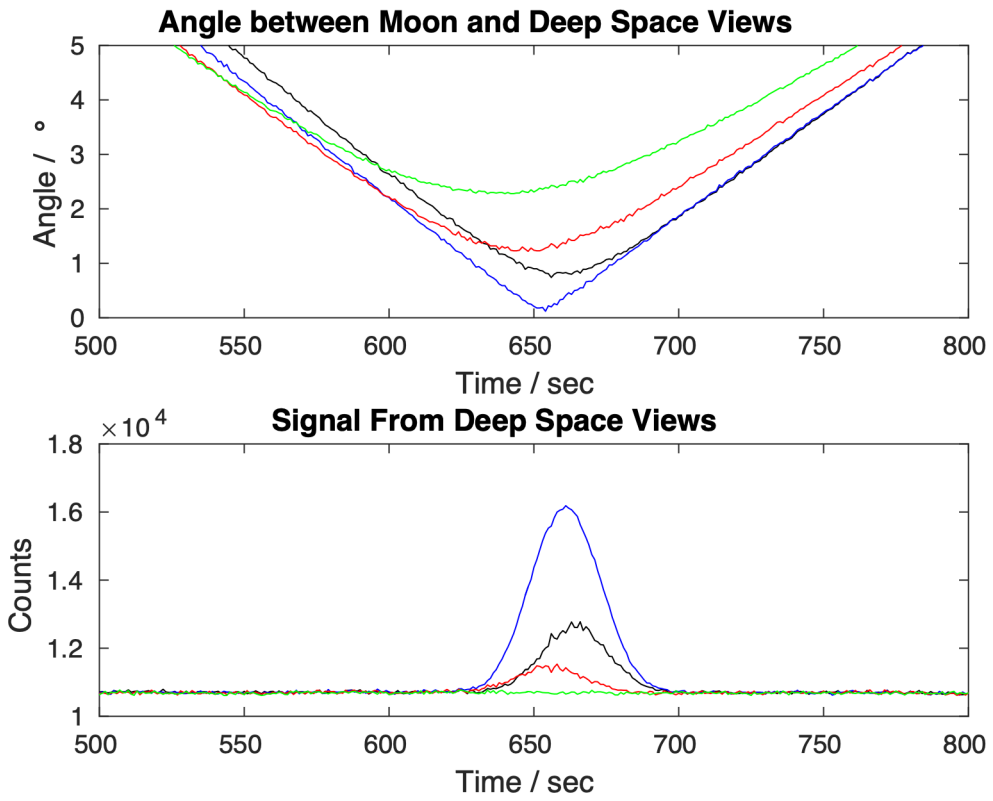
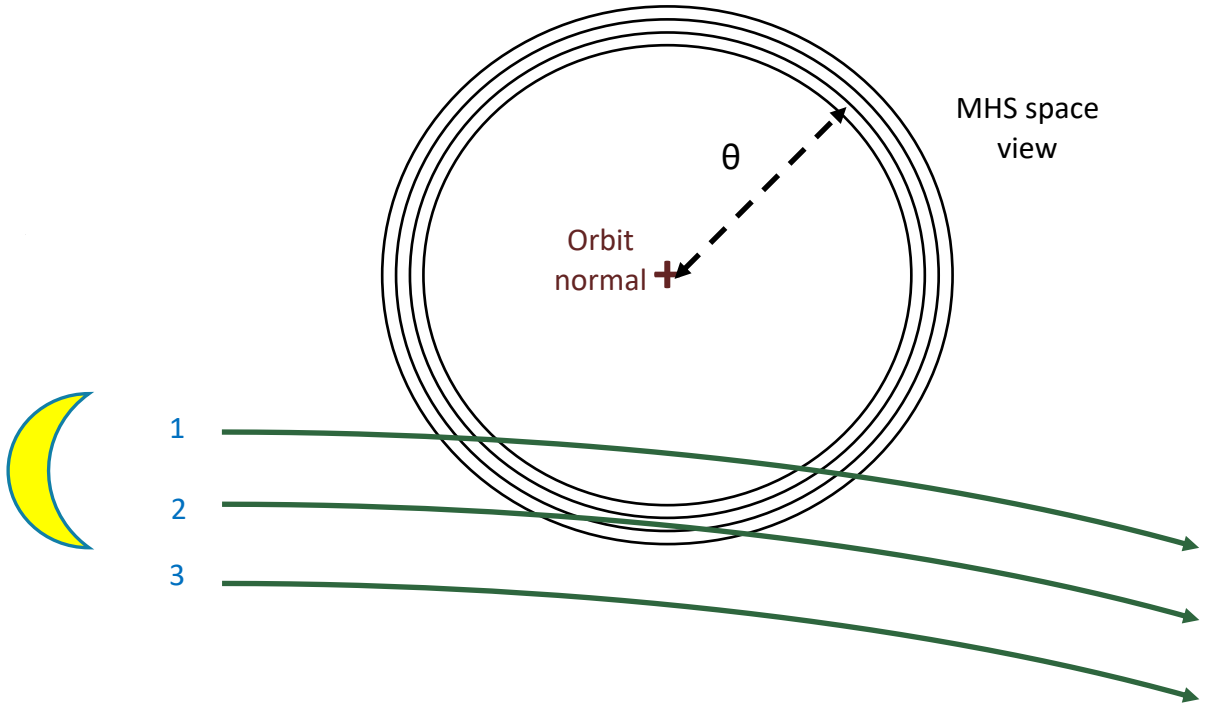
FOUR MHS DEEP SPACE VIEWS CLOSE TO MOON DURING ONE ORBIT





Bonsignori (2018)

$$\Theta_{3dB} = \text{FWHM}\ \omega \sin \theta_p$$

ANTENNA PERFORMANCE – SPACE VIEW

MHS on NOAA-18 (Matra Marconi)

		CHANNEL				Accuracy	REQUIREMENT / COMPLIANCE
		H1 89.3 GHz	H2 157.3 GHz	H34 184.3 GHz	H5 190.6 GHz		
θ 3dB (°)	min	1.07	1.02	1.02	1.04	± 0.01	1.1 ± 0.11 / C
	moy	1.09	1.03	1.05	1.05		
	max	1.12	1.05	1.08	1.06		

40 🌙 Intrusions: 1.20 1.10 1.25 1.26 ±0.01 3 x NC

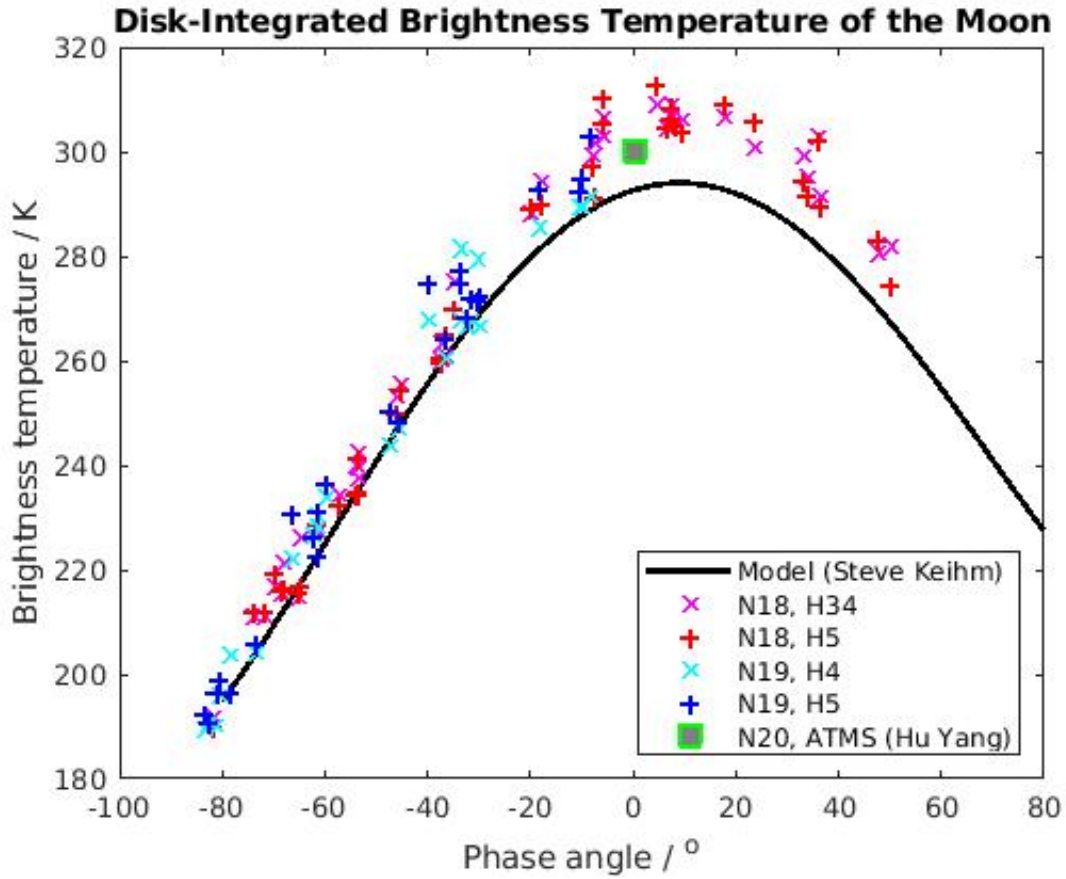
MHS on NOAA-19 (Matra Marconi)

		CHANNEL				Accuracy	REQUIREMENT / COMPLIANCE
		H1 89.3 GHz	H2 157.3 GHz	H34 184.3 GHz	H5 190.6 GHz		
θ 3dB (°)	min	1.08	1.14	1.11	1.10	± 0.01	1.1 ± 0.11 / C
	moy	1.10	1.15	1.12	1.12		
	max	1.11	1.16	1.14	1.15		

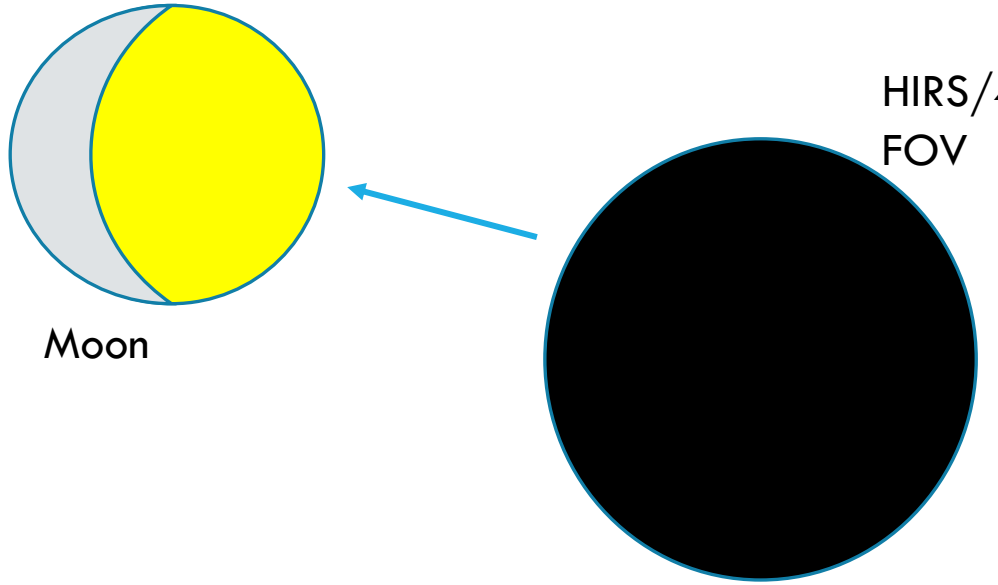
25 🌙 Intrusions: 1.20 1.16 1.29 1.28 ±0.01 3 x NC

LUNAR MICROWAVE BRIGHTNESS TEMP. FOR DIFFERENT PHASE ANGLES

- Orbit drift with NOAA-18 and NOAA-19 =>
- Local Equator Crossing Time changes =>
- Phase angle of Moon in DSV changes
- MHS: 2 channels at 183 GHz, one at 190 GHz
- Agreement within uncertainties
- Situation is similar at 89 GHz



MOON IN FOV OF HIRS DURING DEEP SPACE CALIBRATION



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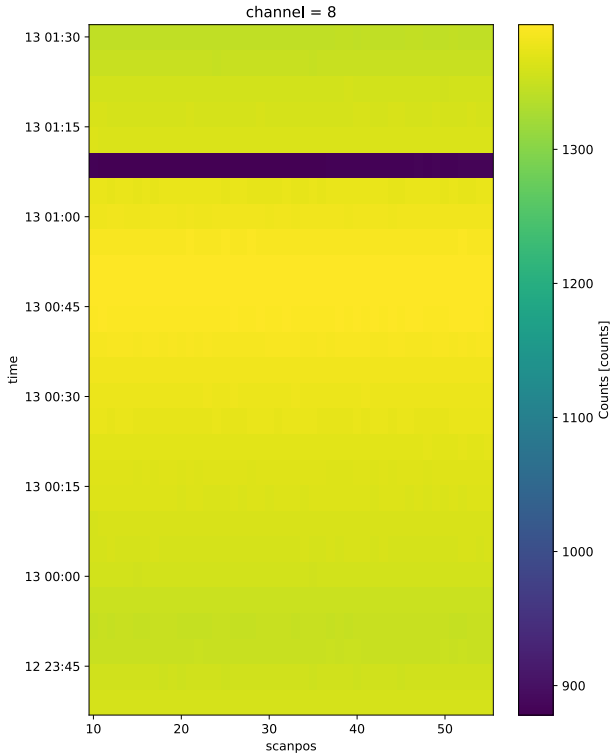

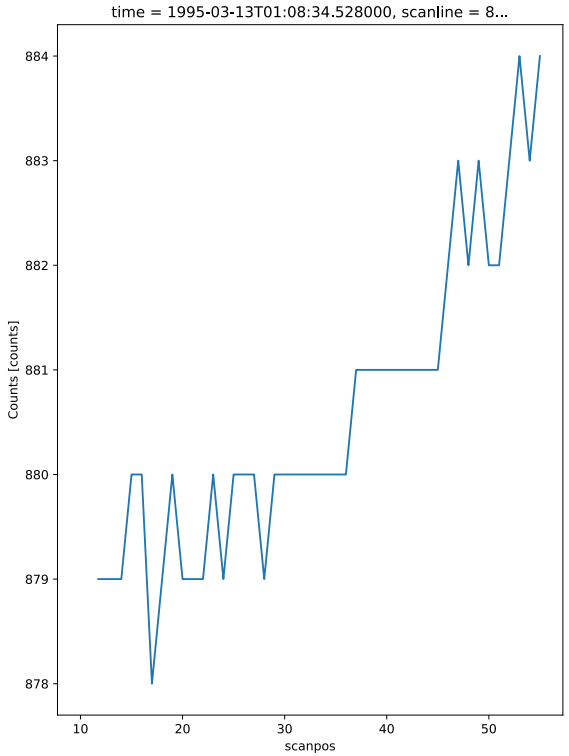

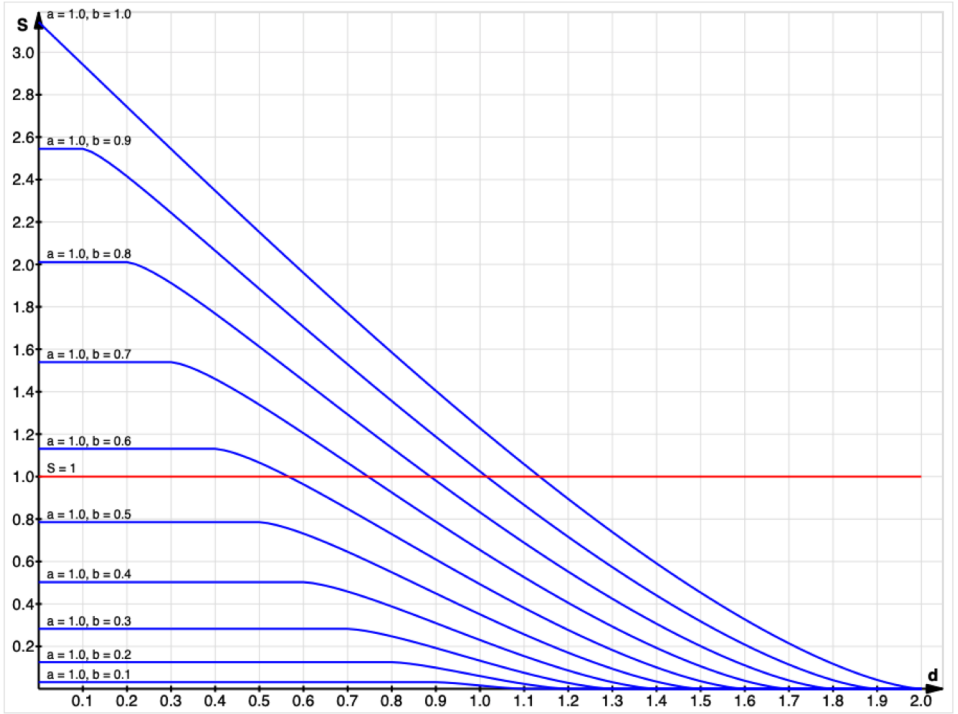

THE MOON WAS OBSERVED WITH HIRS/2, /3, AND /4

- The flux density received from the Moon depends on the FOV^2.
- If one FOV is known, the Moon gives the diameter of all others.
- Web sites, journal articles and books give different values.
- Which one is right?

	HIRS/2	HIRS/3	HIRS/4
AAPP Sci. Description	1.25°	1.25°	0.72°
NOAA KLM User's Guide		1.4° (SW) 1.3° (LW)	0.7°
ESA metop Performance	1.25°	1.25°	1.4° (SW) 1.3° (LW)
OSCAR (WMO)	≈1.4°	≈1.27°	≈0.7°
POES GSFC NASA		14.0	7.0
ITT Aerospace	1.22°		
Various books	1.25°		

THE MOON WAS OBSERVED WITH HIRS/2, /3, AND /4

- The flux density received from the Moon depends on the FOV^2.
- If one FOV is known, the Moon gives the diameter of all others.
- Web sites, journal articles and books give different values.
- OSCAR is (almost) right.

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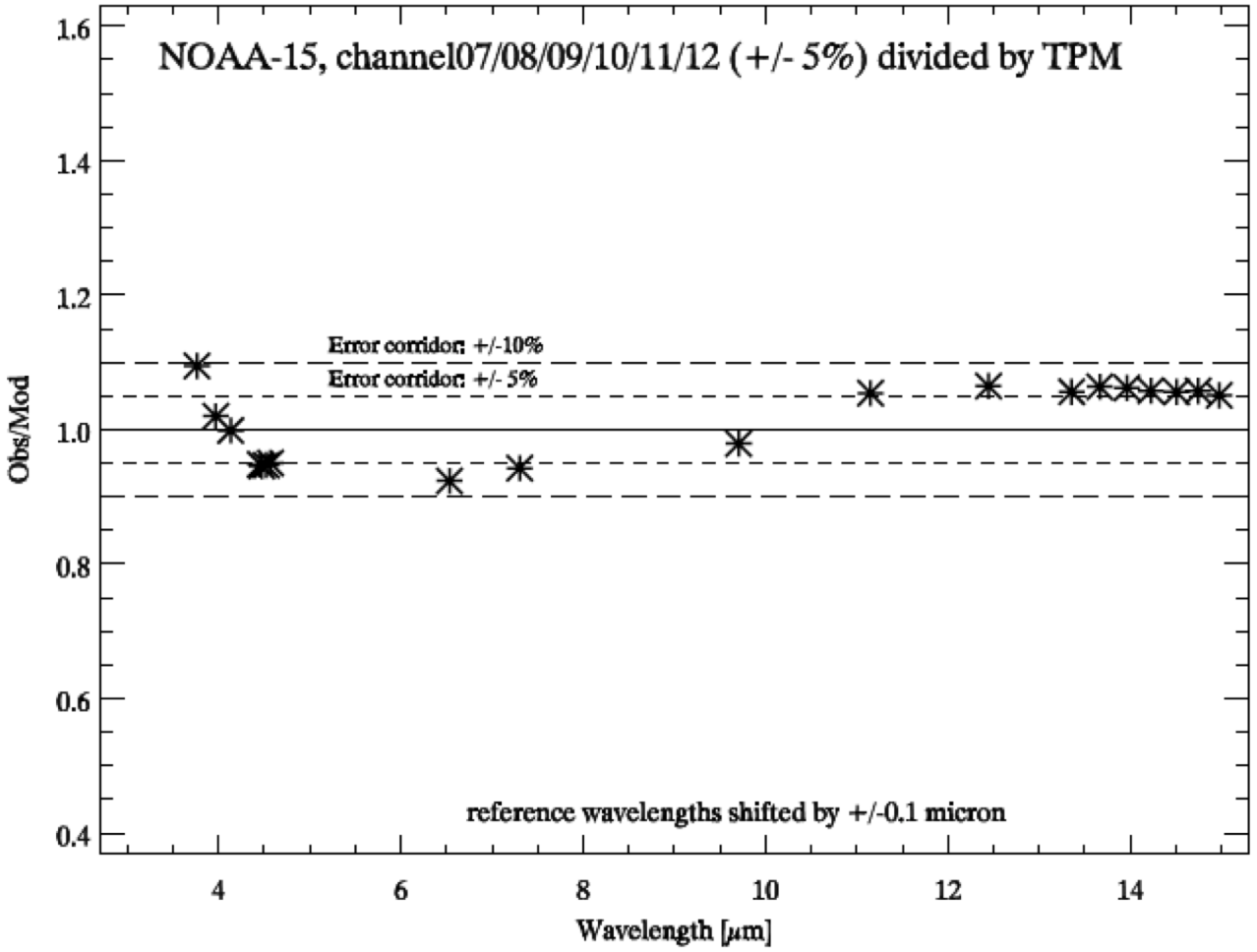
DISK-INTEGRATED OBSERVATIONS WITH HIRS AND A MOON MODEL

- 20 observations of the Moon with HIRS were identified
- Phase angles between -70° and +70°
- Model for all channels
- Check for non-linearity: Radiance from Moon can be 40x radiance from Earth scene in channel 15 => Derive upper limit on non-linearity: 0.1%



SUMMARY AND CONCLUSIONS

Moon With Infrared Sounders

- Signal of Moon gives ratio of beam sizes between instruments.
  - Contradictions between documents straightened out
  - FoV is 1.4° - 1.3° - 0.7° for HIRS/2 - HIRS/3 - HIRS/4
- Beam size + signal of Moon gives its brightness temperature
  - Agreement of different satellites < 3K T_B (LW)
- Moon is great for checking FOV ratios / inter-channel consistency / non-linearity (SW)

Moon With Microwave Sounders

- Duration of the presence of the Moon gives exact beam size
  - Beam size underestimated in ground tests of MHS on NOAA18/19
  - Most channels of MHS on NOAA-18, -19 not compliant with specs
- Maximum signal of Moon gives its brightness temperature
  - Agreement of different instruments and satellites
- Moon is great for checking beam size / inter-channel consistency / photometric stability