PROBING OF HERMEAN EXOSPHERE BY ULTRAVIOLET SPECTROSCOPY

Mercury surface albedo (80 – 160 nm)

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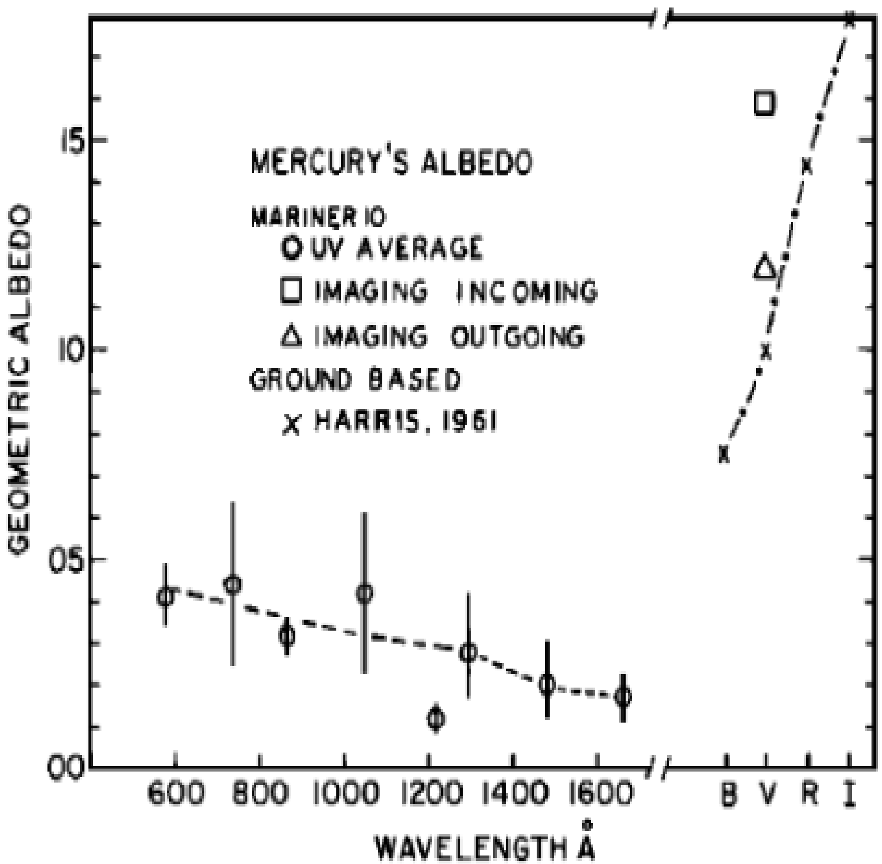
Introduction

First observation of EUV albedo of Mercury by Mariner 10 (1974-1975) at 8 wavelengths



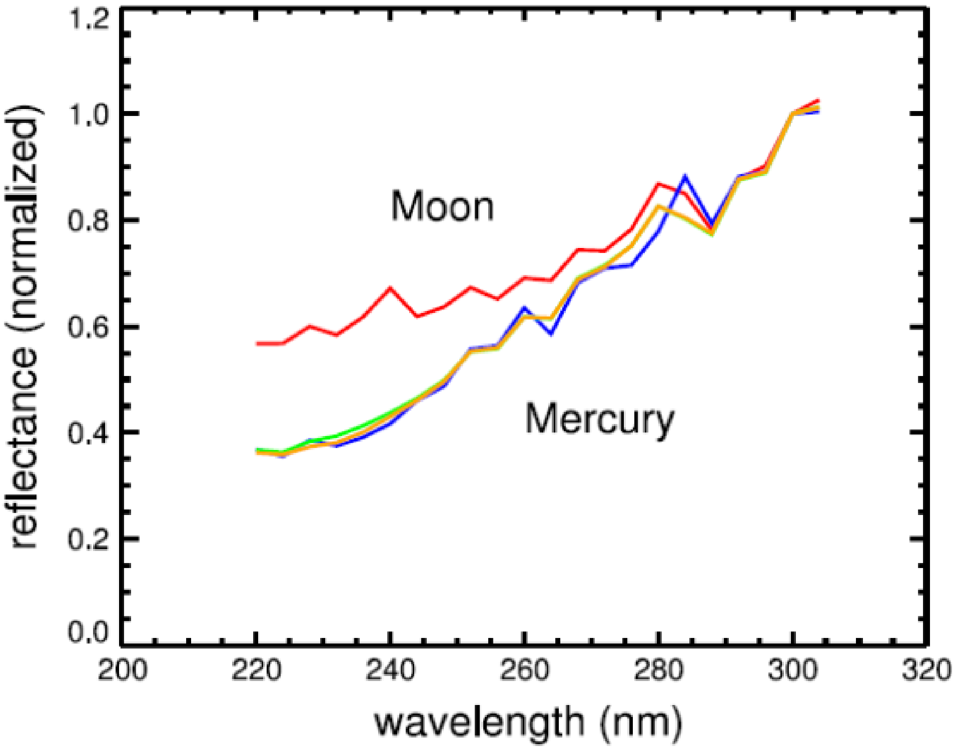
Wu and Broadfoot 1977

- Geometric albedo decrease from 4±0.7% (58.4 nm) to 1.7±0.5 % (165.7 nm)
- Small spectral structures not considered.
- The Mercury geometric albedo is lower than the Moon's albedo (~ 2/3) (due to material or grain sizes ?)

- Mercury FeO abundance is lower than the Moon (Hapke 1977, 2001)

Introduction

UV albedo of Mercury (220-1450 nm) measured by MESSENGER (disk integrated)



Holsclaw et al. 2010

- Mercury surface is low in ferrous iron (FeO) (no absorption near 1000 nm)
- Mercury UV albedo is lower than the albedo of the Moon.
- Moon exhibits a shallow slope relative to Mercury between 220 – 300 nm

PHEBUS observations

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- Observations done on October 9 and October 10

- **EUV channel** (55 - 160 nm) HV = 3400 V + NUVs

- Sequence 1 : 3 observations on 9th October between 01:30 and 02:43
- Sequence 2 : 3 observations on 9th October between 23:46 and 00:23

Geometric parameters

Sun – Mercury :   sequence 1: 0.341 AU
sequence 2 : 0.336 AU

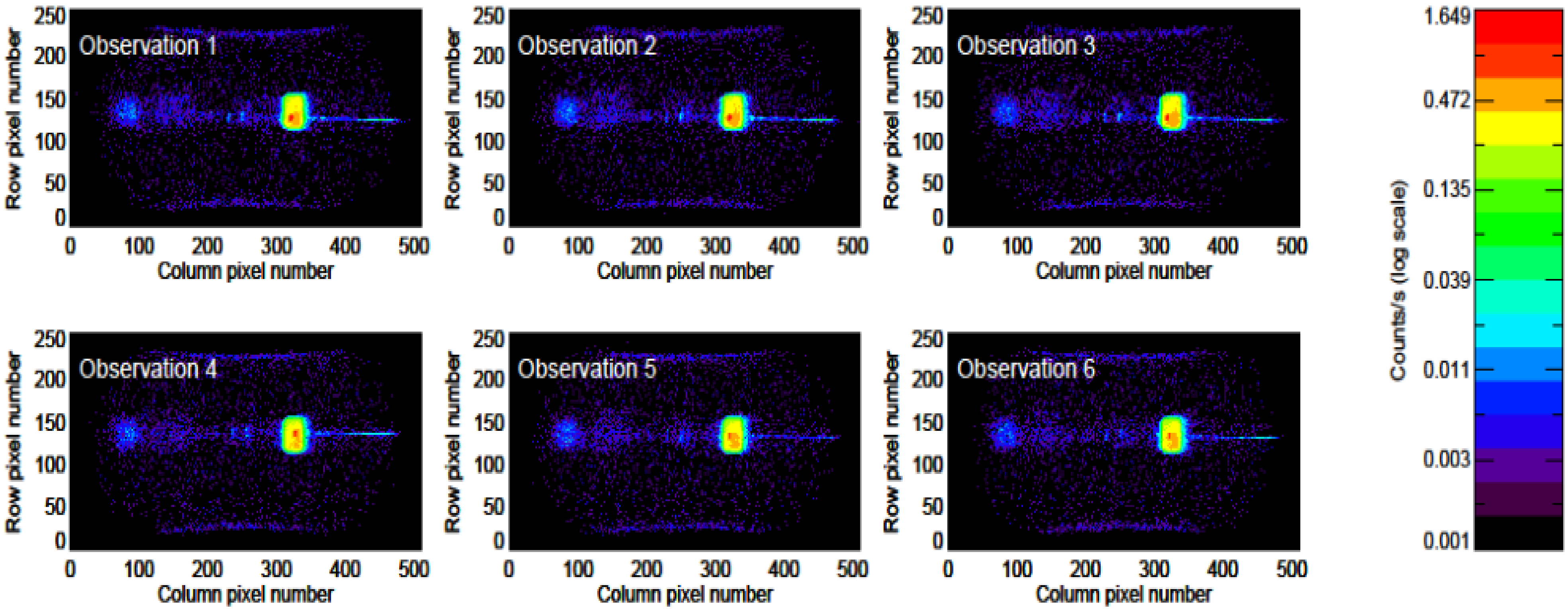
Mercury – BepiColombo : sequence 1 0.027 AU
sequence 2 0.030 AU

Phase Angle : sequence 1 : 68.2
sequence 2 : 71.8°

Disk-integrated observations (no spatial resolution)

PHEBUS observations

Average image of the detector (integratin time ~13 minutes)



Spectral axis

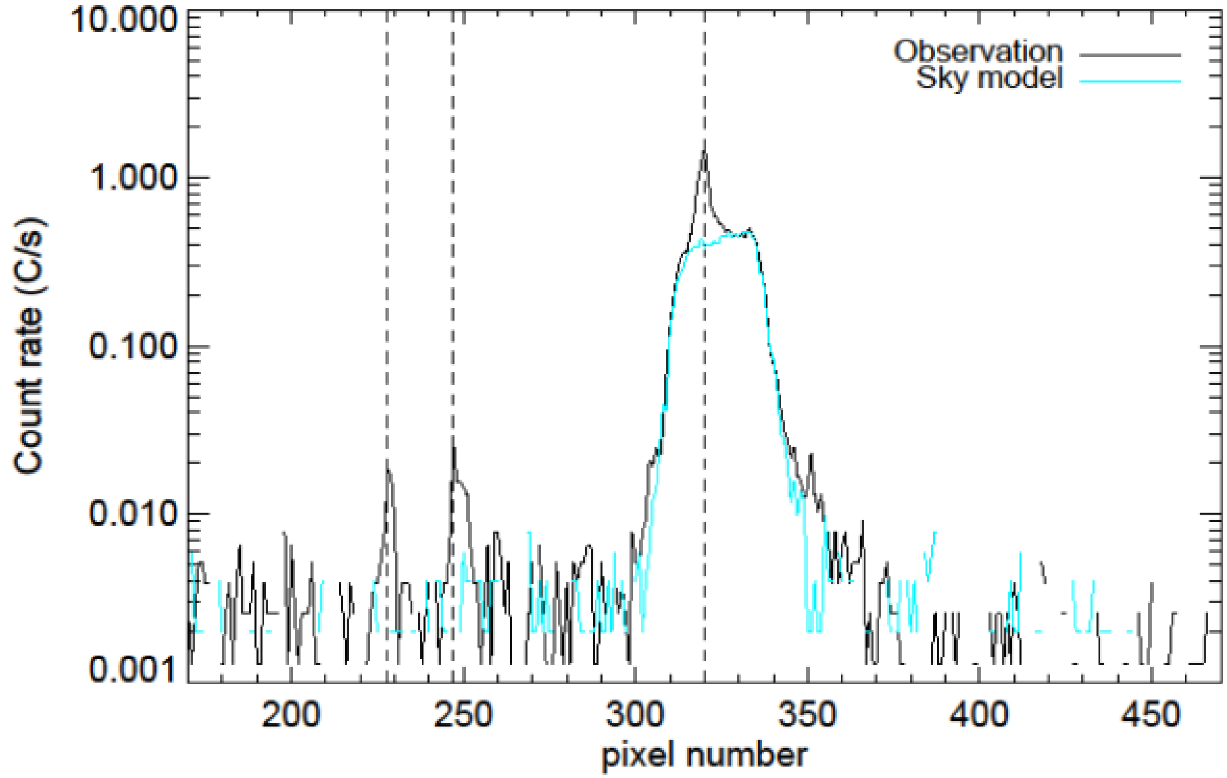
- Solar spectrum reflected by Mercury : narrow horizontal line (point source)
- Interplanetary emissions (58. 3 nm, 121.6 nm, possibly 102.6 nm) (extended source ➔ spatially extended)

Data processing

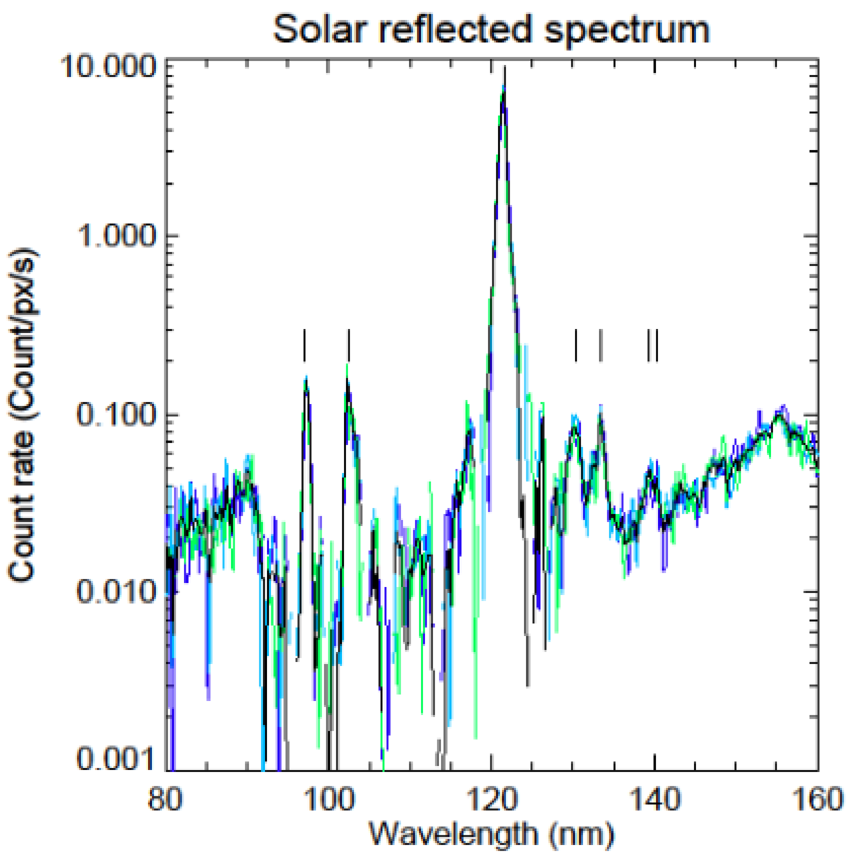
- The lines containing the reflected spectrum are added (wavelength dependent)

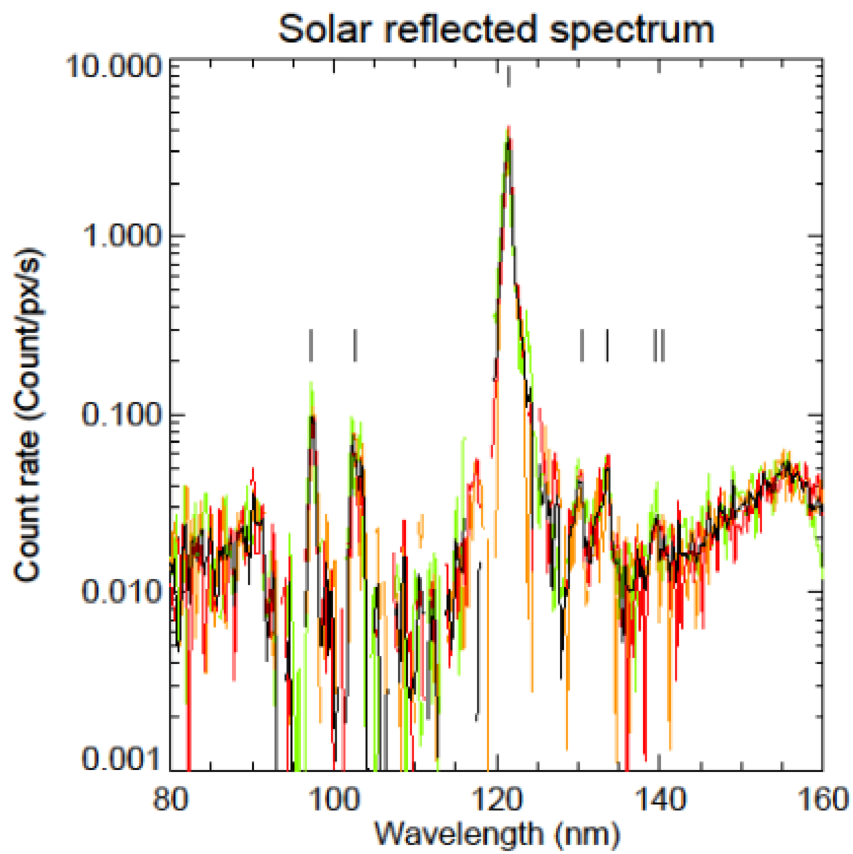
- Subtraction of the interplanetary emission using other sky observations (same HV)

- No detection of the reflected spectrum at 58.4 nm



Data processing

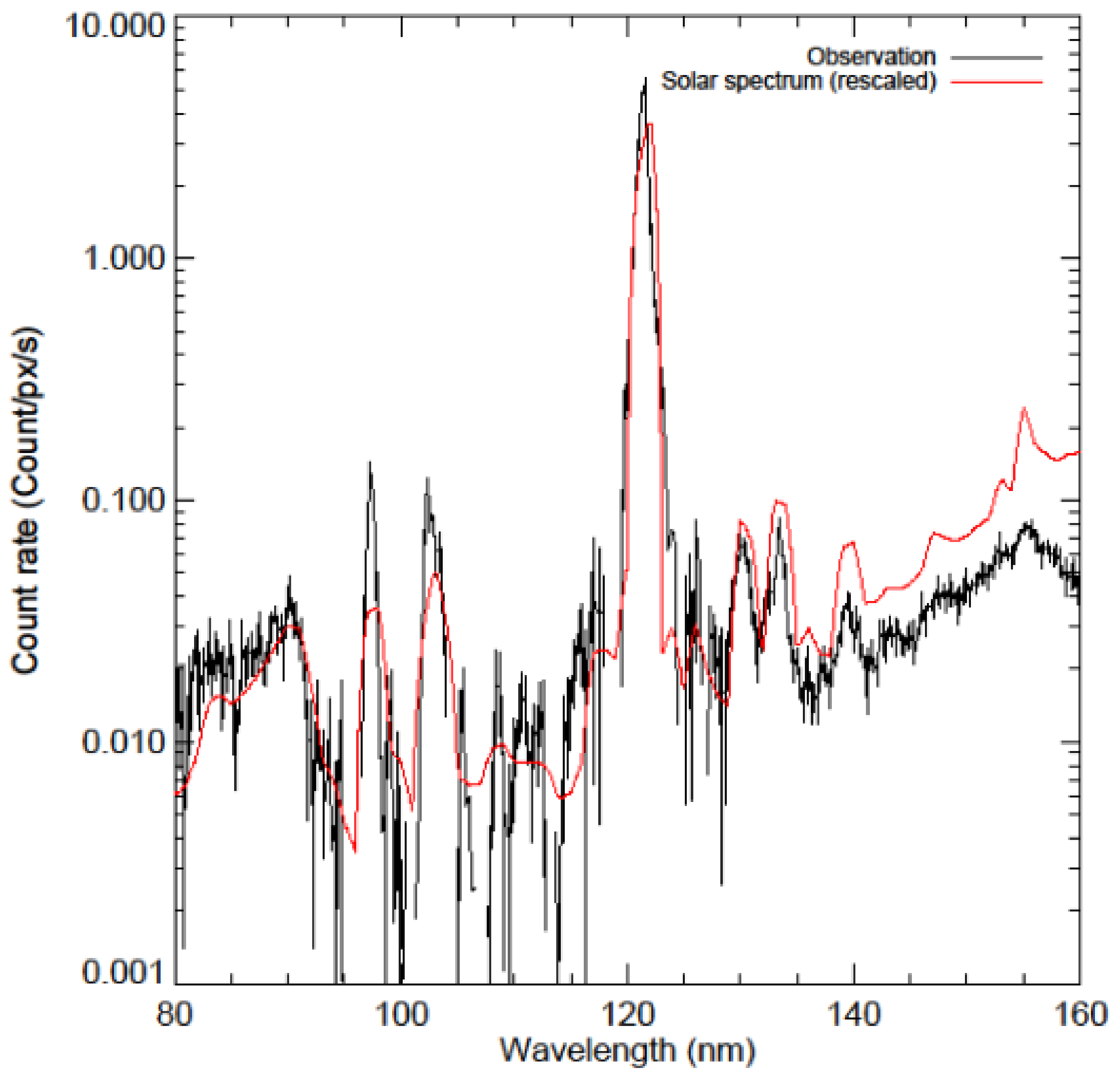




- Specific wavelength calibration for each spectrum (based on emission lines)
- The three spectra of each sequence are summed.

Data processing

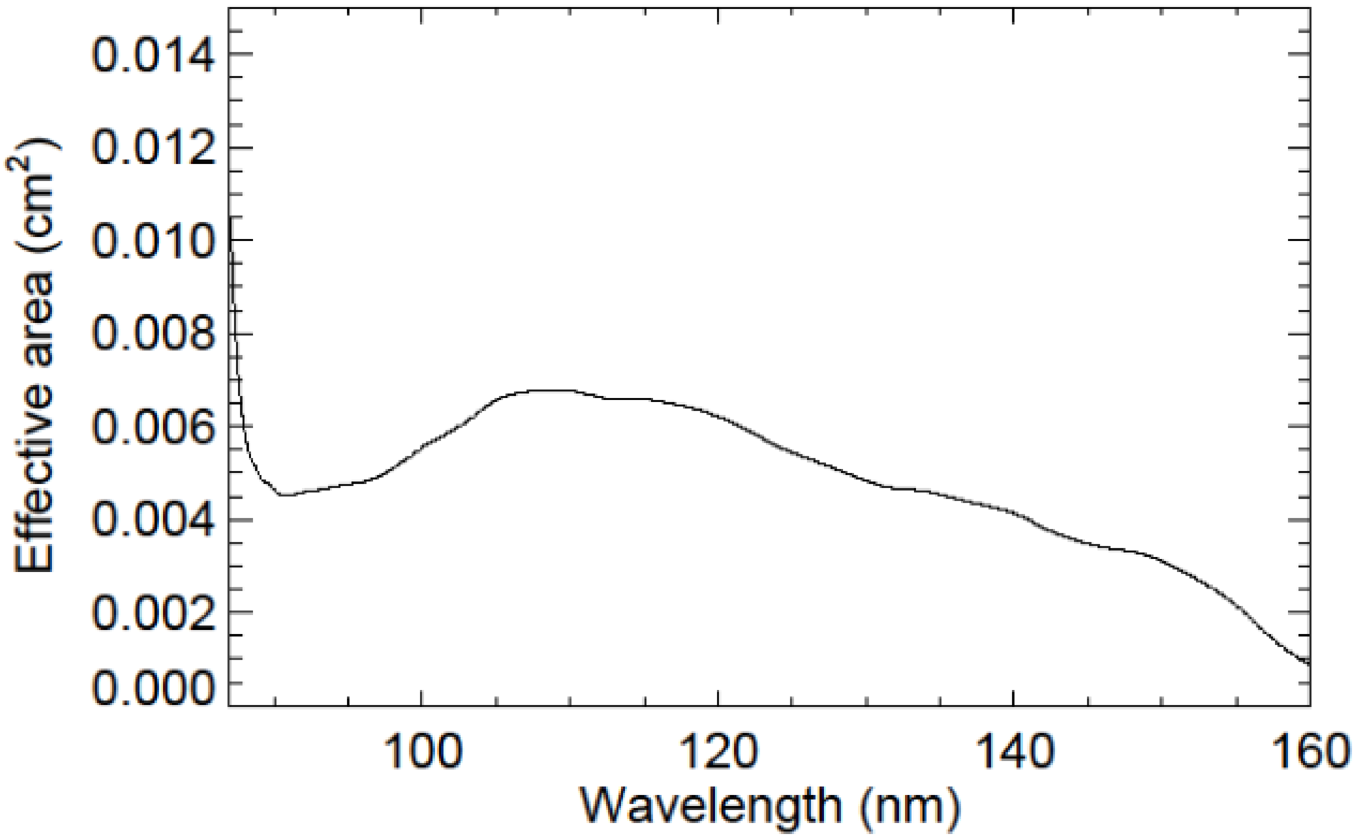
- The two spectra are linearly combined (weighted by the geometric parameters)
- The spectrum is convoluted with a Gaussian profile (1 nm width)
- The reconstructed average spectrum show a global shape consistent with the solar spectrum (ATLAS-1)



Data processing

Irradiance calibration with the EUV effective area derived from two stars observations.

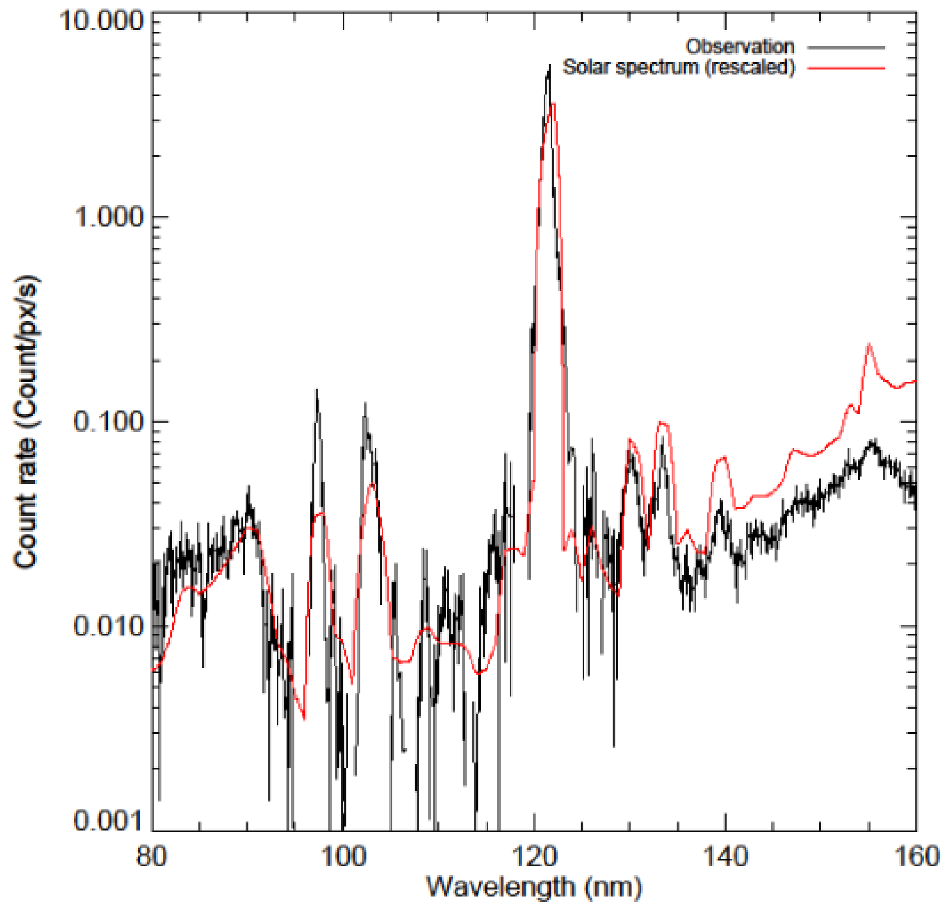
Effective area < 90 nm is still uncertain due to the low signal from stars spectra.



UV reflectance

13 spectral regions
C1 ; 87- 95 nm
Lyman-gamma (97.6 nm)
Lyman-beta (102.6 nm)
C2 : 105 – 115 nm
Lyman-alpha (121.6 nm)
C3 : 125 – 128 nm
O I (130.4 nm)
C II (133.5 nm)
C4 : 135 – 138 nm
Si IV (140 nm)
C5 : 142 – 148 nm
C6 : 148 – 154 nm
C7 : 154 – 160 nm

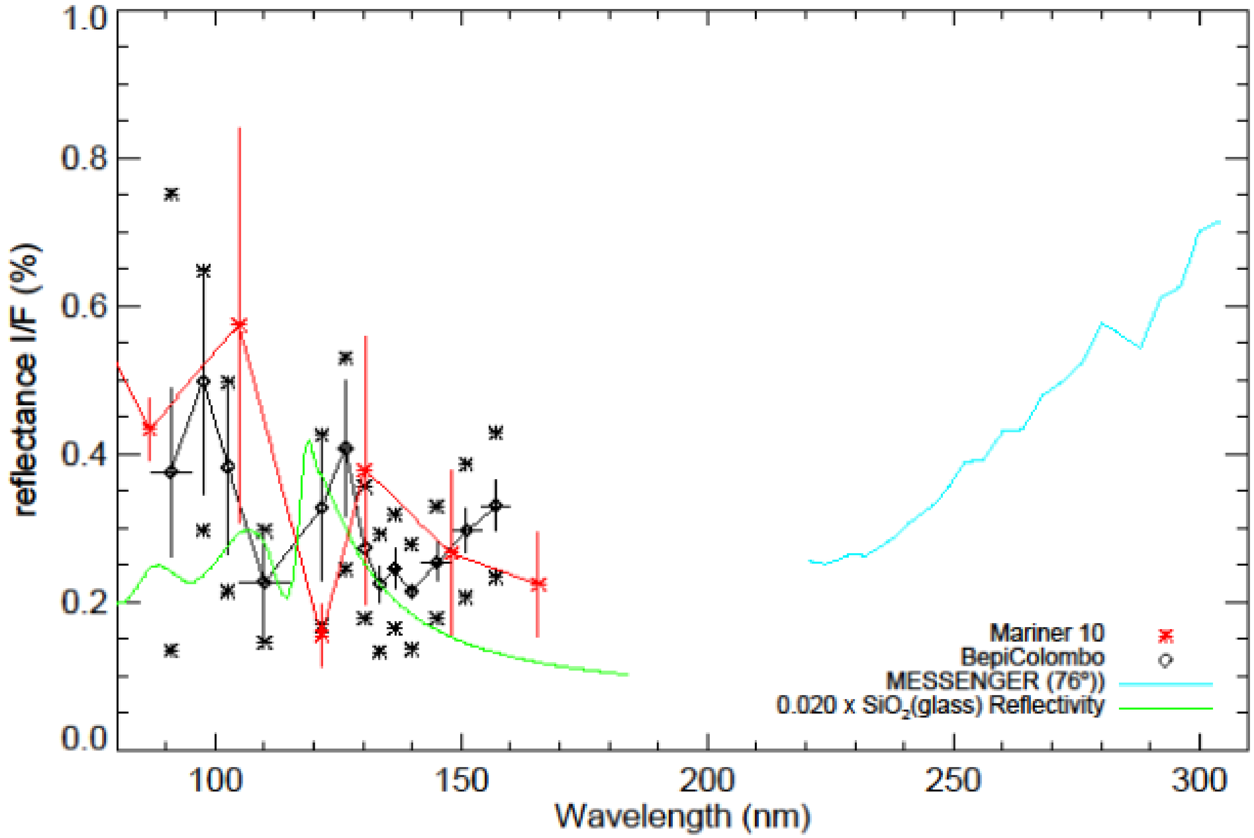
$$I/F\,(\lambda_0, g) = \frac{\sum C(px)}{S_{eff}(\lambda_0)\delta\lambda} \frac{\pi}{\int J_T(\lambda)d\lambda} < \frac{D^2}{\Omega_{object}} >$$



UV reflectance

The Mariner 10 published albedo (*Wu and Broadfoot 1977*) is rescaled to a phase angle = 70° from their integral phase model.

- General good agreement of the derived reflectance with Mariner 10 and MESSENGER (at 220 nm)
- Differences in the spectral shape (real or not ?)
- The spectral profile between 110 – 150 nm is consistent with SiO2 (glass) used to fit the Moon's EUV albedo (from EUVE : *Gladstone et al. 1994*)



Conclusion

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Summary

- First measurement of the EUV albedo (disk-integrated) of Mercury since Mariner 10
- The general value between 80 – 160 nm is in agreement with measurements of Mariner 10 and confirm a lower value on Mercury than on the Moon (due to lower value of FeO)
- Observations of spectral variations. Are they real or not ?

Future work

- Possible new observations in the future (EUV and FUV)
- Interpretation of the observed spectral variability with expected material at the surface of Mercury