PDS-SBN Review of New Horizons LEISA Data

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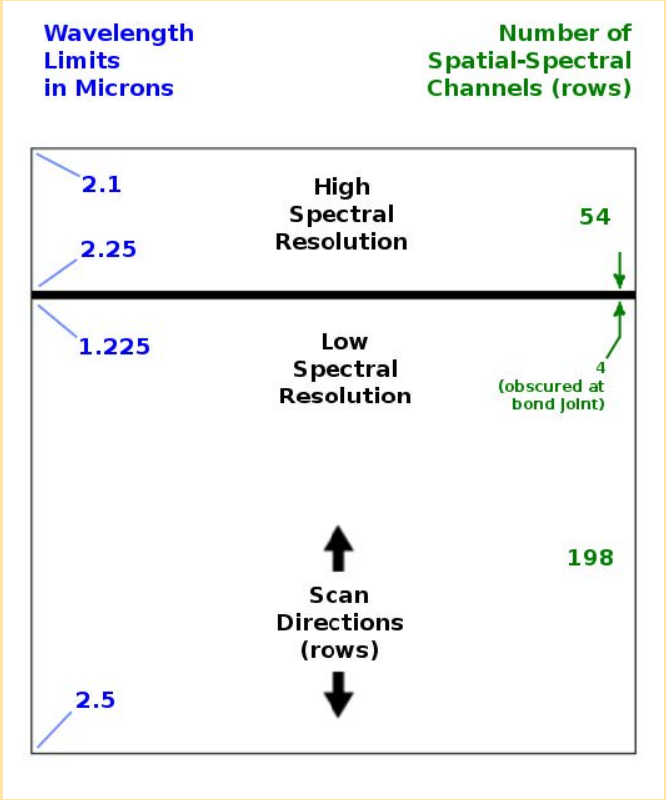
5-6 December 2016

LEISA

A near-IR (1.2 – 2.5 micron) spectrometer that uses a 256x256 Rockwell PICNIC array, with 40 micron square pixels.

It produces low-resolution ($\lambda/\Delta\lambda$ ~ 200-250)* and higher-resolution ($\lambda/\Delta\lambda$ ~ 400-600)* spectra over separate sections (ranges of 54 and 198 rows) that are separated by 4 rows obscured by a bond joint.



Note: Adopted from S. Protopapa's pds LEISA review presentation from December 2014.

* Issues with spectral resolving power and wavelength assignment are addressed below.

A spatial-spectral data cube is created by scanning the FOV across the target in a “push-broom” fashion. The data cube is a 3-dimensional array having 256x256xN elements, where N is the number of 256x256 files accumulated over the scan.

e.g., read in calibrated FITS file = ‘nh-p-leisa-3-pluto-v2.0/data/20150714_029917/lsb_0299172889_0x53c_sci.fit’

file = file(x,y,z),

x=spatial (256 elements),

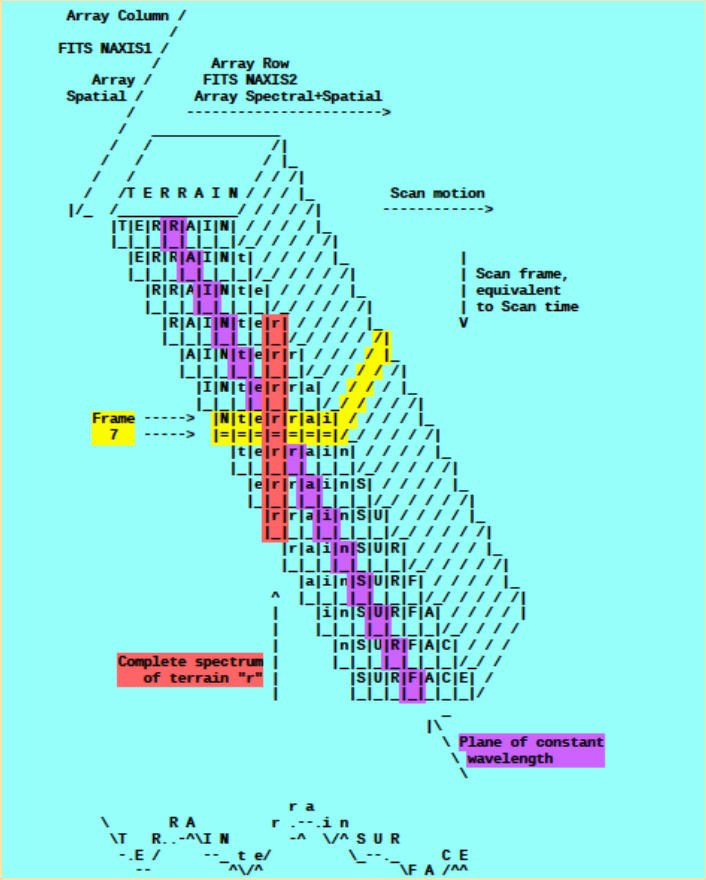
y=lambda(256 elements),

z=spectral/spatial

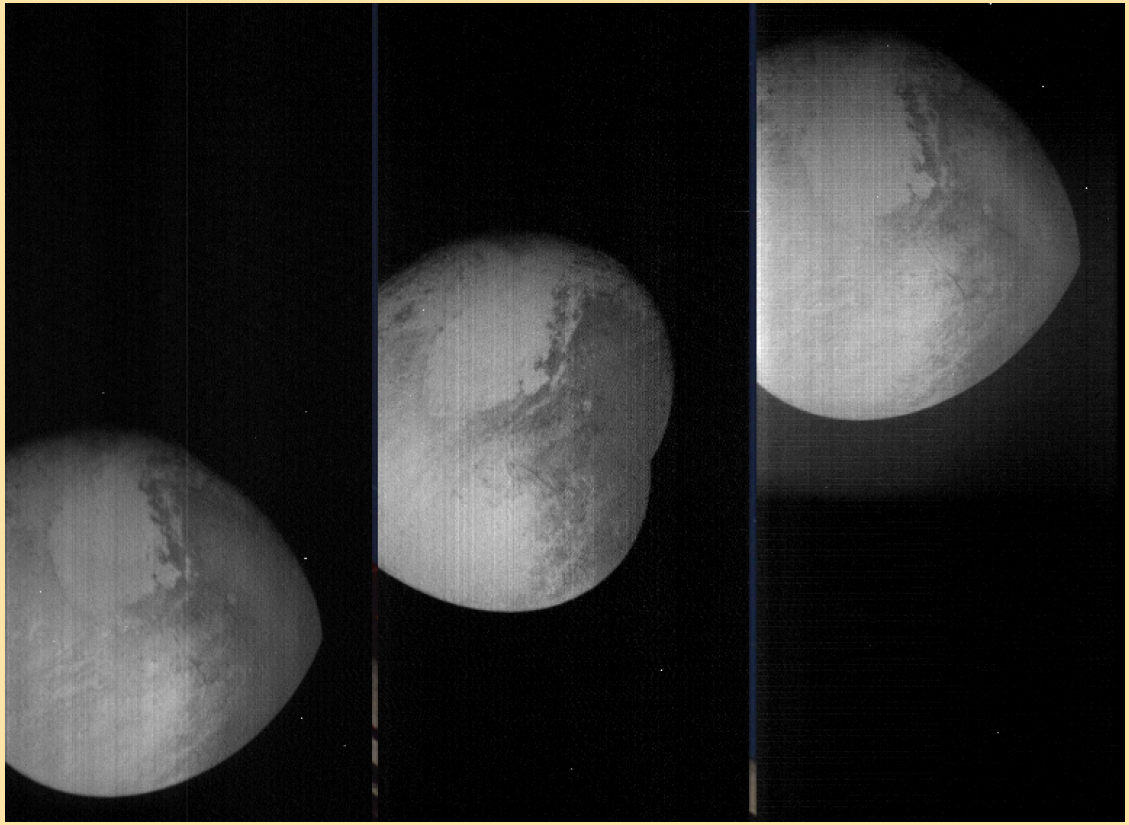
(N=elements; e.g., N=728)

(i.e., lambda varies spatially)

[figure from ‘leisa_data.pdf’ in folder ‘document’]

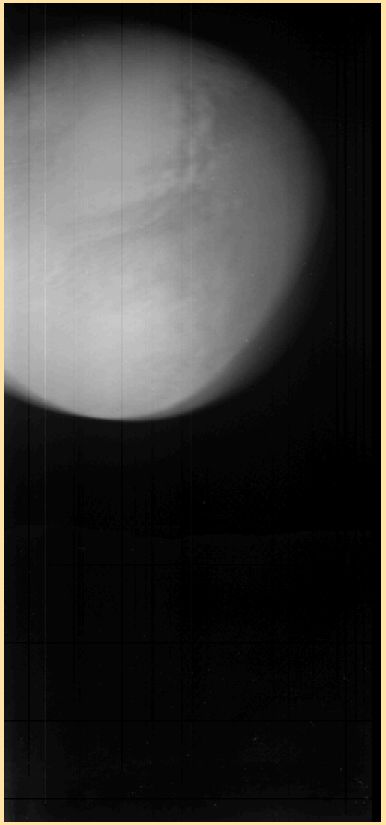


Transpose file(x,y,z) [256,256,N] → file_tr(x,z,y) [256,N,256]



file(0:255,0:N-1,0) file(0:255,0:N-1,127) file(0:255,0:N-1,255)

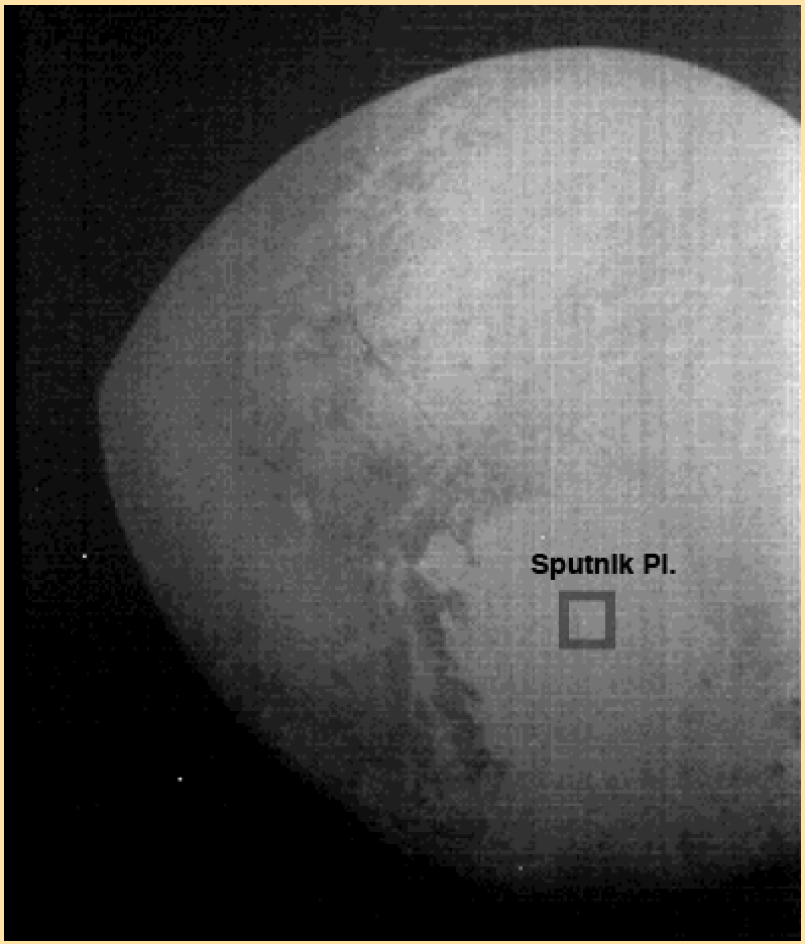
→ shift - register

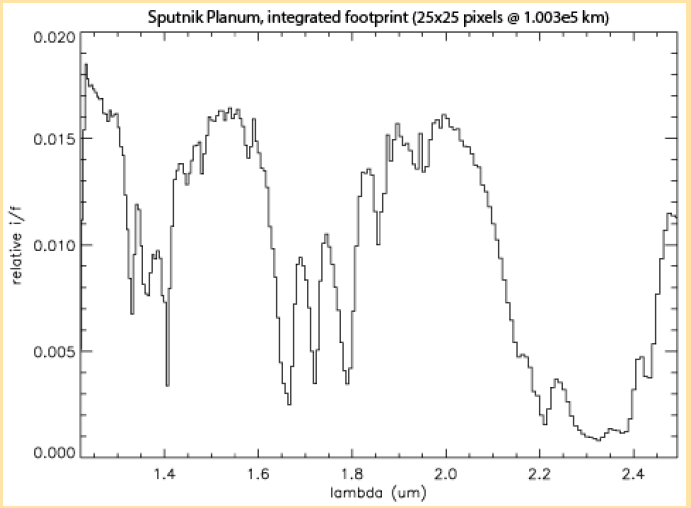


file_tr_sh(0:255,0:N-1,Σ[0:255])
(i.e., over all lambda)

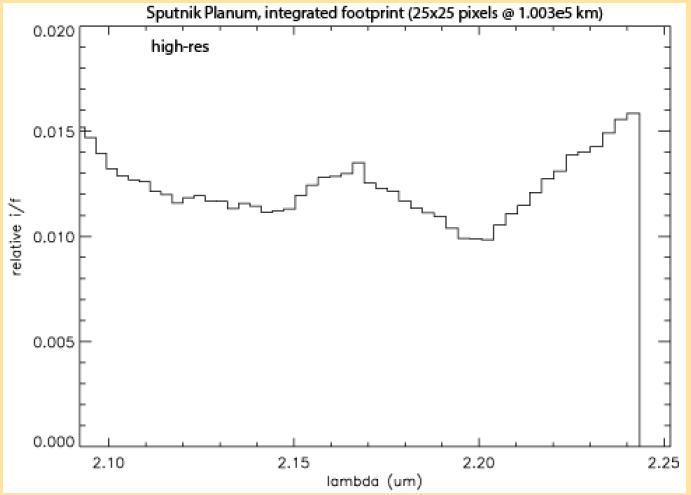
(Some residual wobble in x-dim)

Extract spectra over Sputnik Planum



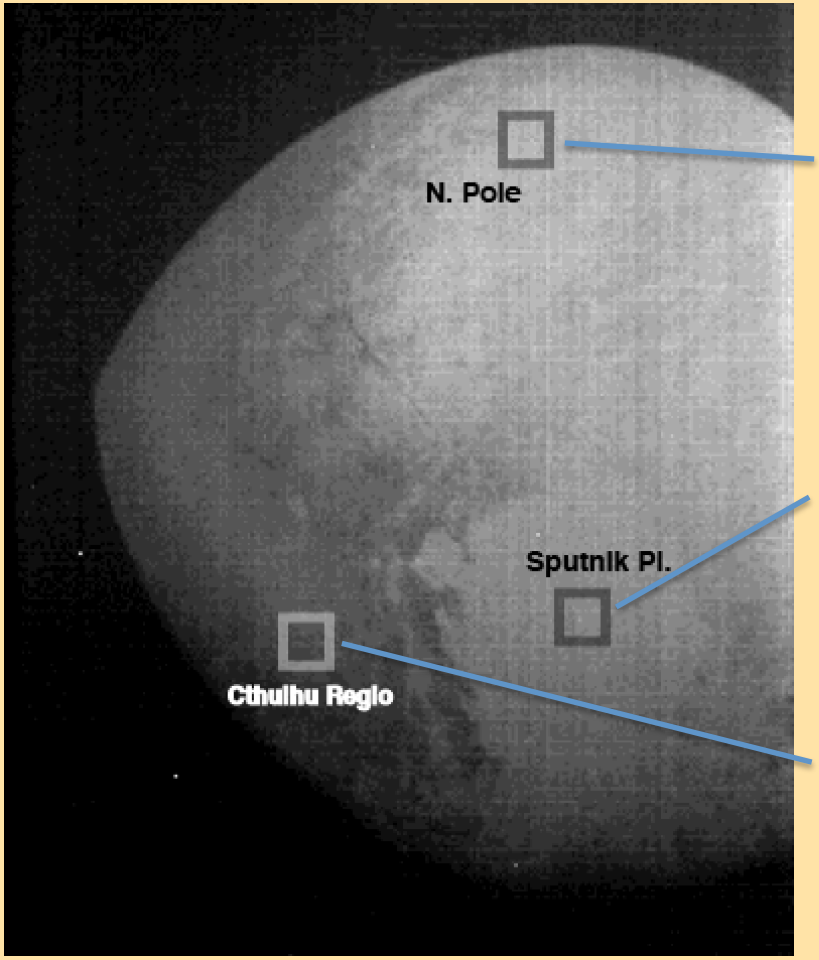


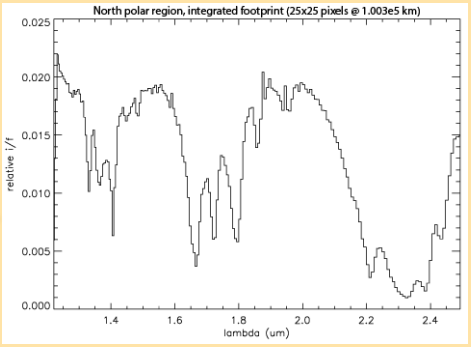
Low Res
($\lambda/\Delta\lambda = 222$)

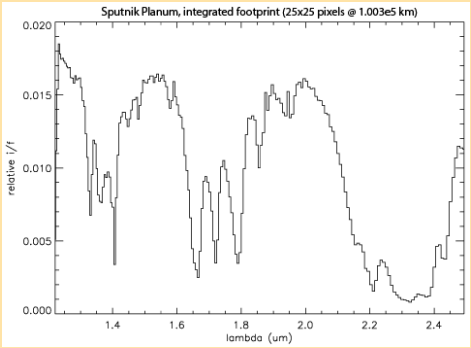


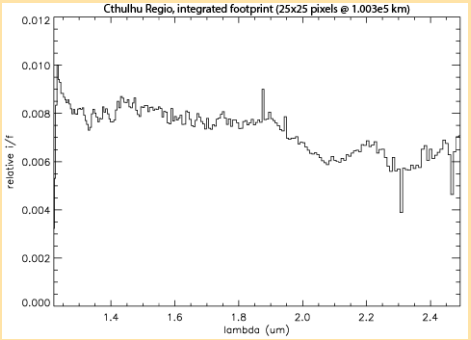
High Res
($\lambda/\Delta\lambda = 425$)

Extract spectra over different regions

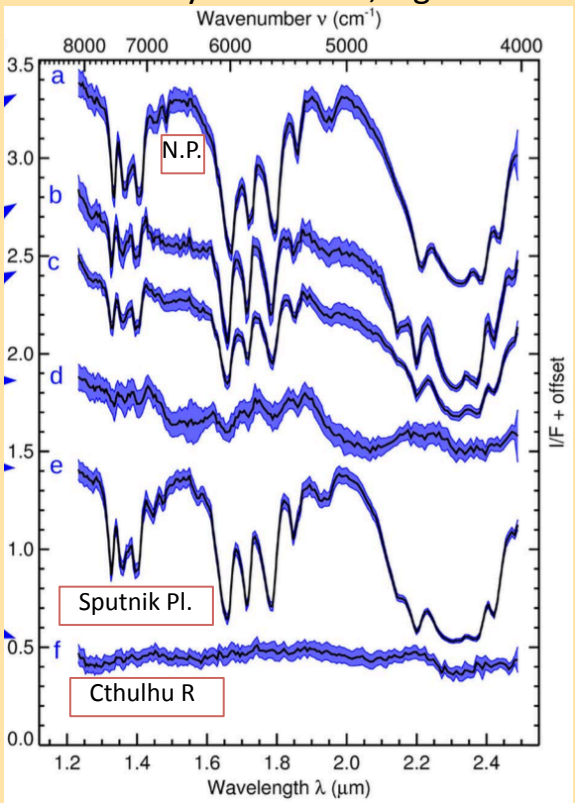






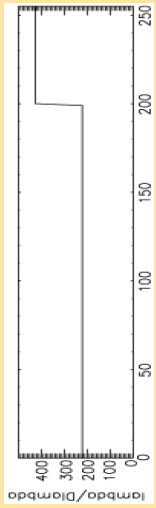


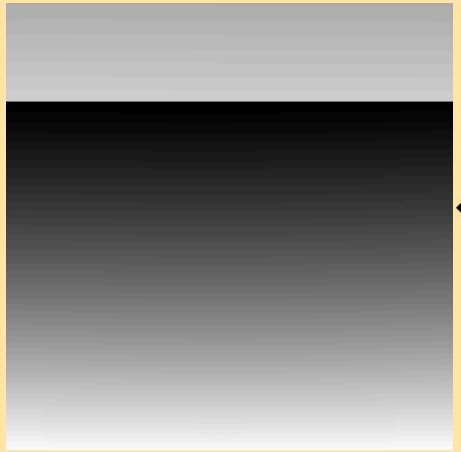
Grundy et al. 2016, Fig. 3B



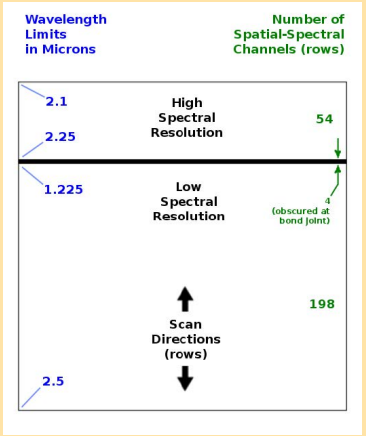
Summary and Issues

- ❑ Beautiful data sets, somewhat conceptually challenging but manageable once one realizes what variables are what in the data cubes.
- ❑ Extracted spectra agree well with corresponding spectra from specific regions on Pluto, as published, e.g., in Grundy et al. 2016 Science 351/6279:aad9189 (8pp.).
- ❑ Issues with spectral resolving power and wavelength assignment . The $\lambda/\Delta\lambda$ from extension number 1 of the FITS file is what I used; this results in values of 220 and 425 for low- and high-resolution segments, respectively, as on the previous slides.
  - However, these values are distinctly lower than those given in the file 'introdoc.pdf' in the main LEISA folder, namely 280 and 580 respectively.
  - The 280 and 580 values are realized if the FITS file '…/calib/initial/wavemap.fit' is used to assign lambda scales. BUT, the sense of this file is reversed from that for the data FITS file:

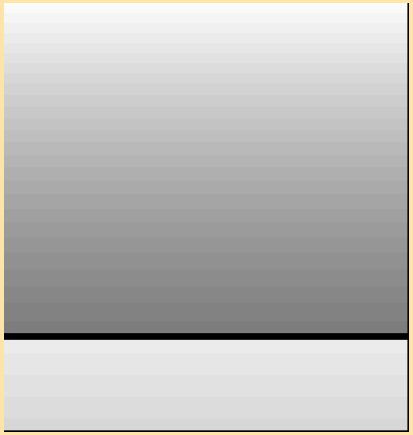


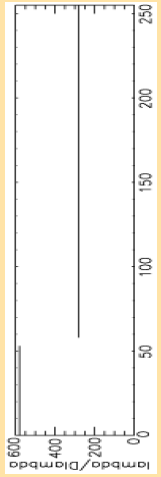


←→



, vs.





lsb_0299172889_0x53c_sci.fit, exten_no = 1

calib/initial/wavemap.fit

Take away: It looks like the wavemap on the right is from an earlier calibration, but it should be updated and be made consistent with what's in extension 1 of the FITS files.

Summary and Issues (cont'd)

- Spatial footprint at Pluto: In the file 'calib/calinfo.txt', pixel solid angle is given as: aOmega = 0.004*0.004*PI/((2*8.6)*(2*8.6)), which is 1.7E-7 cm^2 sr (?), or an AΩ product ("entendue").

For S/C-Pluto distance (d) = 1.003E5 km