PACS spectroscopy range scan

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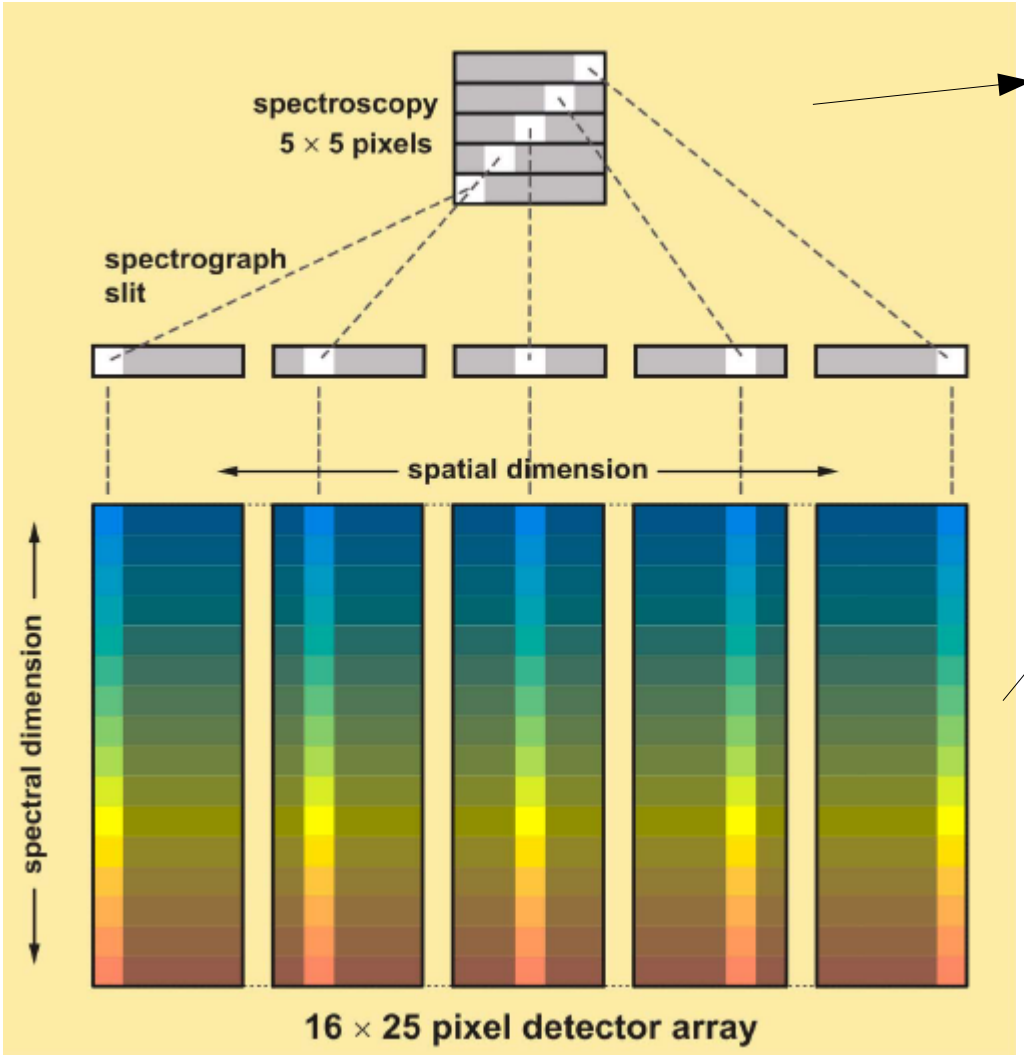
21/02/2007, ESTEC

PACS spectrometer



Integral field:

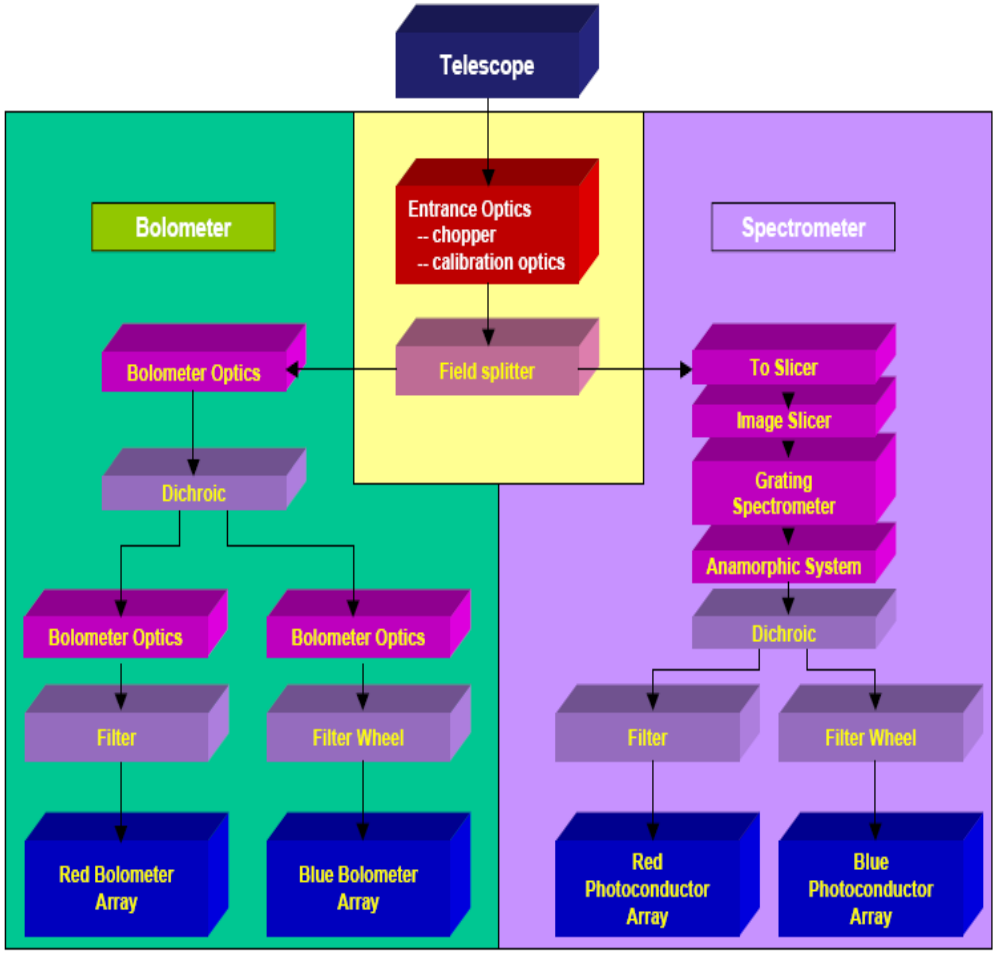
47”x47”

5x5 pixels

Instantaneous spectral coverage:

~ 0.15 - 1µm

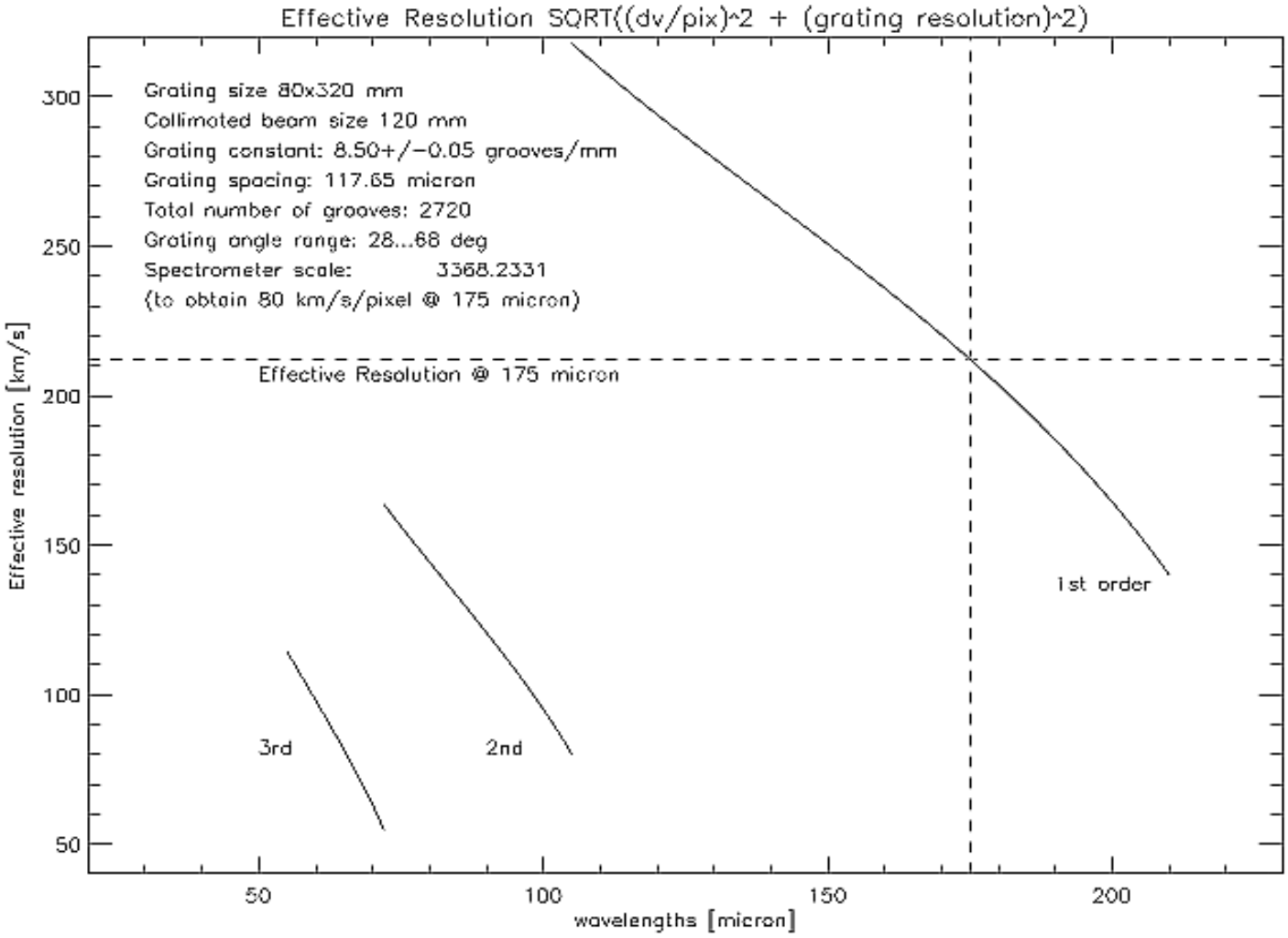
PACS Spectrometer overview



Spectral resolution

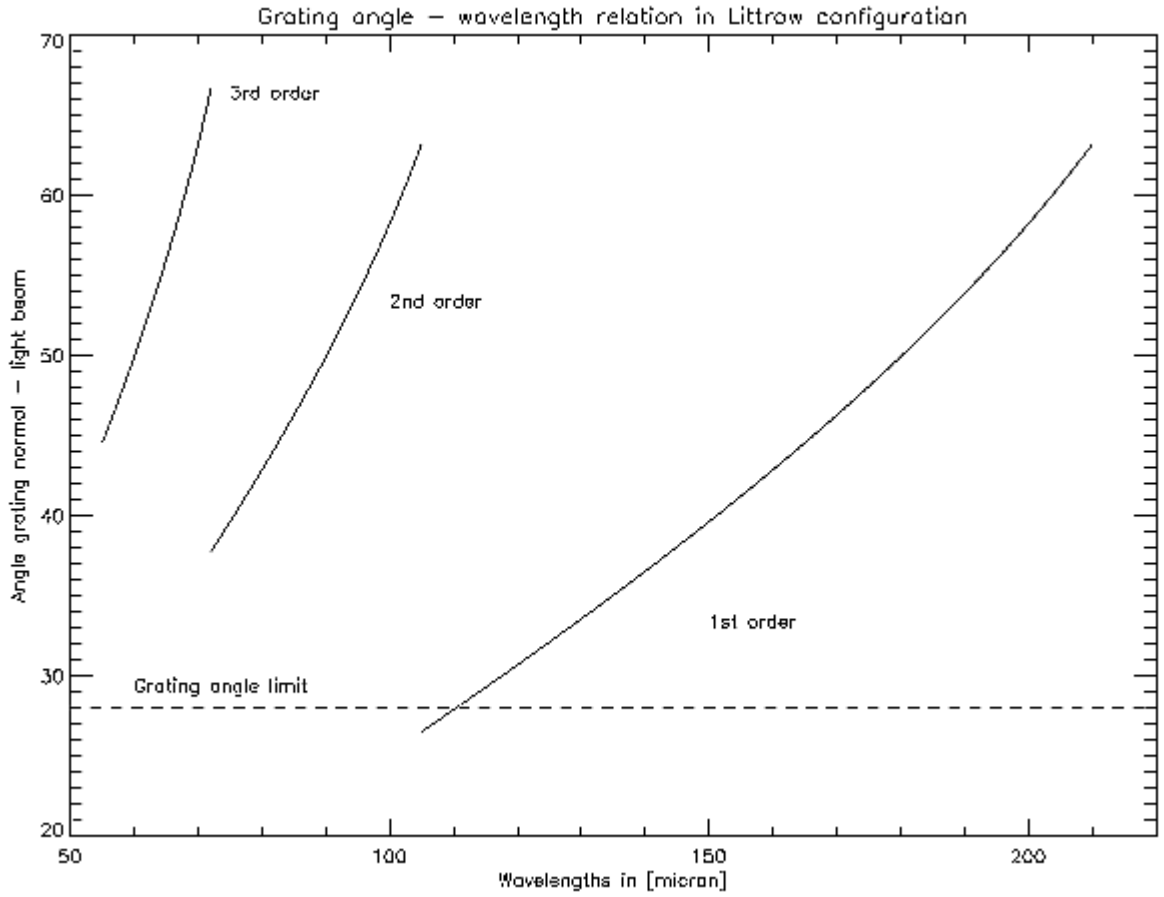
$\lambda / \Delta\lambda \sim 940 - 5500$

$c\,\Delta\lambda / \lambda \sim 55 - 320$ km/s



Parallel blue and red ranges

Different grating orders are observed simultaneously in the red and blue detector



order 1 + 2
105-210 //
72-105µm

or

order 1 + 3
105-210 //
55-72µm

Parallel ranges – examples

- Range scan 60-70 µm [order 3]
  - Will yield 'free' range in order 1 : 180-210µm
- Range scan 72-80 µm in [order 2]
  - Will yield 'free' range in order 1 : 144-160µm
- Range scan 120-180 µm [order 1]
  - Can yield 'free' range in order 2 : (60-)72-90 µm
    [order selection filter: cut-off short of 72µm]
  - Can yield 'free' range in order 3 : (40-)55-60 µm
    [cut-off short of 55µm]

Ranges within 1 AOR – limitations

- Maximum 10 different wavelength ranges
- No filter wheel change -> only one combination of
  - order 1 // order 2
  - order 1 // order 3
- If more wavelength ranges or order 2 and 3 needed: concatenate several AORs

Full range scan

- PACS full range scan: 2 concatenated AORs
  - AOR 1 : order 1 & 2
    - order 1 : 105-210 µm
    - order 2 : (52 –)72 - 105 µm

      [order selection filter: cut-off short of 72µm]
  - AOR 2 : order 1 & 3
    - order 1 : 165 – 210 µm
    - order 3 : 55 – 72 µm
- Full range scans are predefined in HSPOT:
  - SED Blue [order 3]
  - SED Red [order 2]

Two spectral sampling densities

- Nyquist sampling
  - Unresolved line FWHM Nyquist sampled
  - Nyquist considering all 16 spectral pixel
  - This sampling is chosen for SED mode (PACS full range AOR)

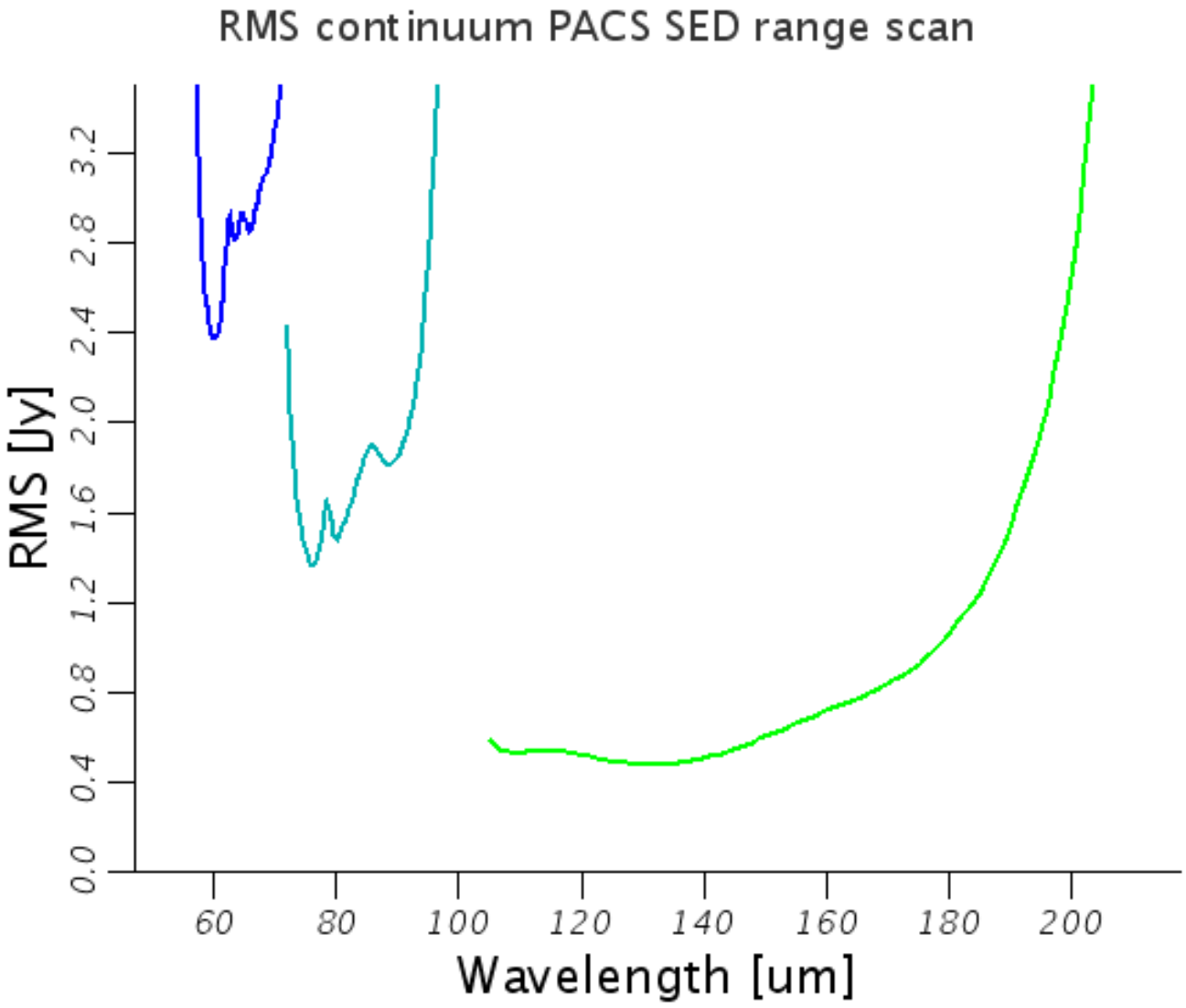
- *High Sampling*
  - Spectral sampling as in line spectroscopy
  - ~3 samples per FWHM in every detector

Nyquist sampling

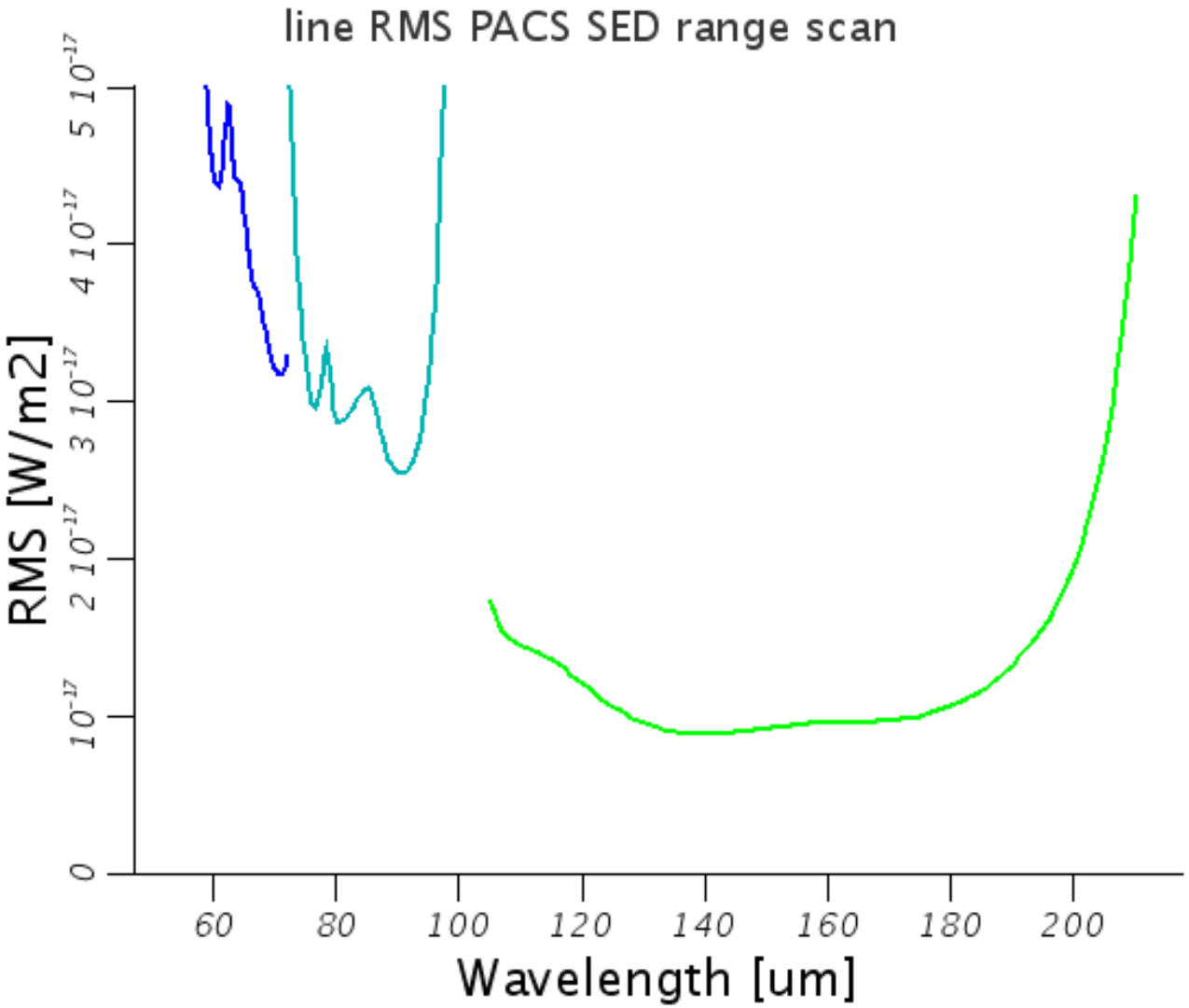
- 4 scans in 1 telescope nod cycle
  - 1 up / 1 down wavelength direction
  - Repeated on 2nd nod position
- Duration, e.g. full range
  - 105 - 210 µm (72-105 for free) : ~2050 sec
  - 55 – 72 µm (extra 165-210 free): ~1300 sec

    [total full PACS range ~ 0.9h]
- Sensitivity (line / continuum)
  - Varies over wavelengths
  - Increase S/N : repeat nod cycle

Nyquist : continuum sensitivity



Nyquist: line sensitivity

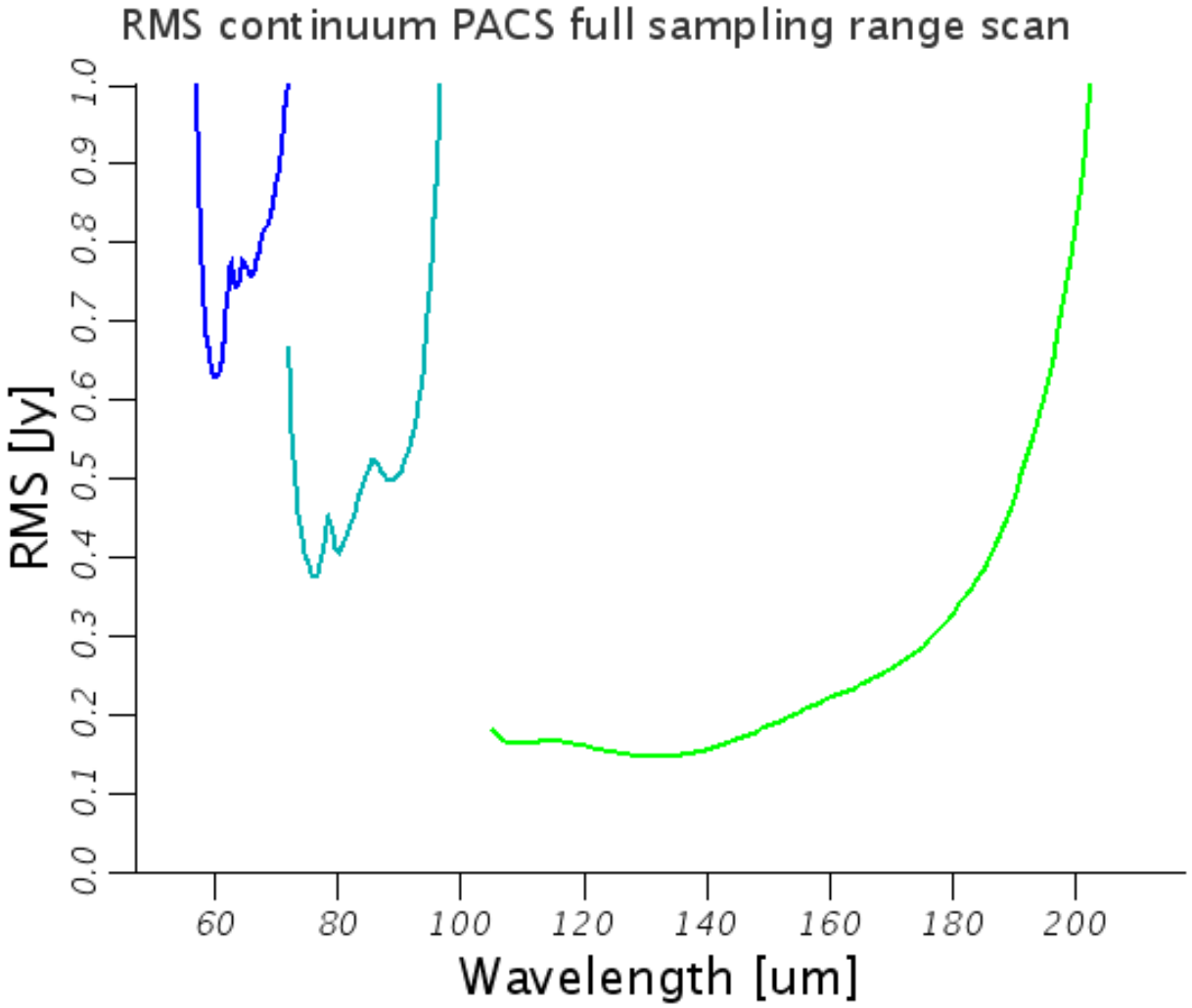


High sampling

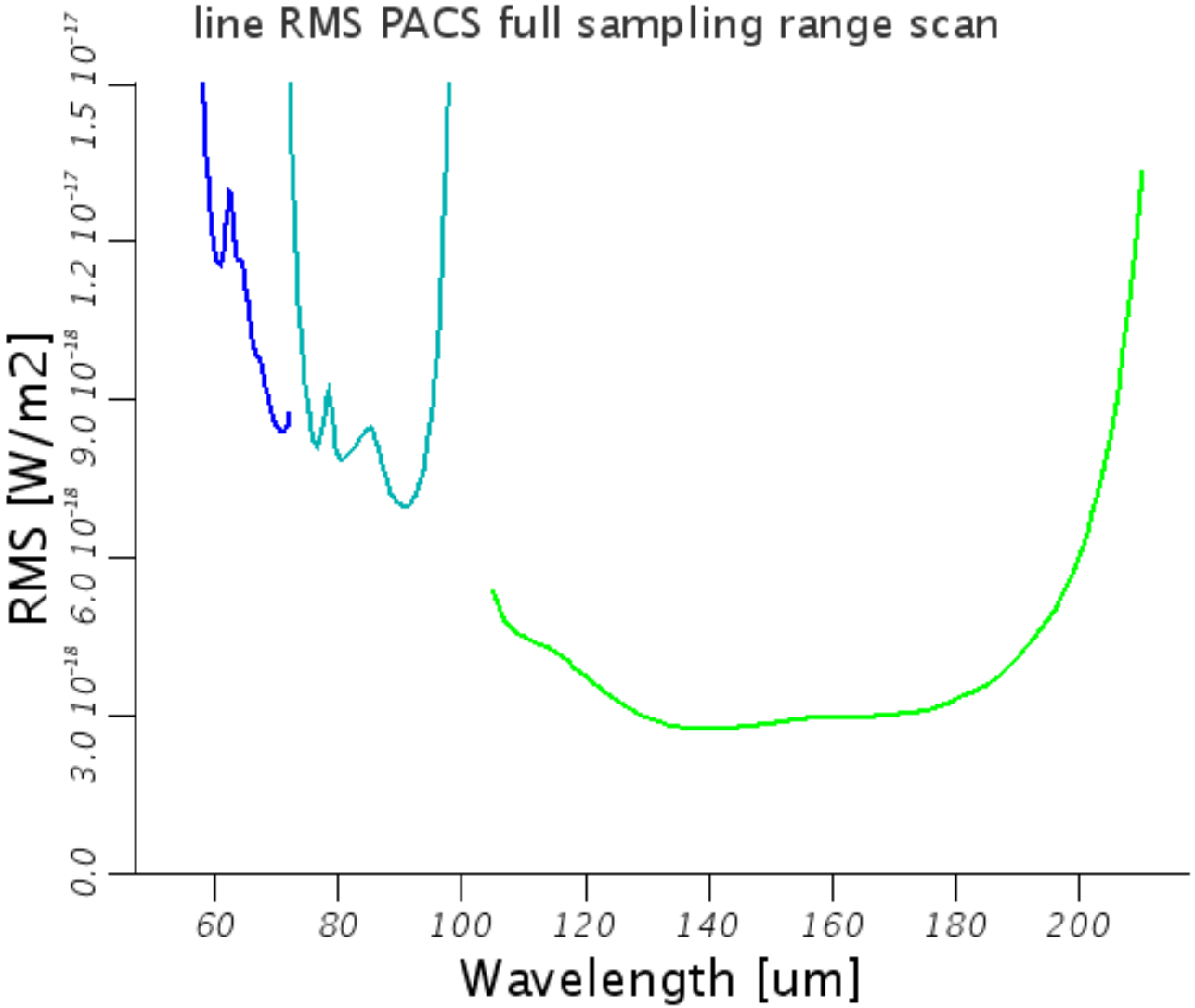
- 4 scans in 1 telescope nod cycle
  - 1 up / 1 down wavelength direction
  - Repeated on 2nd nod position
- Duration, e.g. full range
  - 105 - 210 µm (72-105 for free) : ~18300 sec
  - 55 – 72 µm (extra 165-210 free): ~15601 sec

    [total: ~9.4 hours]
- Sensitivity (line / continuum)
  - Varies over wavelengths
  - Increase S/N : repeat nod cycle

High sampling – continuum Sensitivity



High Sampling – line sensitivity



Source type and chopping

- Point-like sources : *Pointed*
  - Chopping / nodding
    - Small (1')/ Medium (3')/ Large throw (6')
- Compact, but resolved : *Pointed with dither*

  Goal: eliminate diffraction effects field slicer
  - Chopping / nodding
    - Small (1')/ Medium (3')/ Large throw (6')
- Extended sources : *Mapping*
  - Chopping / nodding (Large throw; 6'): maximum size 6'
  - Off position