Last progresses on longitudinal bunch profile studies using infrared spectroscopy techniques

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Coherent radiation

spectral energy density

$$\boxed{\frac{dU}{d\omega} = C\ N^2 \left| F_{long}(\omega) \right|^2 T(\omega, \gamma, r_b, \theta, source)}$$

$$\boxed{F_{long}(\omega) = \int_{-\infty}^{\infty} \tilde{\rho}(t) \exp(-i\omega t) dt}$$

normalized charge density

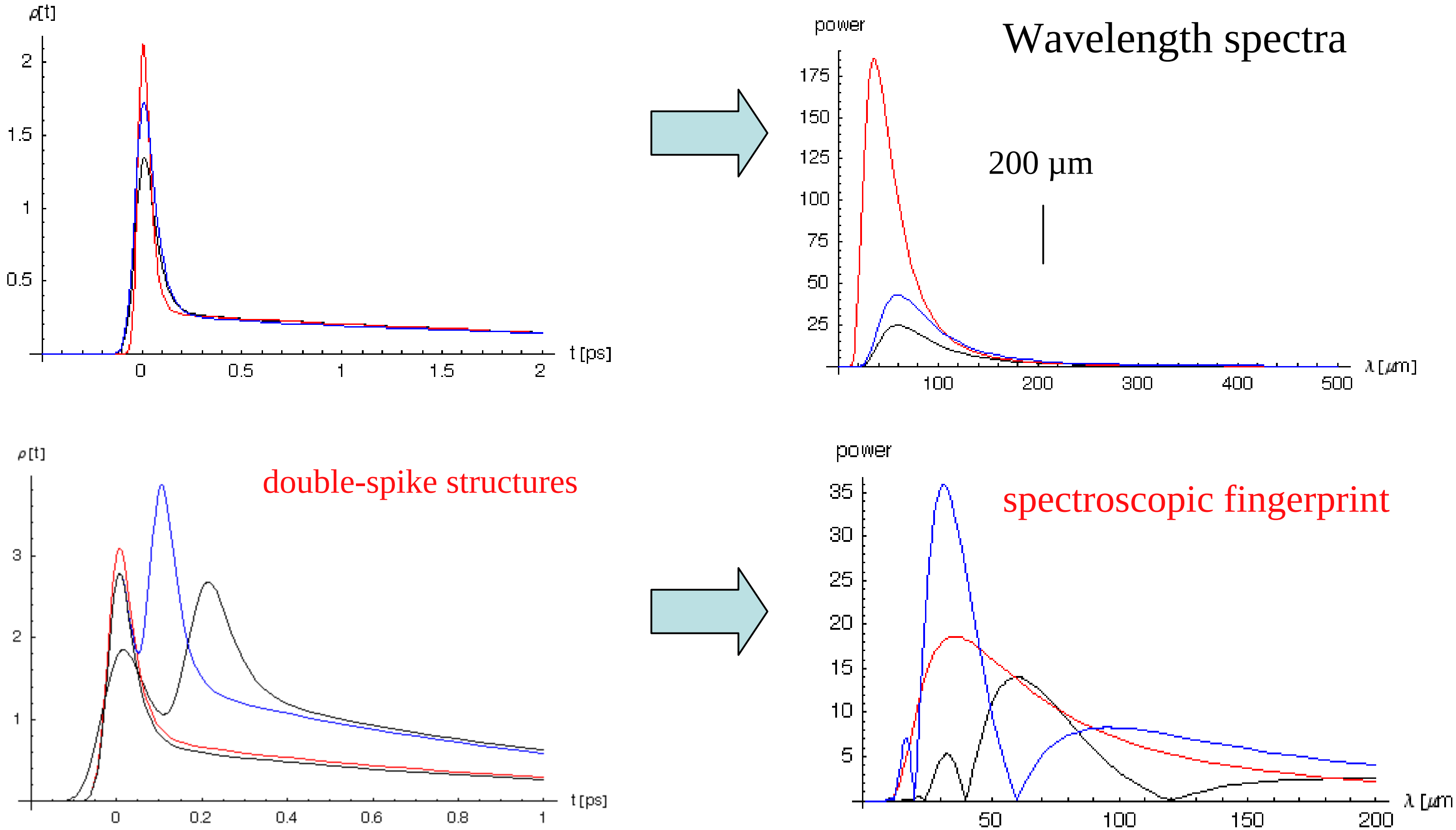
- integral intensity

'compression factor', effective bunch length

- spectral resolved intensity

+ bunch structure, 'longitudinal fingerprint'

Wavelength range of relevance

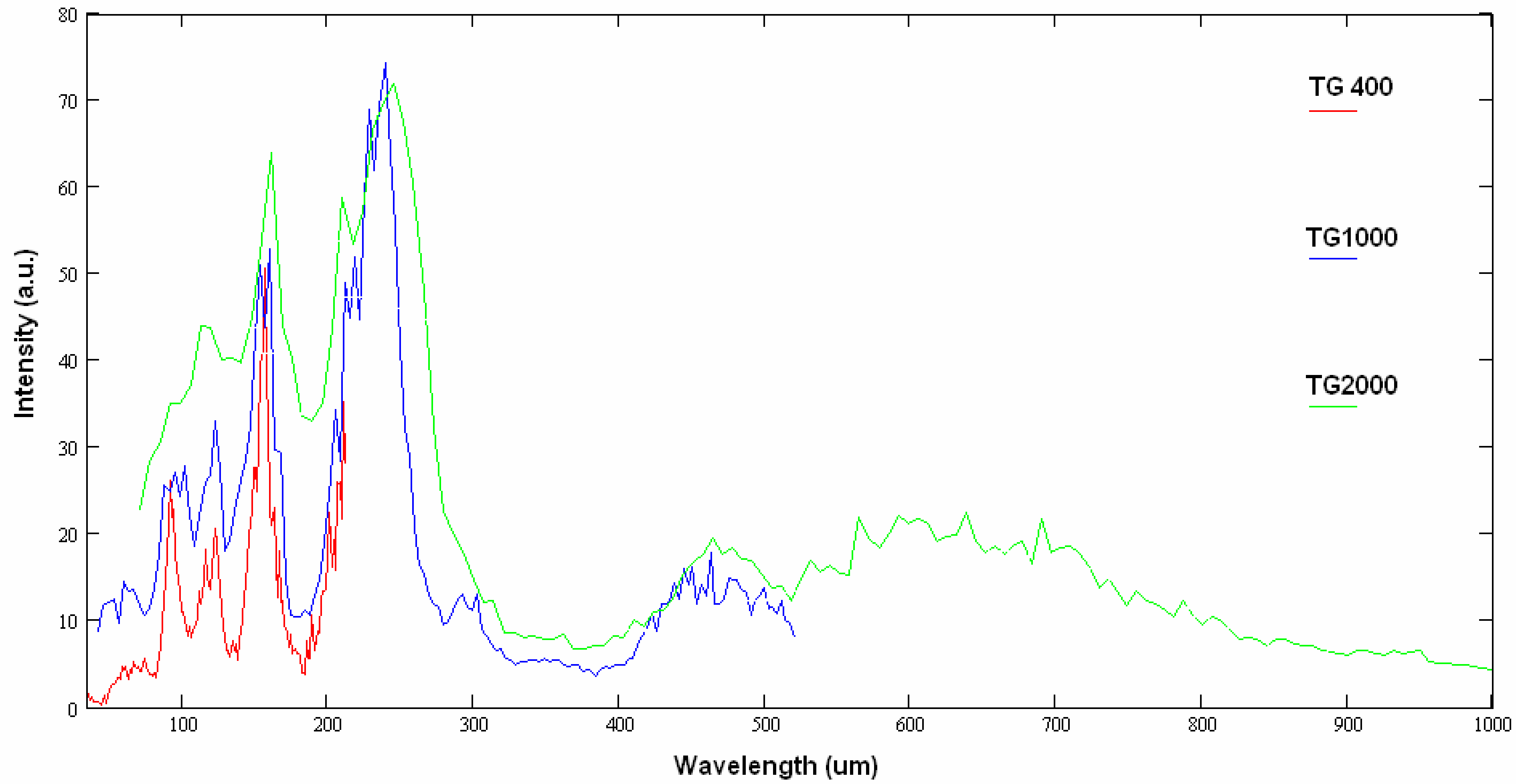



TG
Off-axis
Paraboloid
Crystalline
quartz
Pyroelectric
crystal
Flat mirrors

Rotating mirror spectrometer-transmission grating

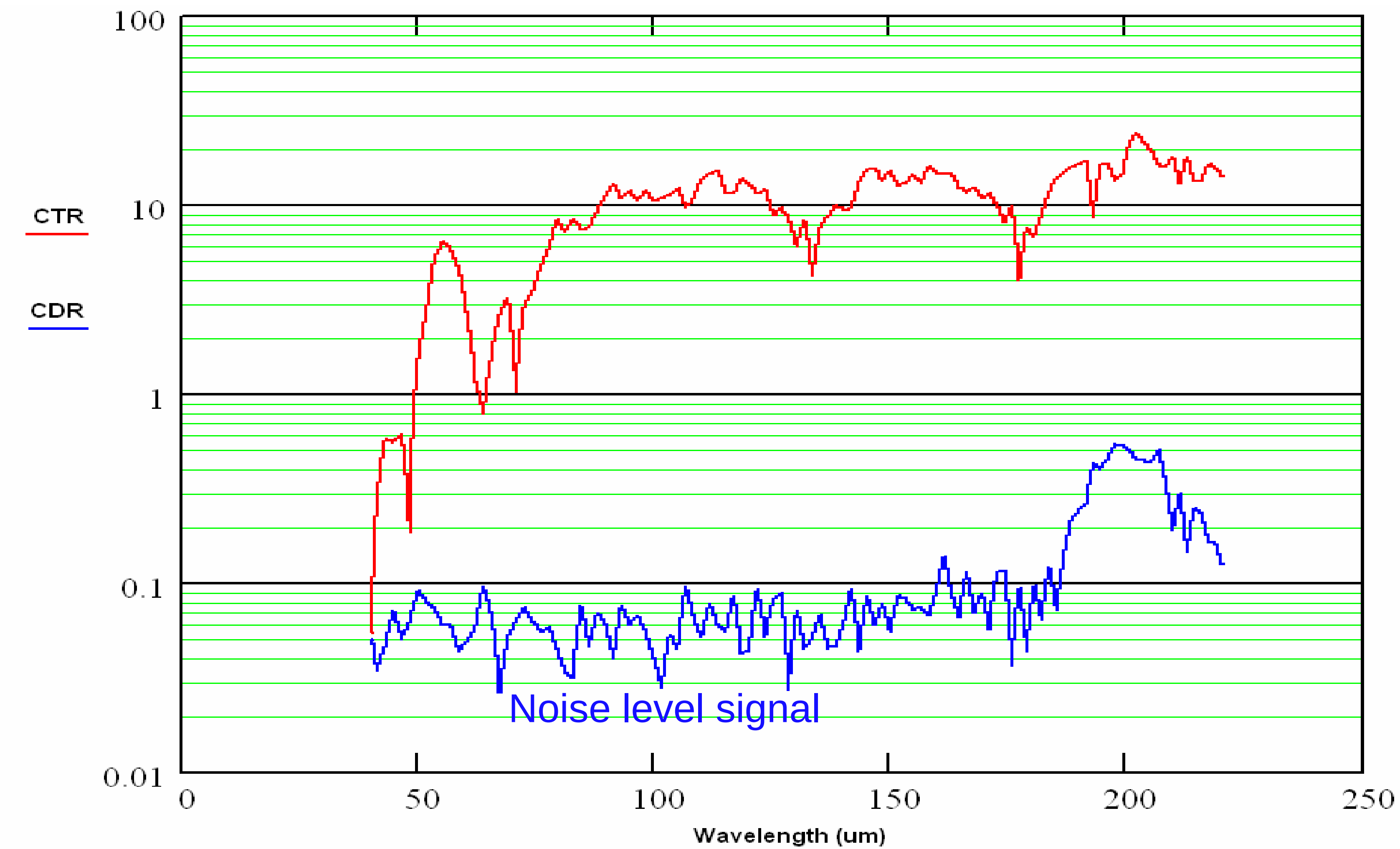
(~1.5 m air)

30 bunches, slit diffraction radiator, standard pyroelectric detectors

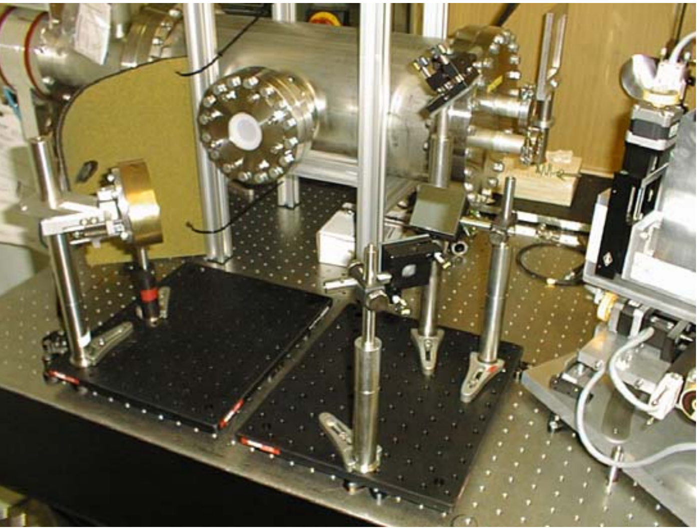


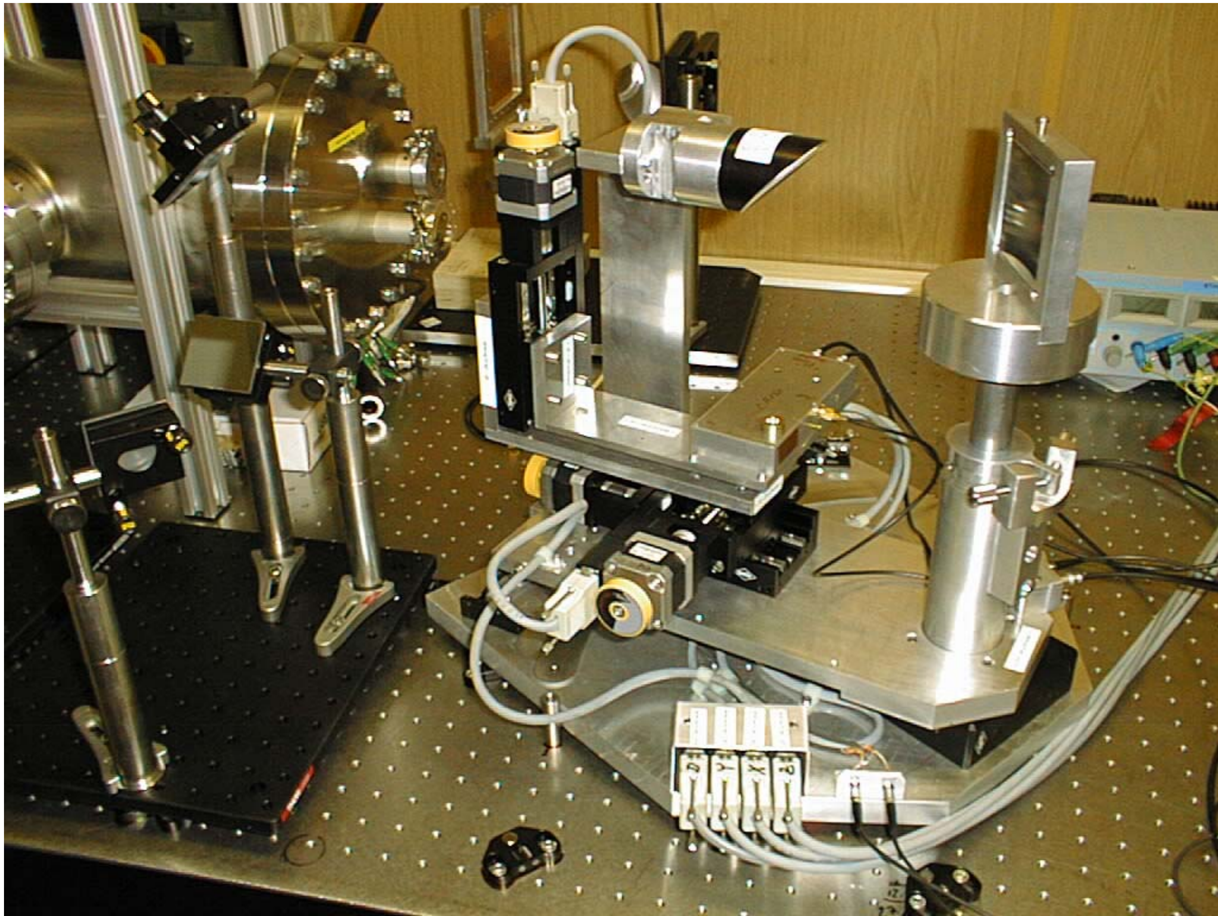
CTR versus CDR

Using flat response Golay-cell detectors, it is shown that in order to study short wavelengths part of the spectra CTR has to be used.



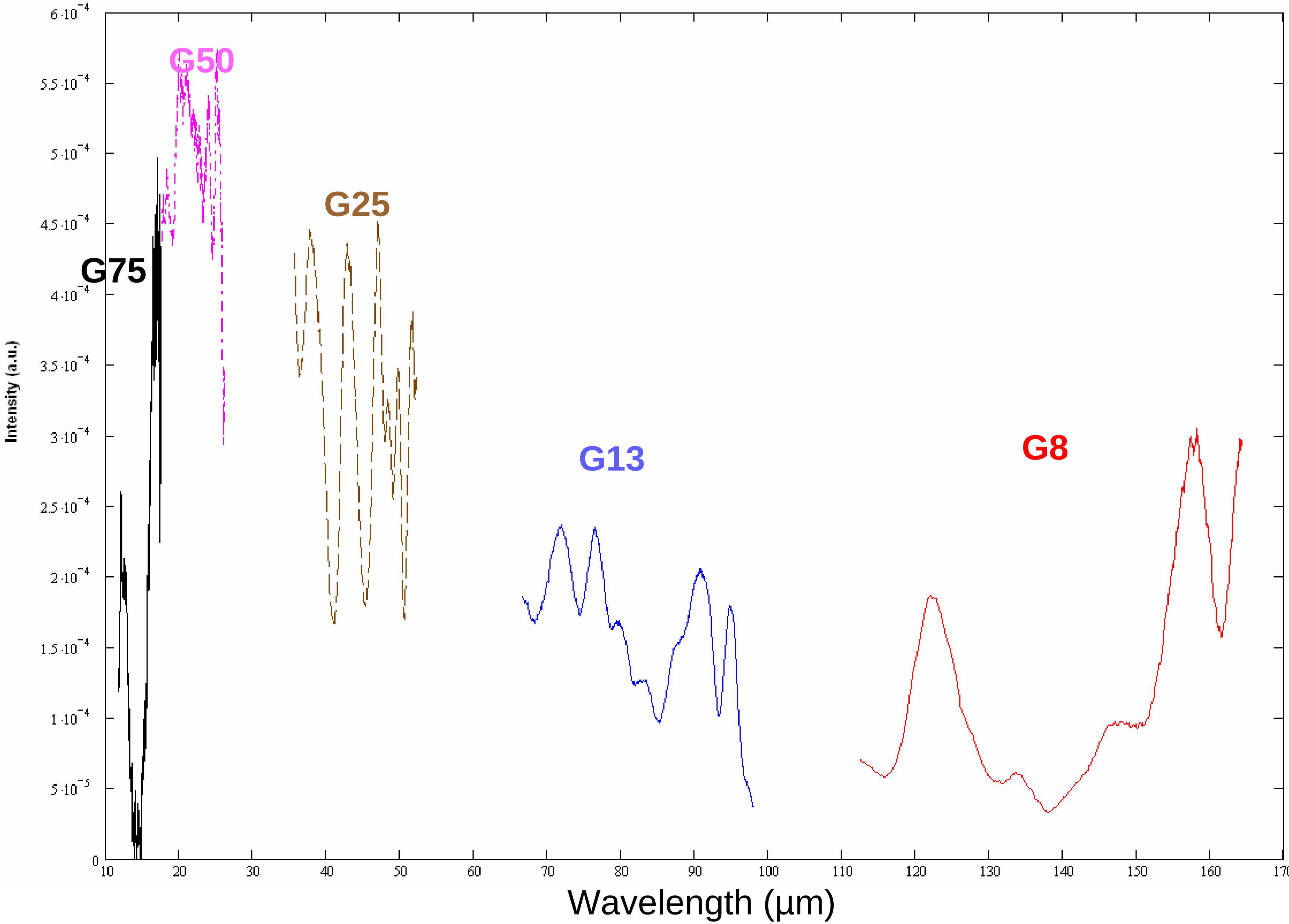
Rotating mirror spectrometer-reflectance grating



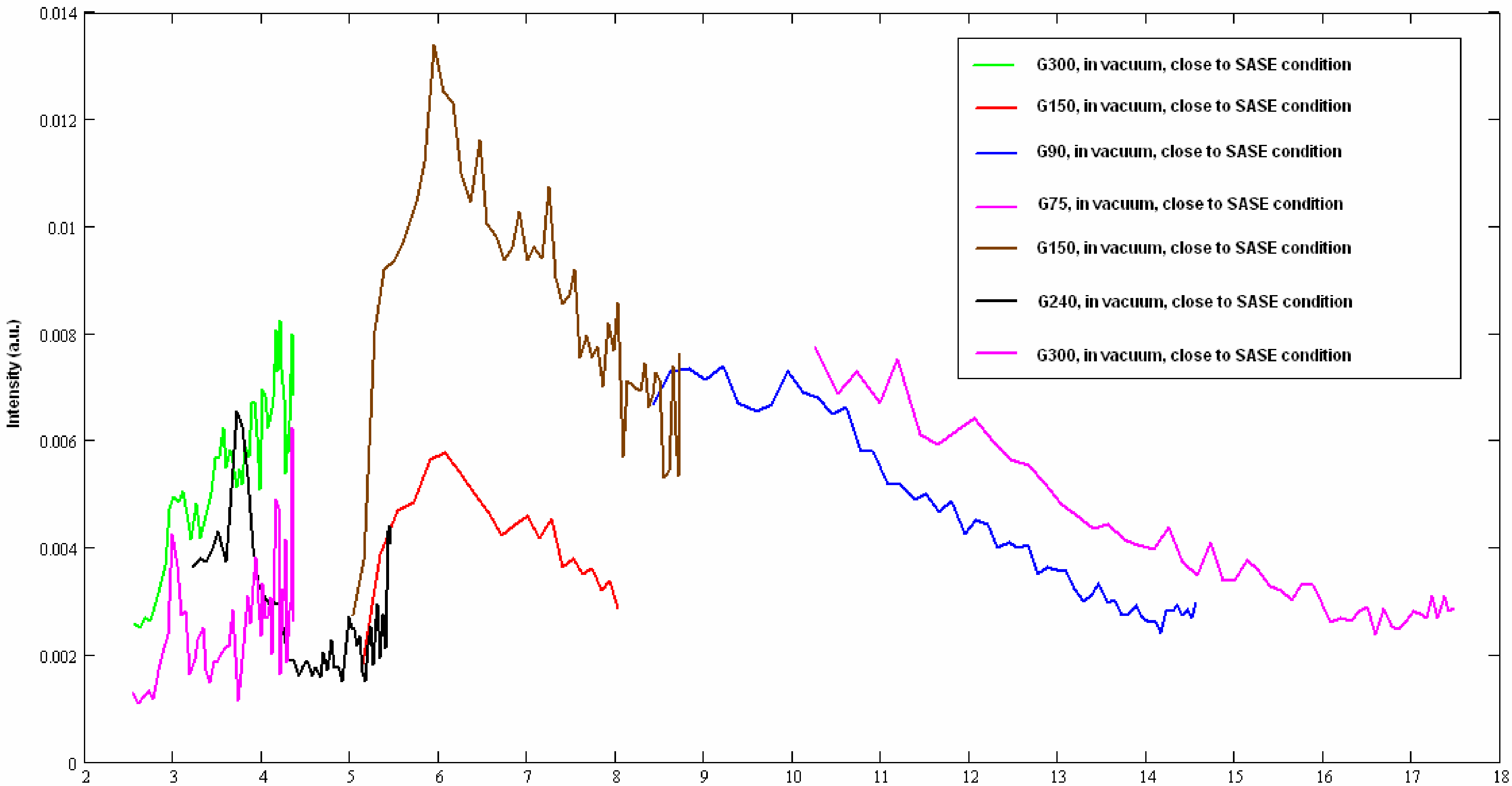


Rotating mirror spectrometer-reflectance grating

(~1.5 m air)

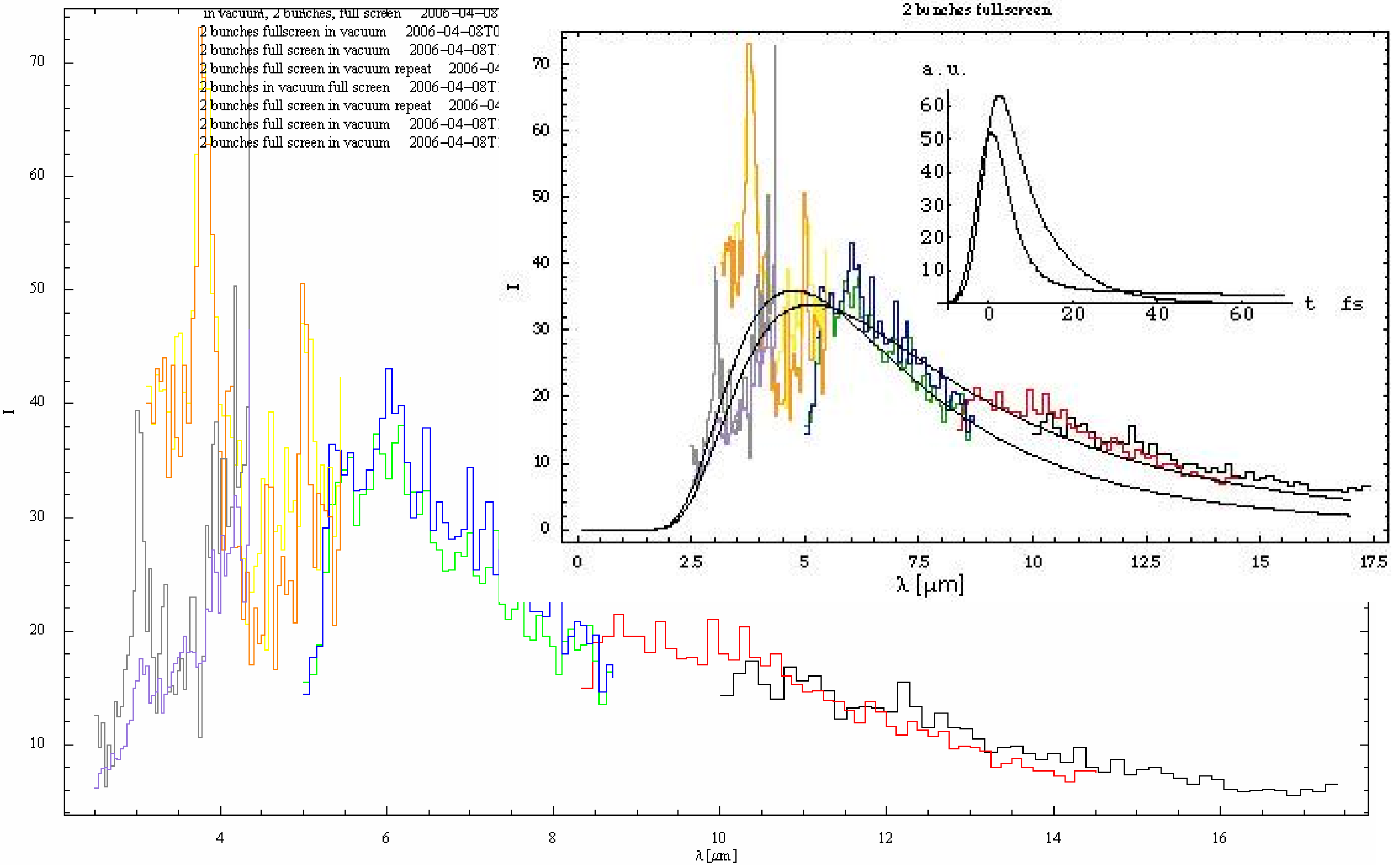


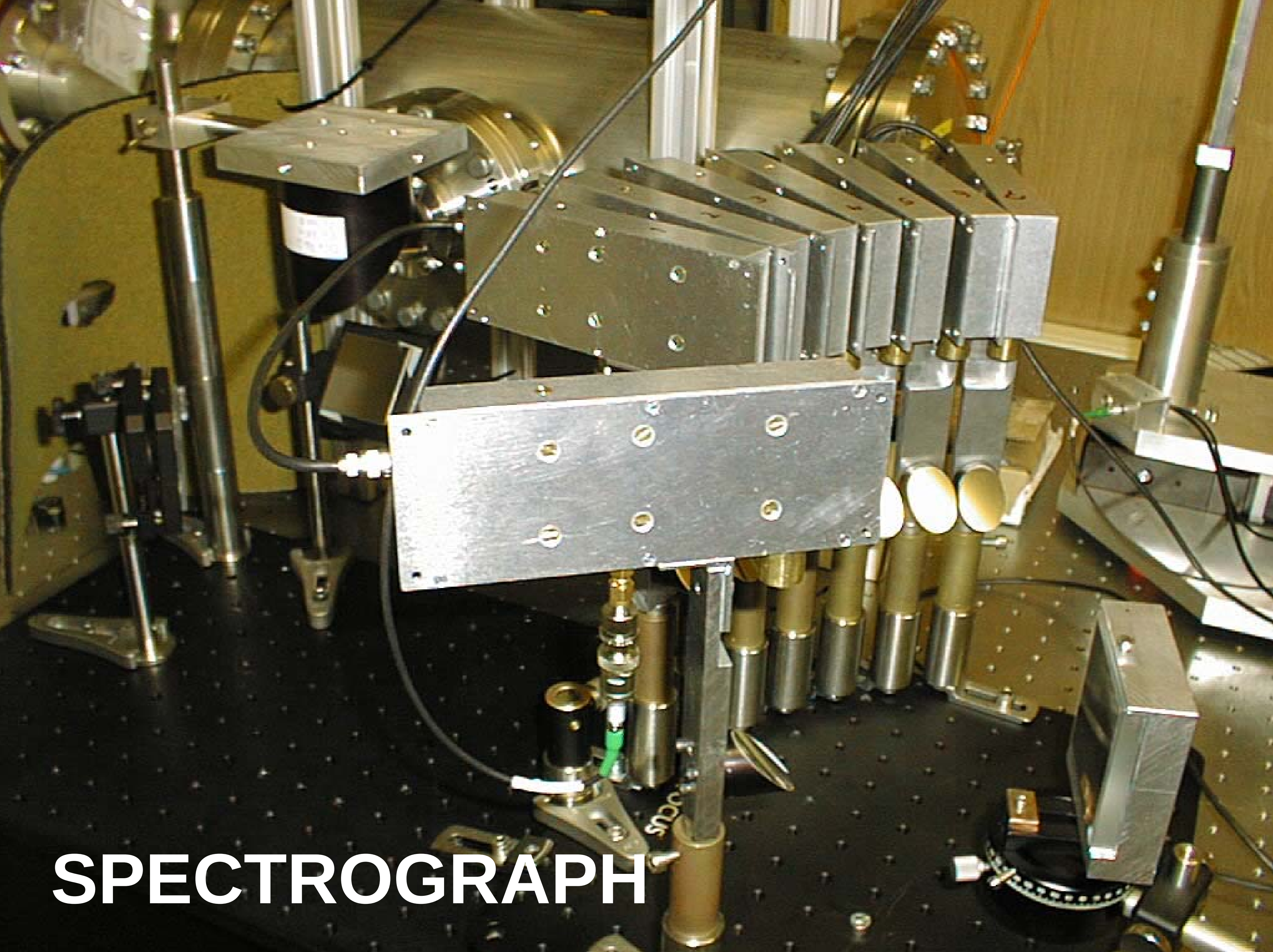
Rotating mirror spectrometer-reflectance grating (short wavelengths in vacuum)



Wavelength (µm)

Rotating mirror spectrometer-reflectance grating (short wavelengths in vacuum)

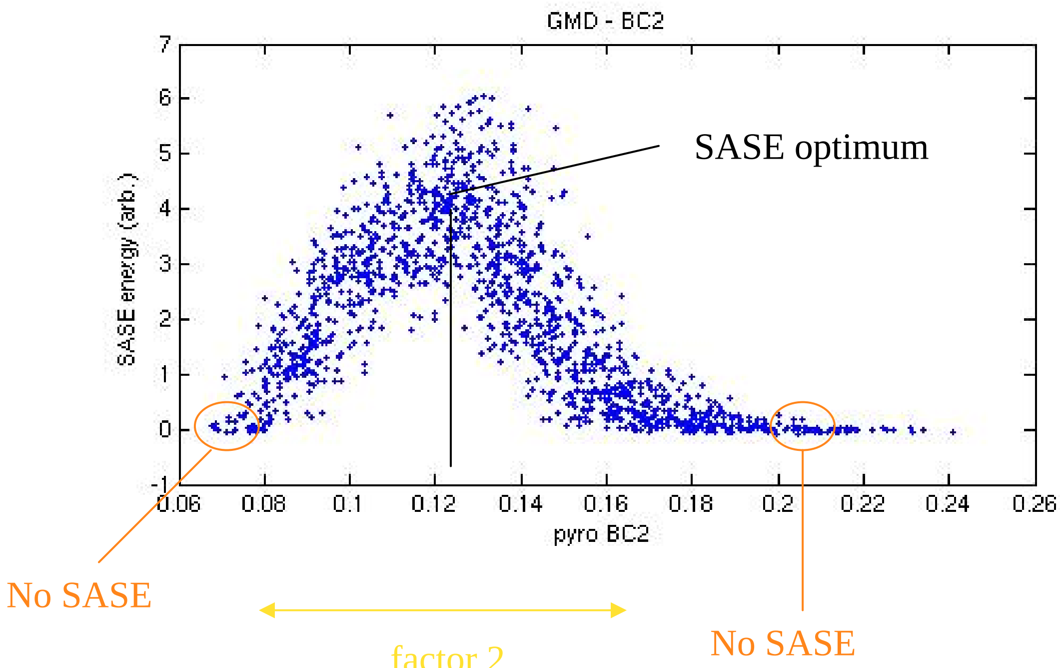




SPECTROGRAPH

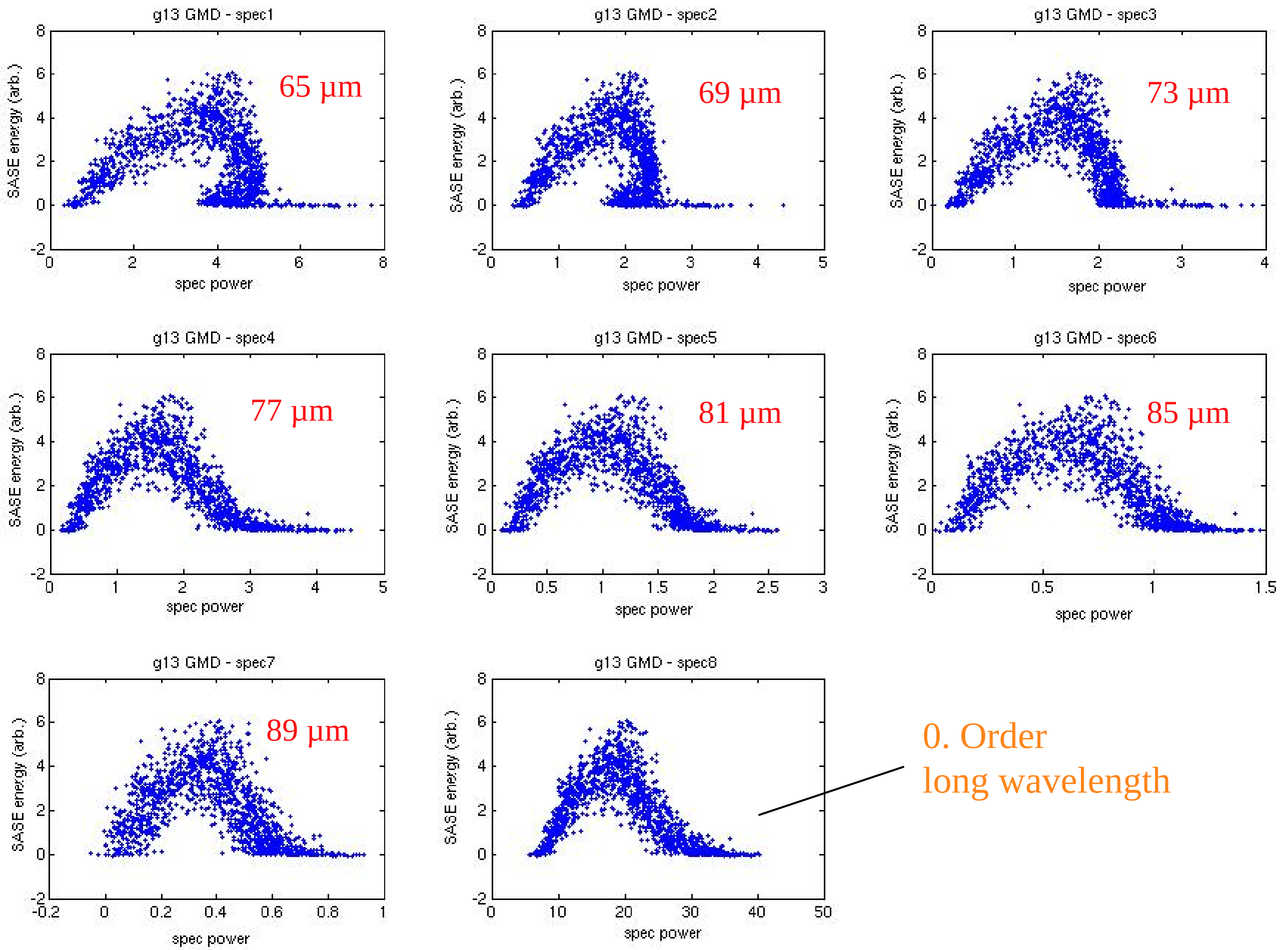
Correlations SASE - BC2

BC2 compression monitor

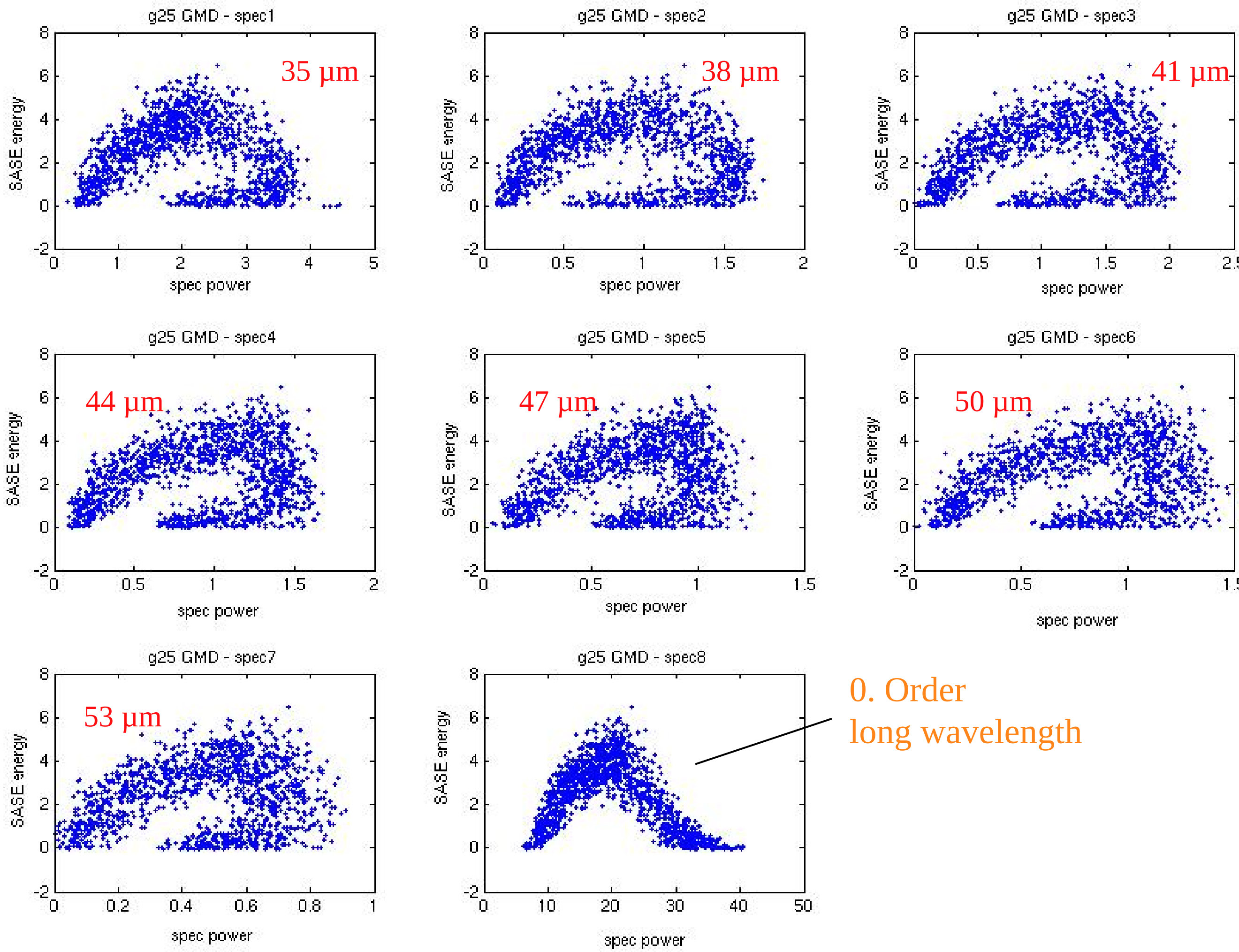


- compression (BC2) fluctuates from 'under' to 'over' compressed

Correlations SASE - short wavelengths - I



Correlations SASE - short wavelengths - II



Outlook

SASE correlation to shortest wavelengths that more correspond to the spike

Improve the RMS for remote change of the gratings

The circuit which makes it possible to readout from 30 pyro-detectors and has amplifiers all in one unit

Set-up the spectrograph stages based on the new designed mirror and readout

Conclusion

The wavelength calibration of the spectrometers is checked with THz filters and all the results are consistence. The effects of crystalline-quartz, LD-PE and diamond window transmission is clearly observed.

The suppression of short wavelengths with diffraction radiator is clearly seen, for most interesting part of the study, short wavelengths, CTR should be used.

Pyro-electric detectors could be used as detectors for spectrograph.

RBG can be used to get almost full information about the spectra. Staging them in right order and design, they provide an ultra broadband free spectral range. TG as the last stage of the spectrograph makes the device more compact.

Already first measurements in vacuum show very short structures in the FLASH electron bunch.