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Two Stage, Single Shot IR Spectrometer

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Introduction

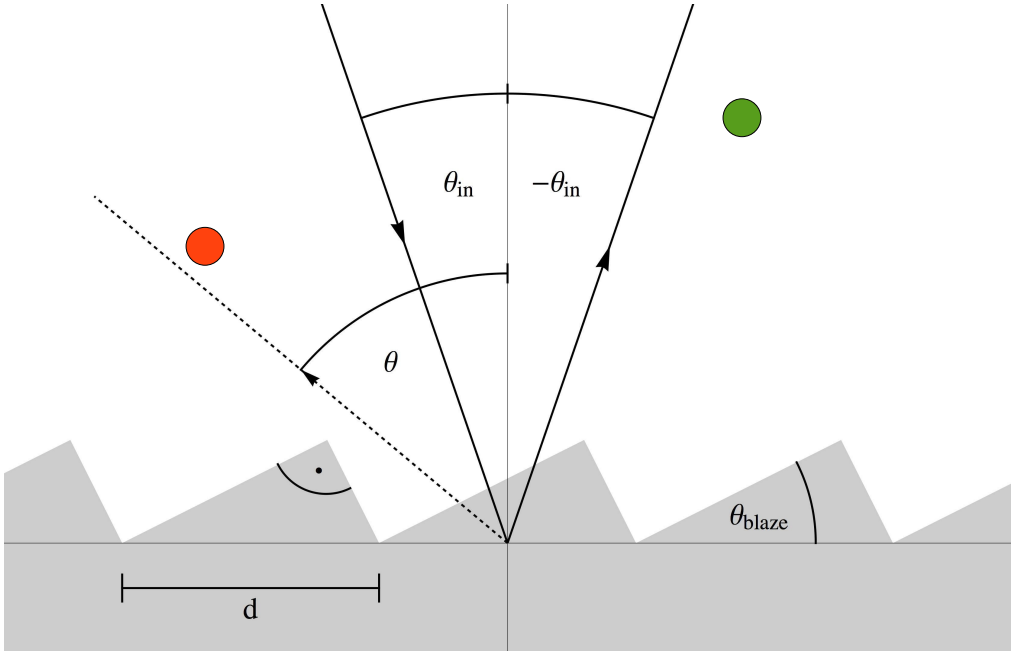
Goals:

1. Cover large spectral range
2. Single shot capability
3. Repetionrate up to 1MHz

Realisation:

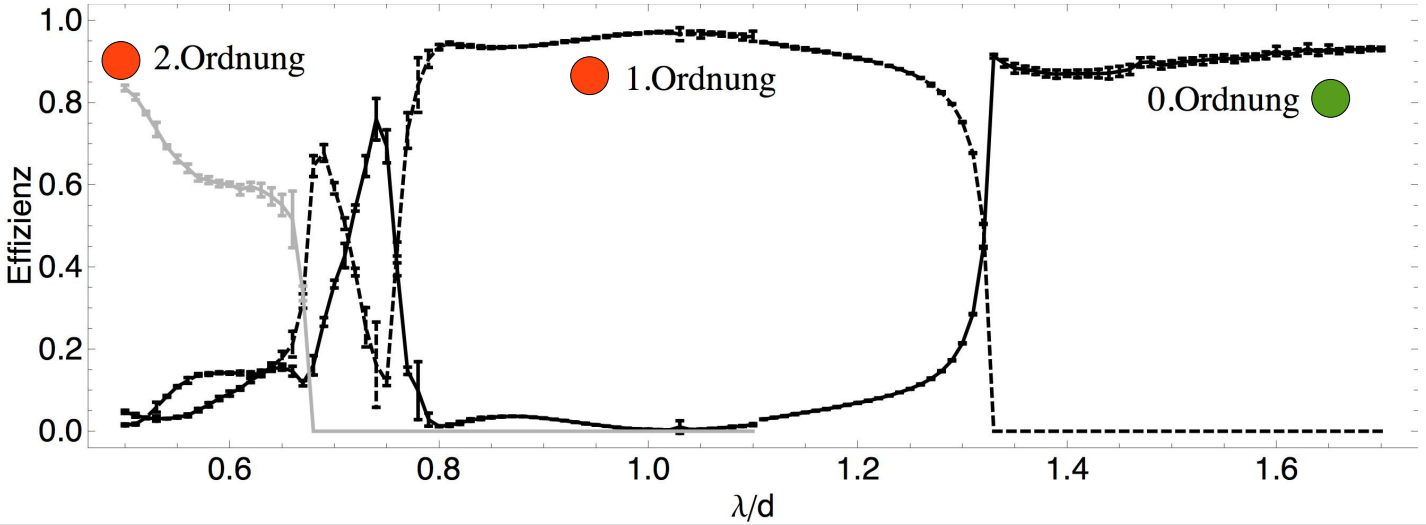
a. Staging gratings with different pitch sizes
b. Detection with pyroelectric sensors
c. Fast readout electronics

Reflective blazed gratings



Grating acts as dispersive element or mirror depending on wavelength.

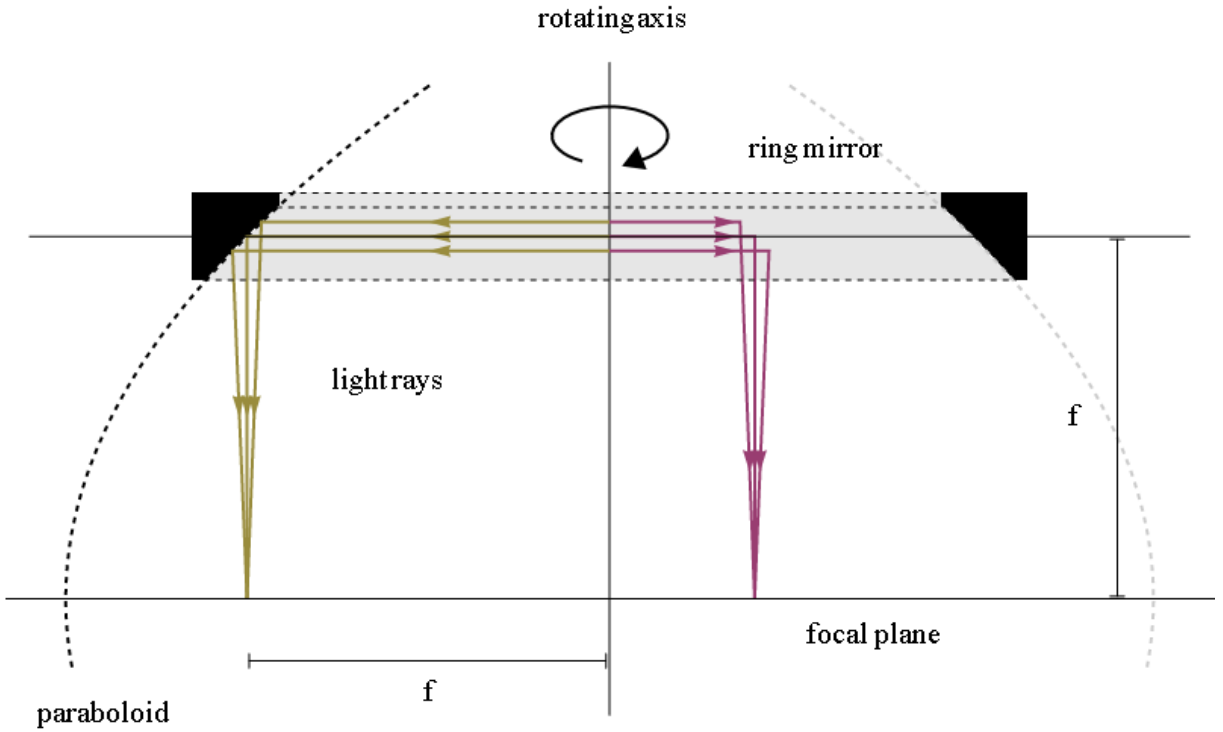
P – polarisation



Computation with *GSolver4.2*

Ring mirror

Mirror is a ring segment, allows for distortion free large angle focusing of dispersed radiation.

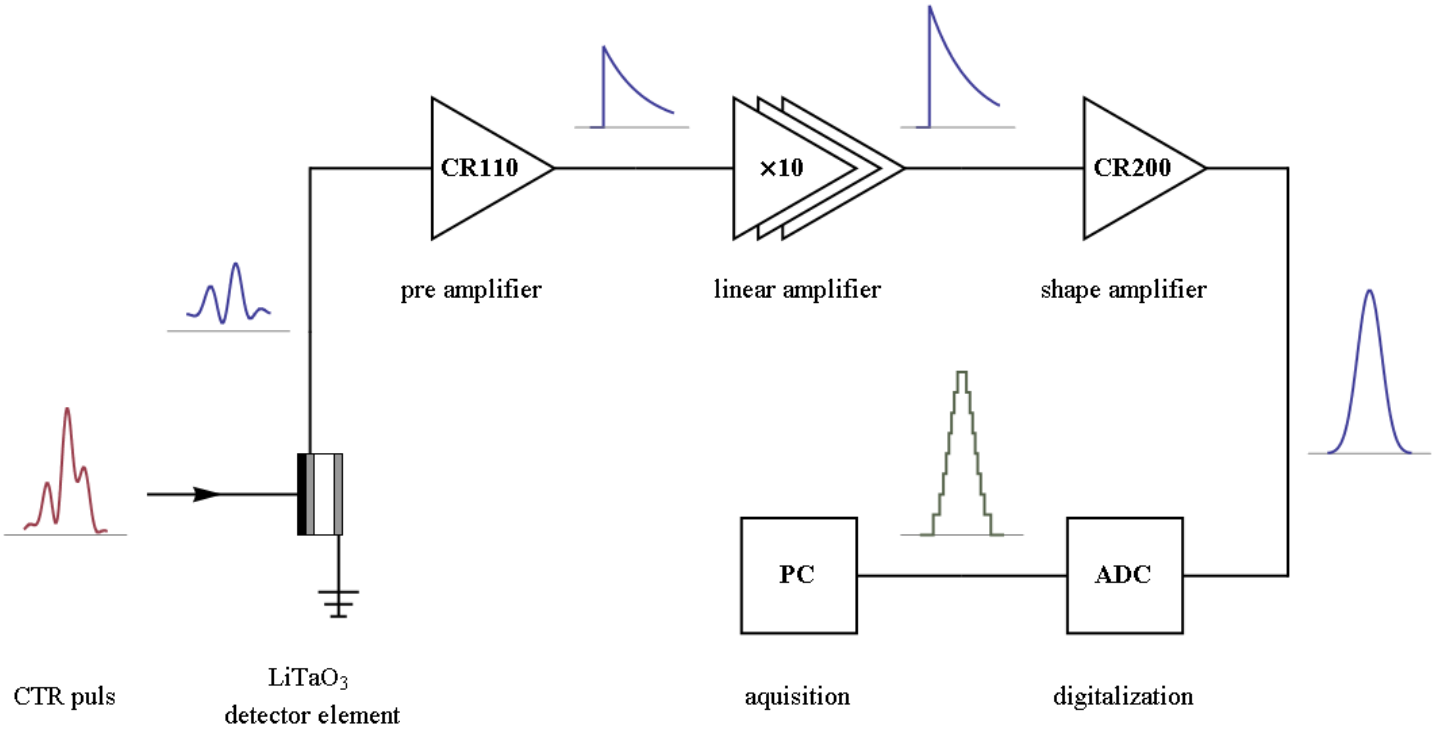


90° deflection

r = ½ R = ½ f

Pyroelectric detectors + Electronic chain

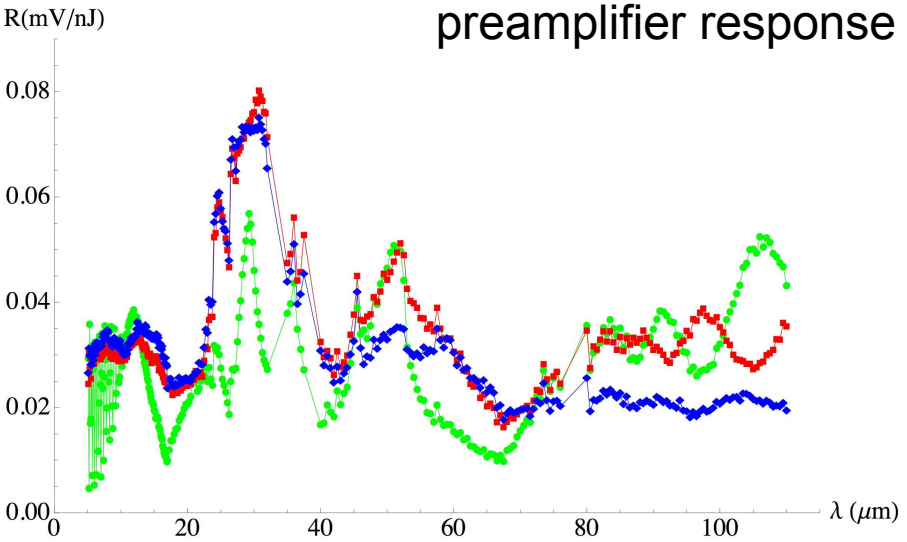
Decay constant
τ =150 µs



Gaussian shape
width
σ = 100 ns – 4 µs

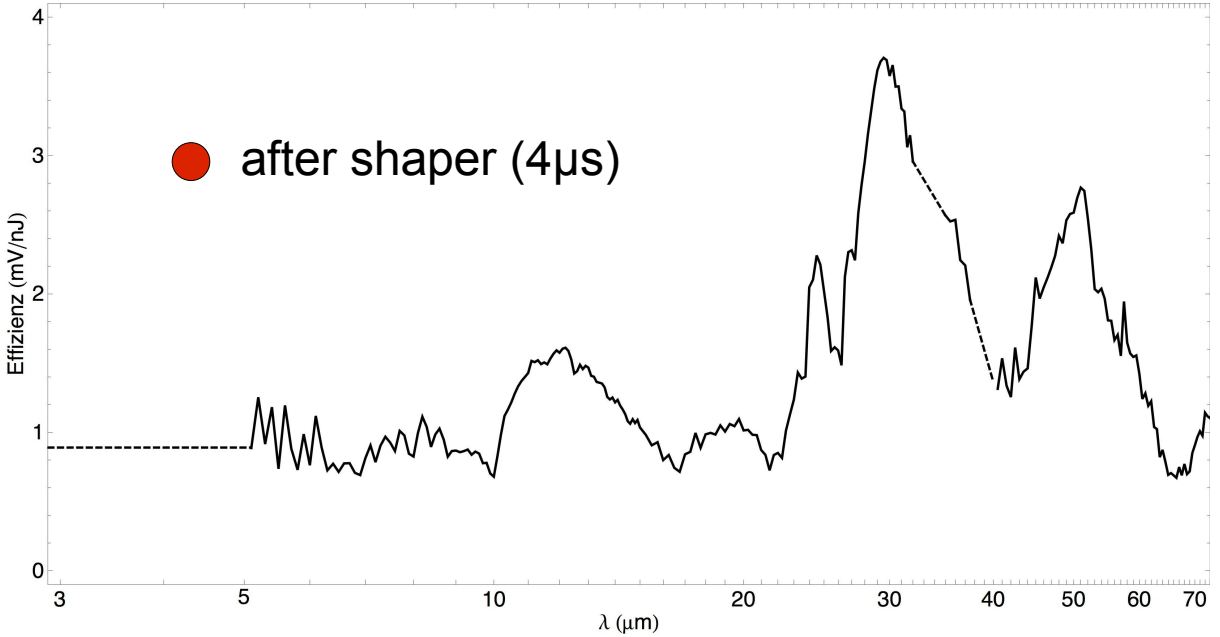
Pyroelectric detectors + Electronic chain

preamplifier response R



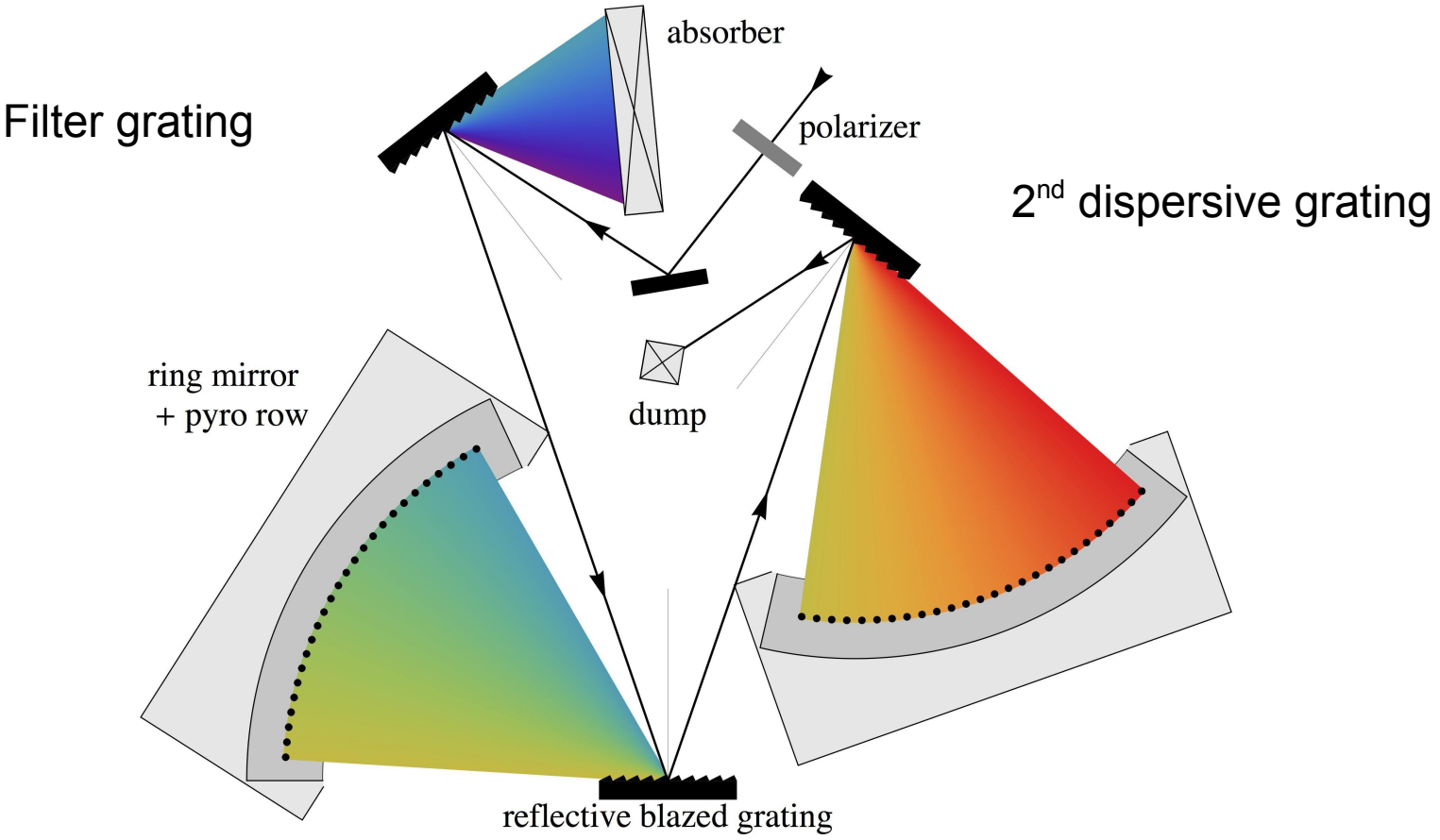
Calibration done at FELIX
(infrared FEL)

3 different sensor types



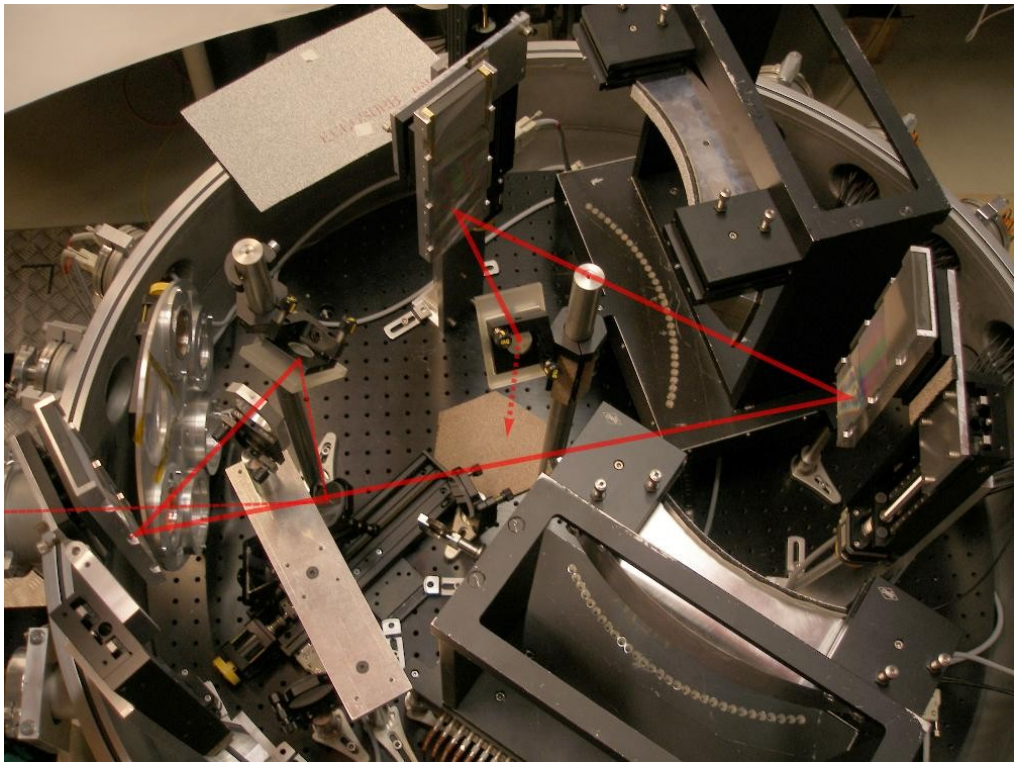
2 stage spectrometer

Latest version

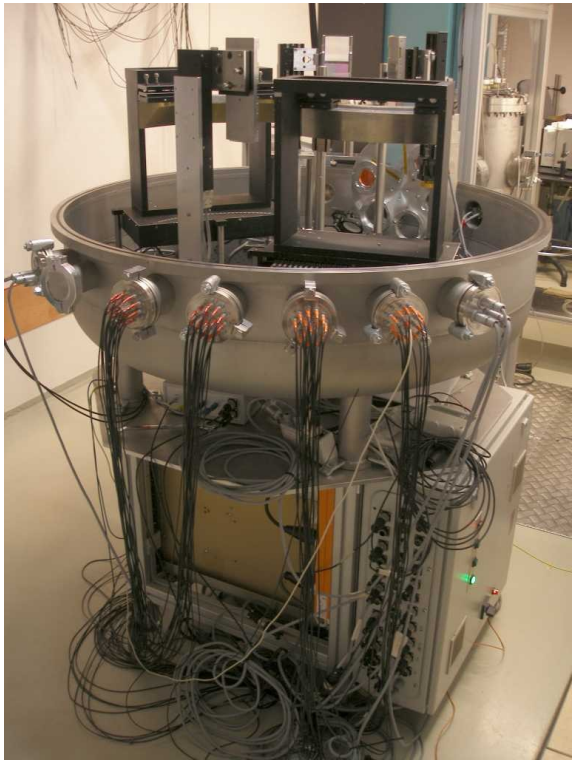


2 stage spectrometer

Prototype spectrometer - breadboard design



Characteristic:
i. 3 grating combination
ii. 60 pyro channels
iii. 5Hz single shot

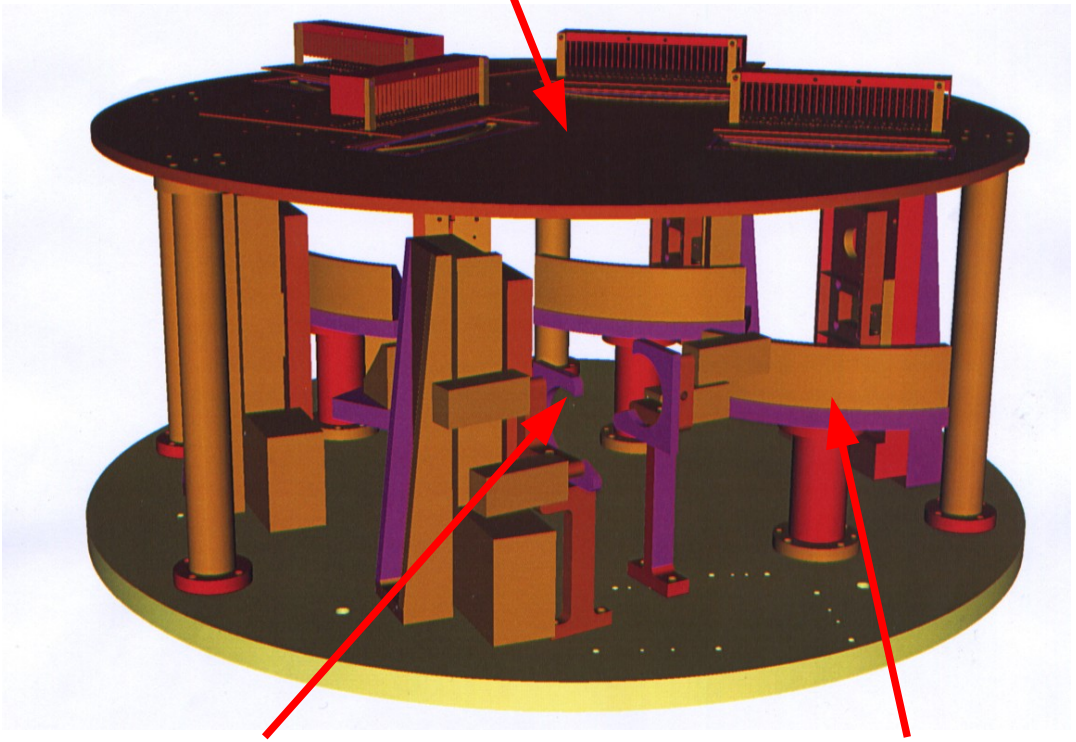


Measurements presented in B. Schmidt's talk!

4 stage spectrometer

Engineered version (in progress)

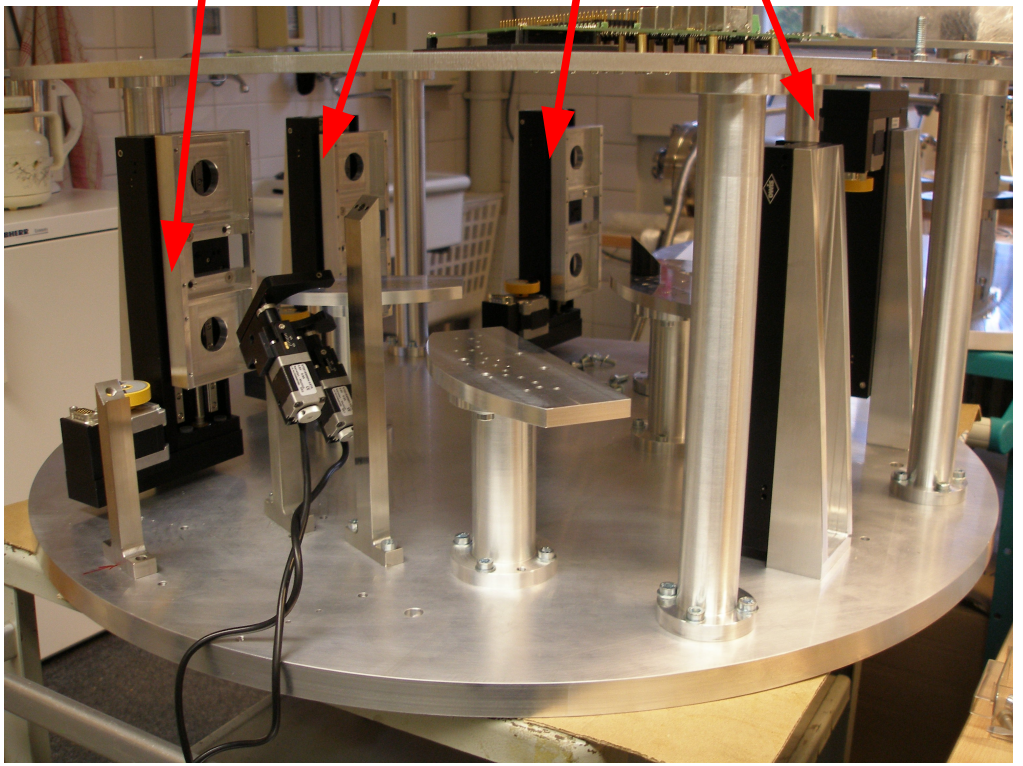
Detector plane



Dispersion plane

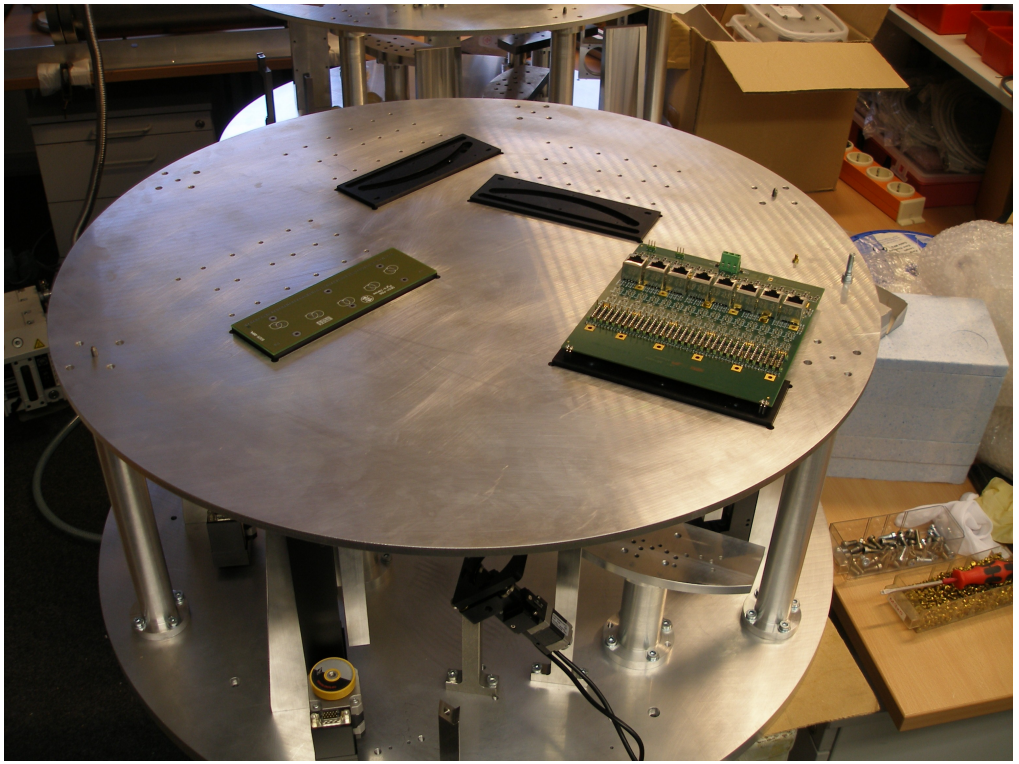
Ring mirrors

(4+1) movable stages with 2 grating sets



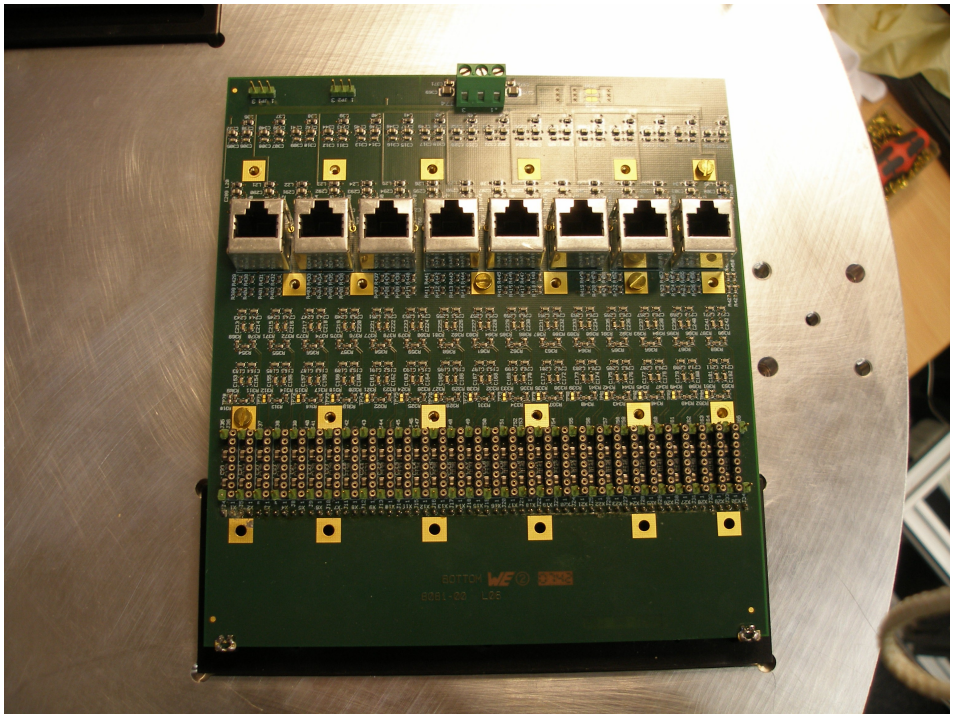
Possible spectral range with 4 gratings: $\lambda_{max} = 11\ \lambda_{min}$

4 stage spectrometer



Detector plane with 4 pyro line arrays

30 channel readout board



120 channel parallel readout with shielded twisted pair cables