

# HIRIMS

## High Resolution Imaging Spectrometer for JGO/EJSM

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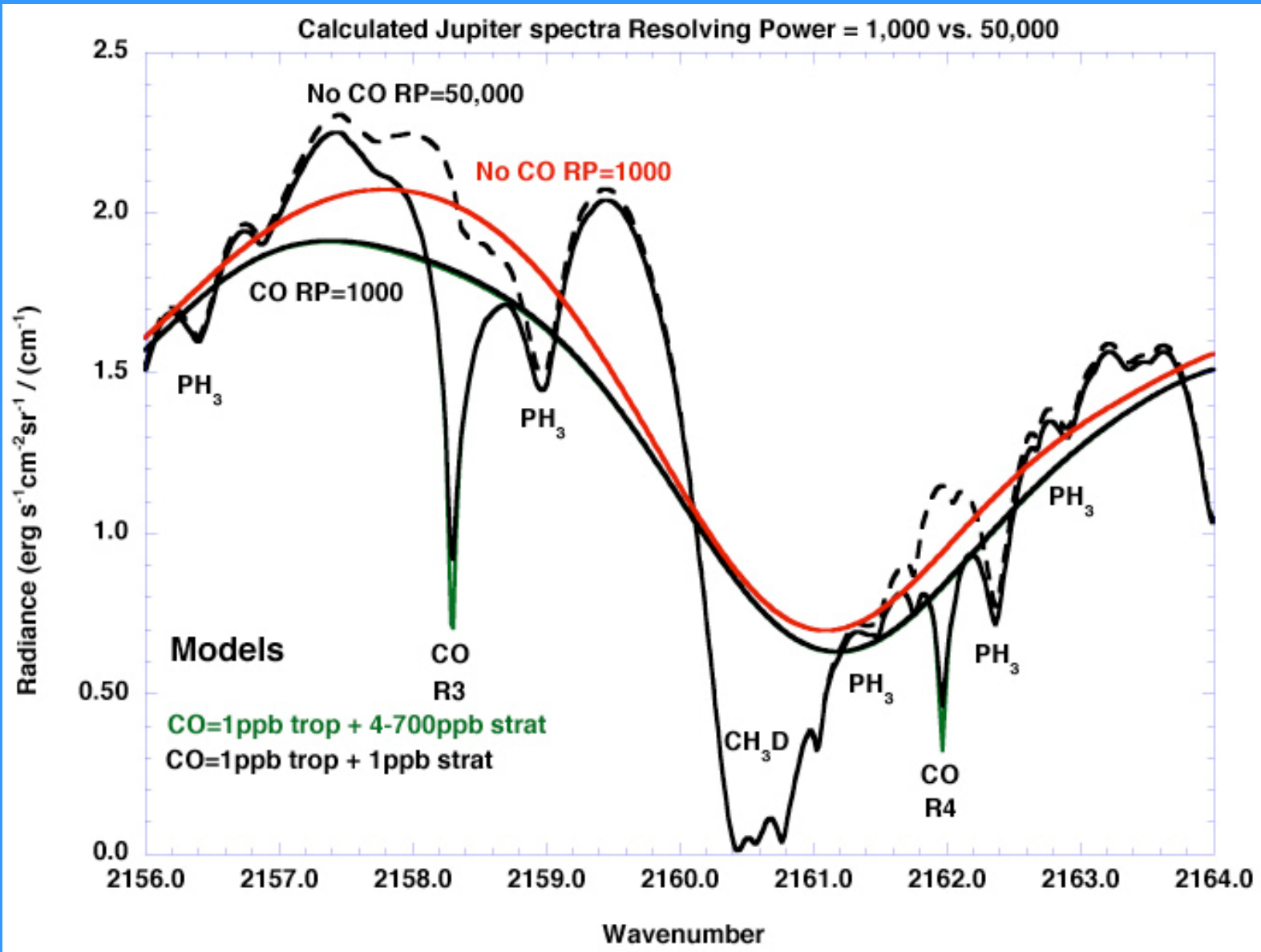


Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

# Science objectives

- Jupiter atmospheric composition : what is accessible for remote sensing after VGR/GLL/Juno ?
- Need for high spectral resolution for specific components:
  - CO : disentangle the external/internal sources  
Map the variations
  - H<sub>2</sub>O : weathering on Jupiter, isotopic ratio (<sup>18</sup>O)
  - H<sub>3</sub><sup>+</sup> : individual line measurements =>
  - Other high atmospheric emissions : CH<sub>4</sub>, H<sub>2</sub>
- Main objective = dynamical

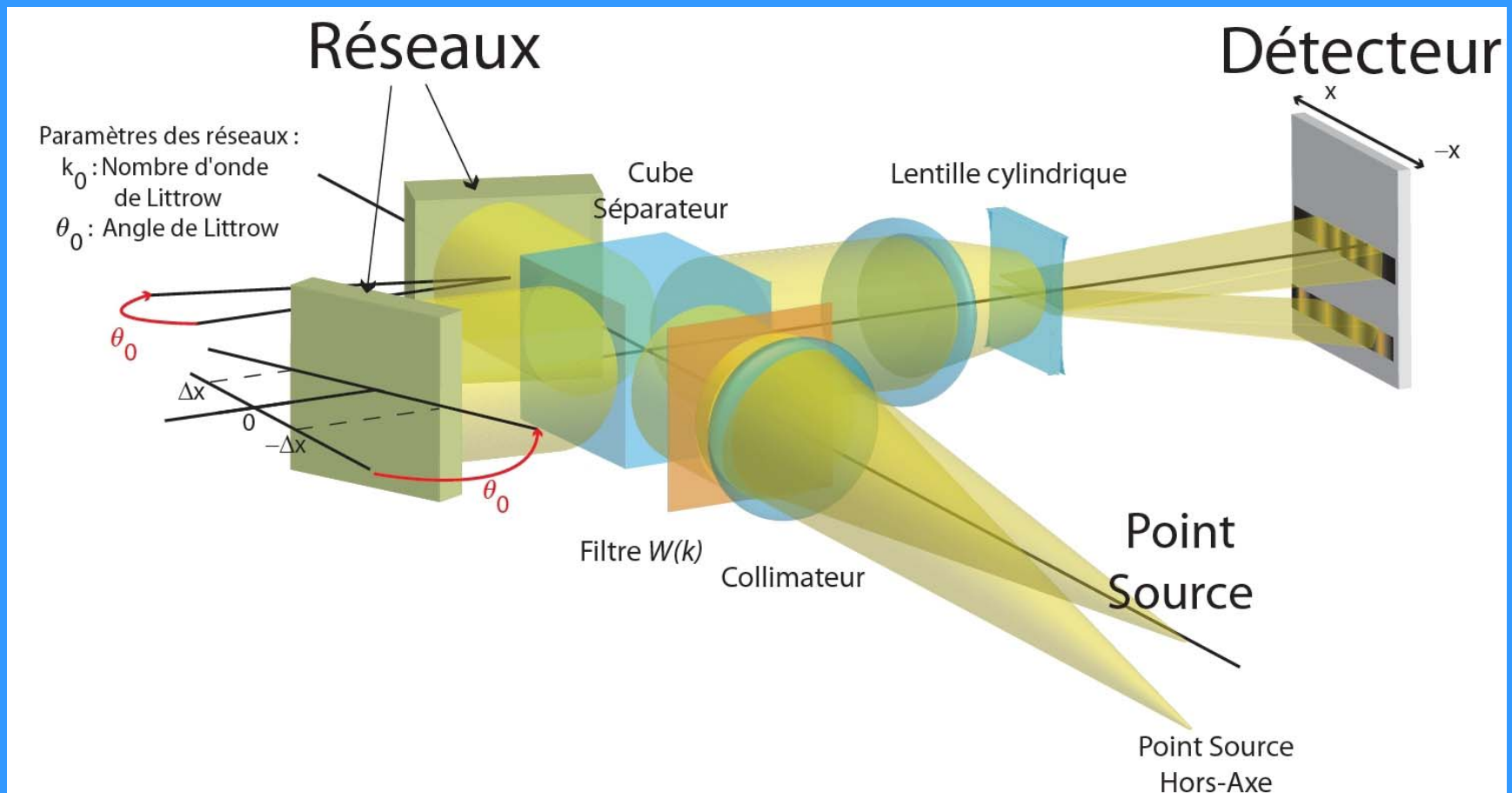
# CO line simulation @ 5 micron



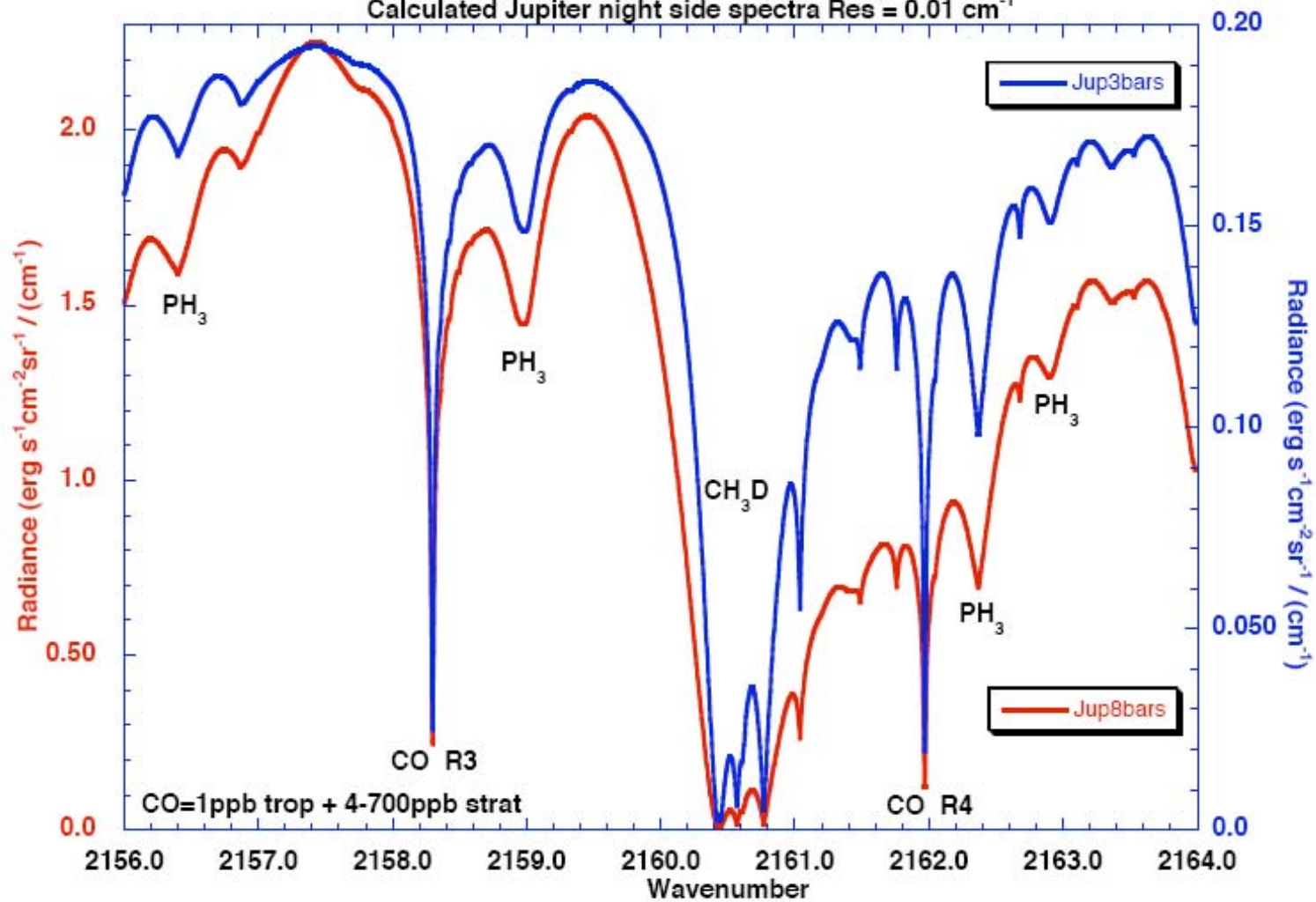
# A High Spectral Resolution Near-Infrared Mapping Spectrometer for EISM/JGO progress report on DOI proposal

- **Science investigations completed:**
  - Simulation of CO- 5 micron range for scientific specifications (G. Bjoraker, GSFC)
  - Simulation of H<sub>3</sub><sup>+</sup> variations related to Gravity Waves on Jupiter (K. Matcheva, Univ. Florida) : AGU presentation (December 2009)
- **Technical investigations :**
  - Joint design study @ 5 micron and @ 3 micron
- **Management (ongoing) :**
  - consortium with DSI/VIRHIS under study to limit the ressource requests (mass, TM, etc.)
- **Budget :**
  - CNES budget provided for technical investigations; no serious constrains on foreign collaborations due to limited travel budget

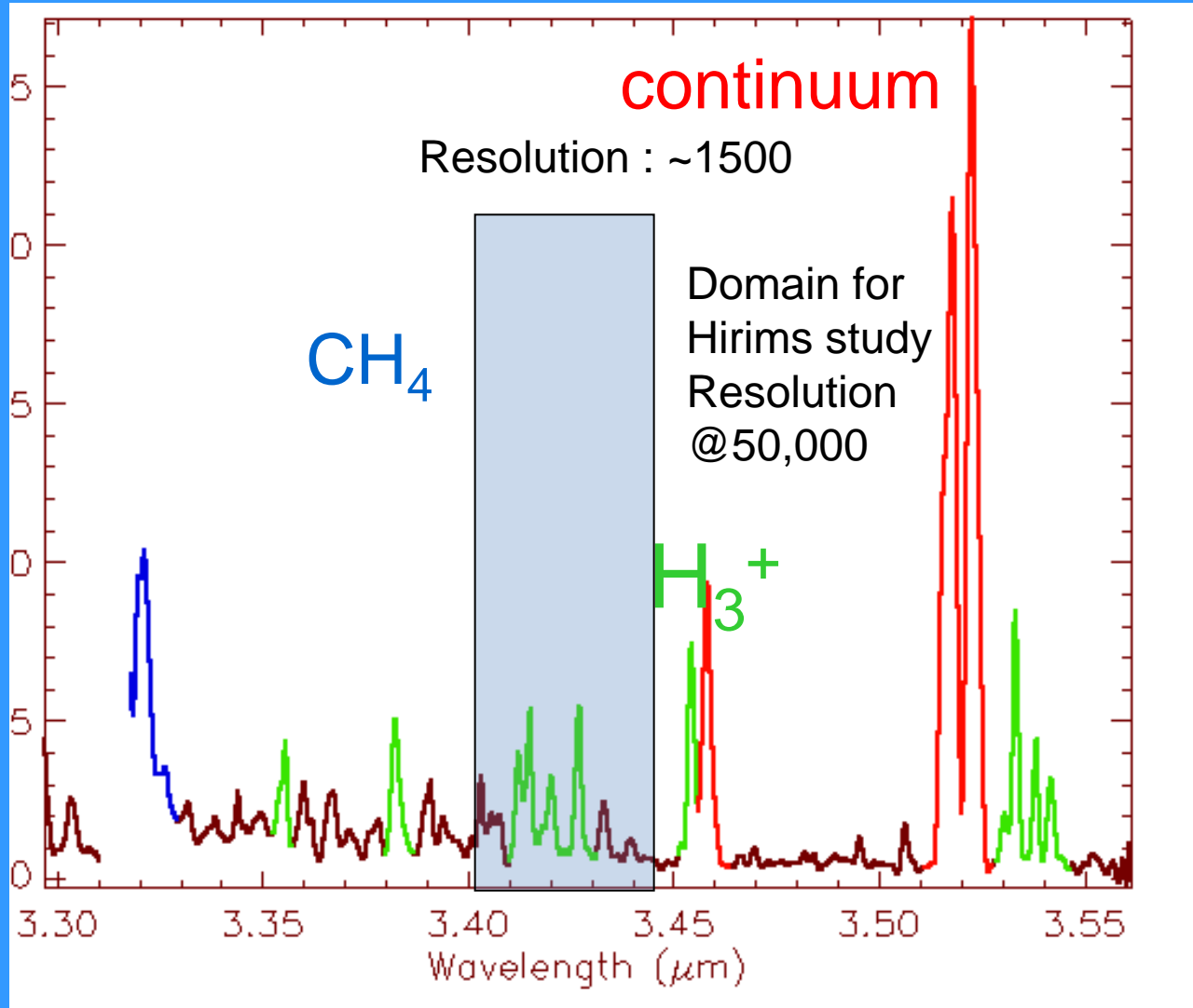
# Optical concept : static Fourier Transform Spectrometer (also called Heterodyne Fourier Transform Spectrometer)



Calculated Jupiter night side spectra Res = 0.01 cm<sup>-1</sup>



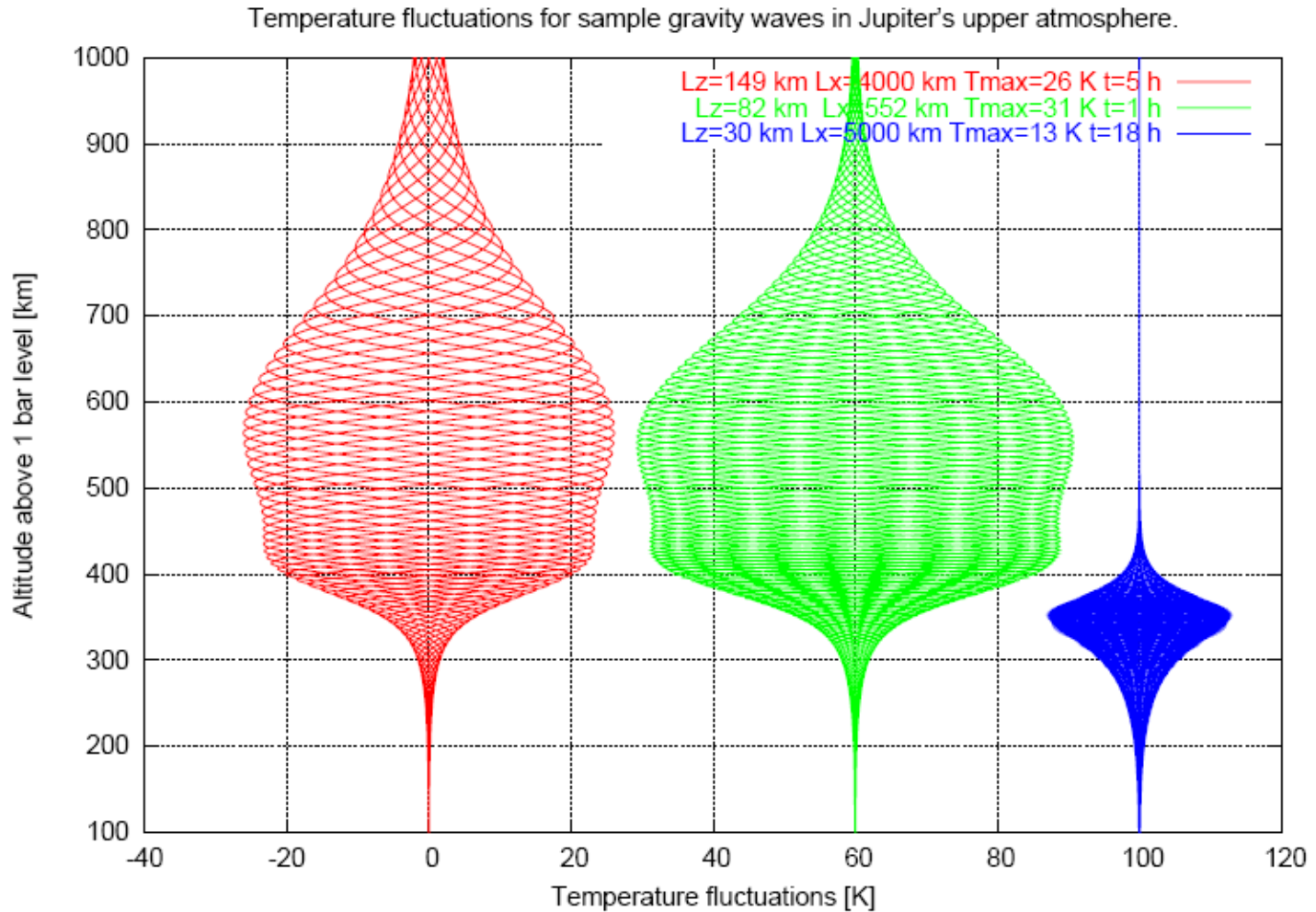
# Observed spectra of Jupiter's mesosphere at 3.5 $\mu\text{m}$ (VLT/ISAAC)



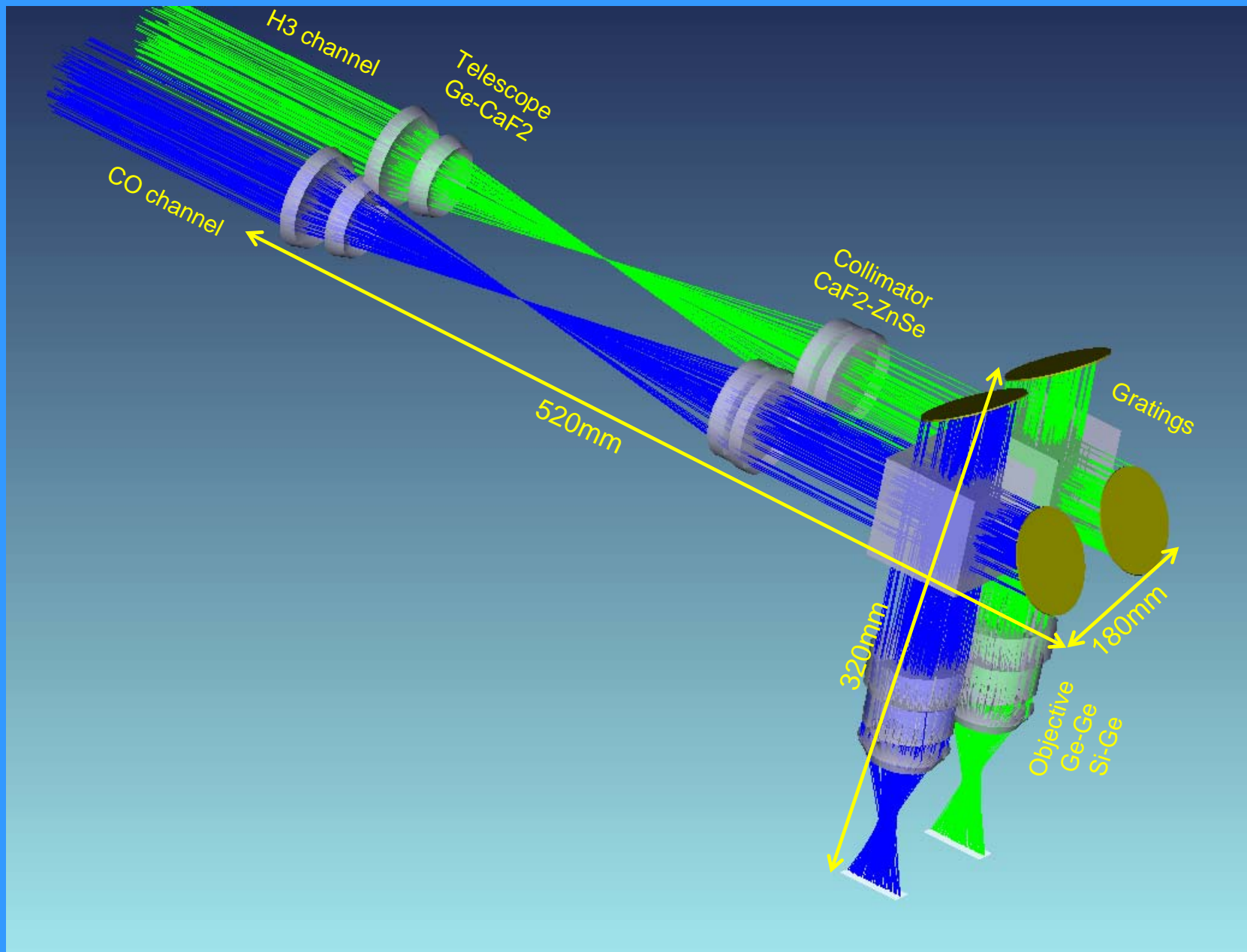
Wave simulation =>  
Expected  
fluctuations of the  
order of a few  
percent

AGU abstract  
proposed for  
Dec'09

# Dynamics of Gravity Waves : Temperature fluctuations from GW





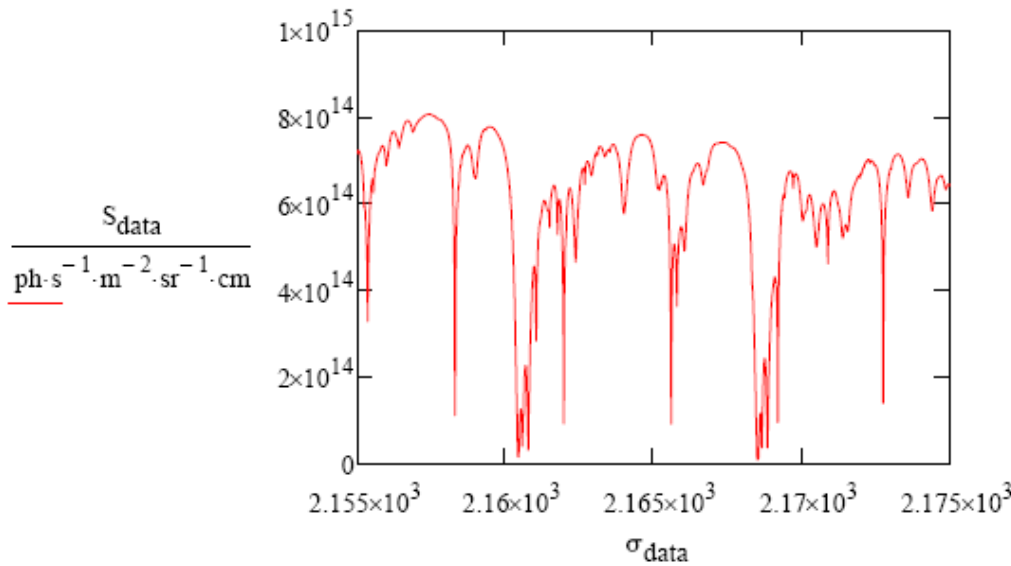


## HIRIMS relevant parameters

Parameter		CO channel	H3 channel
Bandwidth	cm-1	2155-2175	2913-2934
	μm	4.598-4.640	3.408-3.432
Spectral resolution		45 000	50 000
I FOV	mrاد	0.5	0.5
FOV	mrاد	100	100
Spectrometer temperature	K	140	140
Detector temperature	K	90	120
Pixel size	μm	45	45
Φpup	mm	40	40

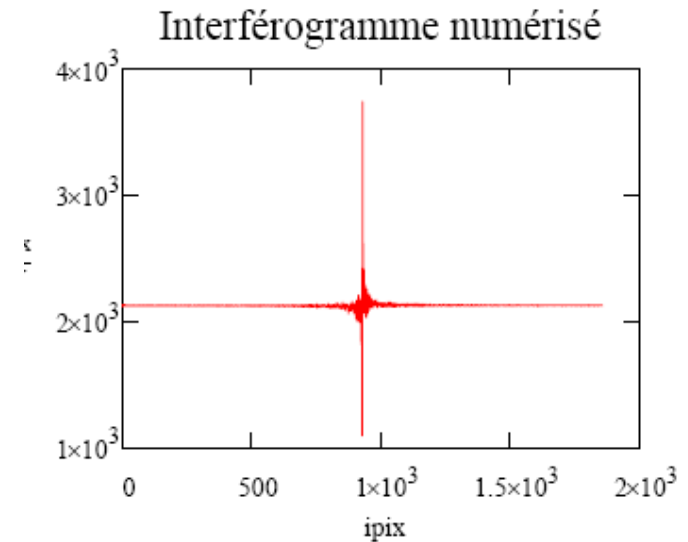
# Dimensioning of a spectrometer

## From spectrum to interferogram

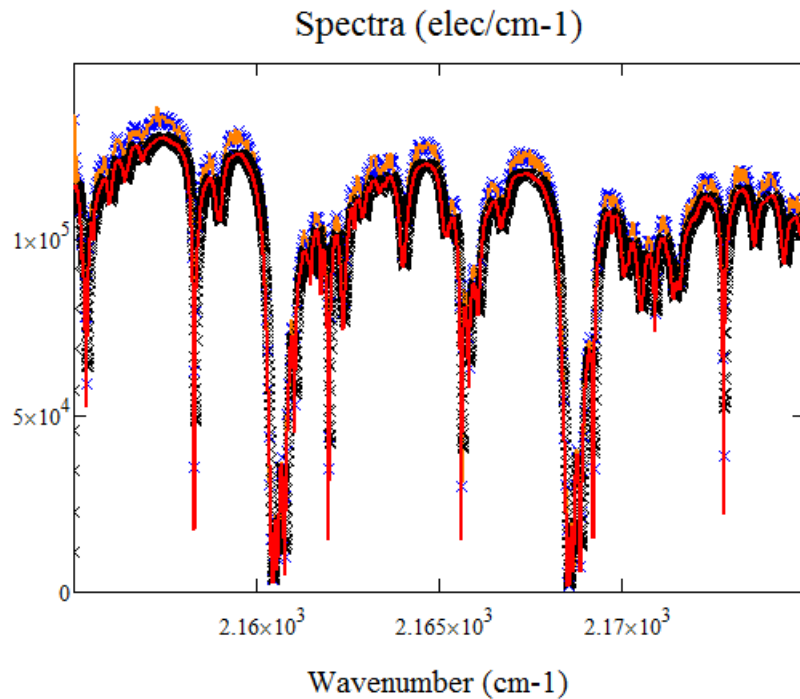
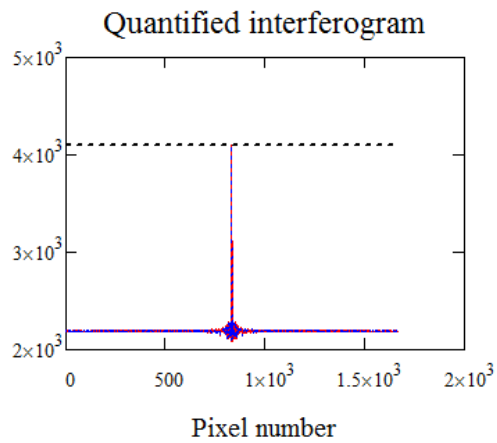


### Données instrument

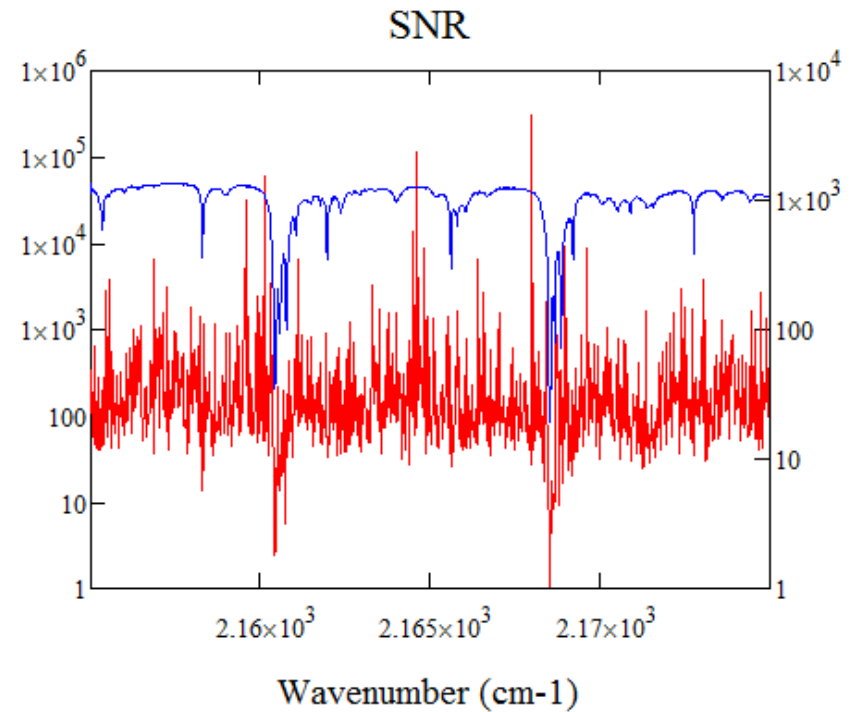
Température spectro	$T_s := 100\text{K}$	
Température détecteur	$T_d := 80\text{K}$	
Diamètre pupille d'entrée	$\Phi_{\text{pup}} := 30\text{mm}$	
Transmission	$\tau := 0.5-0.8$	
Efficacité quantique	$\eta := 0.7$	
Saturation détecteur zone de linéarité	$I_{\text{max}} := 1.5 \cdot 10^6 \text{elec}$	
Convertisseur	conv := 12bit	$2^{\text{conv}} = 4096$



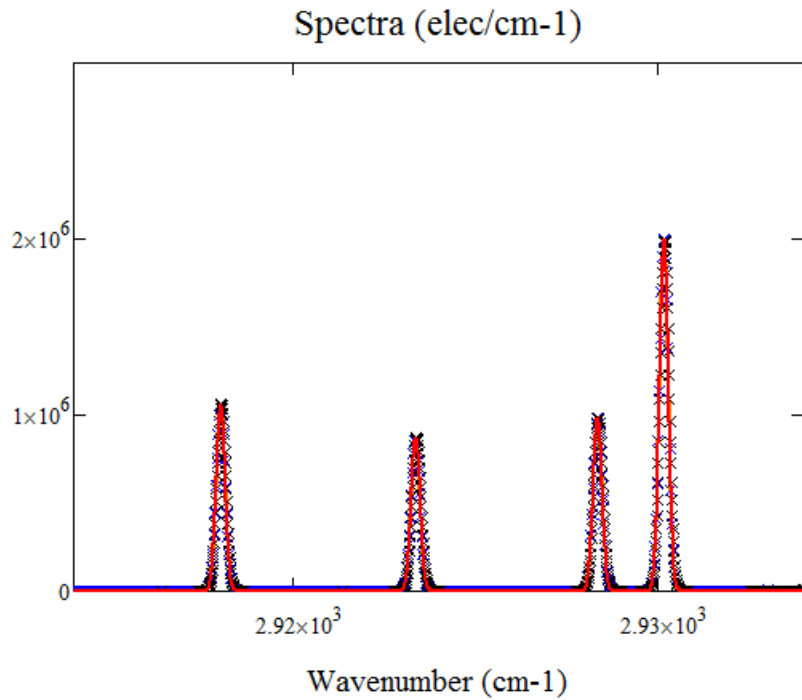
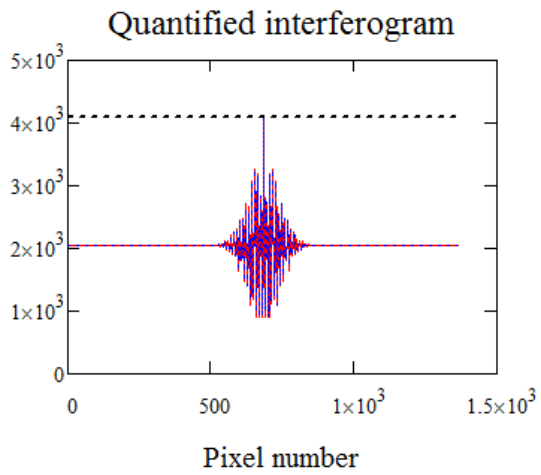
# HIRIMS performances (CO)



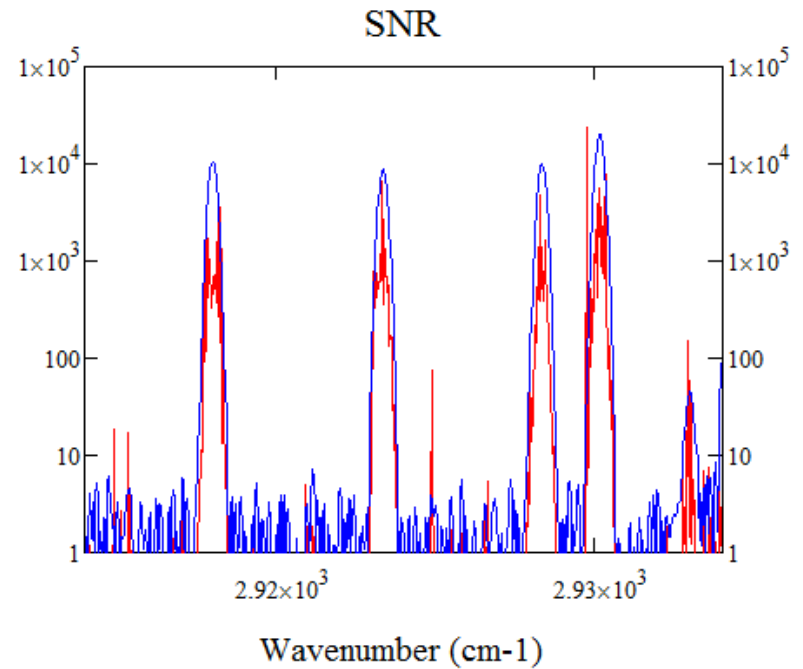
- ××× Reconstructed spectrum (no noise)
- Reconstructed spectrum with noise
- ××× Convolved initial spectrum
- Initial spectrum (oversampled)



# HIRIMS performances (H3)

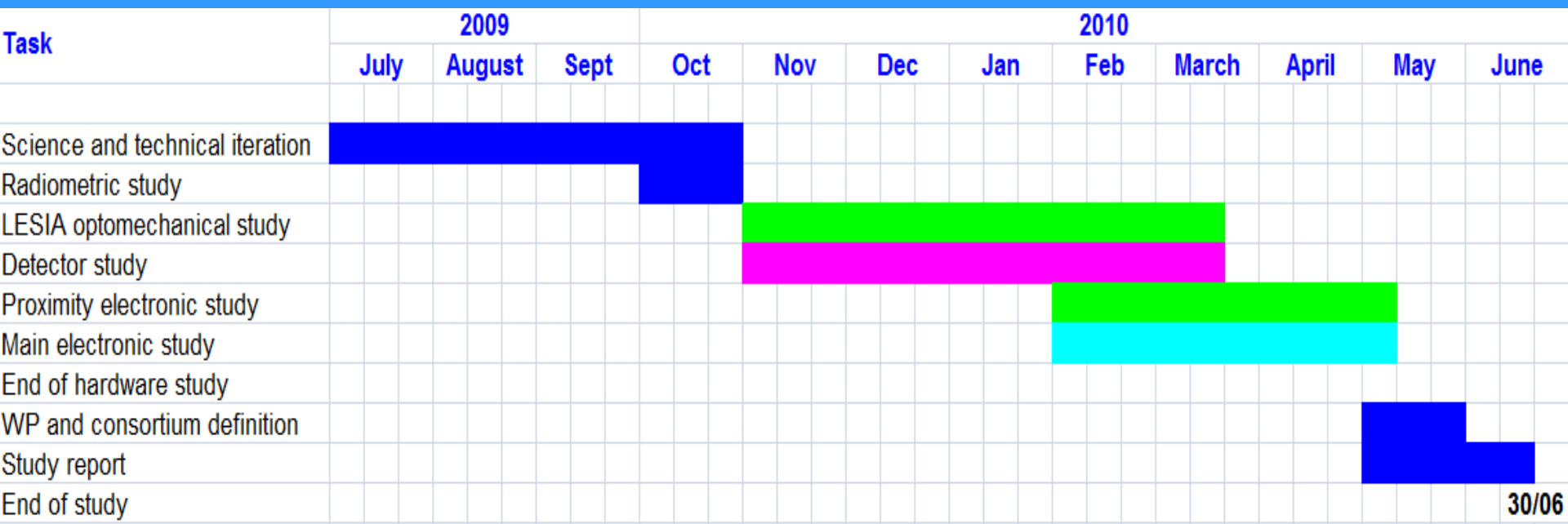


- ××× Reconstructed spectrum (no noise)
- Reconstructed spectrum with noise
- ××× Convolved initial spectrum
- Initial spectrum (oversampled)



# Working plan

Combined science and technical developments to ensure an acceptable TRL level



Budget for HIRIMS study : CNES, IKI