Status of Holograms for AuxTel

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LSST DESC
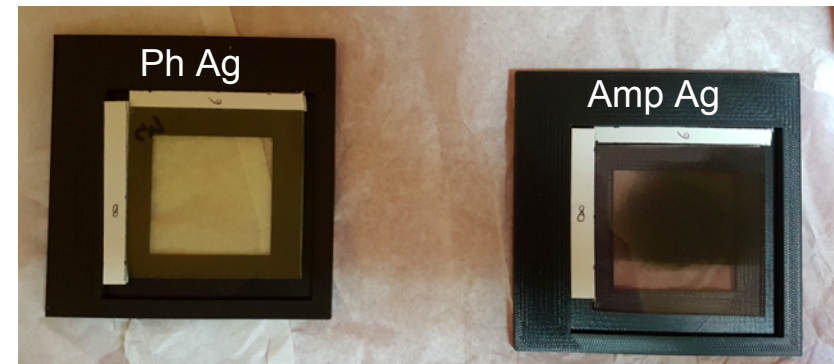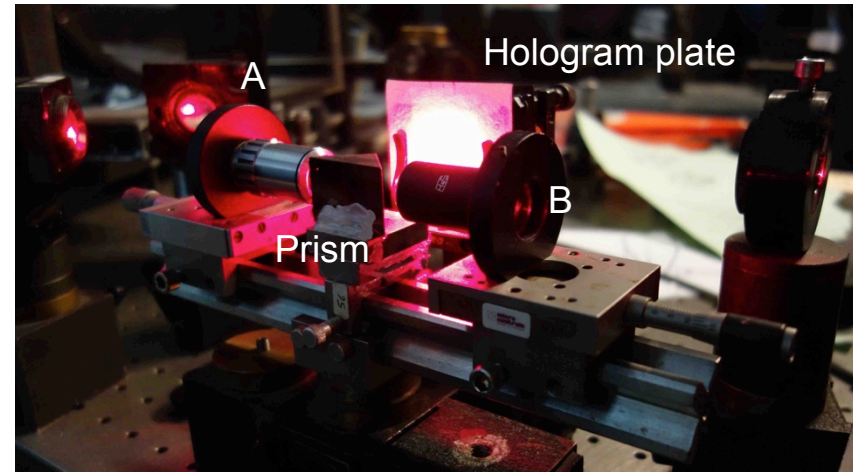Dark Energy Science Collaboration

Holograms for AuxTel

- **<u>Usual gratings:</u> all wavelengths** not focussed simultaneously on the focal plane because used with a convergent beam

- **<u>Holograms:</u> forced focussing on** the focal plane at almost all wavelengths
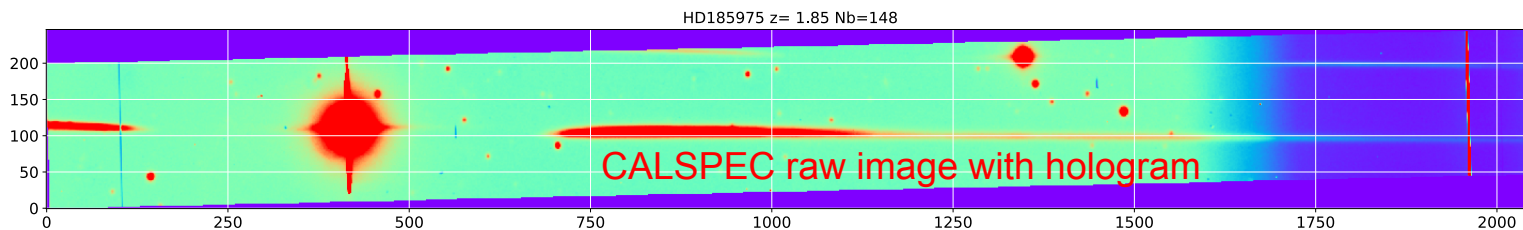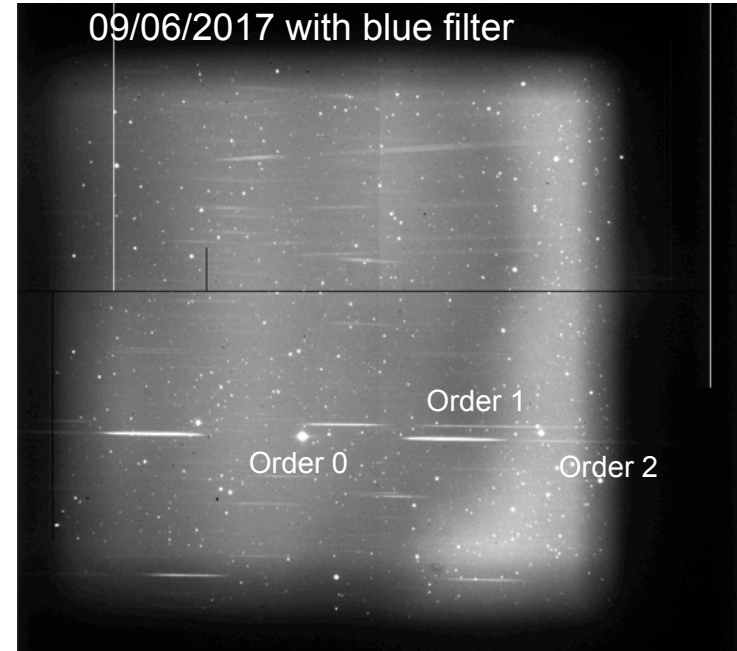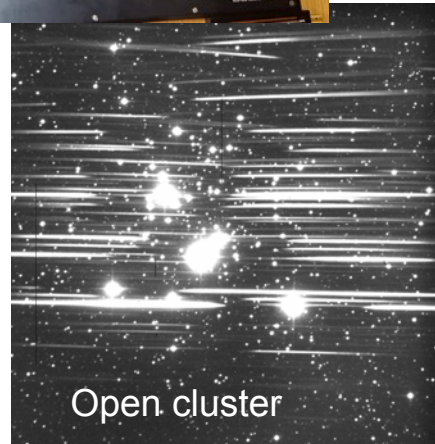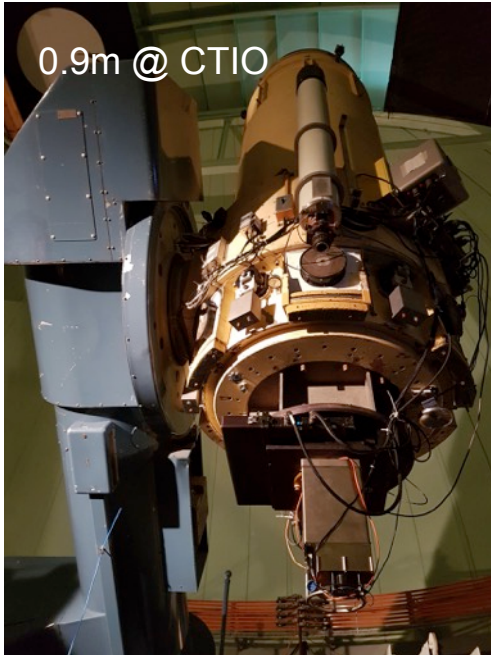
Holograms in a nutshell

Yves Gentet for UH and butterfly hologram
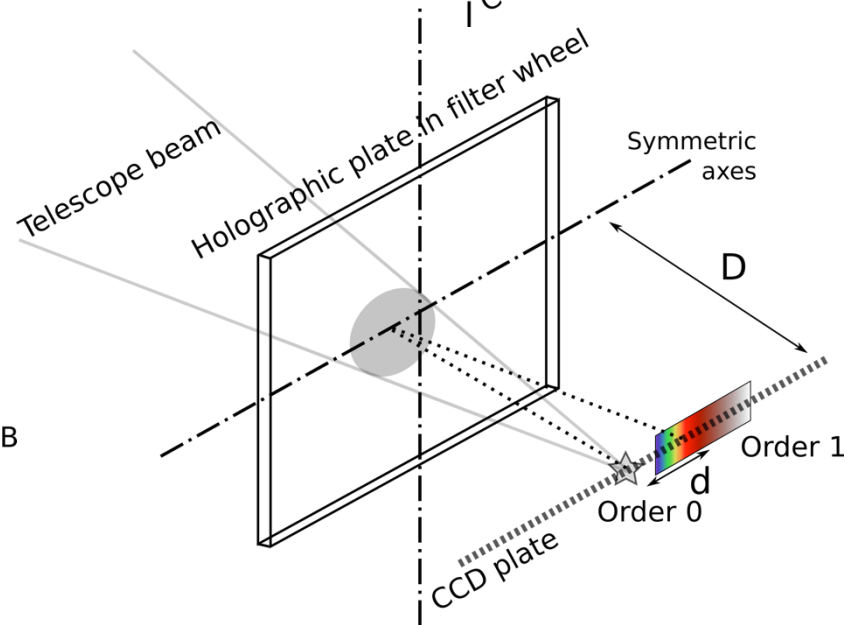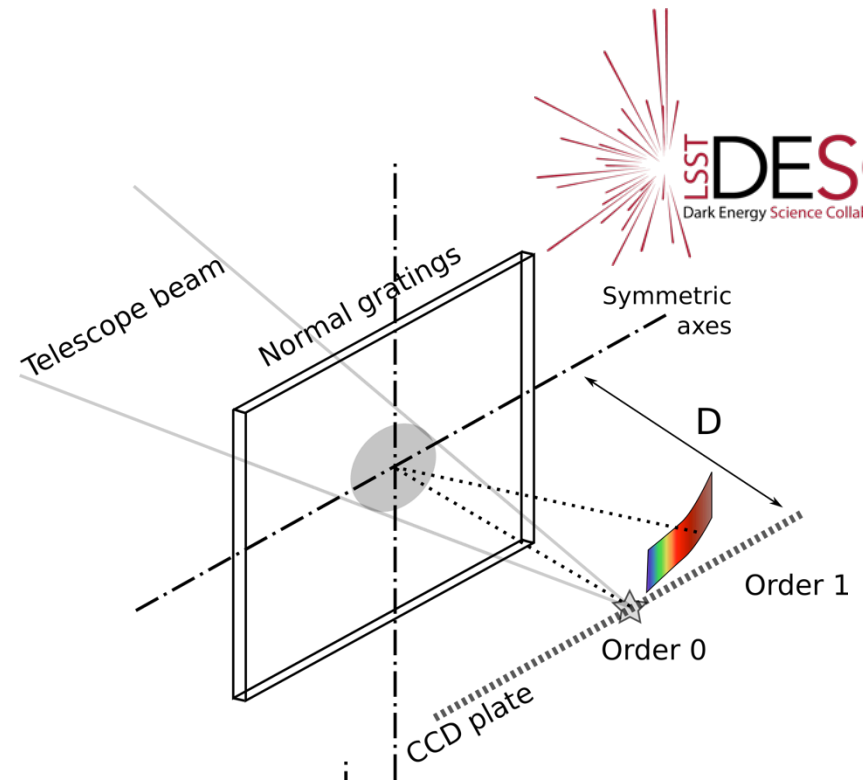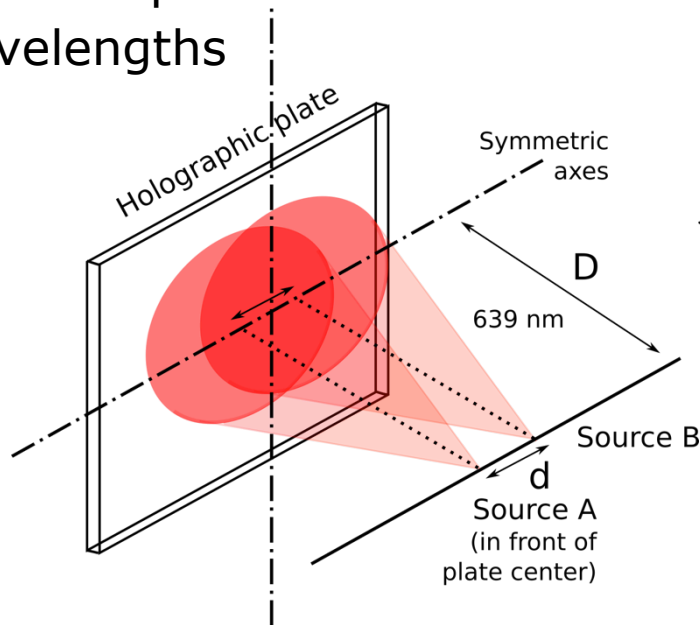
- Prototypes made in Bordeaux by Ultimate Holographics "Best holograms in the world"
- Three different technologies tested :
  - Phase with polymers
  - Phase with Ag
  - Amplitude with Ag
- Brought to CTIO for 18 test nights:
  - calibration, characterisation
  - Atmospheric studies
  - Compared with Ronchi 400 gr/mm and blazed grating 300 gr/mm

Hologram plate
A
B
Prism

Ph Ag
Amp Ag

Holograms in a nutshell

0.9m @ CTIO

Filter wheel

09/06/2017 with blue filter

Order 1

Order 0

Order 2

Open cluster

HD185975 z= 1.85 Nb=148

CALSPEC raw image with hologram
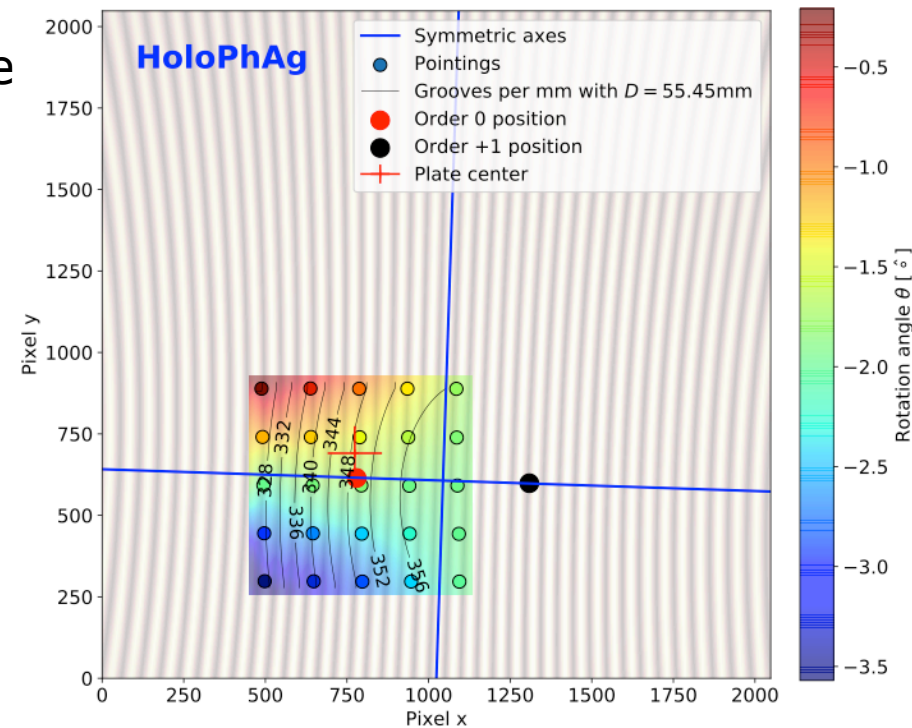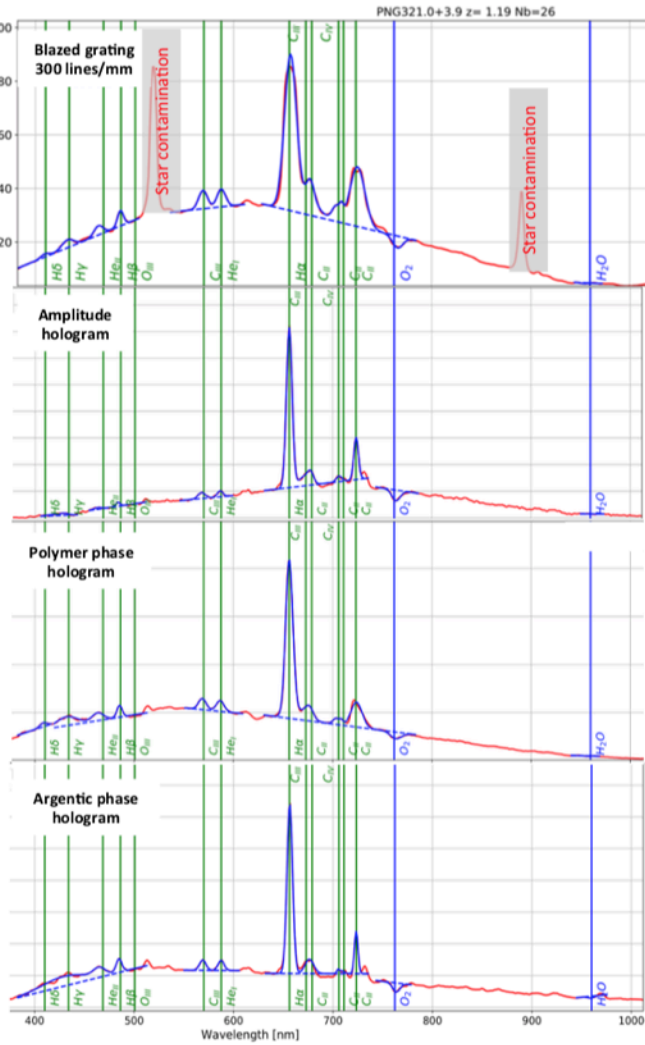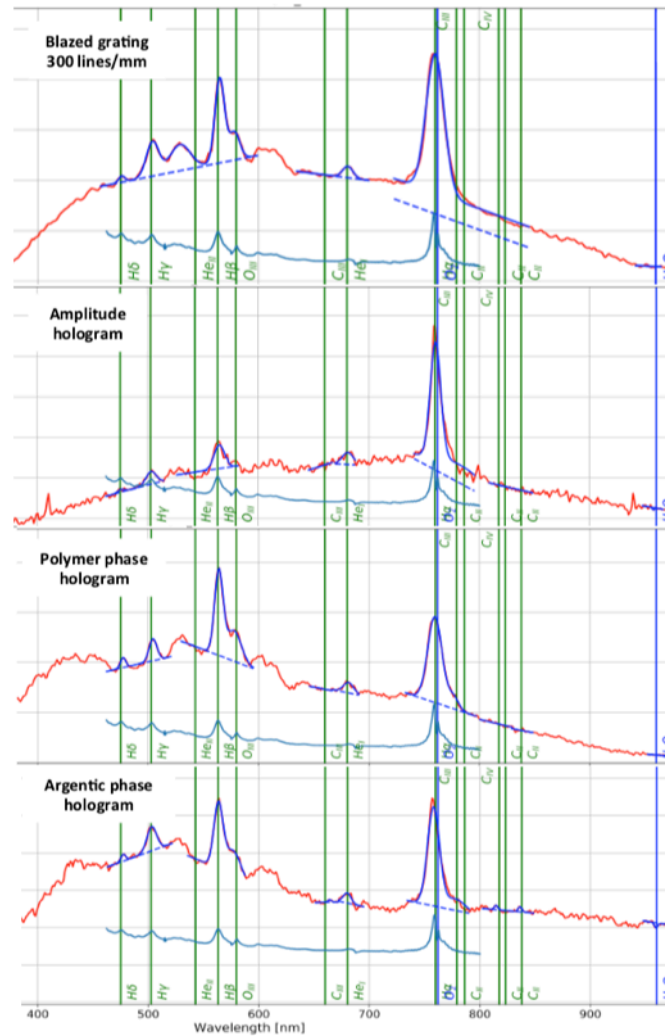
Tests at CTIO (18 nights in June)

- Scans of 25 pointings to calibrate and characterise the holograms

  - Rotation angle field

  - Effective grooves per mm

  - Transverse width

  - Order 2 contamination

- Observation of emission line objects and CALSPECs
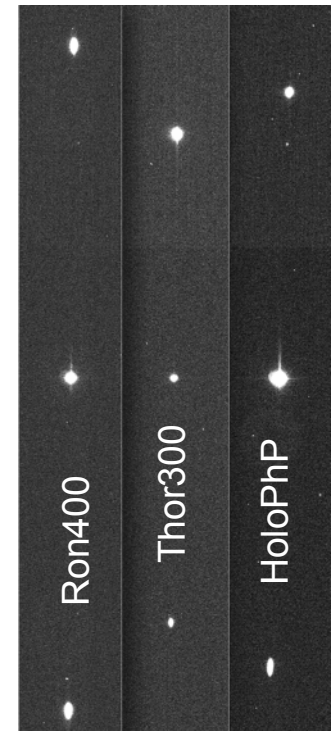
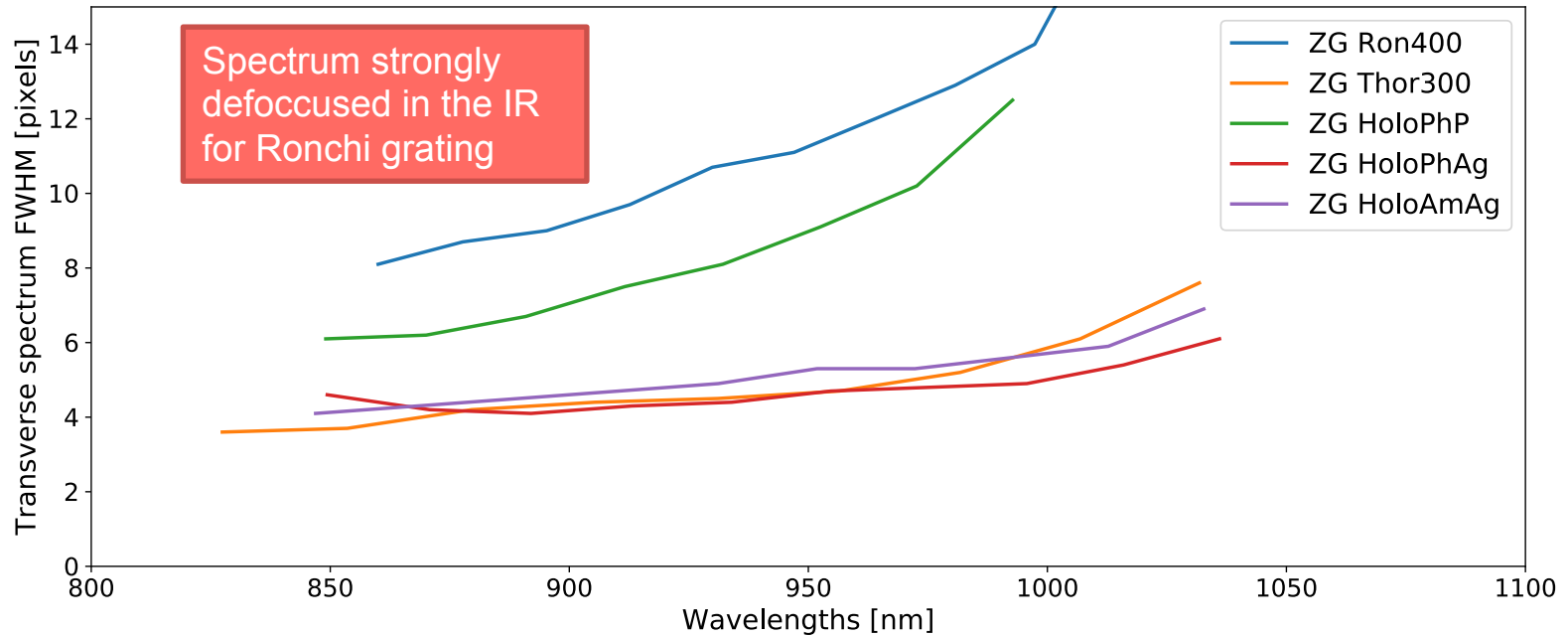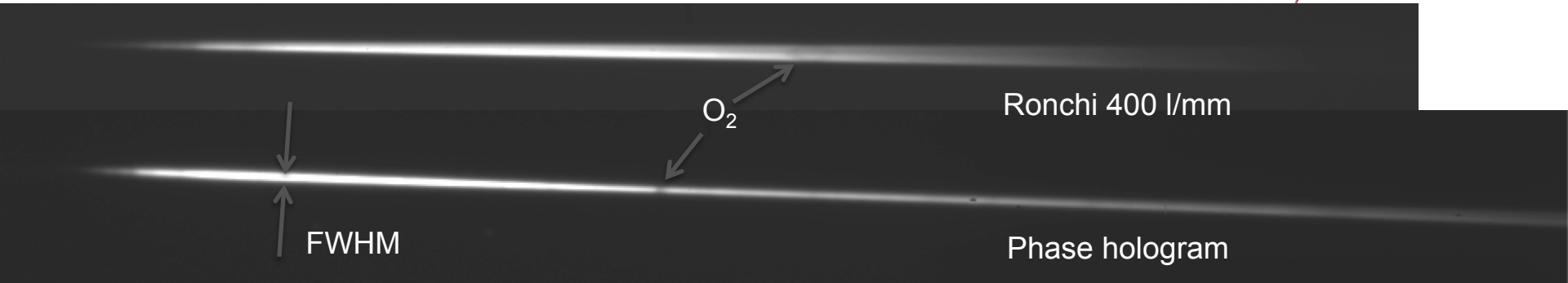# Tests at CTIO (18 nights in June)

Planetary nebula

Quasar (redshifted)

Tests at CTIO (18 nights in June)

O_2

Ronchi 400 l/mm

FWHM

Phase hologram

Spectrum strongly defoccused in the IR for Ronchi grating

Legend:
- ZG Ron400
- ZG Thor300
- ZG HoloPhP
- ZG HoloPhAg
- ZG HoloAmAg

Transverse spectrum FWHM [pixels] vs Wavelengths [nm]

Partial conclusions

|	Resolution	Order 2	Transmission
HoloPhP	~	✔	✔
HoloPhAg	✔	✘	✔
HoloAmAg	✔	✘	✘
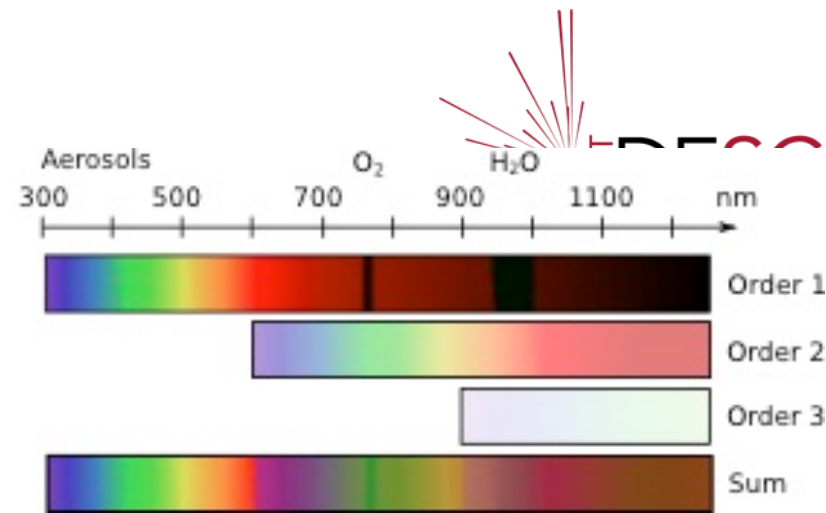
- Pros and cons for tested technologies
- Hologram maker is confident in optimising emulsions to get 80% of light in order 1 and nearly suppress order 2
- R&D funded by IN2P3/LAL
- 18 nights of data to measure atmospheric absorptions with holograms

8
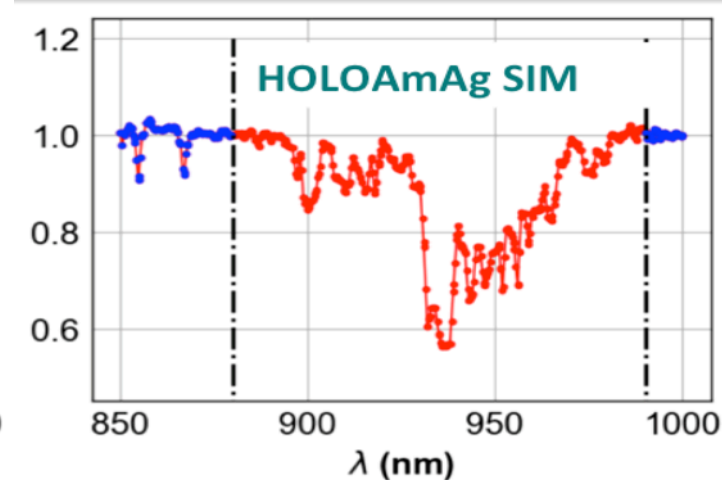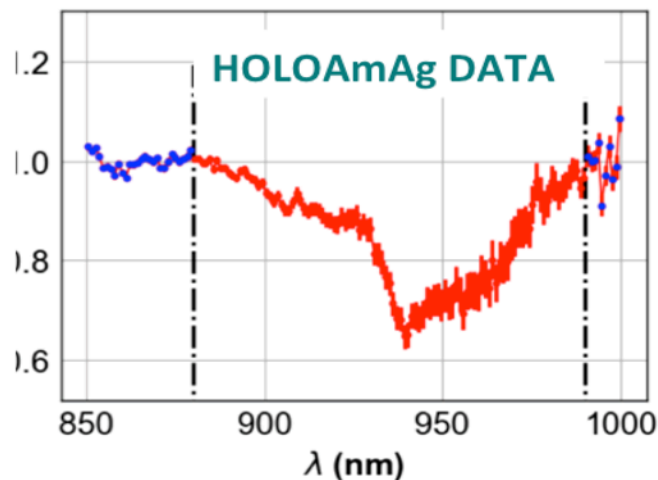
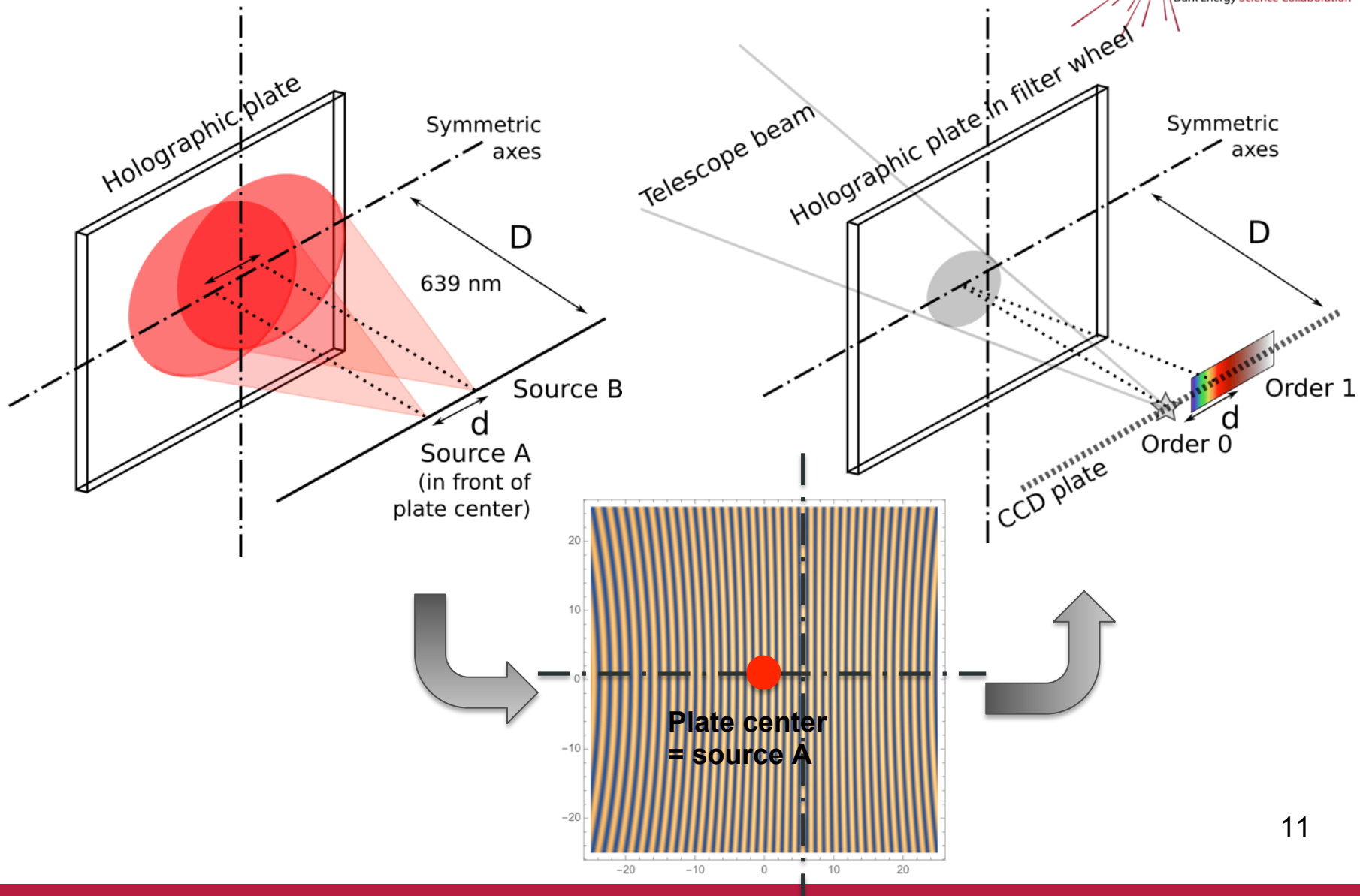# Tests on optical bench (under construction)

- Second calibration and characterisation on optical bench

  - Parabolic mirrors

  - LSST CCD

- More precise scanning of the hologram properties

  - In particular hologram transmission ratios order1/order0 and order2/order1

- Summer/autumn 2018: print and test of holograms for AuxTel

Basic camera

mask

Off-axis parabolic mirror f=310mm

Off-axis parabolic mirror f=646mm

Integrating sphere
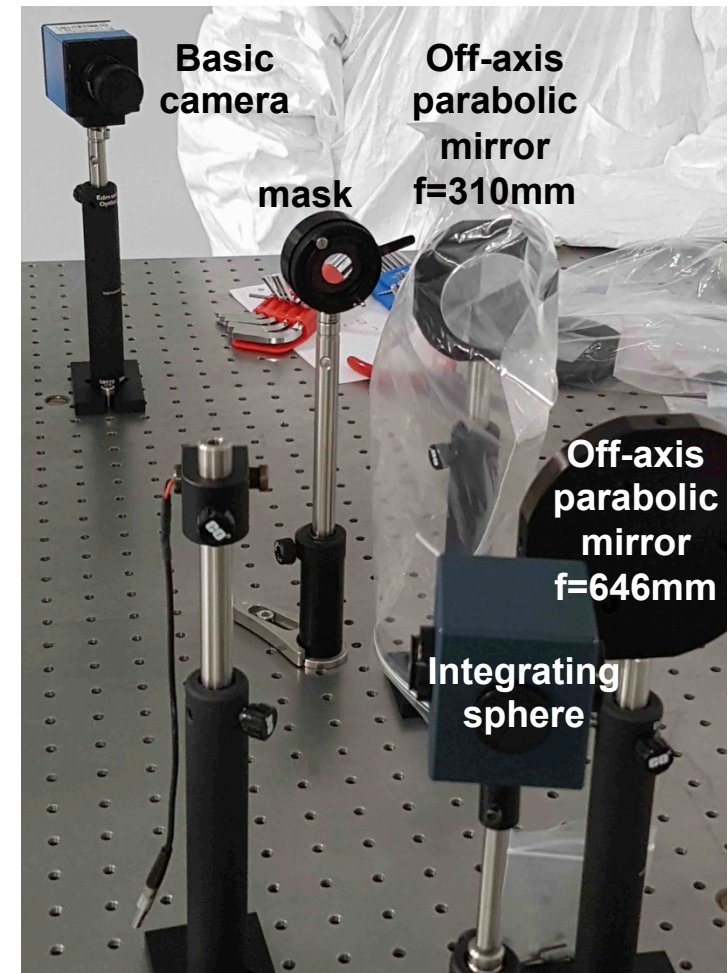
Back-up slides

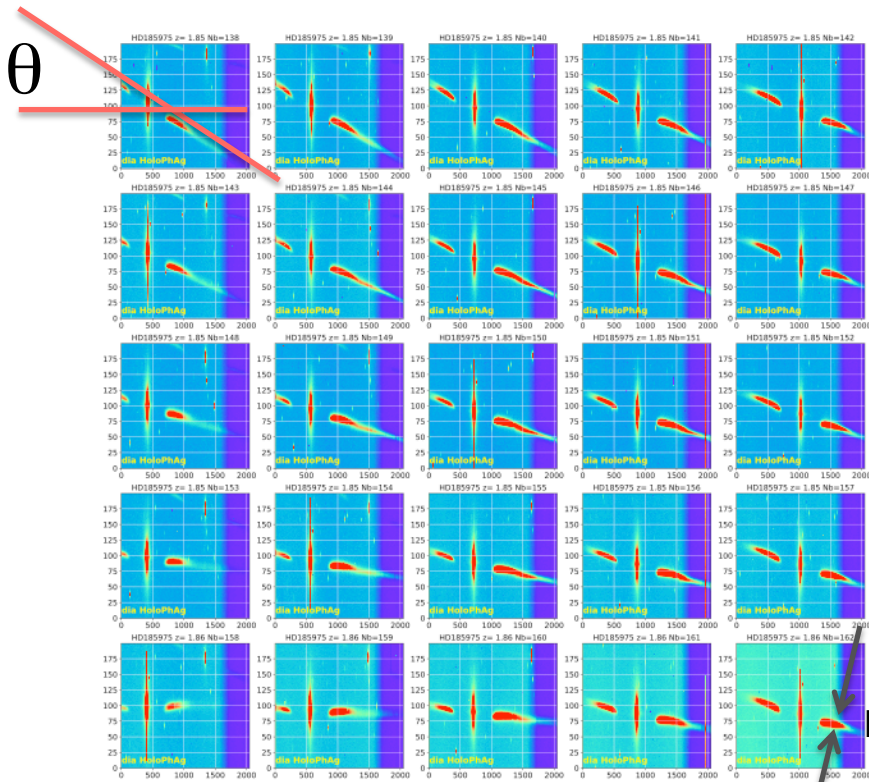# Hologram principles

Hologram geometry
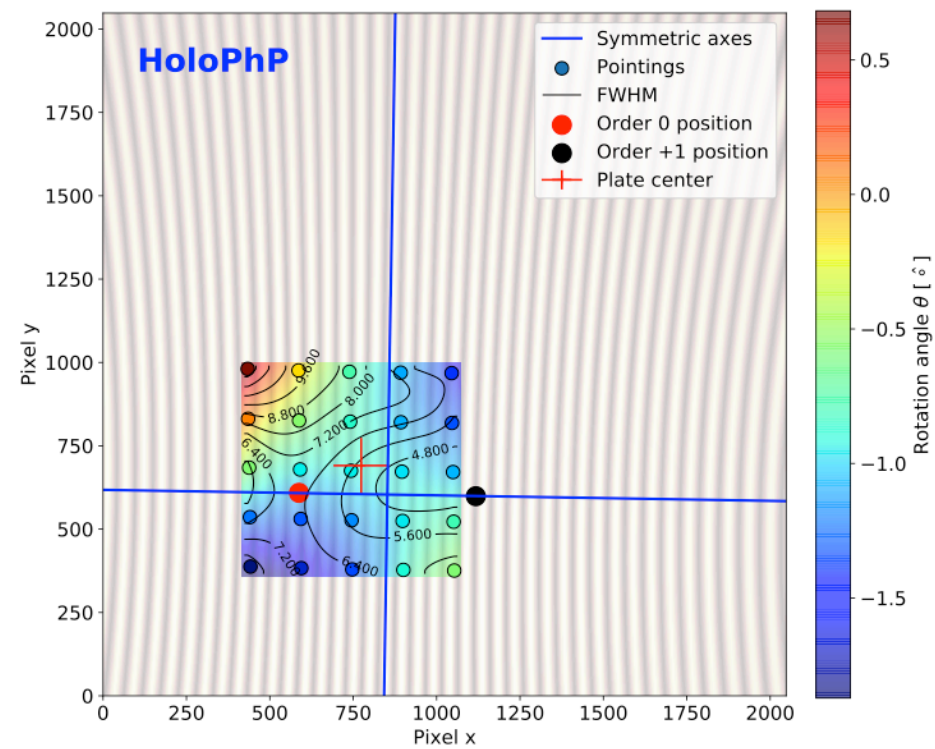

θ
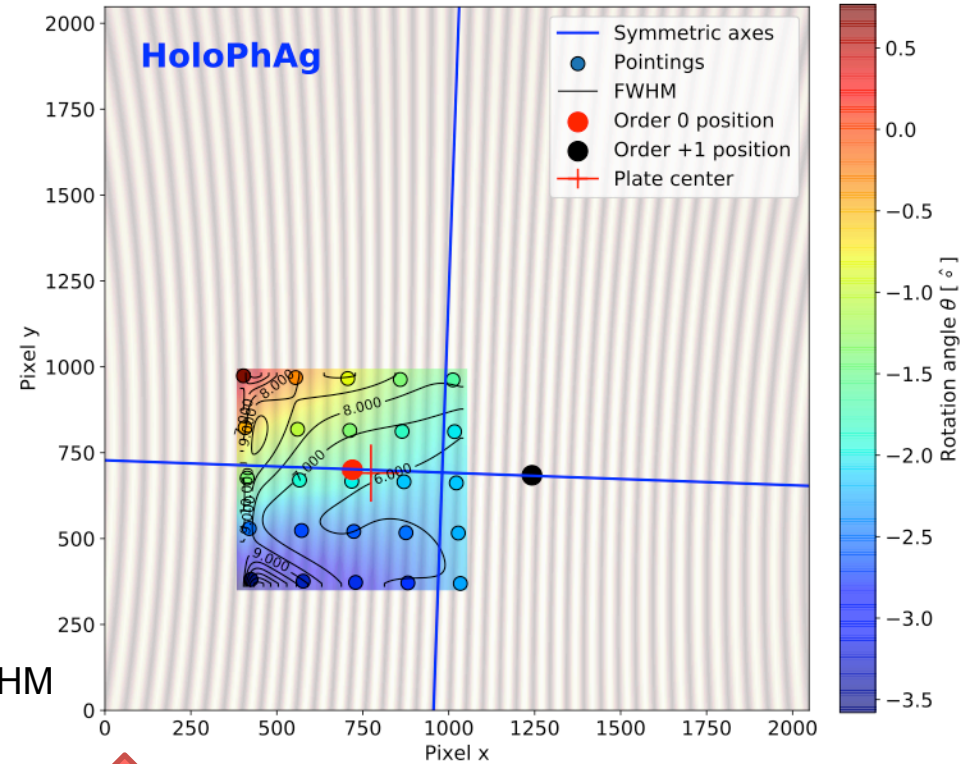
FWHM
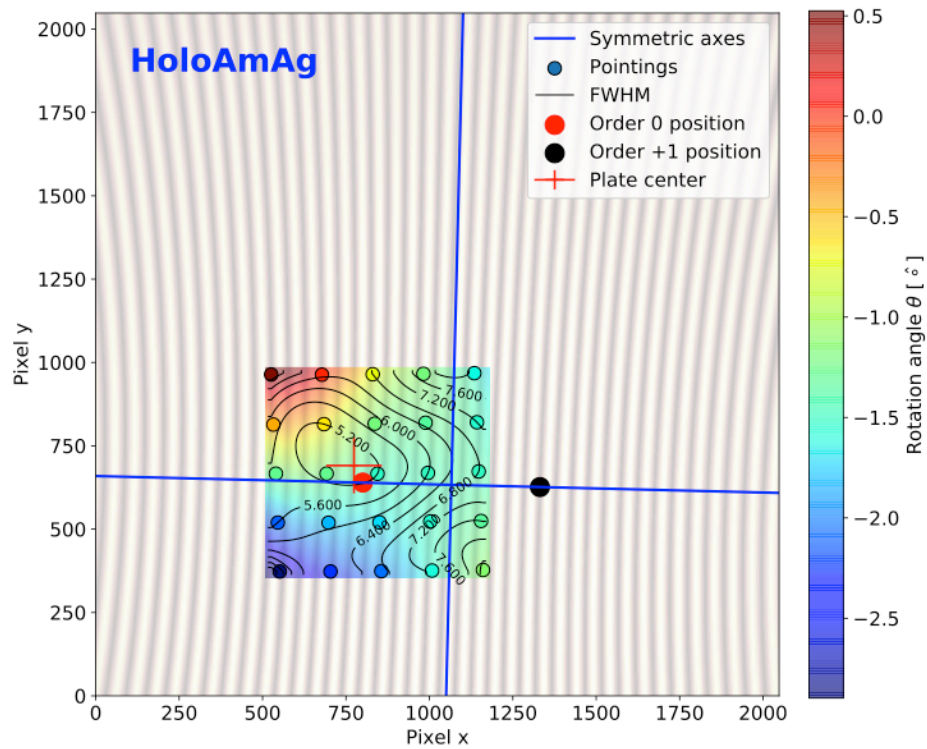
Analyse des θ et FWHM
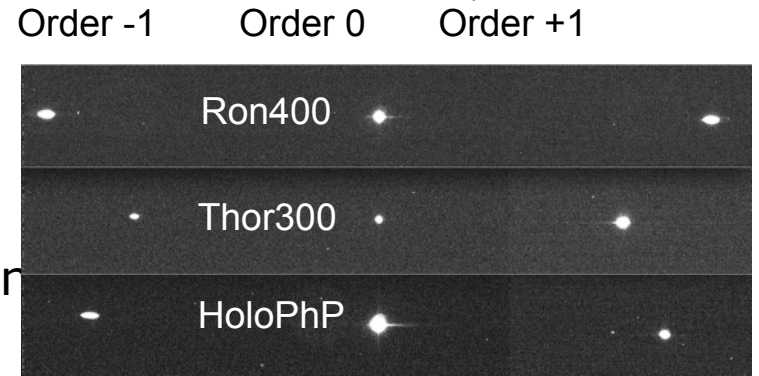sur 25 pointés

Hologram geometry
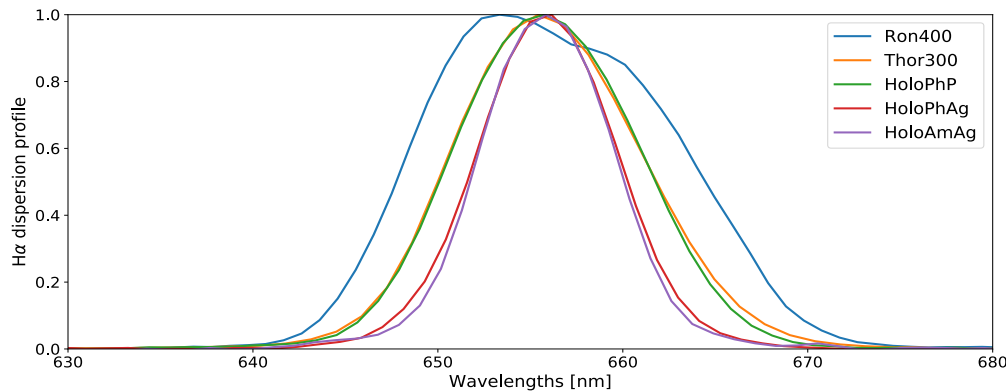
Hologram resolutions

- **Determination of effective grooves per mm number**

    - With H-alpha 655.9 nm

    - Calibration of D distance with known Thor300 et Ron400

        $$D = 55.5 +/- 0.2 \text{ mm}$$

- **Comparison of the different resolutions**

Order -1   Order 0   Order +1

Filter	$\lambda/\delta\lambda$ order +1	$\lambda/\delta\lambda$ order -1	FWHM transverse (pix)
Ronchi 400	72	69	6.0
Thorlabs 300	124	114	4.0
HoloPhP	131	62	4.1
HoloPhAg	283	30	4.4
HoloAmpAg	367	38	4.1

Hologram resolutions