

Star formation in the Local Group



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Summary

Compact programme (15 hours) with two main goals:

1. address properties of star formation in different environments, also at low-metallicity (similar to $z \approx 2$)
2. showcase MOS capabilities of NIRSpec for stellar studies very early on in the mission

Observations will give us medium- and high-resolution spectra of hundreds of known pre-main sequence (PMS) stars of different ages hosted in massive starburst clusters located in the Milky Way and Magellanic Clouds.

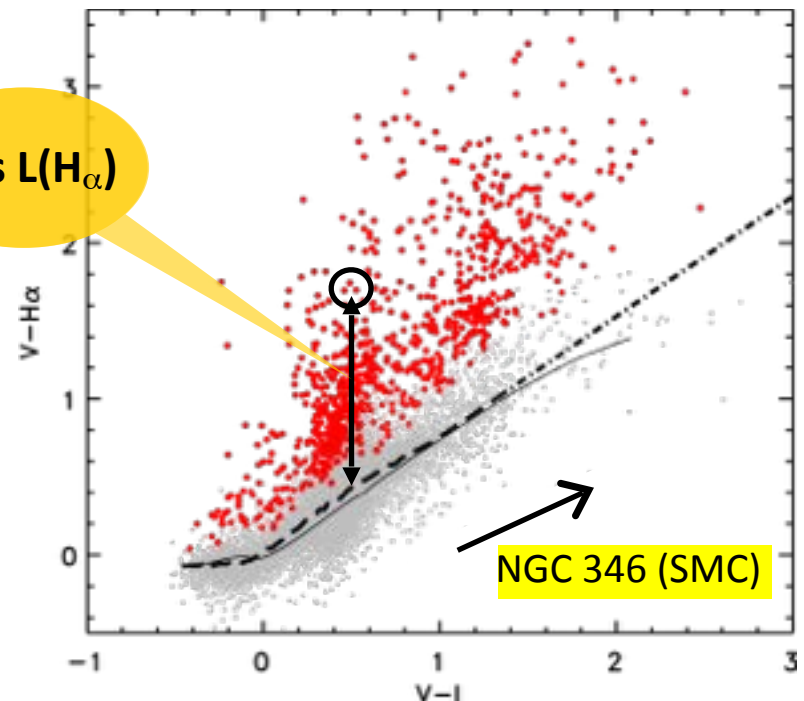
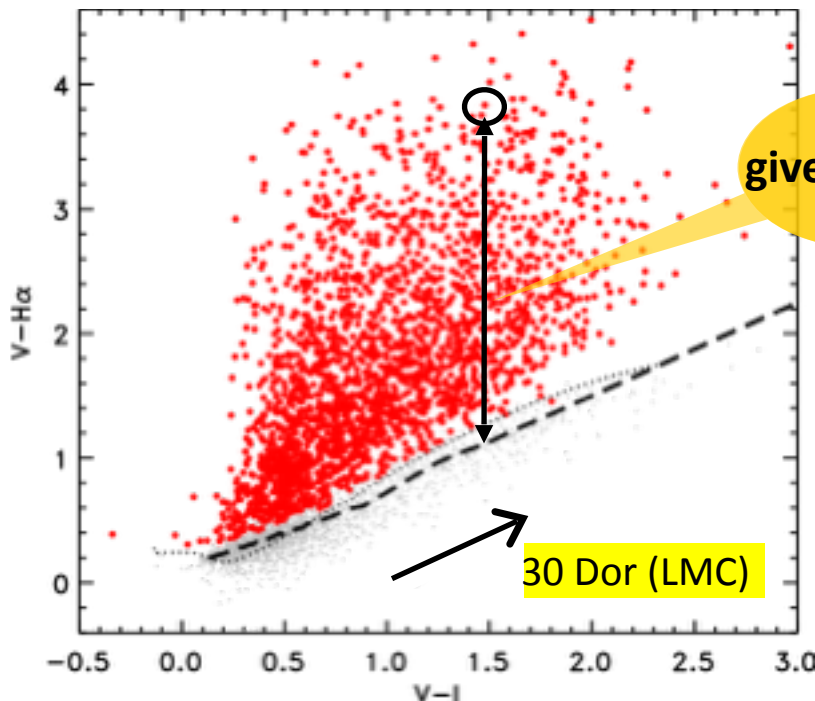
Actively accreting PMS stars

HST observations of massive young clusters in the local group have revealed that there are many PMS stars that continue to accrete matter for periods much longer than the few Myr typical of nearby associations of low total mass.

These PMS stars are discovered from broad-band (V , I) and narrow-band ($H\alpha$) photometry and show strong $H\alpha$ excess emission due to ongoing accretion.

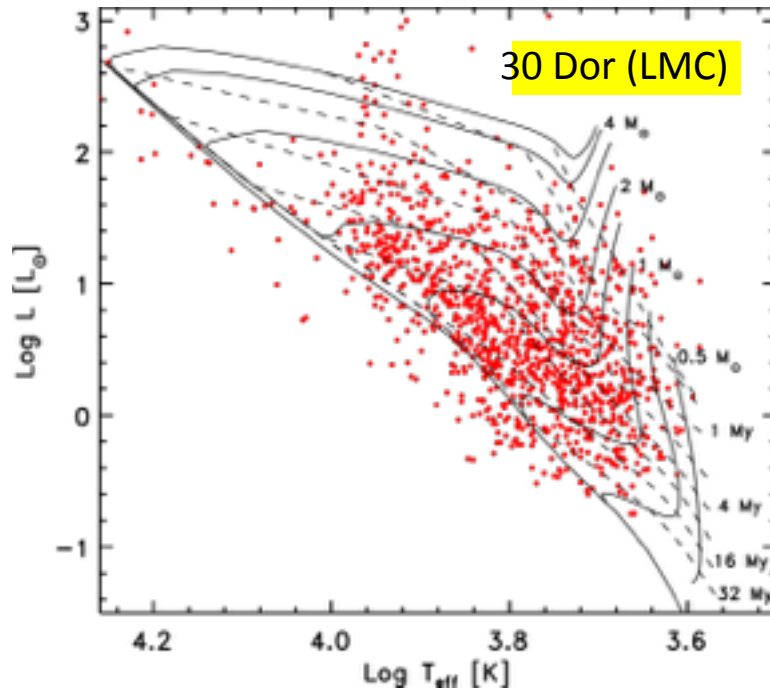
De Marchi et al. 2011a, 2017

De Marchi et al. 2011b, 2011c, 2013

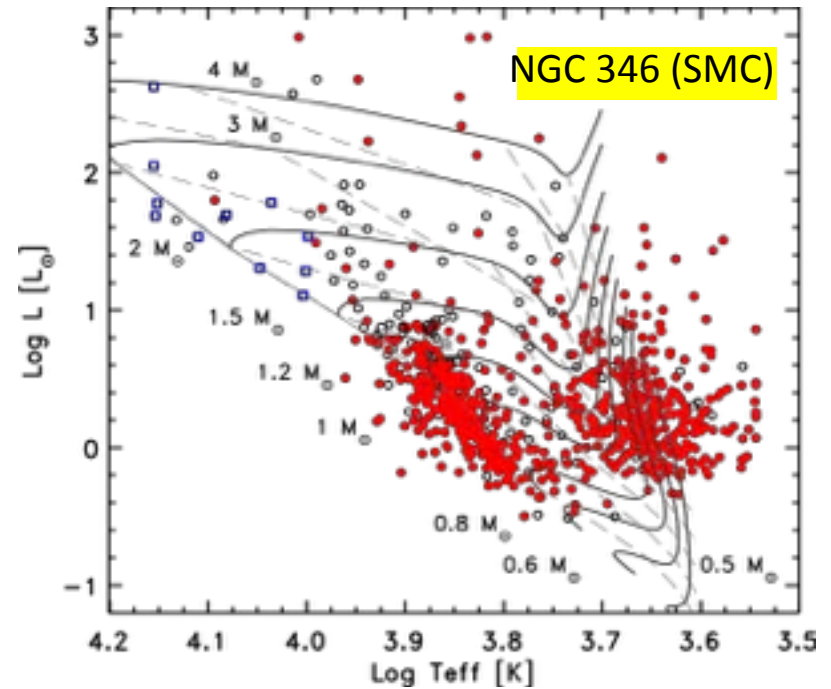


A matter of age...

De Marchi et al. 2011a, 2017



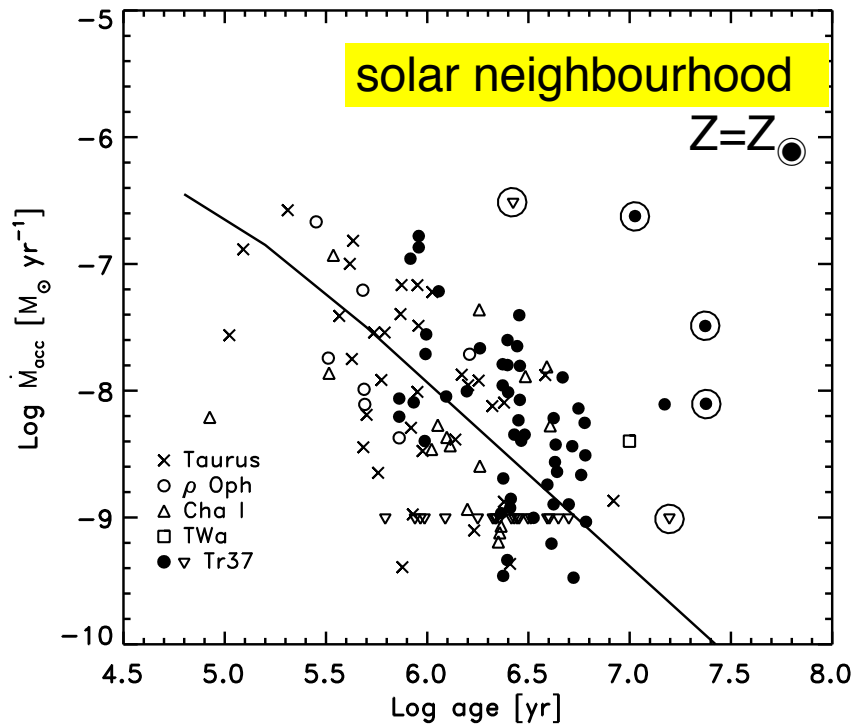
De Marchi et al. 2011b, 2013



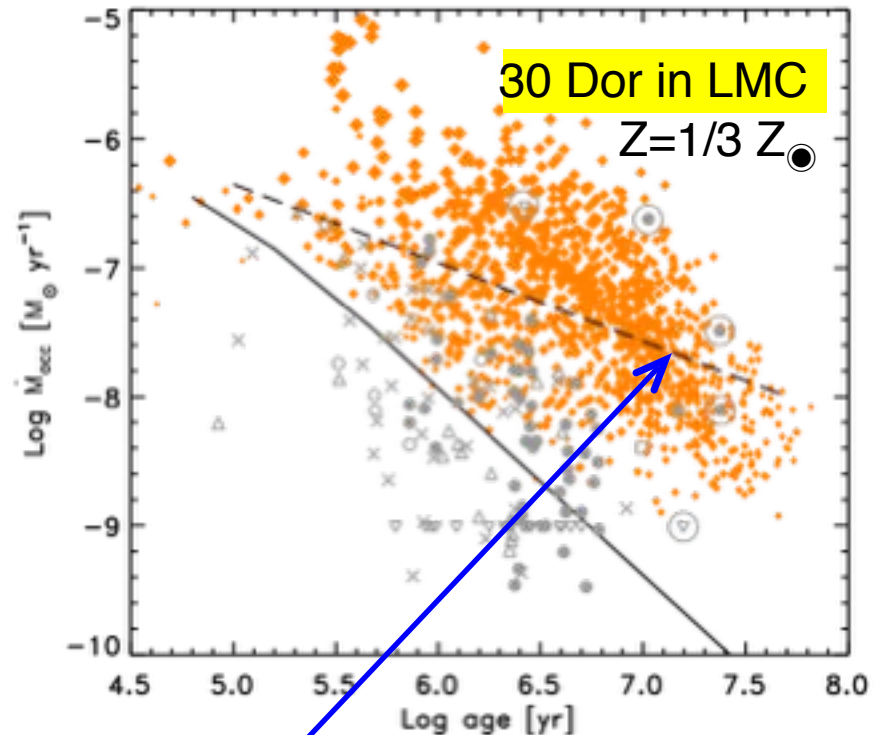
These stars with excess are found in different regions of the HR diagram **and** in different regions of the cluster. So there is an intrinsic difference between these stars: the difference is age. The observations reveal that star formation has proceeded in these regions for at least ~ 30 Myr. In solar neighbourhood these objects are very rare.

Evolution of mass accretion in PMS stars

Sicilia Aguilar et al. 2006; 2010



De Marchi et al. 2011a; 2017



Not only are there many older PMS stars still actively accreting, but at low metallicity they appear to accrete more and for a longer time. So circumstellar discs live longer. Did more planets form at high redshift?

Target regions

NGC 3603 (MW)



30 Dor (LMC)



NGC 346 (SMC)

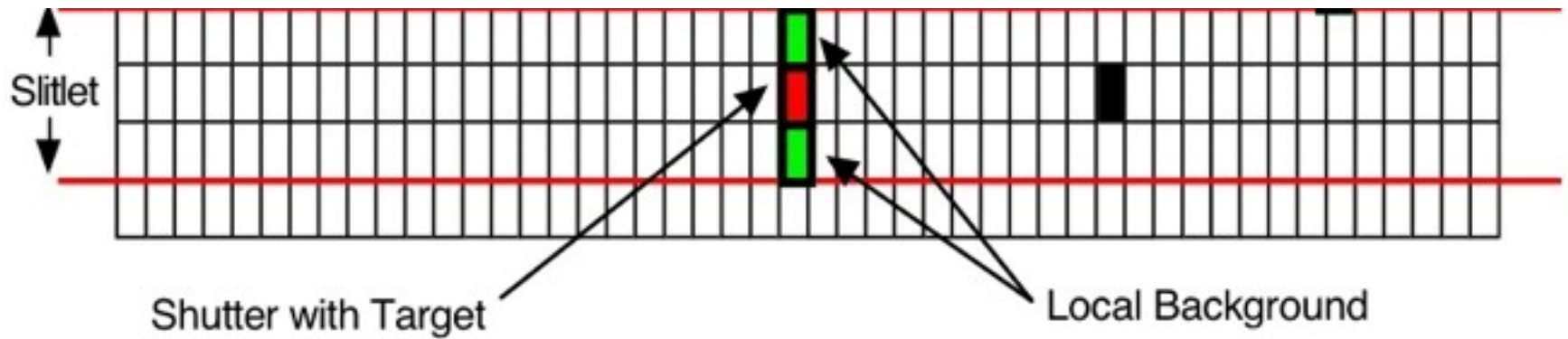


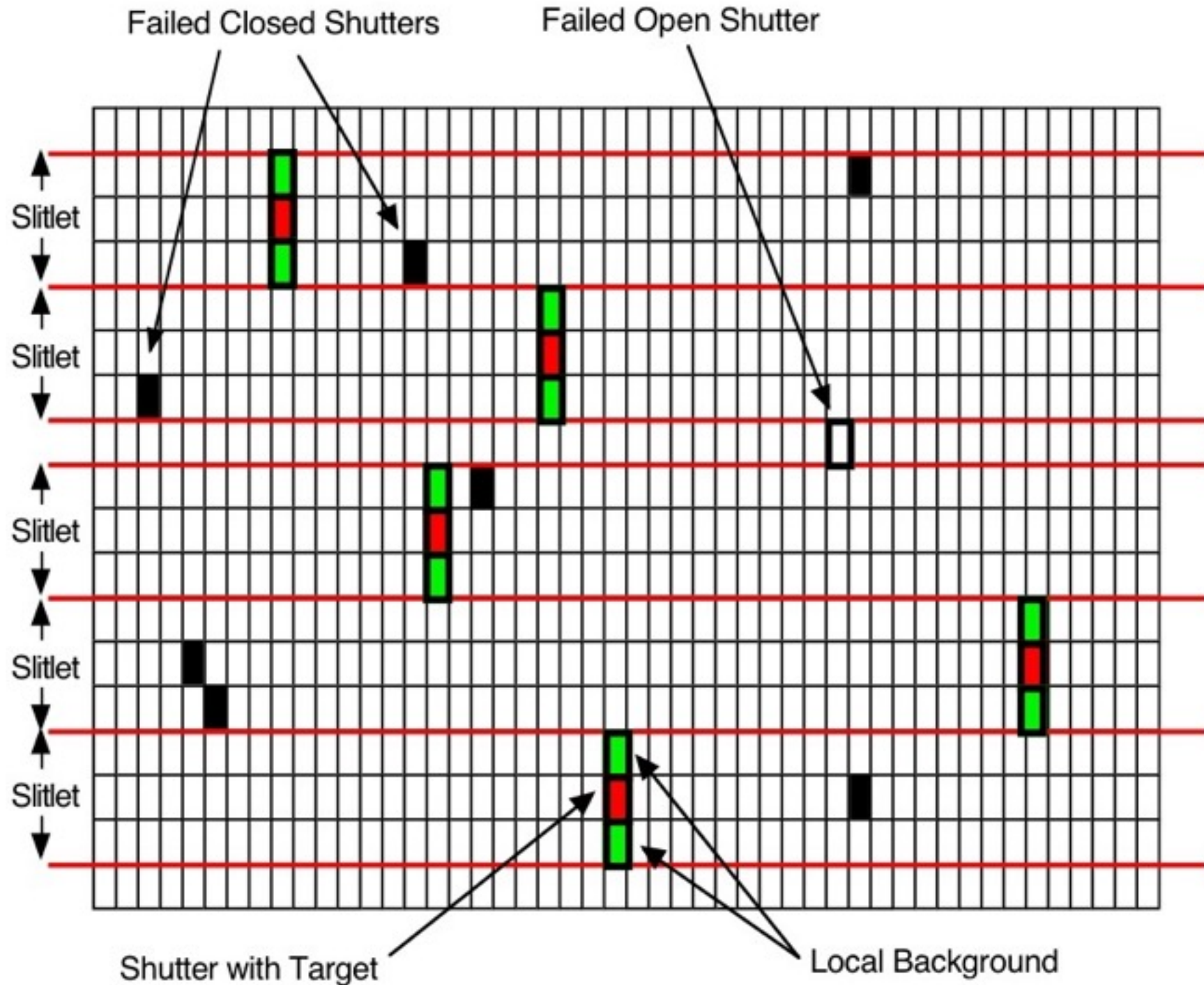
Typical 3' x 3' field has ~800 PMS stars, good multiplexing

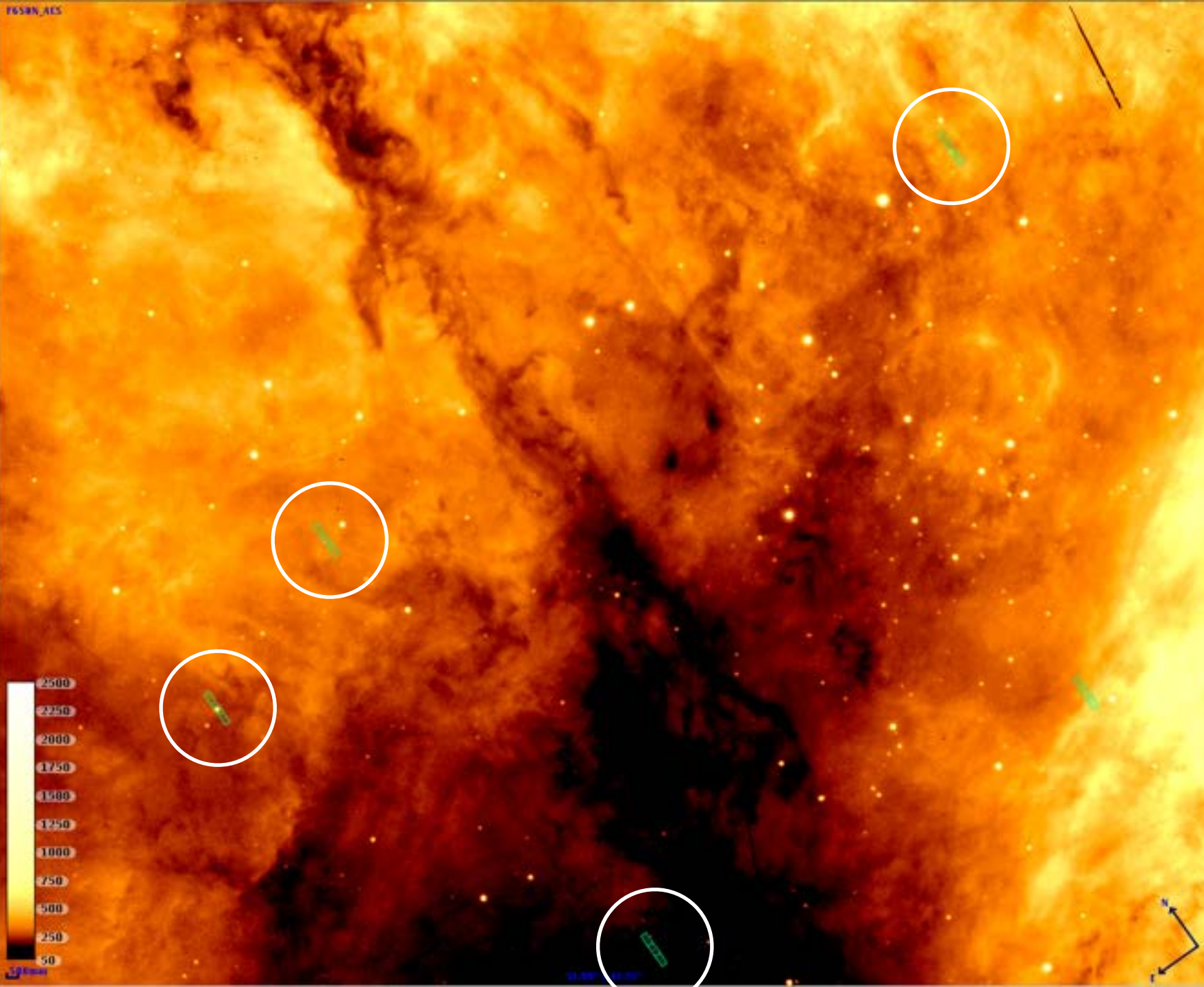
HST astrometry for all, no pre-imaging needed

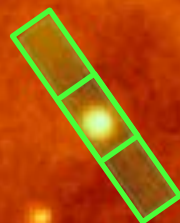
Optimal filling of the NIRSspec MSA for any roll angle (~60–70 stars)

Fitting targets in microshutters









Playing with MSA planning tool

Primary and filler sources in the same catalogue

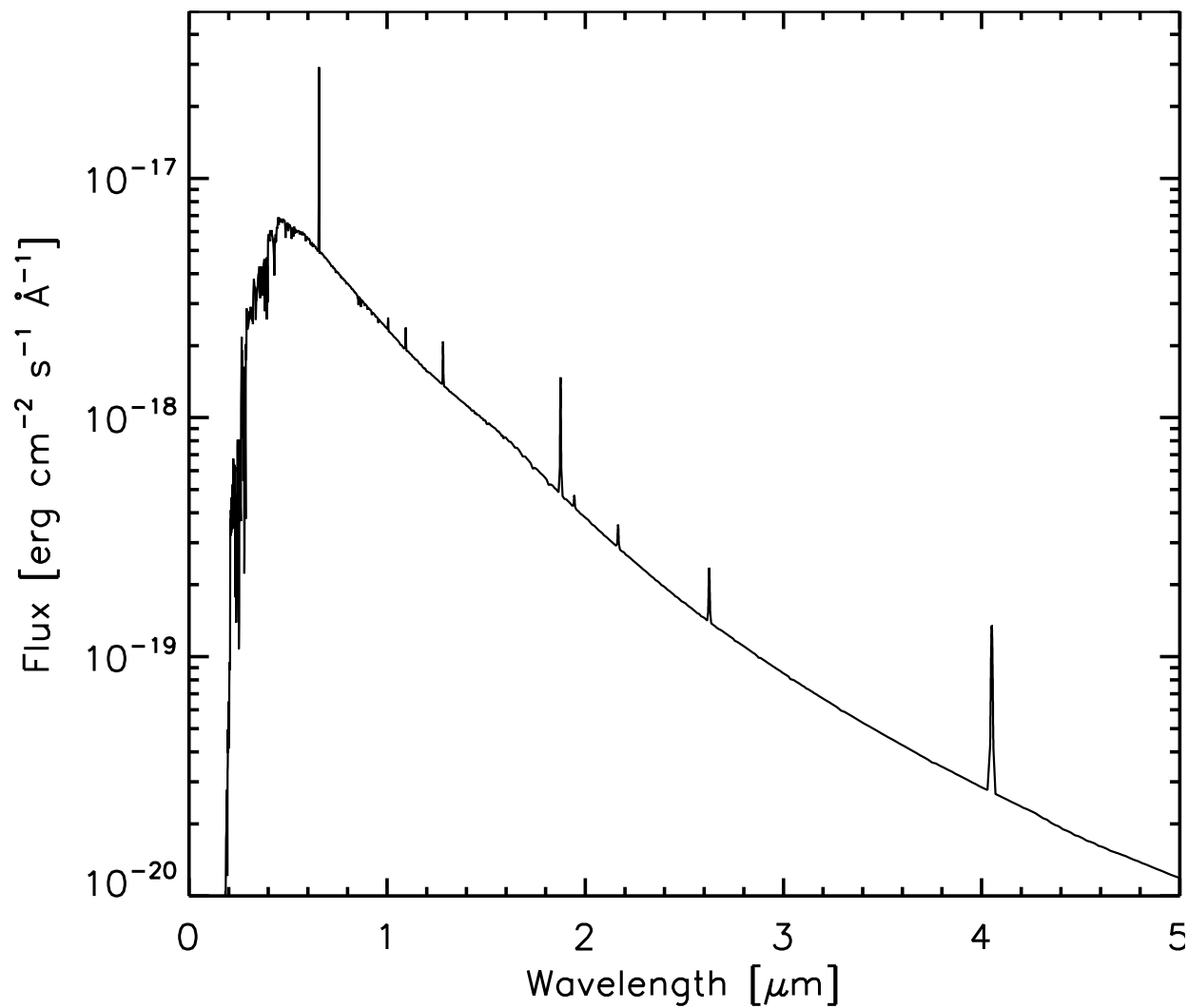
Sources at beginning of list receive higher priority

Catalogue must contain all sources in the field

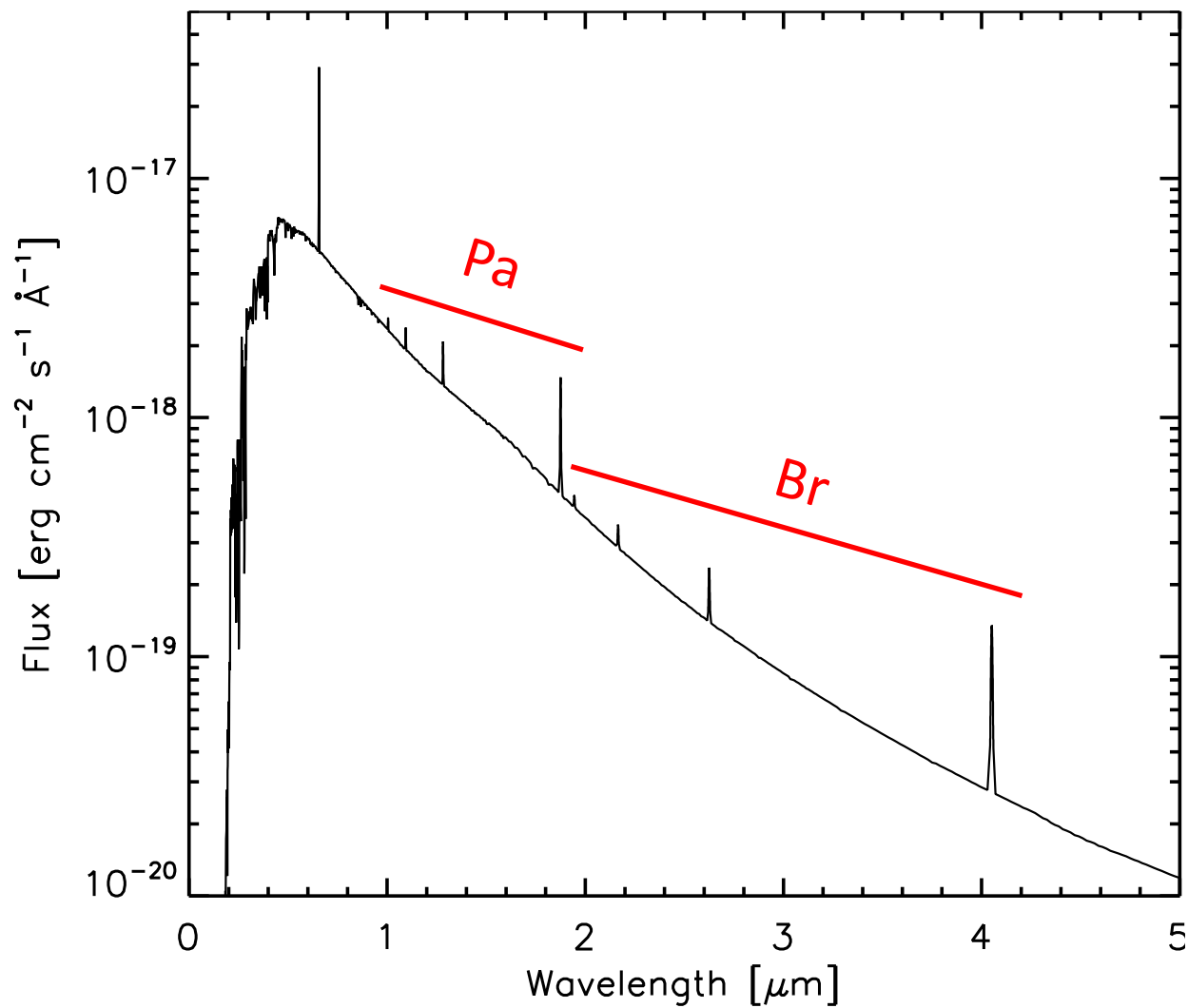
Reference stars used for target acquisition must be included

Also include stars that will not be observed, in order to avoid them

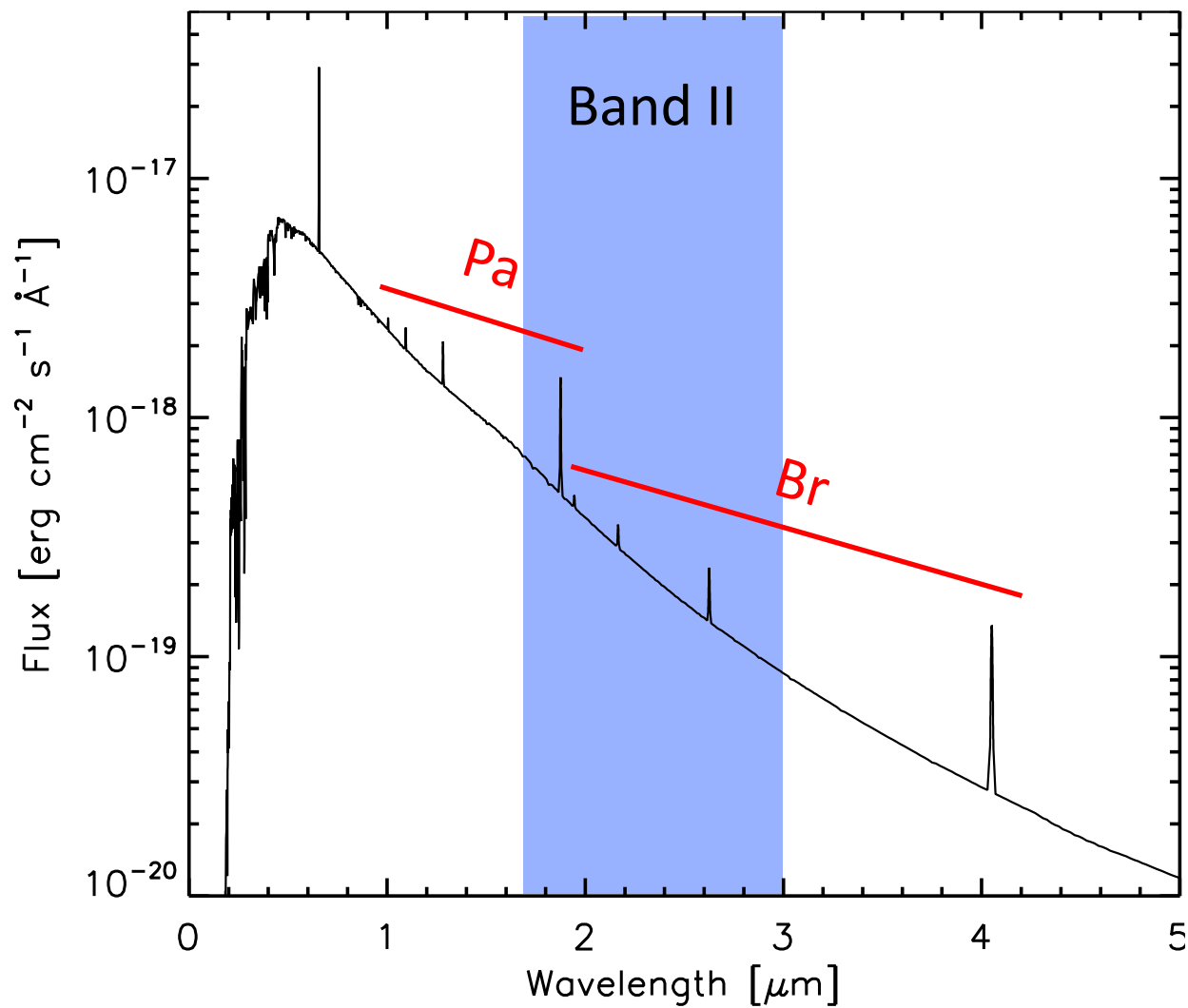
Observations: spectral range



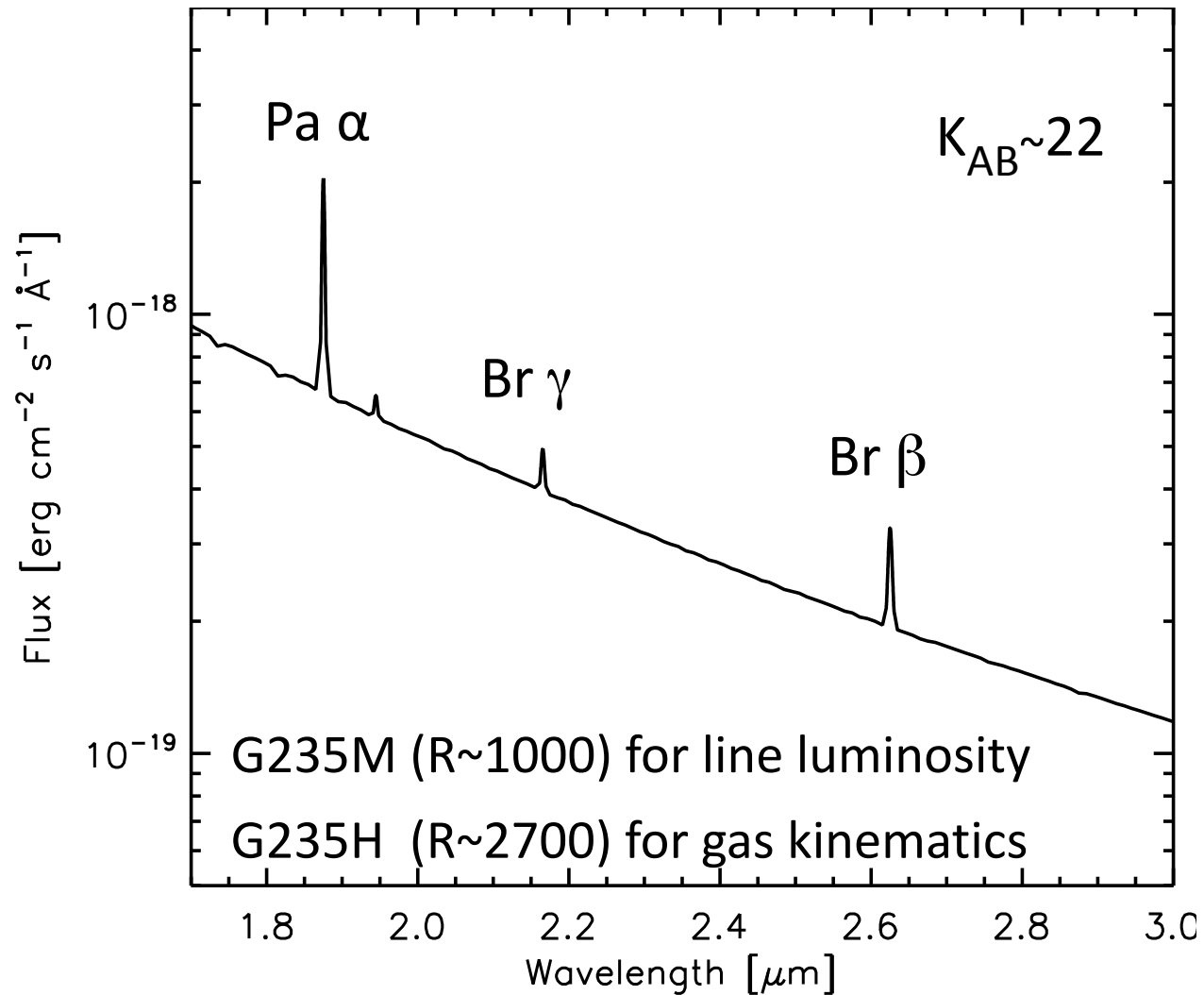
Observations: spectral range



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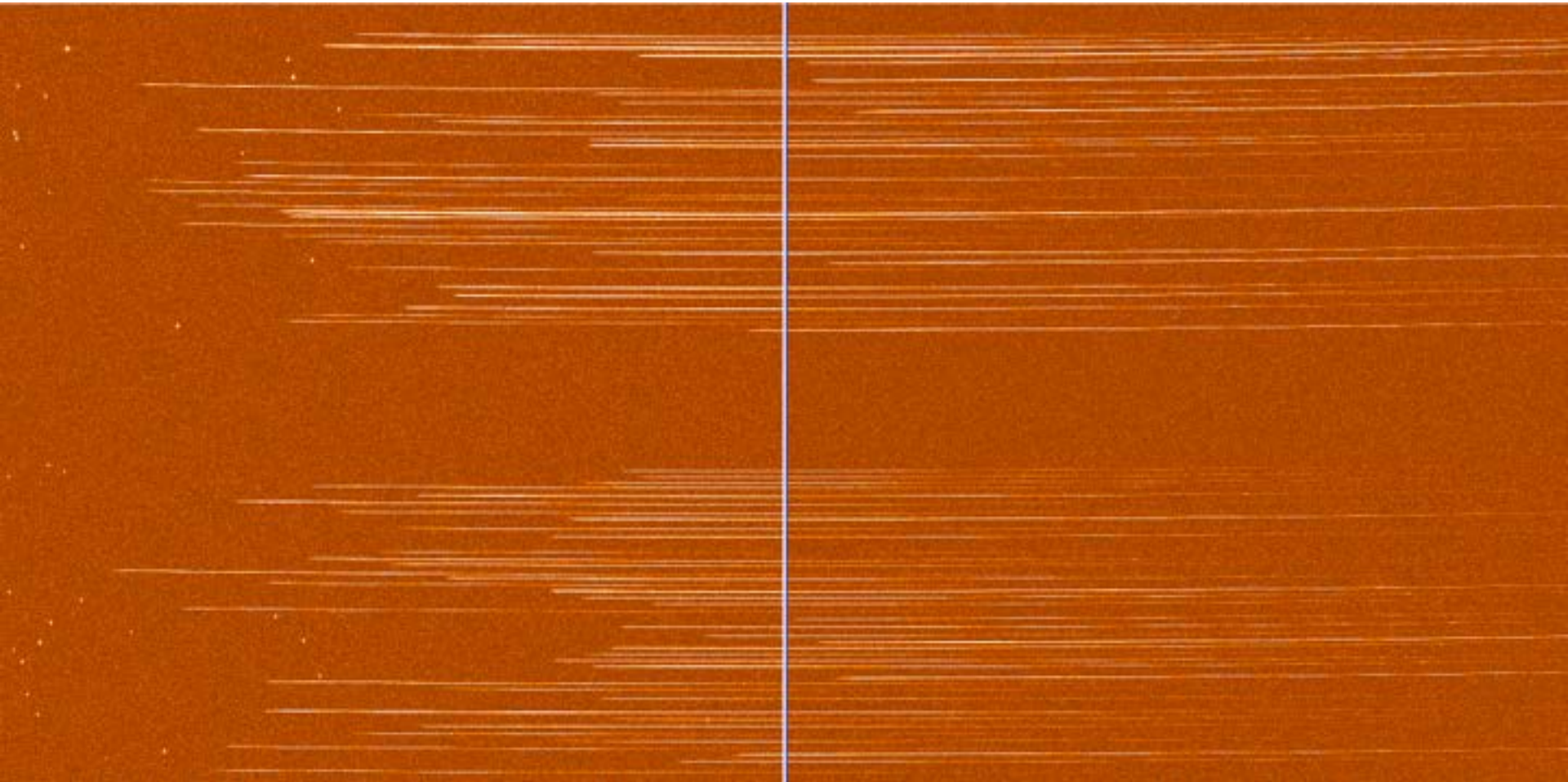


Observations: spectral features



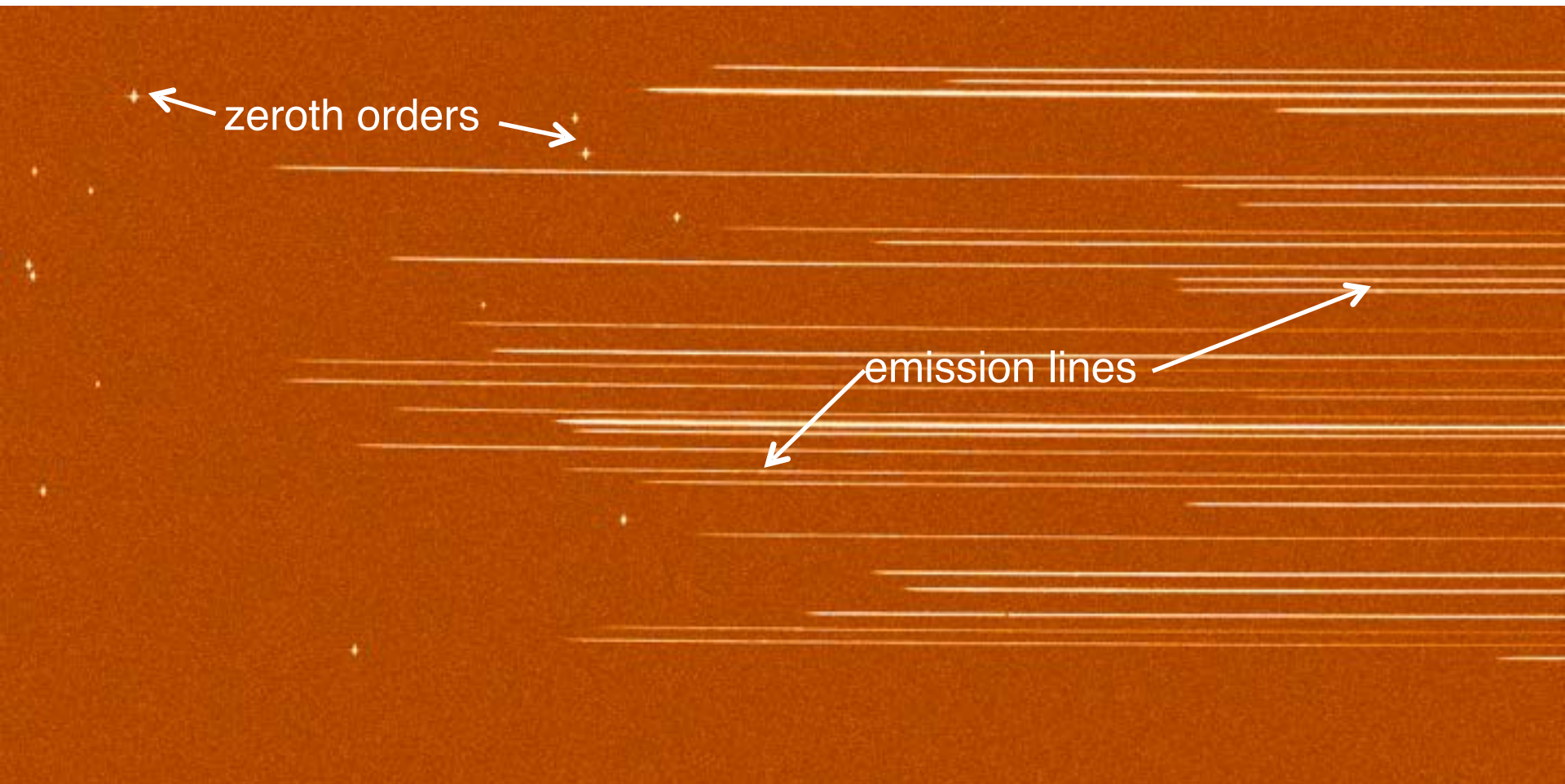
Simulated spectra on detectors

In the G235M/F170LP mode all wavelengths above $1.7\ \mu\text{m}$ are recorded. First order is left half of spectrum. Also zeroth and second orders visible.

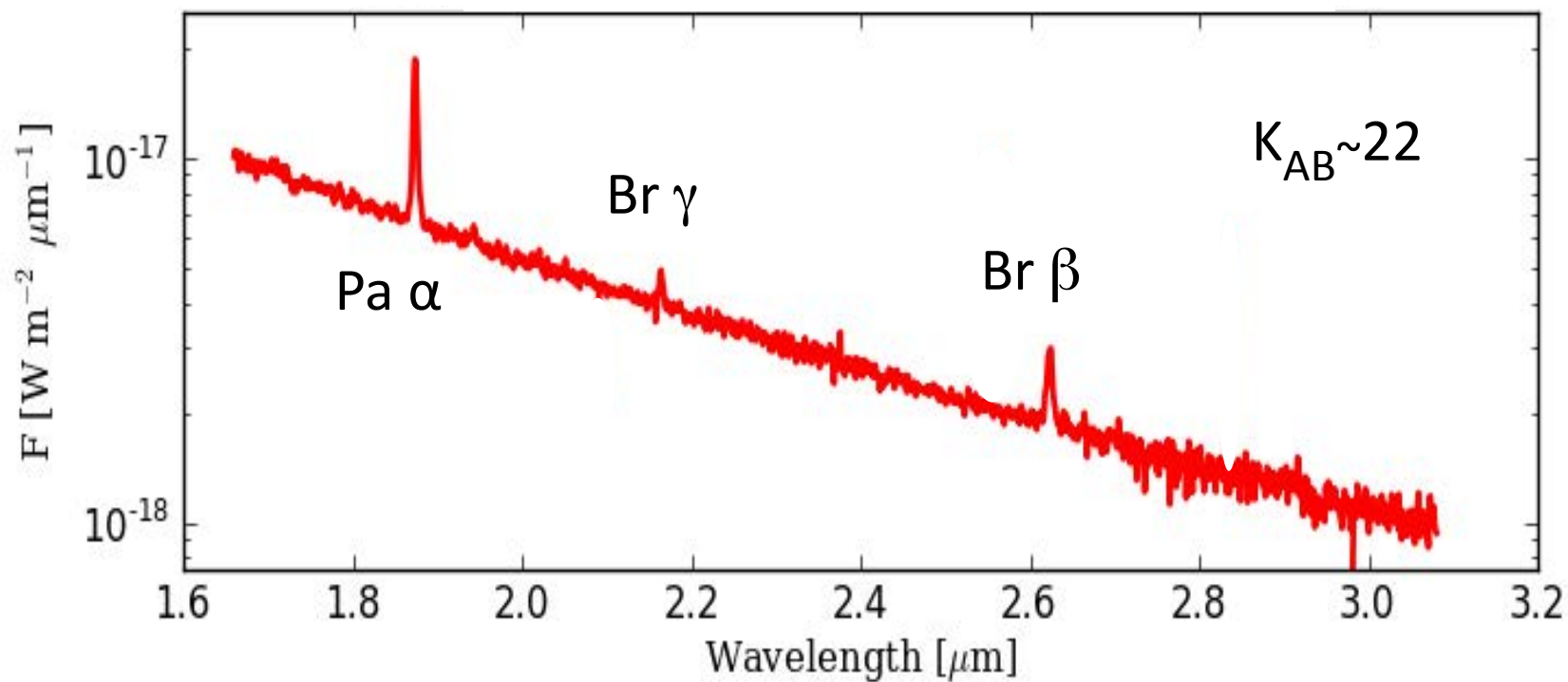


Simulated spectra on detectors

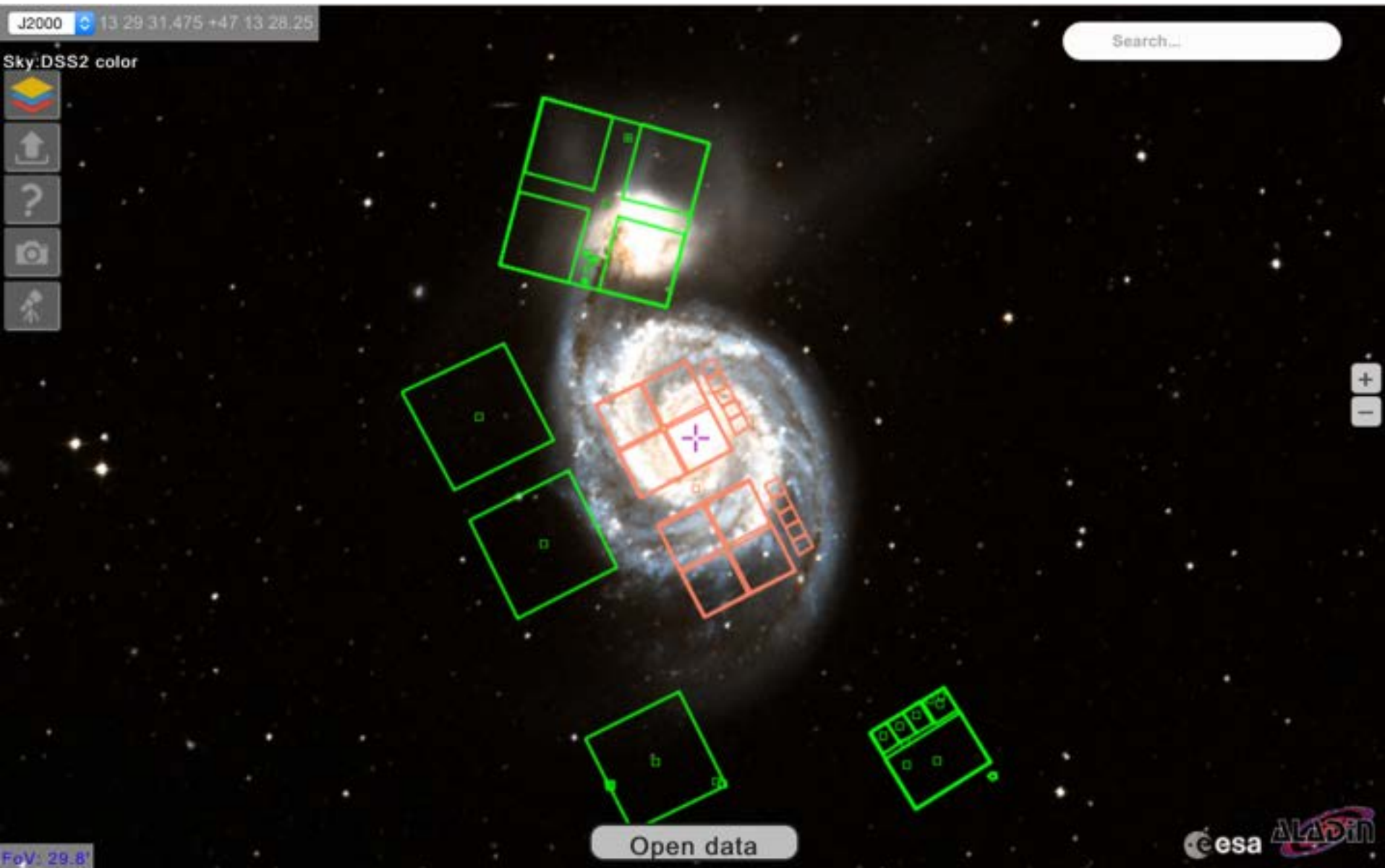
In the G235M/F170LP mode all wavelengths above $1.7\ \mu\text{m}$ are recorded. First order is left half of spectrum. Also zeroth and second orders visible.



Extracted spectrum R~1000



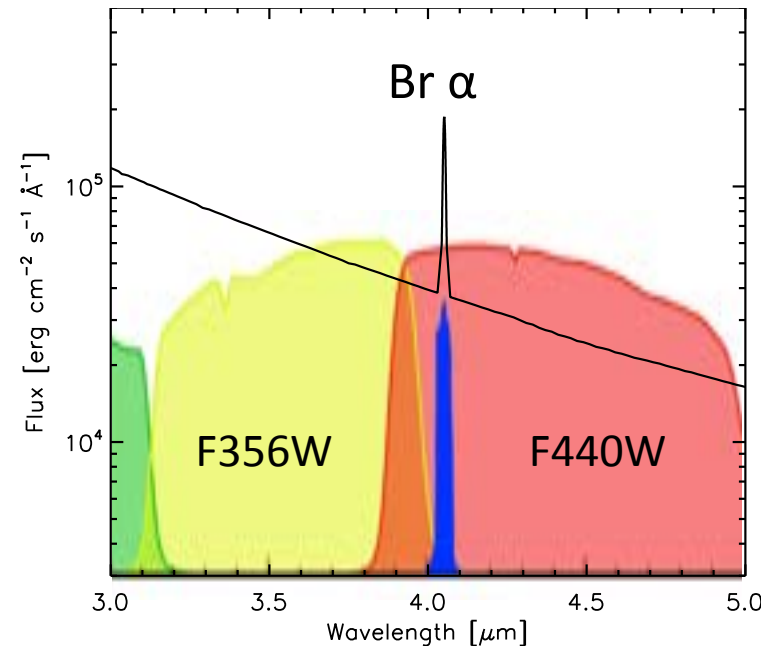
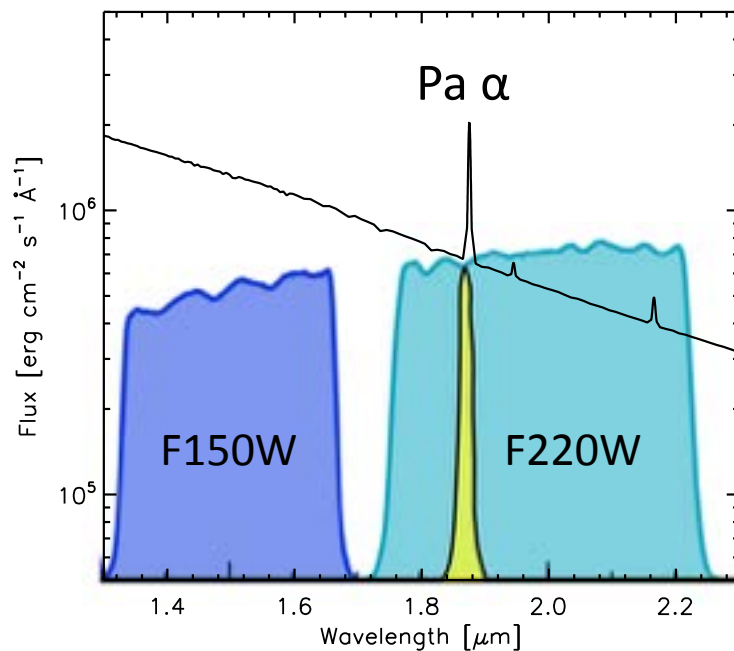
sky.esa.int

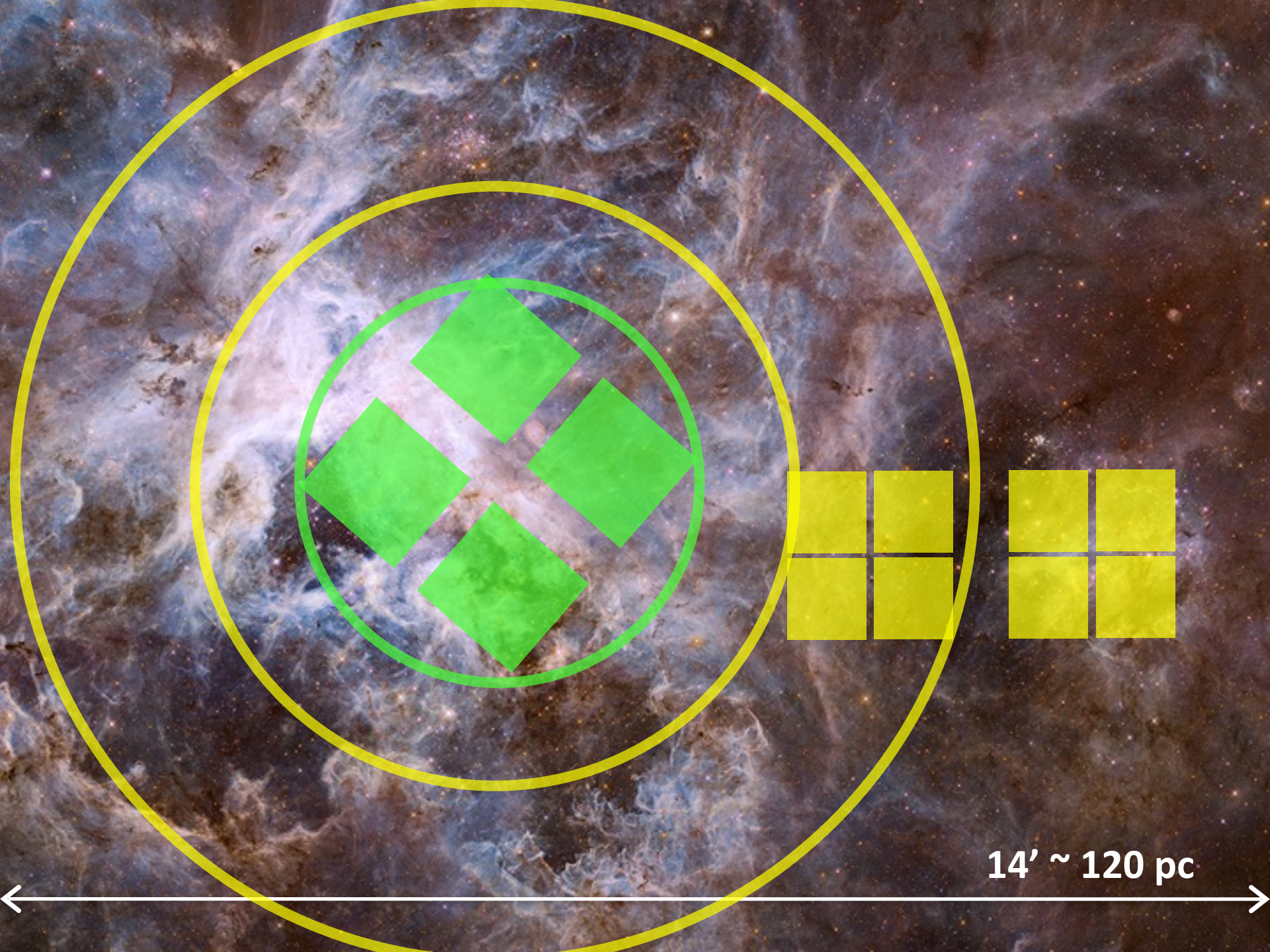


Coordinated parallels

NIRCam will cover fields about 7.5 arcmin from NIRSspec, still plenty of star formation going on in those regions!

We will use broad- and narrow-band (Pa α , Br α) filters to identify PMS stars that are accreting. Same as we did with HST H α photometry.





Plans for early release

These observations can be scheduled early on in the cycle, plus Magellanic Clouds are always reachable (CVZ)

Observations and lessons learnt from this programme are crucial to showcase NIRSpec's MOS capabilities for stellar population studies

We plan to make available to the community the NIRSpec G235M observations of NGC 346, which is least complex of the three regions

We expect to have the data pipeline processed and ready for release 3 months after observations. An accompanying paper will address both the science and the lessons learnt.

