Star formation in the Local Group

Guido De Marchi (ESA) for the NIRSpec GTO

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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 ≈ 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 *(Hα)* photometry and show strong Hα excess emission due to ongoing accretion.
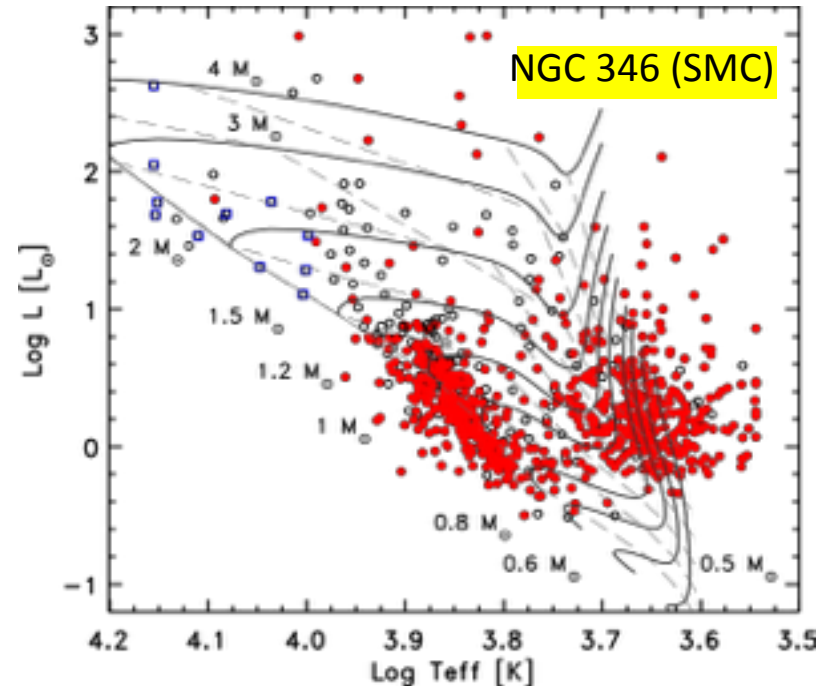

De Marchi et al. 2011a, 2017 · De Marchi et al. 2011b, 2011c, 2013
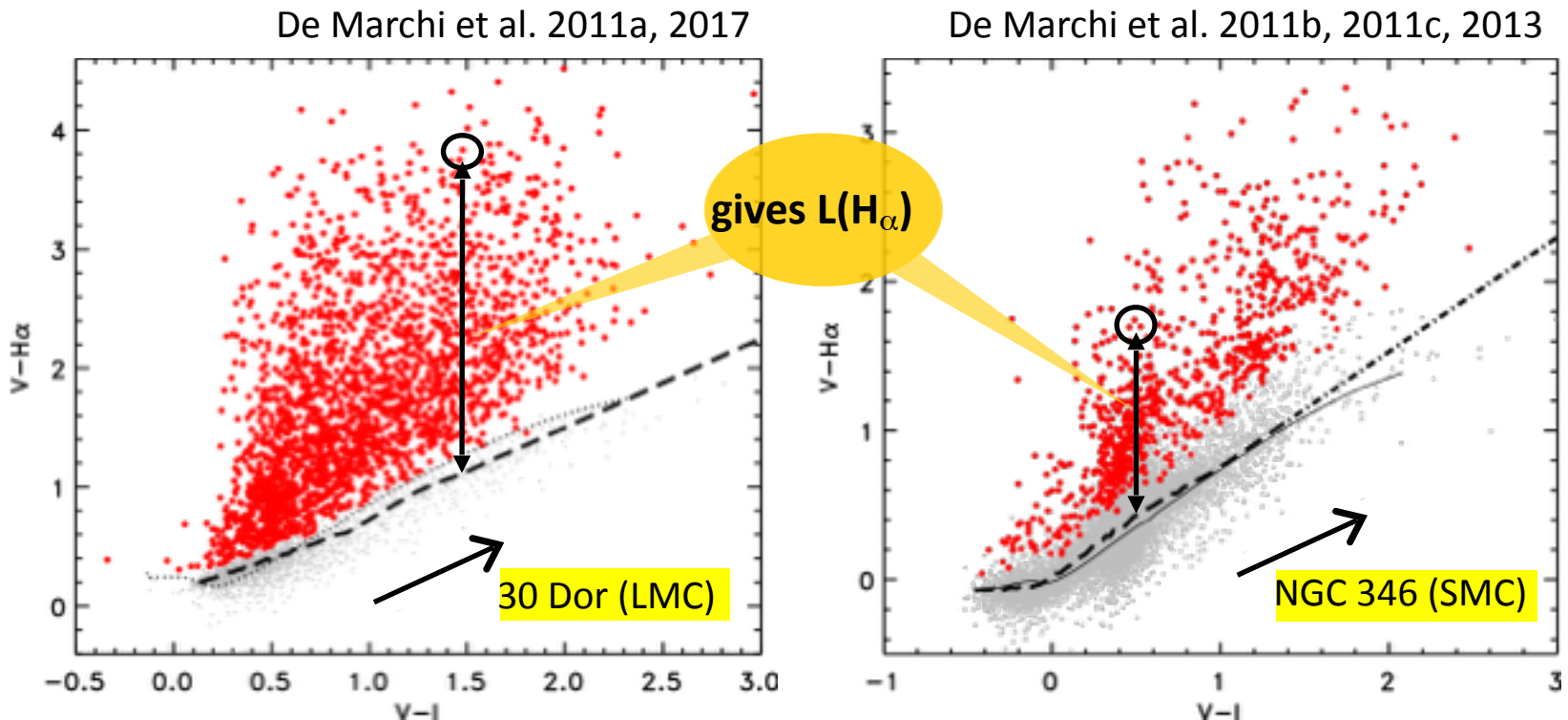
A matter of age…
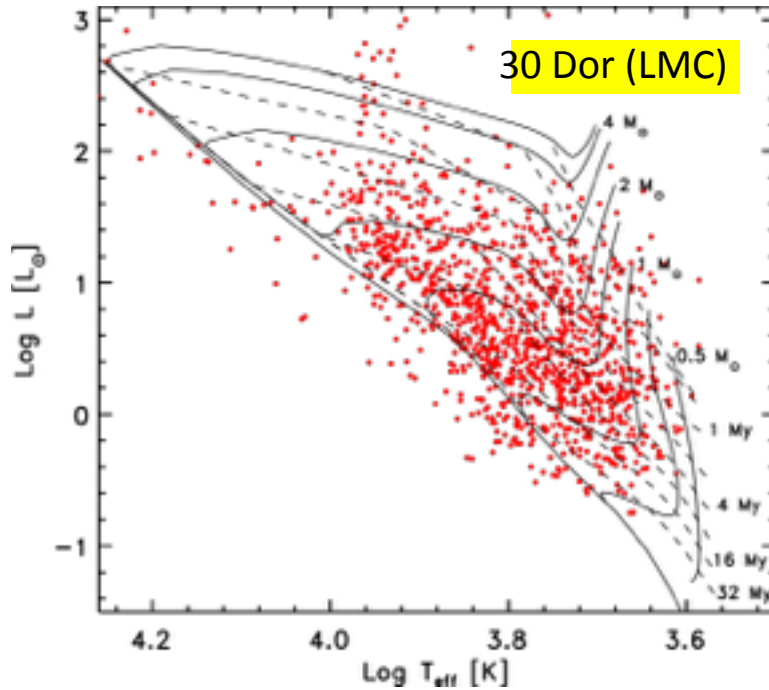
De Marchi et al. 2011a, 2017 · De Marchi et al. 2011b, 2013

30 Dor (LMC)

NGC 346 (SMC)

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
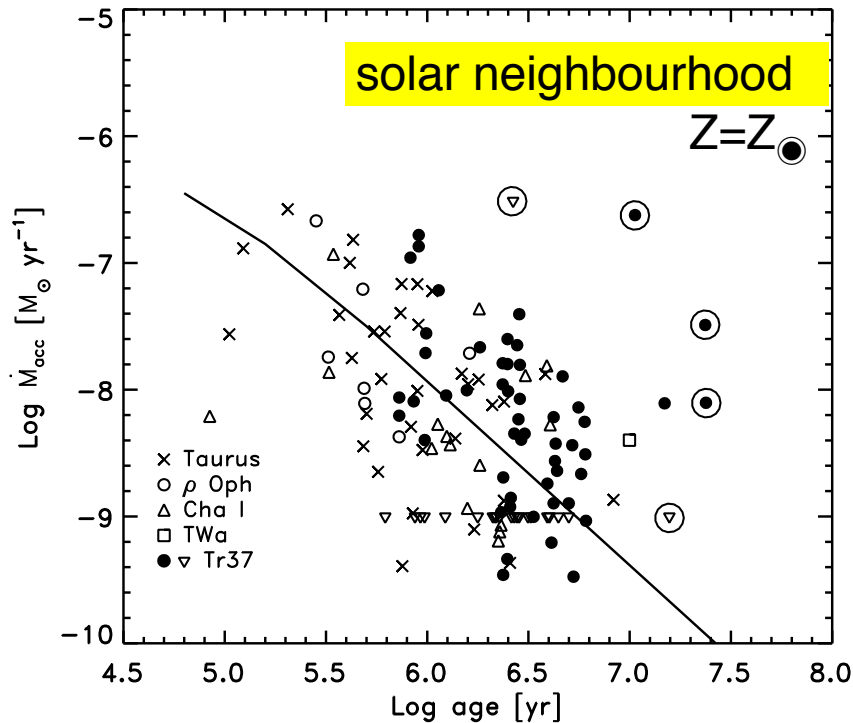
De Marchi et al. 2011a; 2017
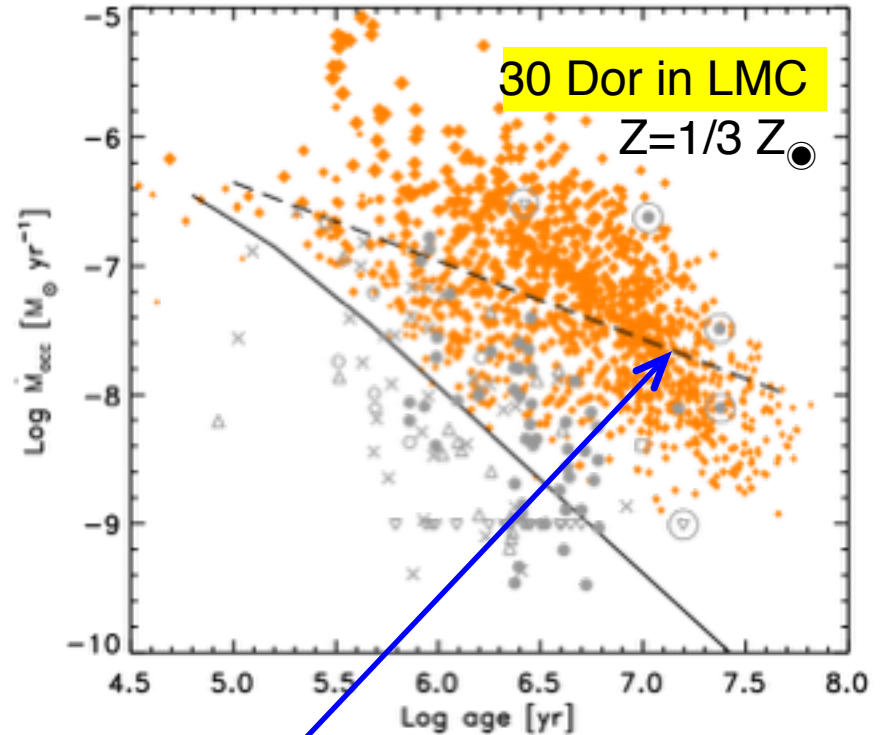
Not only are there many older PMS stars still actively accreting, but at low metallicity they appear to accrete more and for a longer time. So circumstellar discs live longer. Did more planets form at high redshift?

Target regions
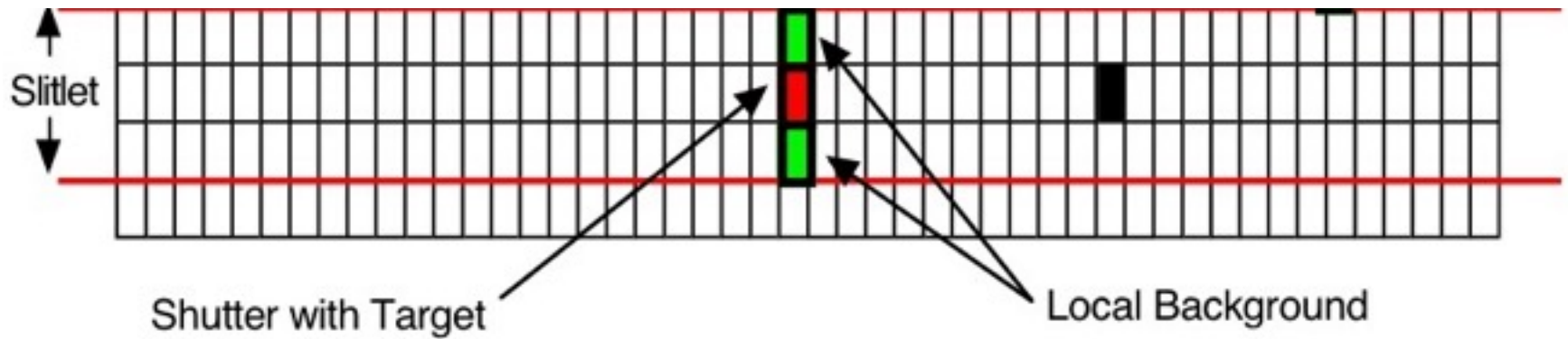
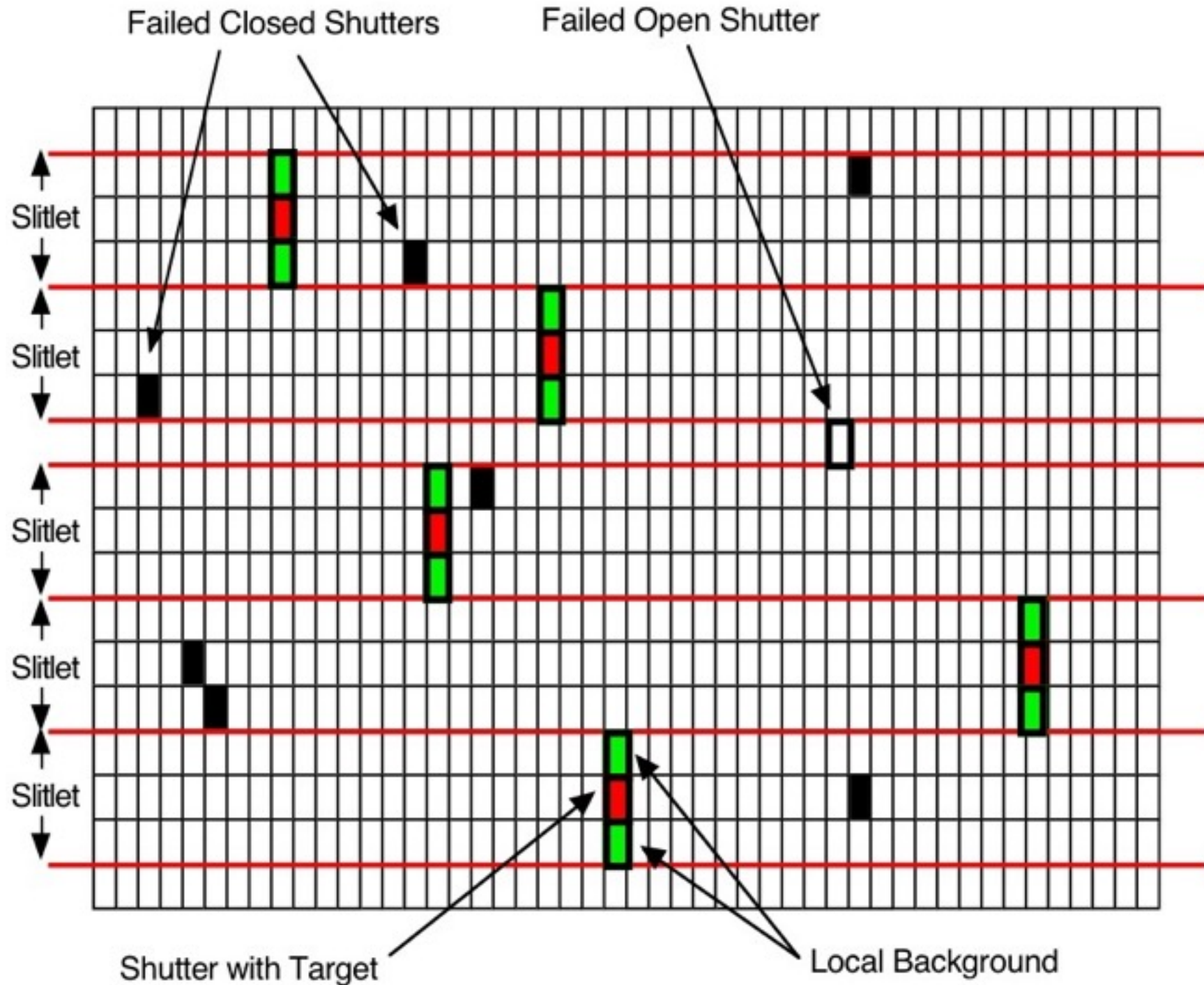NGC 3603 (MW)   30 Dor (LMC)   NGC 346 (SMC)

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

HST astrometry for all, no pre-imaging needed

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

Fitting targets in microshutters

Failed Closed Shutters

Failed Open Shutter

Slitlet

Slitlet

Slitlet

Slitlet

Slitlet

Shutter with Target

Local Background
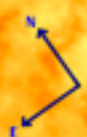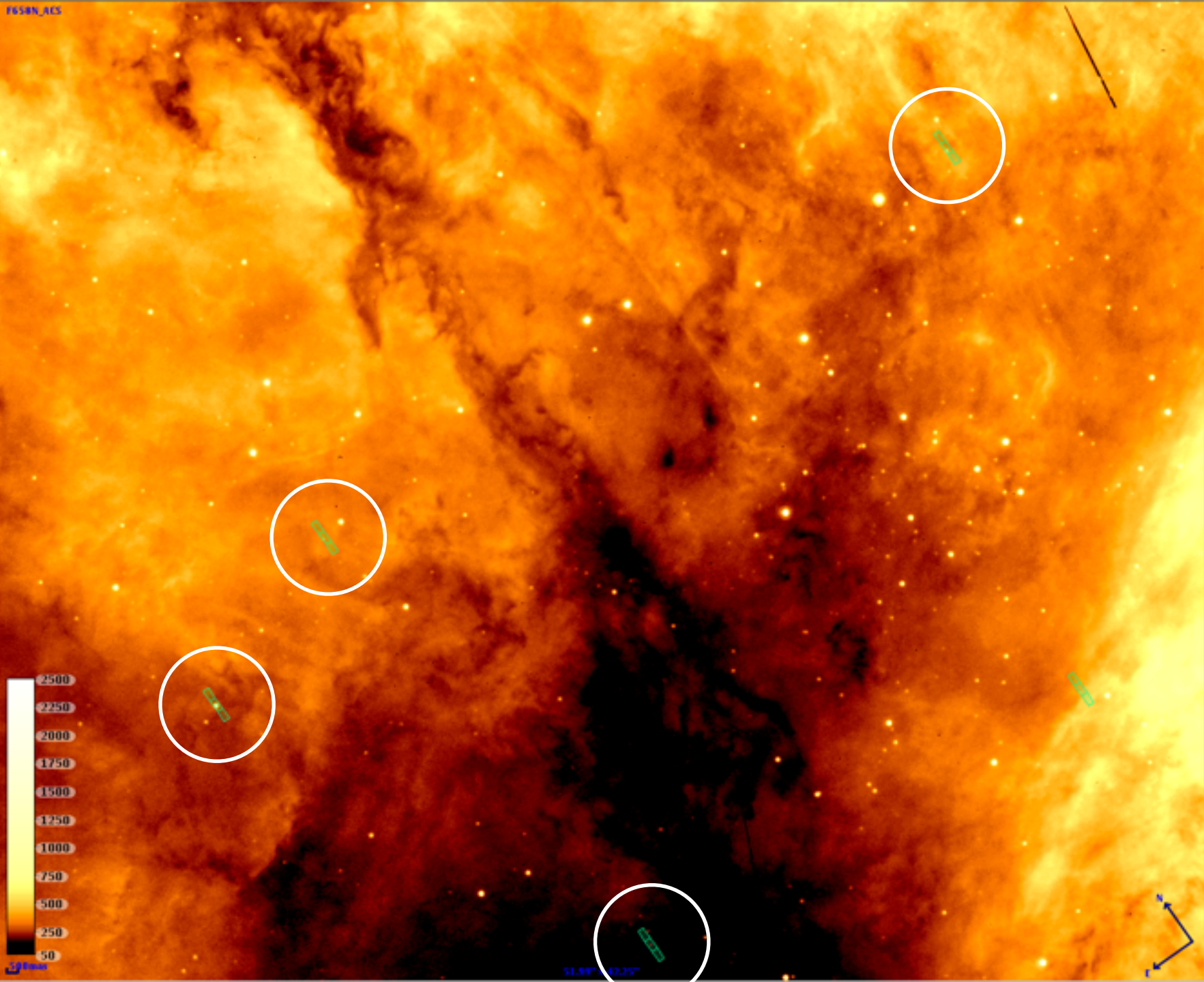
Playing with MSA planning tool

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
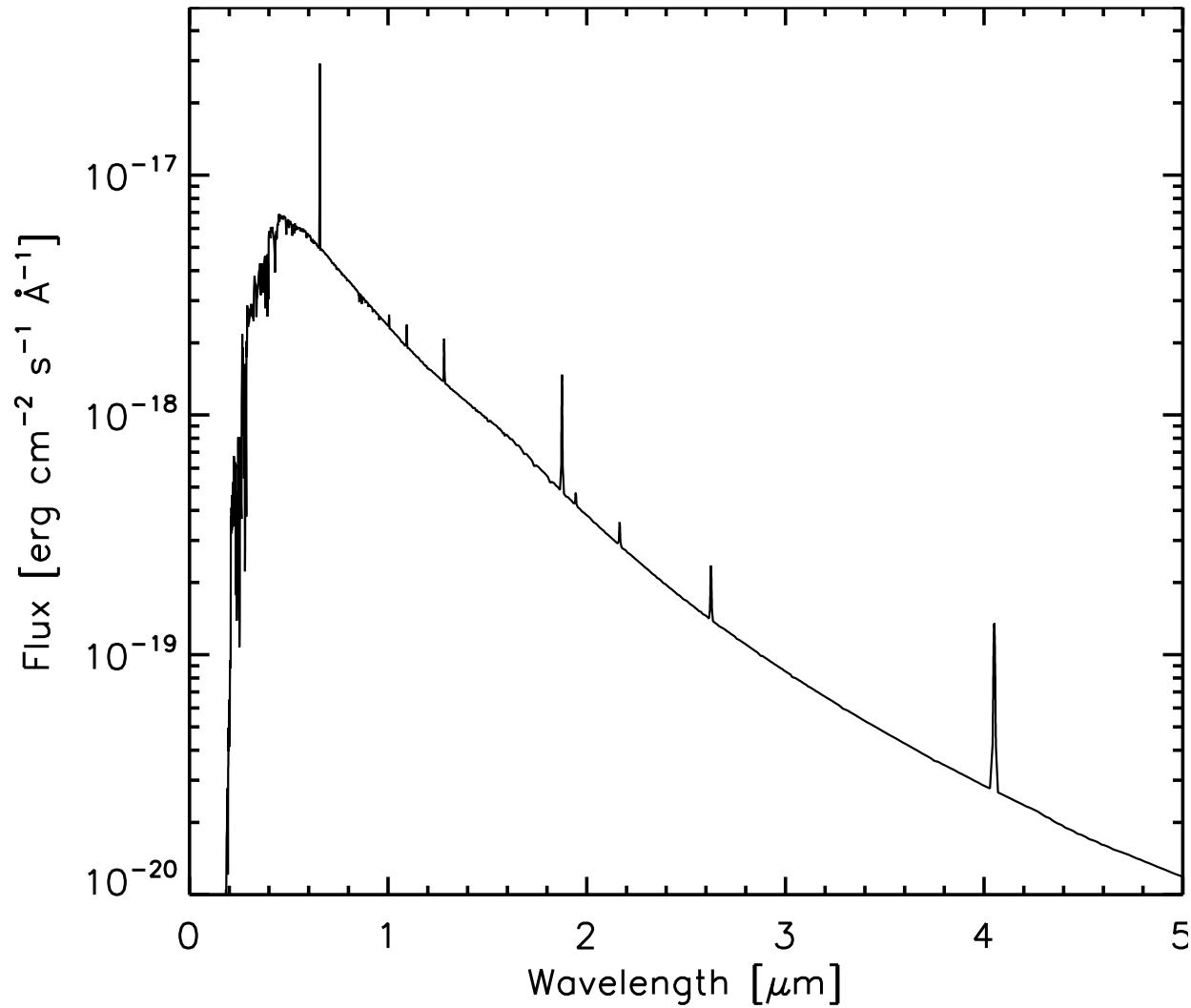
Observations: spectral range
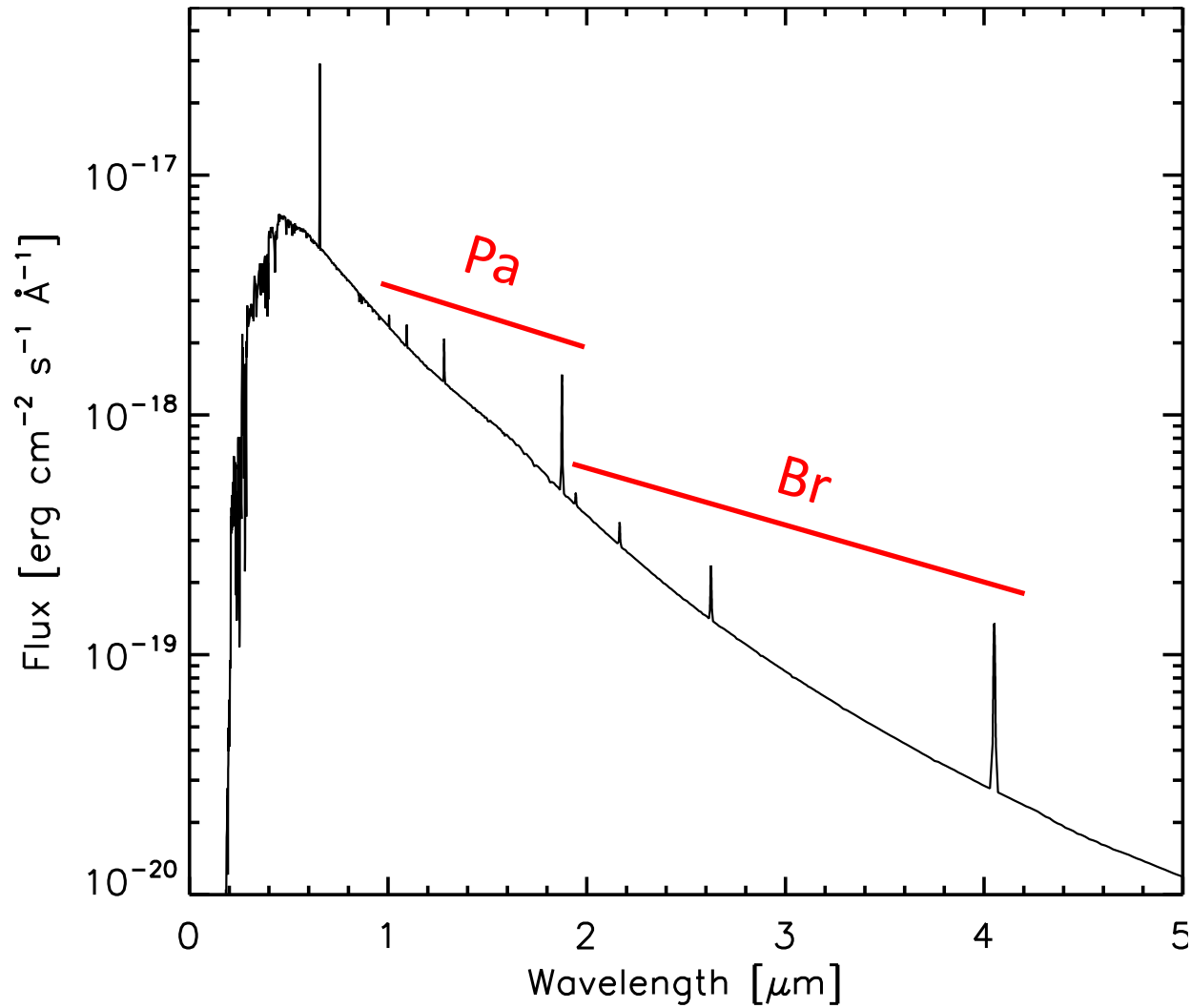
Observations: spectral range
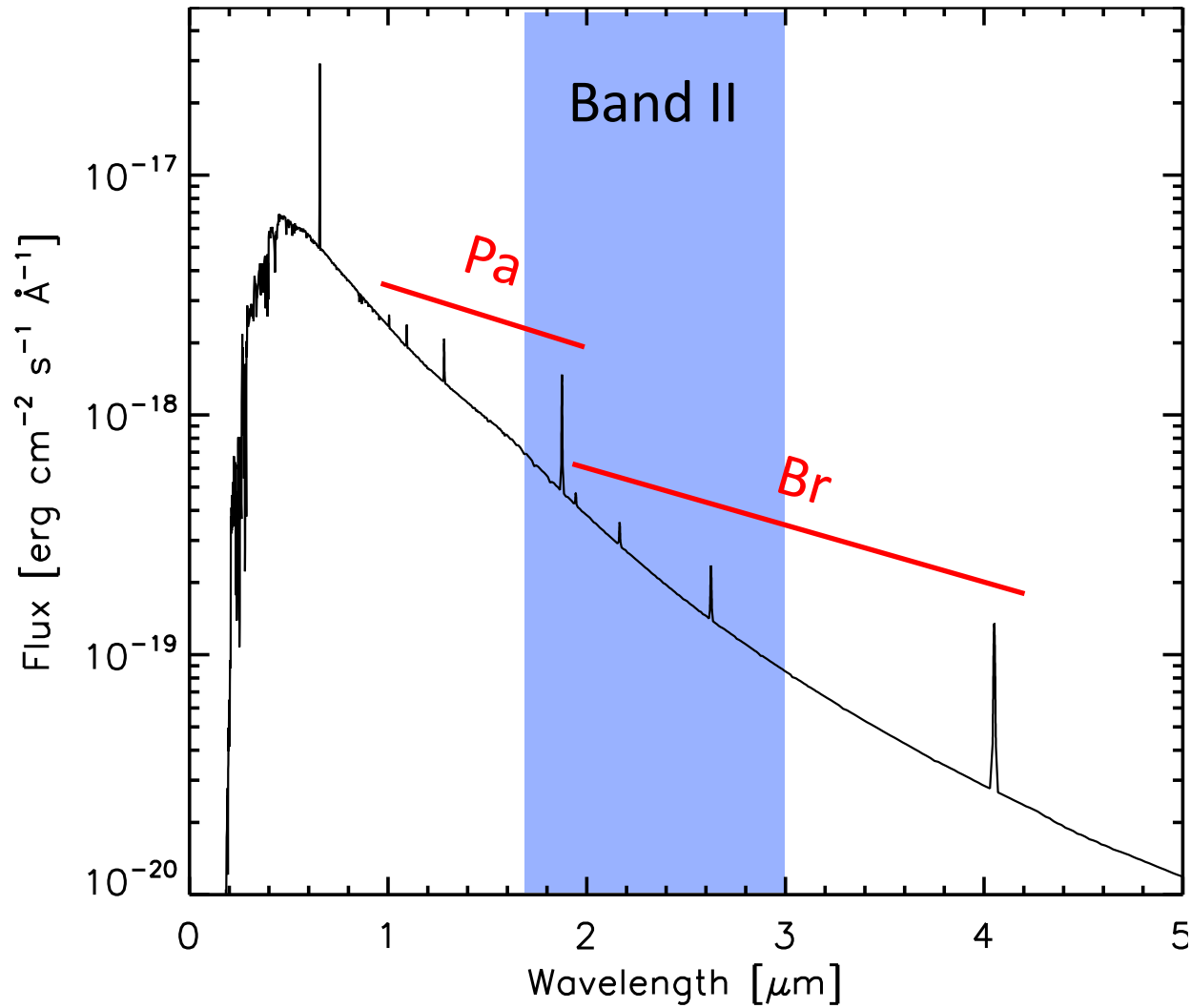
Observations: spectral features
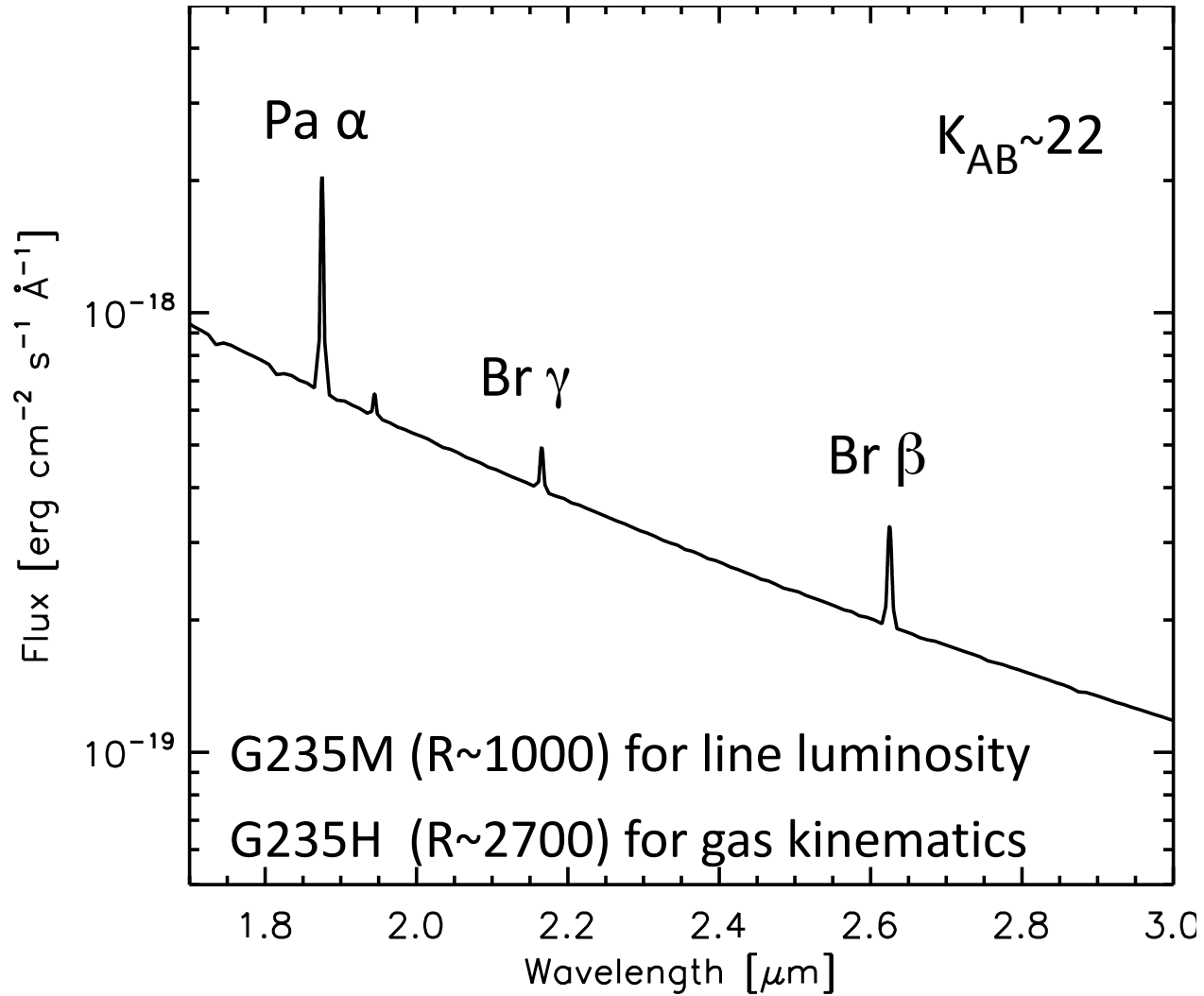
Pa α

Br γ

Br β

$K_{AB} \sim 22$

Flux [erg cm^{-2} s^{-1} Å^{-1}]

10^{-18}

10^{-19}

G235M (R~1000) for line luminosity

G235H (R~2700) for gas kinematics

Wavelength [μm]

Simulated spectra on detectors

In the G235M/F170LP mode all wavelengths above 1.7 µm are recorded. First order is left half of spectrum. Also zeroth and second orders visible.
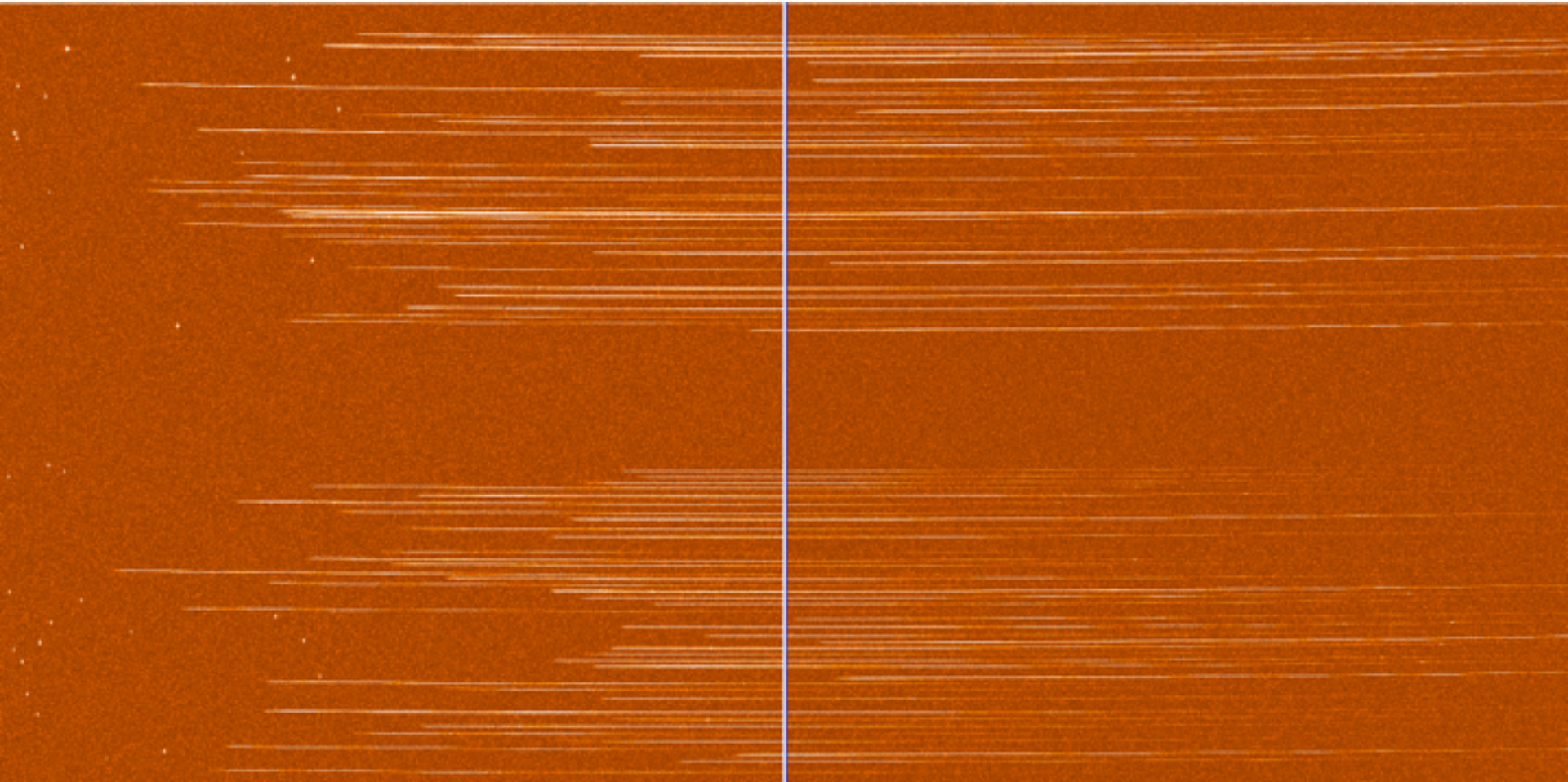
Simulated spectra on detectors

In the G235M/F170LP mode all wavelengths above 1.7 μm are recorded. First order is left half of spectrum. Also zeroth and second orders visible.
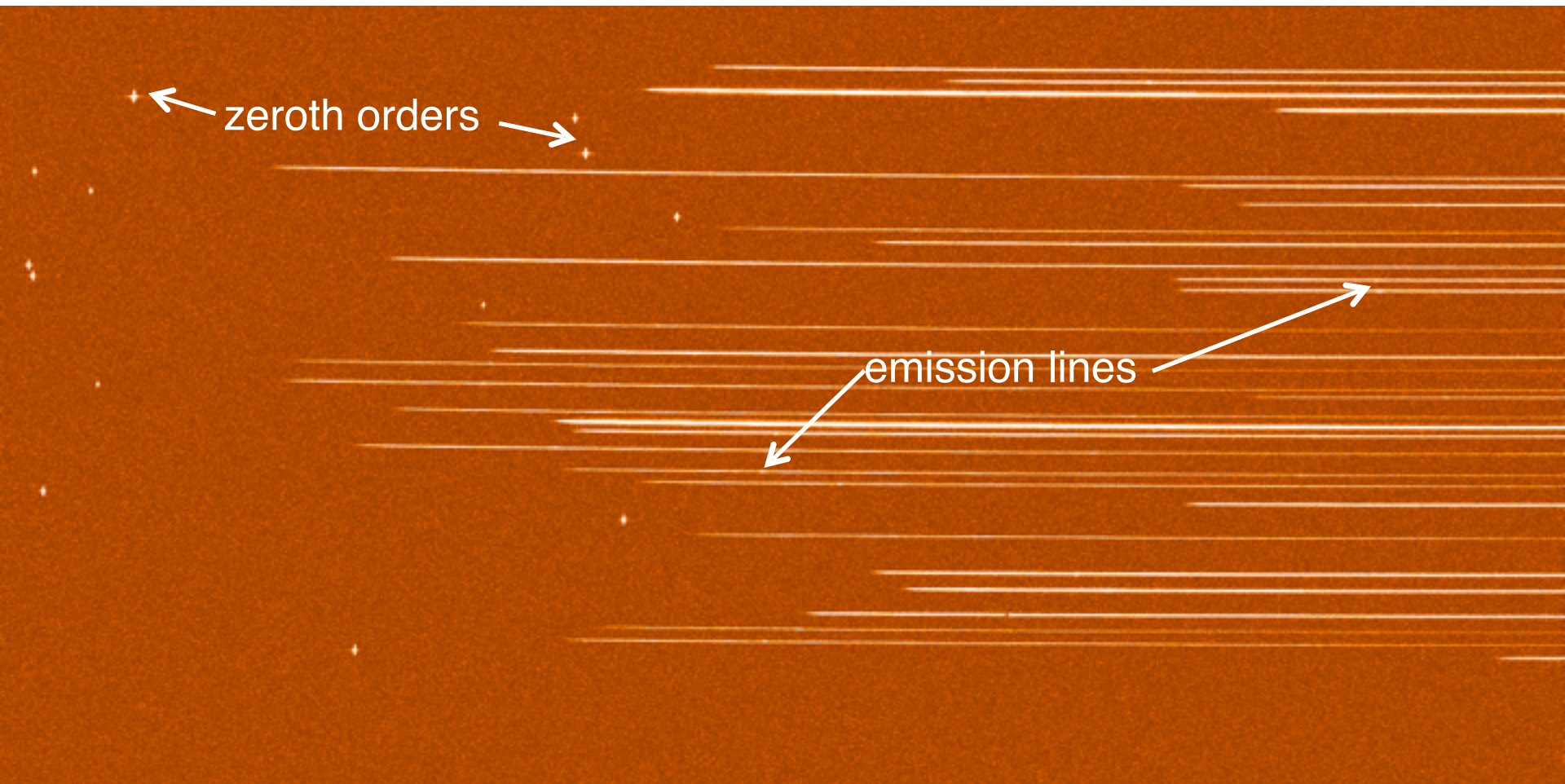
Extracted spectrum R~1000
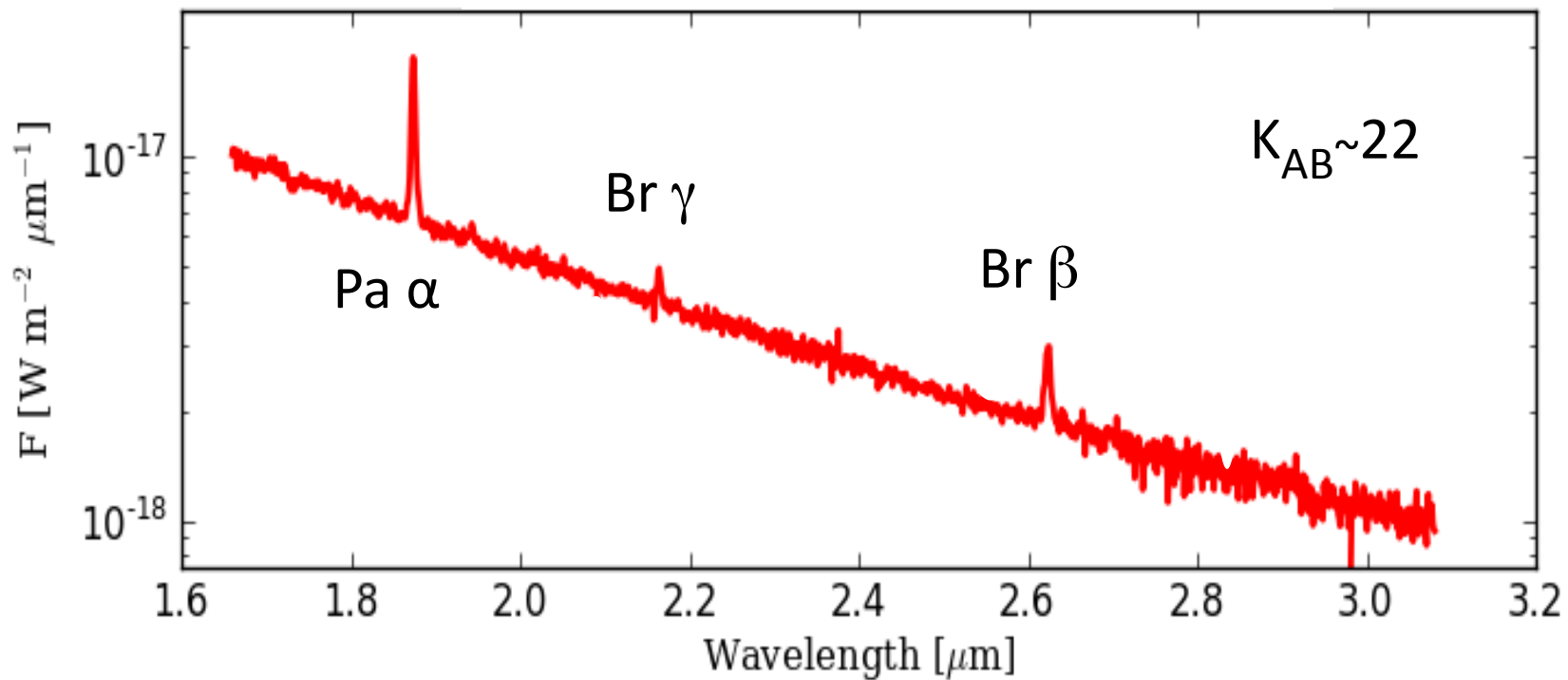
sky.esa.int

Coordinated parallels

NIRCam will cover fields about 7.5 arcmin from NIRSpec, 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 Hα photometry.
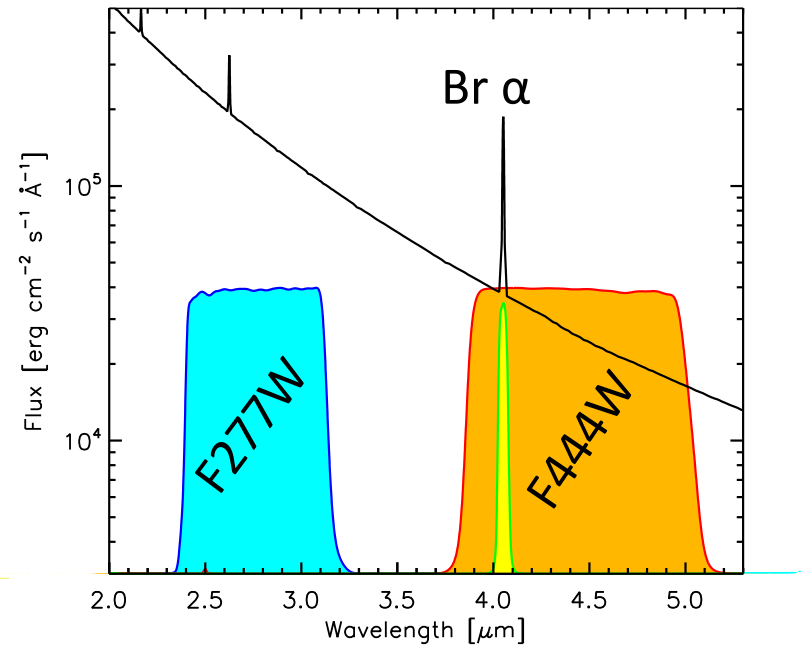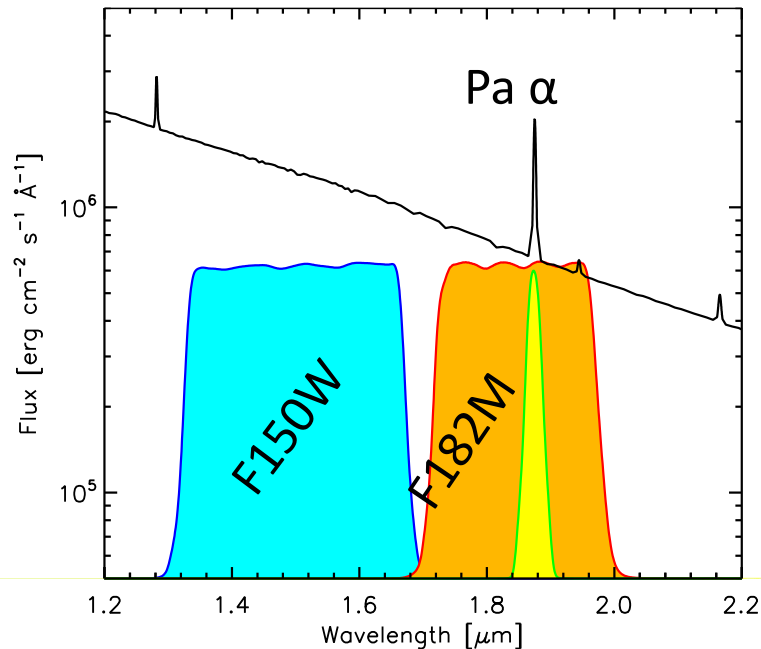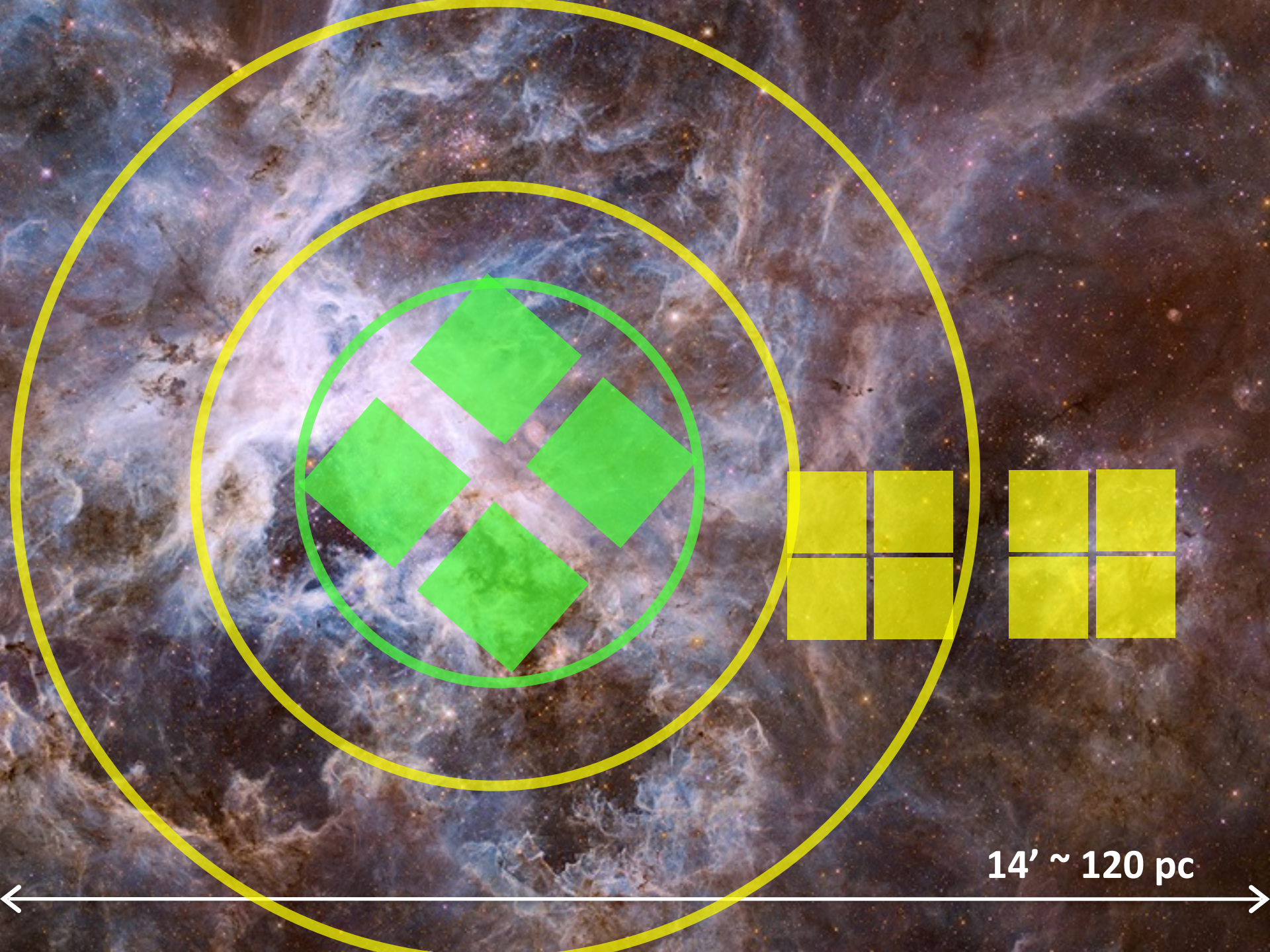
14' ~ 120 pc

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.

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Paper (2010)

...metric determination of ...thod and application to the ...

Guido De Marchi (ESA), Nino Panagia (S...

We have developed and successfully tes...
(PMS) objects actively undergoing mass...
method does not require spectroscopy a...
imaging to: (1) identify all stars with ex...
Hα emission equivalent width; (4) deriv...
mass accretion rate M_acc from L_acc a...
photometric accuracy in Hα better than...

james webb space telescope   esa

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THE JAMES WEBB SPACE TELESCOPE
Welcome to ESA's website for JWST's scientific community

MISSION STATUS:
Launch in October 2018

EVENTS:
...24 March 2017 in Venice, Italy
...with the Hubble and James Webb space telescopes V

...October 2017 in ESAC, Spain
ESAC 2017 JWST workshop - Planning your JWST observations - [GET SET]

IMAGE OF THE MONTH:

The primary mirror of JWST is being carefully inspected before the start of the acoustic and vibration tests that the telescope together with the scientific instruments will undergo in the coming months.

cosmos.esa.int/jwst

...R SPEC

JWST/NIRSPEC

GTO
PROGRAM

5 January 2017