

A night sky filled with stars and a faint comet, with a modern building in the foreground.

Observing comets with BlueMUSE

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Aurélie Guilbert-Lepoutre

(1) The University of Edinburgh

BlueMUSE Science meeting, 24 April 2024



Observing (interstellar) comets with BlueMUSE

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Comets are remnants of the early Solar System

Studying comets is studying the history of the Solar System

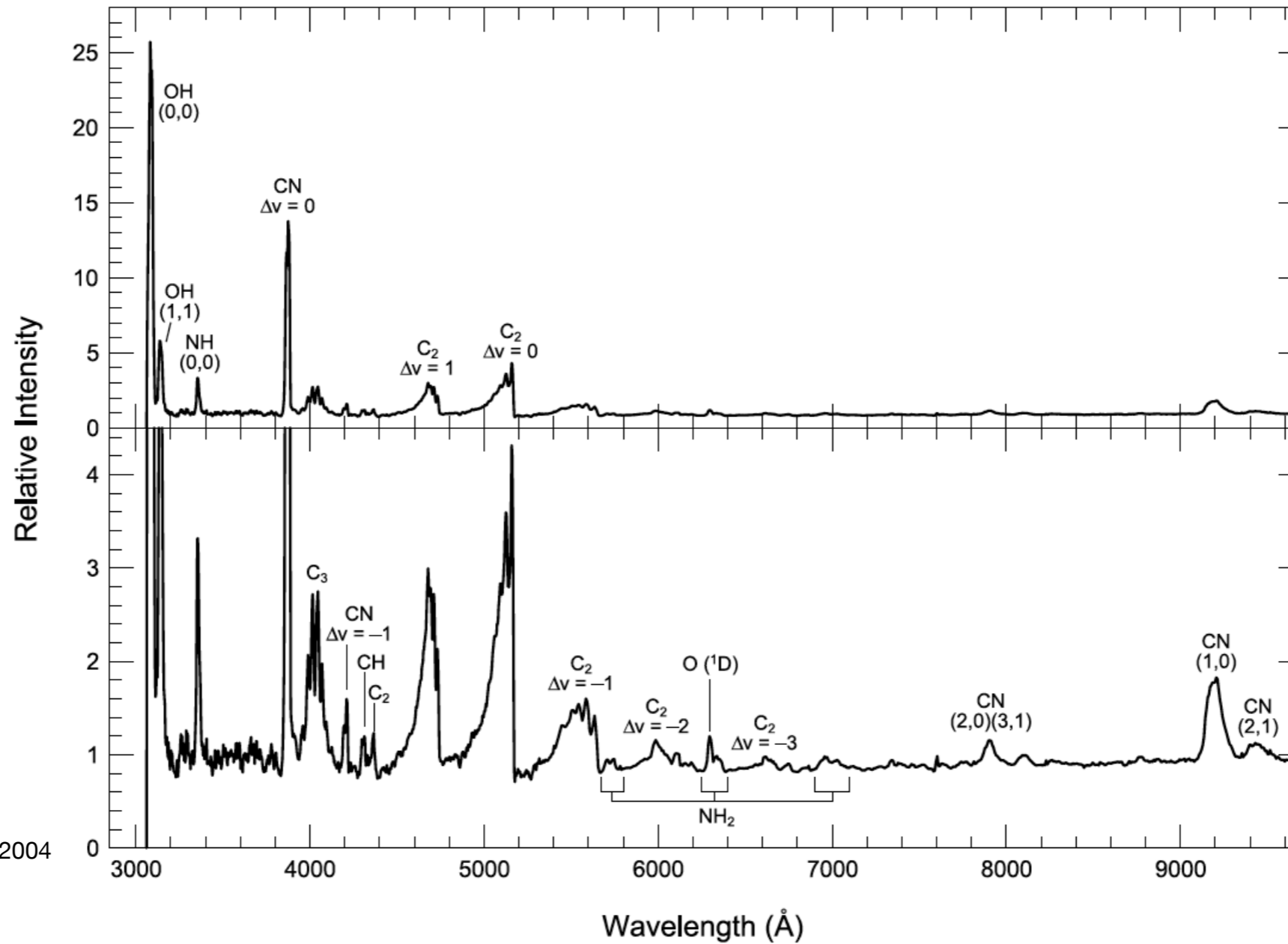
Interstellar comets are particularly interesting as they allow us to probe the composition of other planetary systems

COMETS ARE EXTENDED AND VARIABLE OBJECTS



IFUS ARE IDEAL TO OBSERVE COMETS

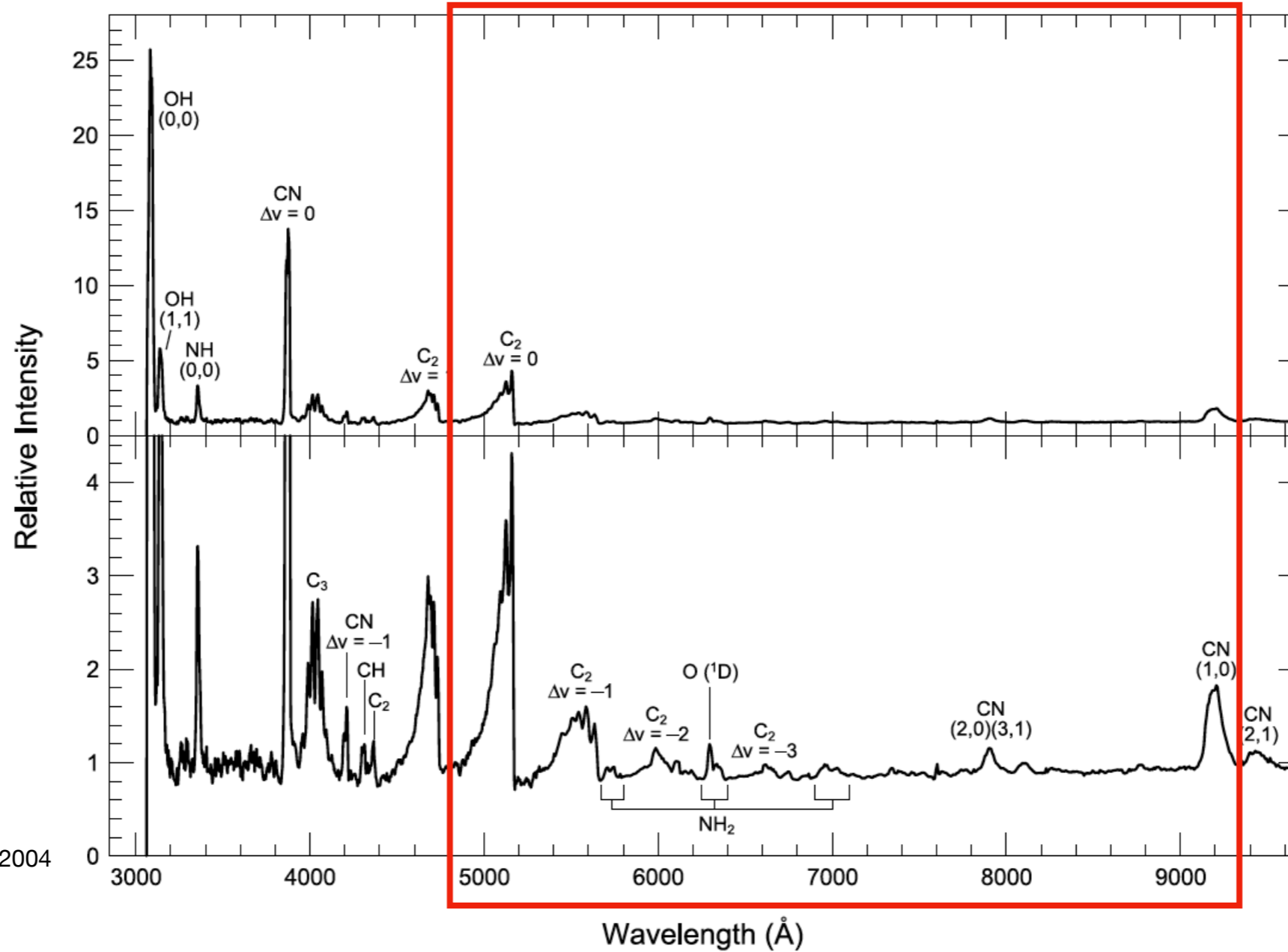
COMETS AT OPTICAL WAVELENGTHS



Feldman et al., 2004

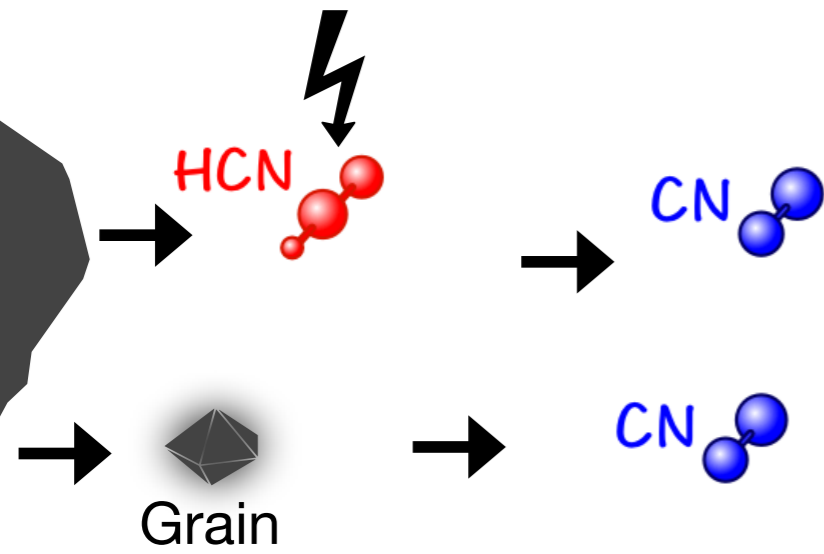
COMETS AT OPTICAL WAVELENGTHS

MUSE

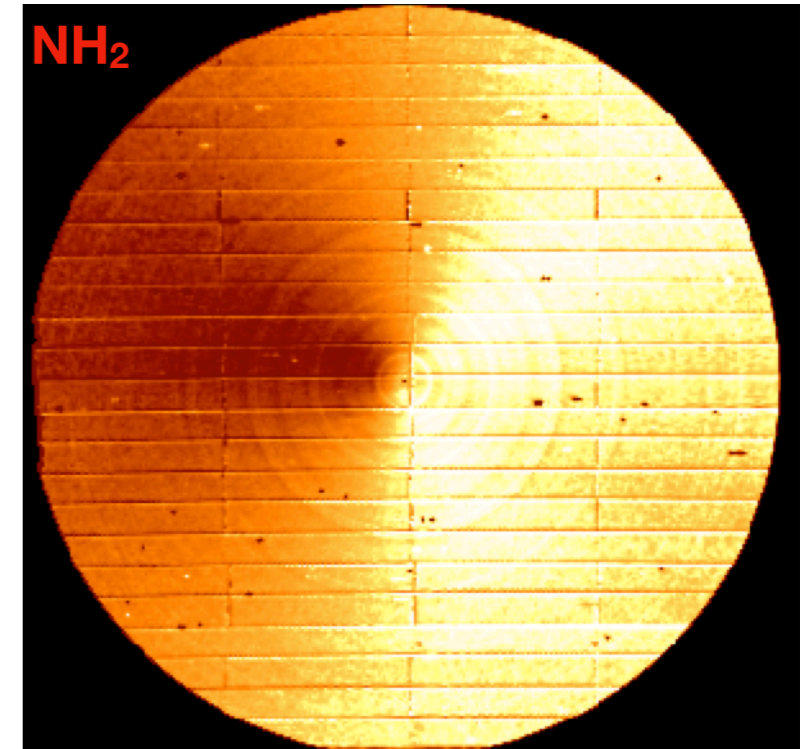
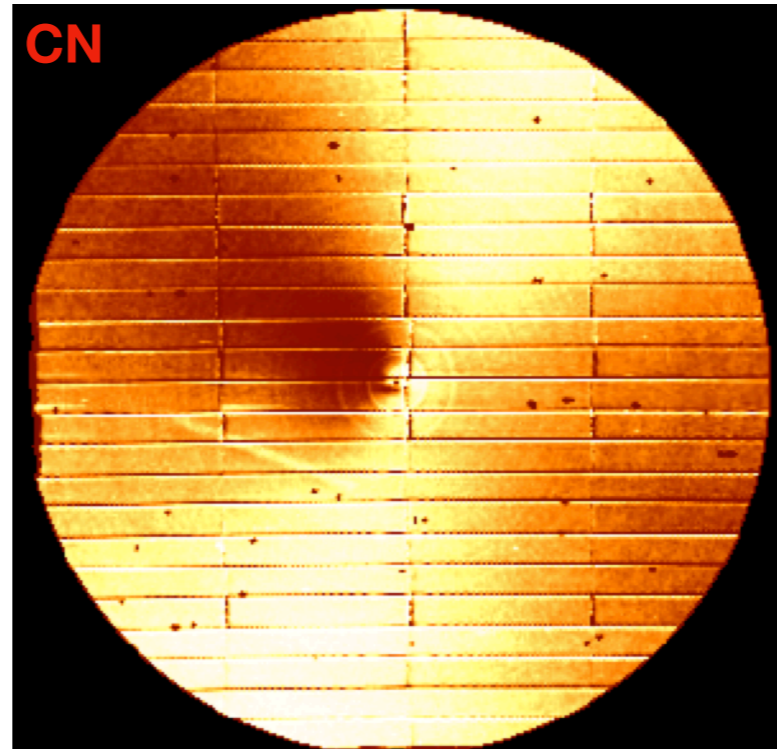
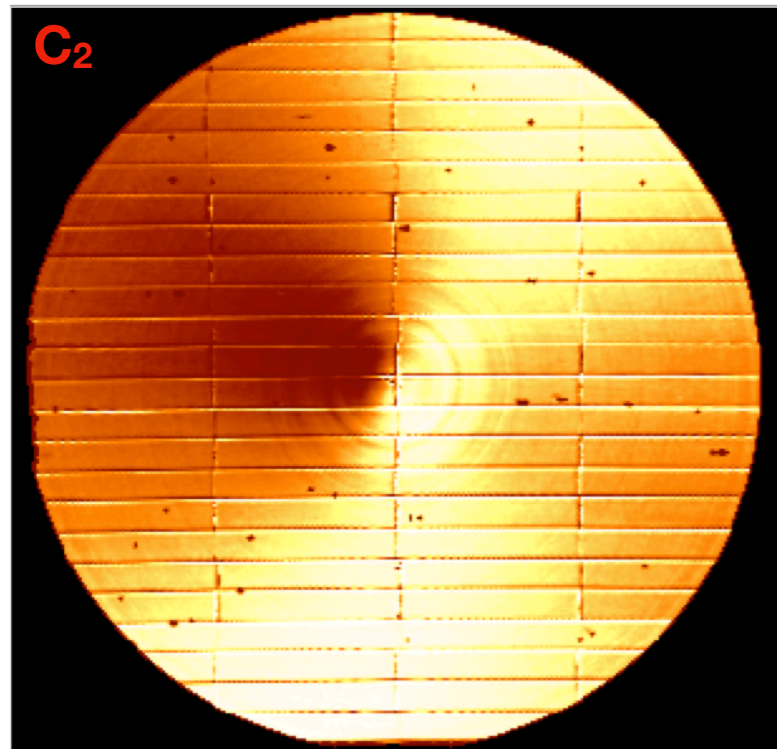


Feldman et al., 2004

COMETS WITH MUSE



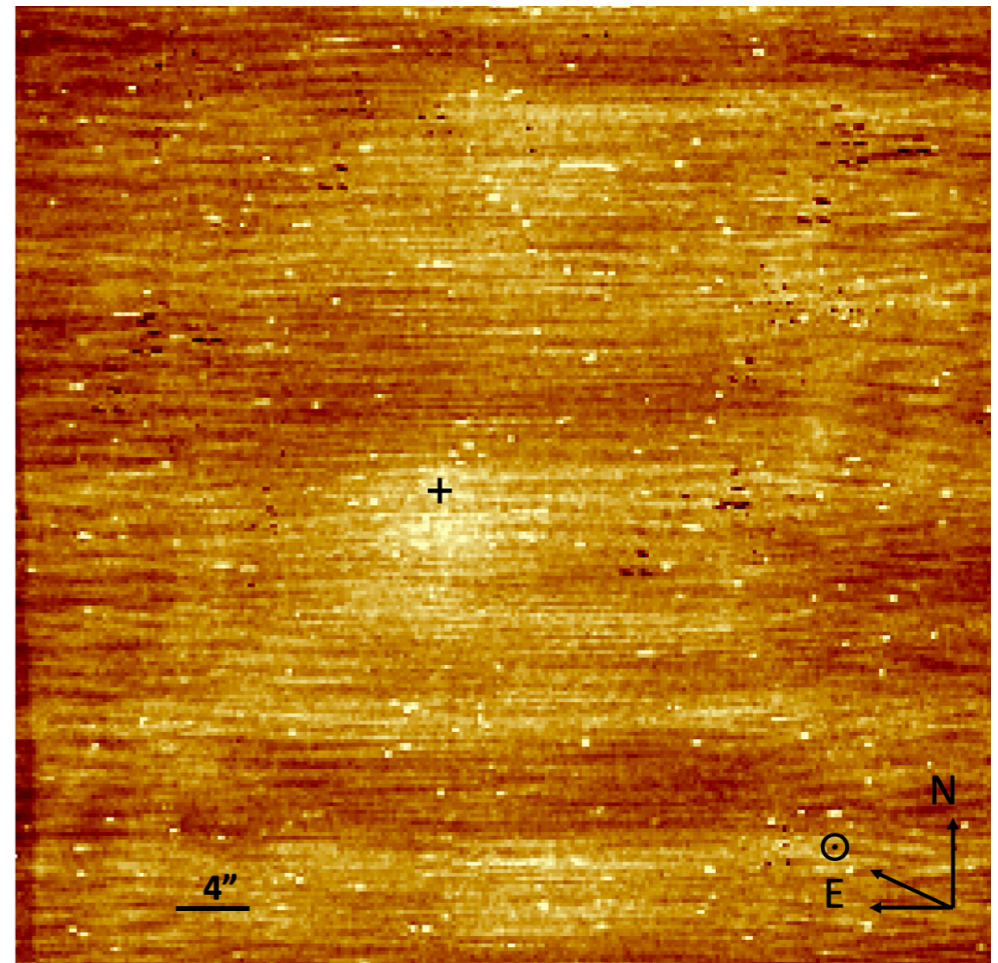
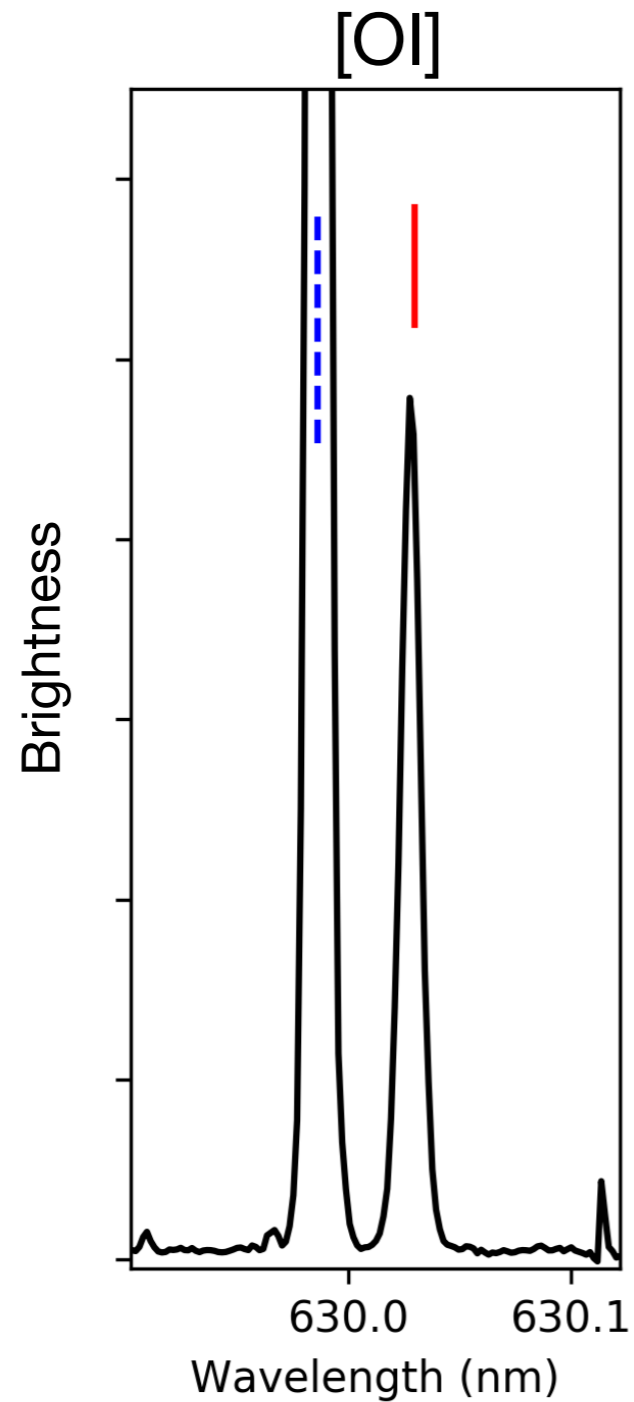
Investigating the origin of species in the coma



Opitom et al., 2019

COMETS WITH MUSE

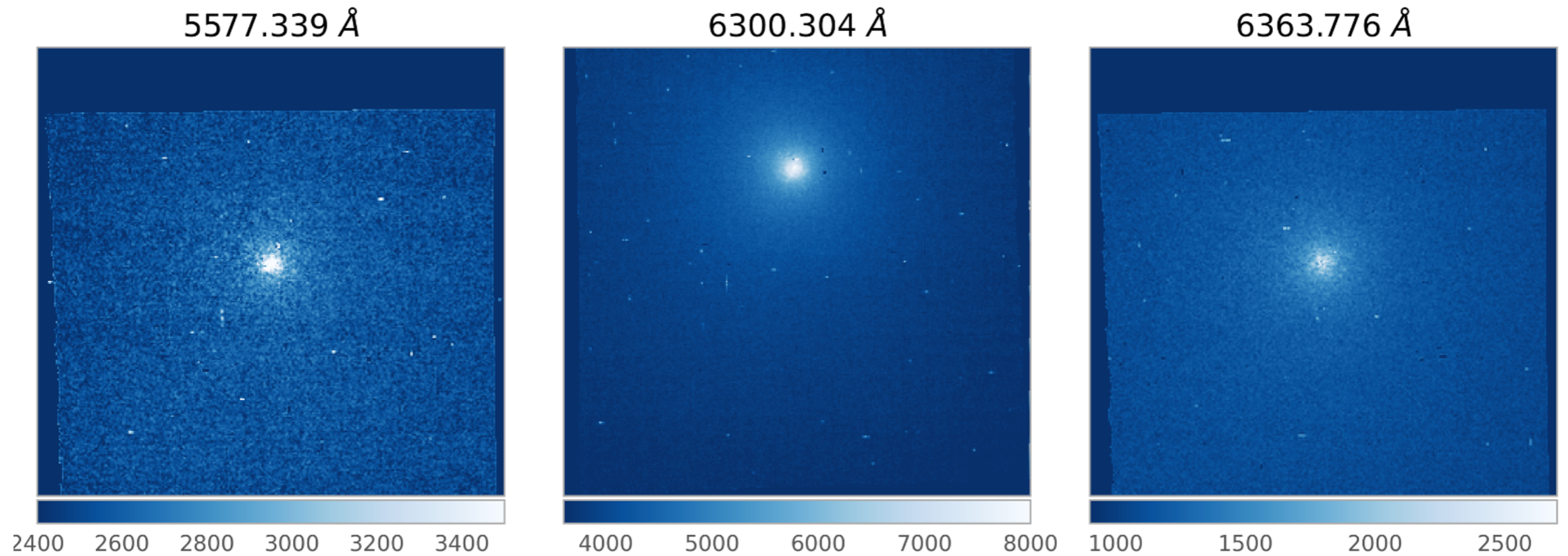
Detect faint level of activity in (interstellar) comets



Opitom et al., 2020

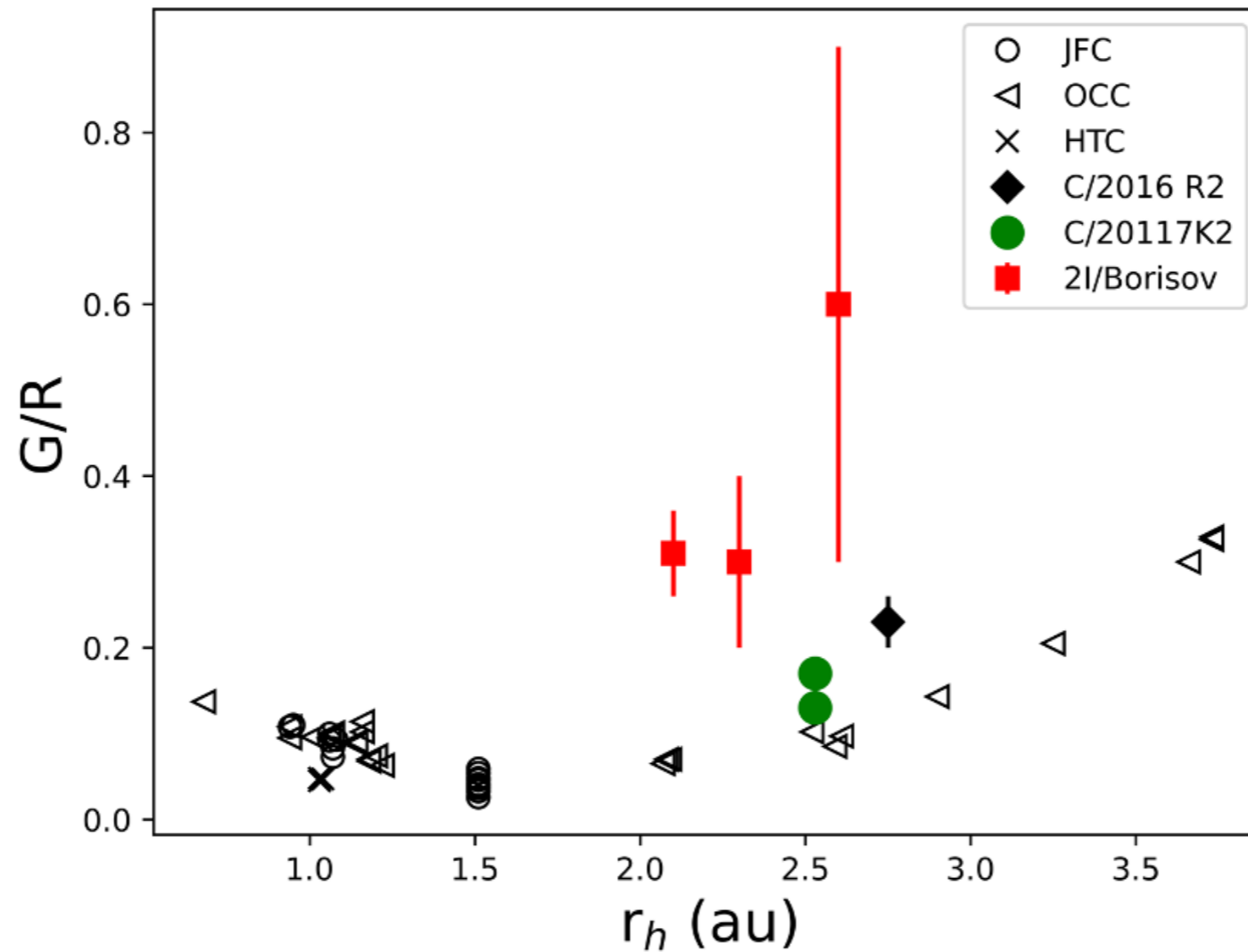
COMETS WITH MUSE

And determine the drivers of the activity using 3 forbidden oxygen lines



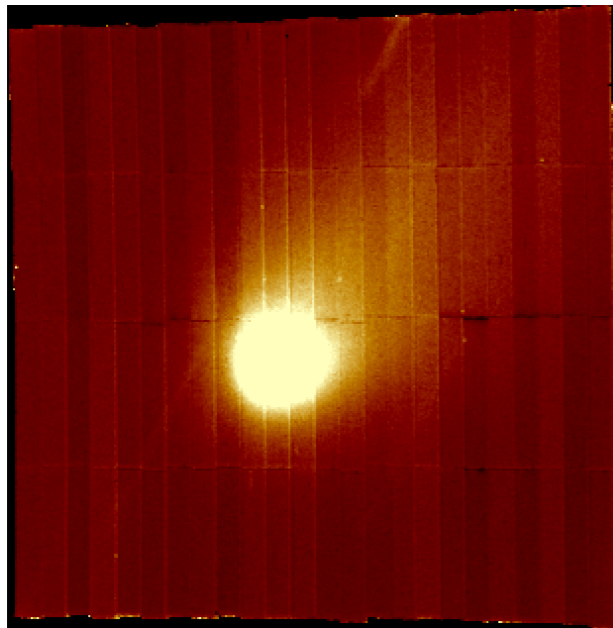
COMETS WITH MUSE

And determine the drivers of the activity using 3 forbidden oxygen lines

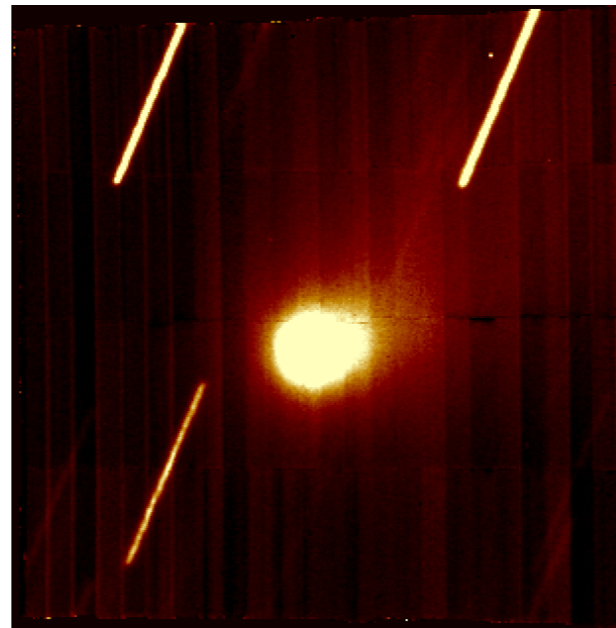


COMETS WITH MUSE

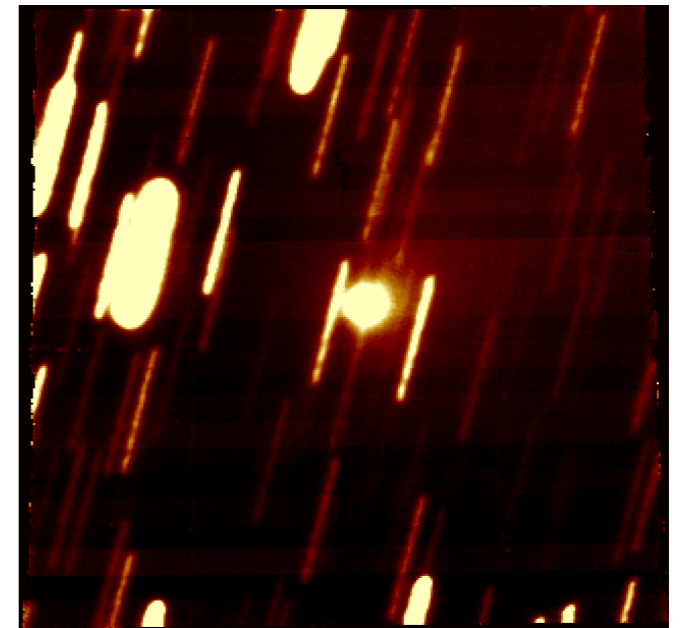
Follow-up the composition of (interstellar) comets



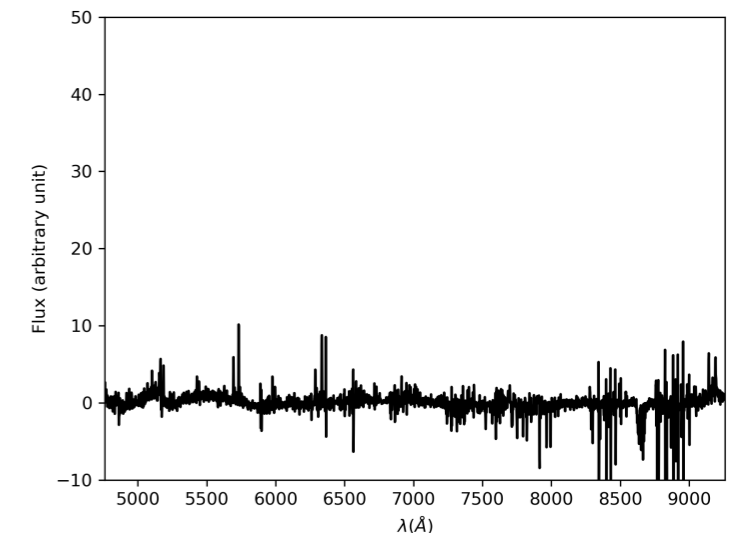
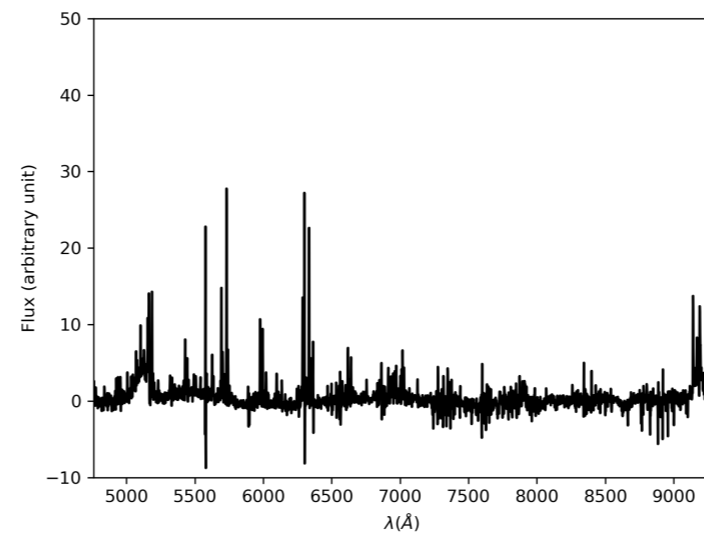
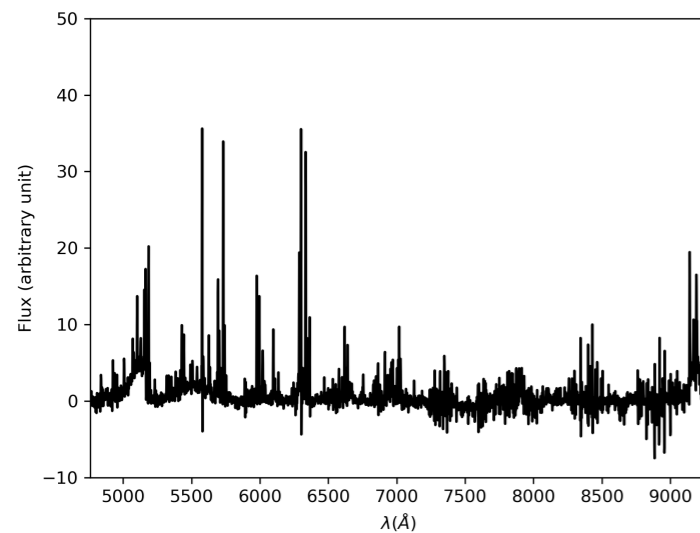
06/12/2019: $r_h=2.0$ au, $\Delta = 2.0$ au



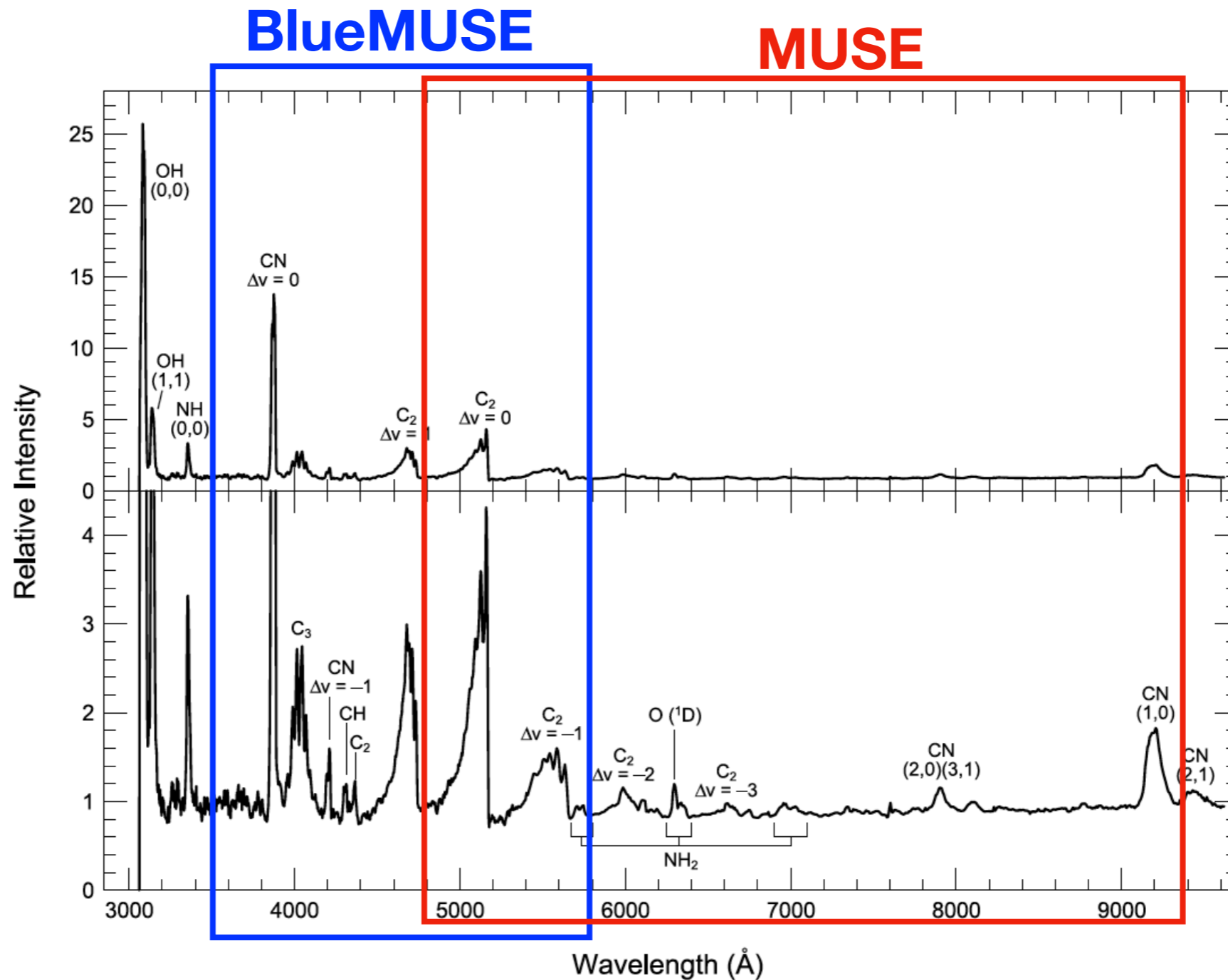
31/12/2019: $r_h=2.1$ au, $\Delta = 1.9$ au



02/02/2020: $r_h=2.4$ au, $\Delta = 2.1$ au



COMETS WITH BlueMUSE

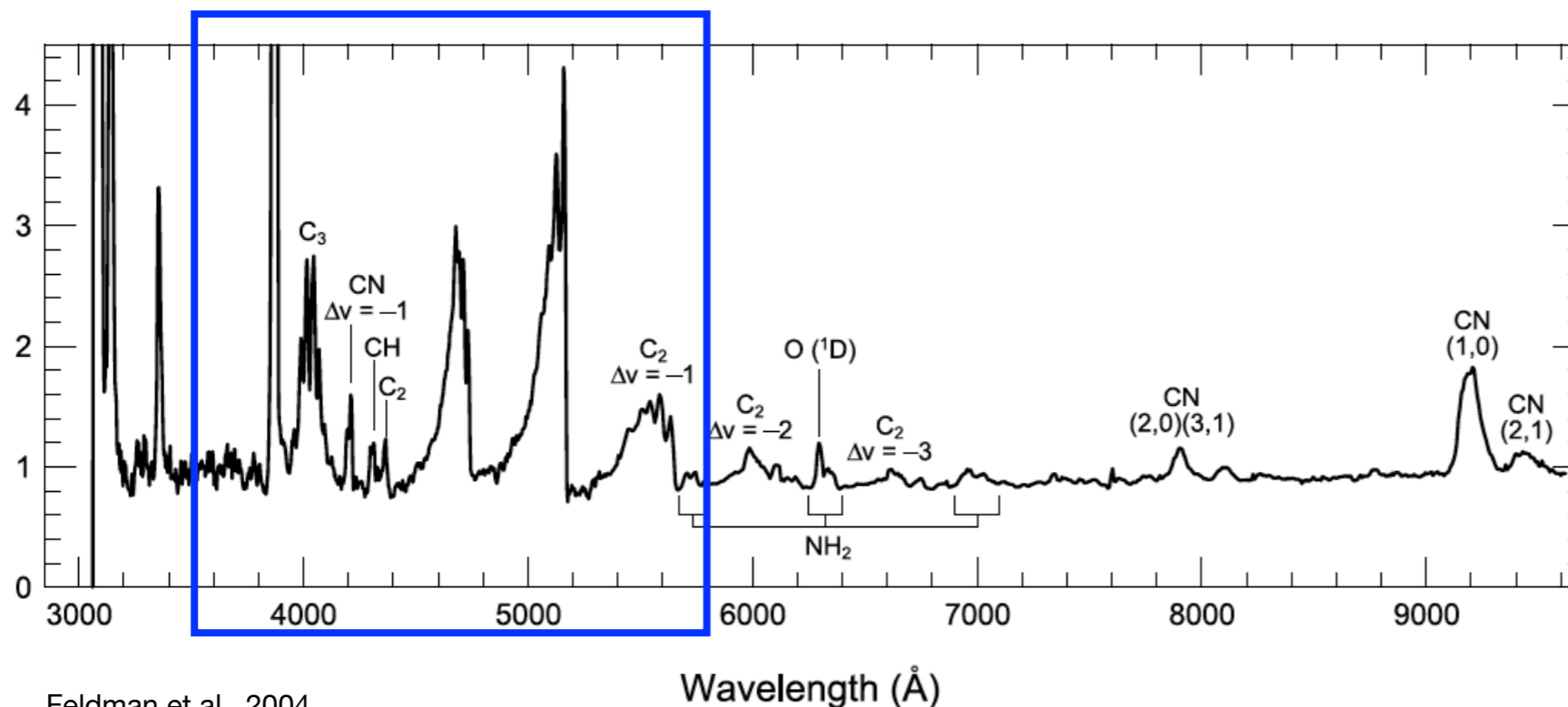


Feldman et al., 2004

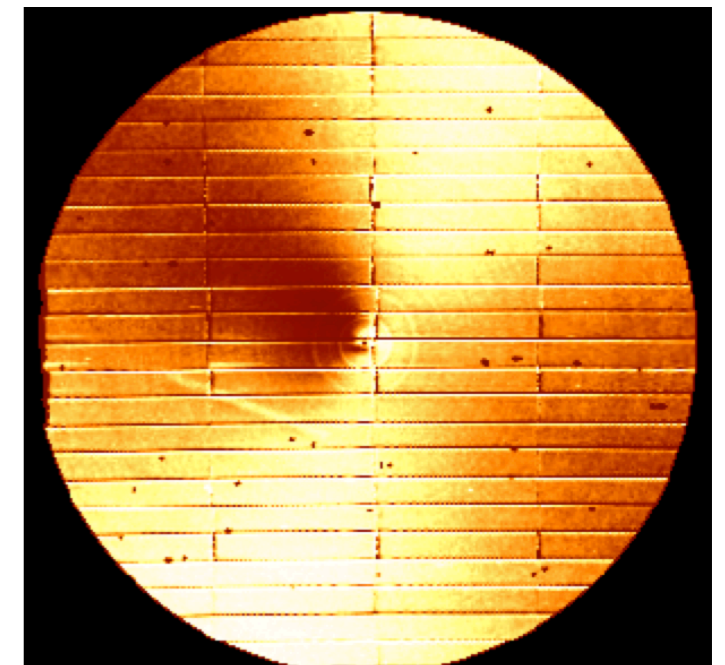
Access to blue CN system, C₃, and CH in addition to C₂ and NH₂

COMETS WITH BlueMUSE

- Study the species parentage for fainter comets and for a larger number of species (CN, C₃, CH, C₂, and NH₂)
- Use the blue CN $\Delta\nu=0$ line to detect activity in fainter comets
- Bright comets are very extended -> study larger scales in the coma

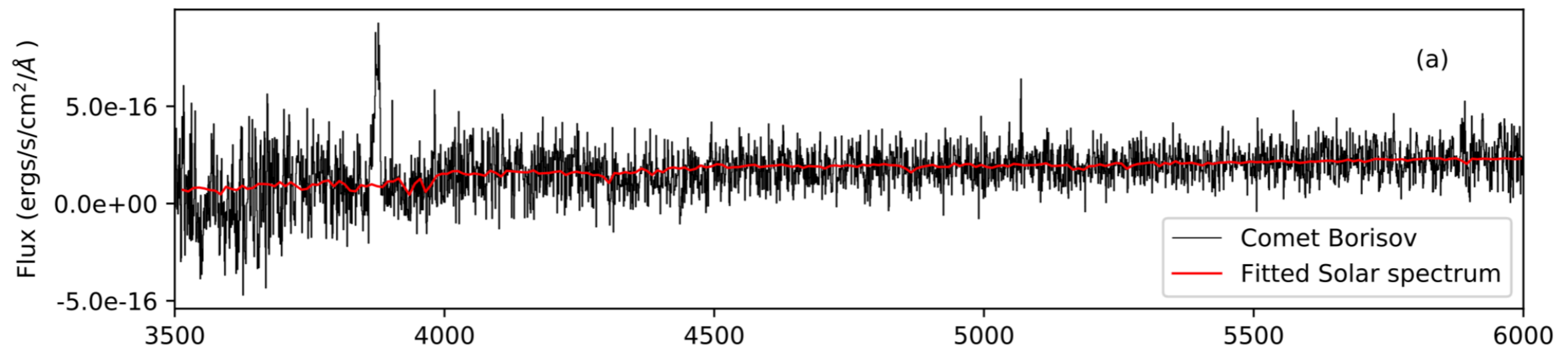


Feldman et al., 2004



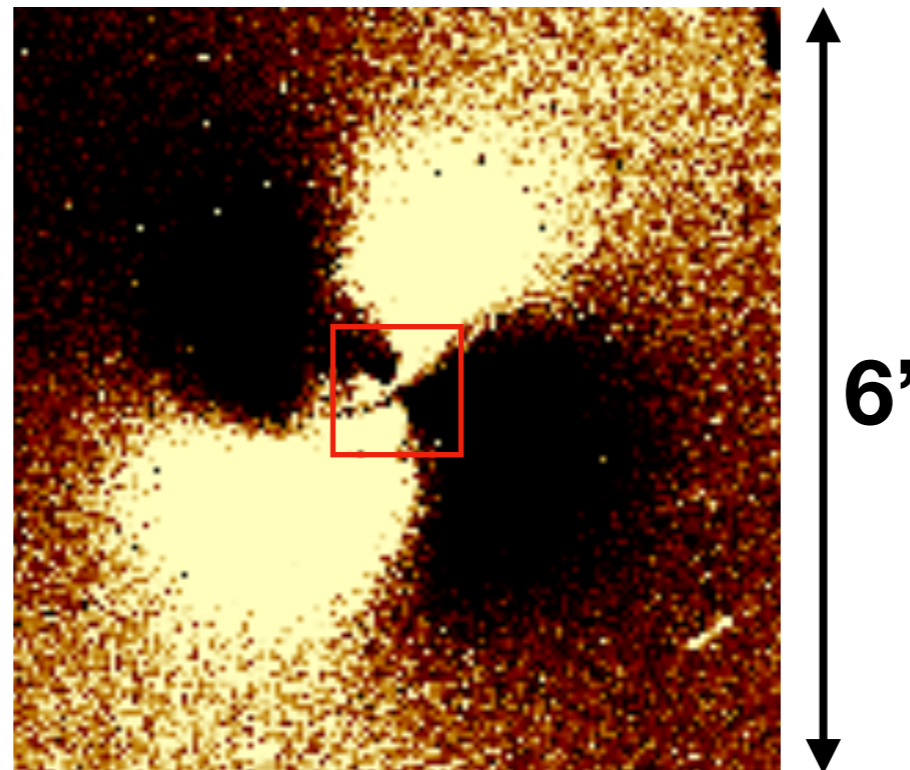
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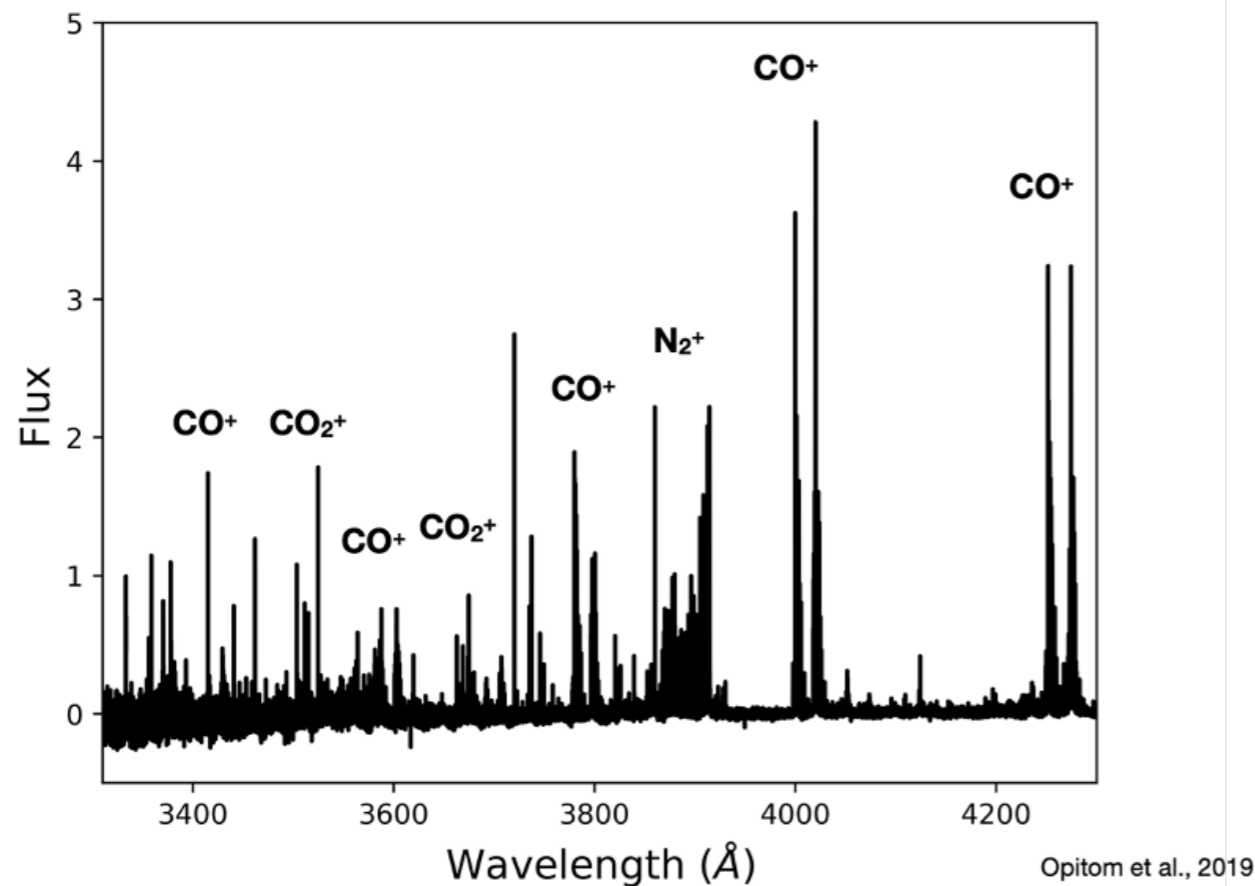


Opitom et al., 2016

COMETS WITH BlueMUSE

- Measure the N_2/CO ratio in the coma of comets

Spectrum of comet C/2016 R2 with UVES



- Several ions in the 3800-4300 Å range (CO^+ , N_2^+)
- CO and N_2 are difficult to detect
- Those ions can be used to estimate the N_2/CO ratio in comets, which is very sensitive to formation temperatures
- CO^+ and N_2^+ bands usually faint and hard to detect. Only detected in a handful of comets.
- Potentially detected only along the tail
-> advantage of large FoV

COMETS WITH BlueMUSE

Requirements:

- Spectral resolution : >1000
- Spatial resolution: seeing limited is sufficient
- FOV: $>$ than MUSE FoV (the larger the better), object size ranges from a few arcsecond to several degrees.
- Source properties: Total V-band magnitude 6 - 18 mag (but these are extended targets)
- Exposure time goal: 22 mag/arcsec² in 1h

Conclusion

BlueMUSE will allow us to:

- ✓ Study species parentage in comets
- ✓ Study the composition and activity of distant comets or interstellar comets
- ✓ Measure the N_2/CO in a sample of (interstellar) comets

Synergies with MUSE, CUBES