Investigation of Solar System objects with WST

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Inner/outer solar system

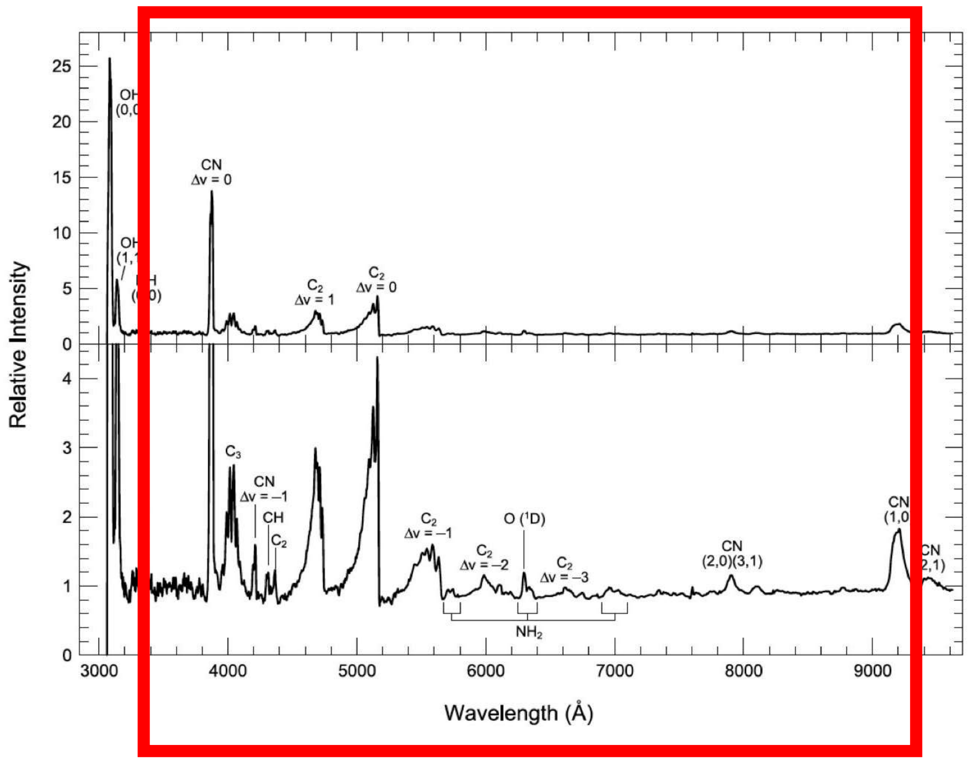
Outer solar system

Galilean moons

Kuiper Belt Objec

Comets (at optical wavelengths)

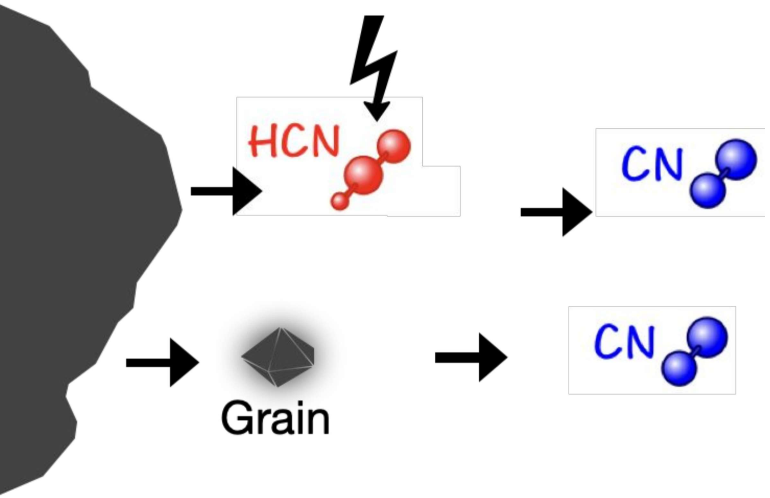
Comets are relics from the early solar system -> studying their composition allows us to understand the solar system formation and evolution

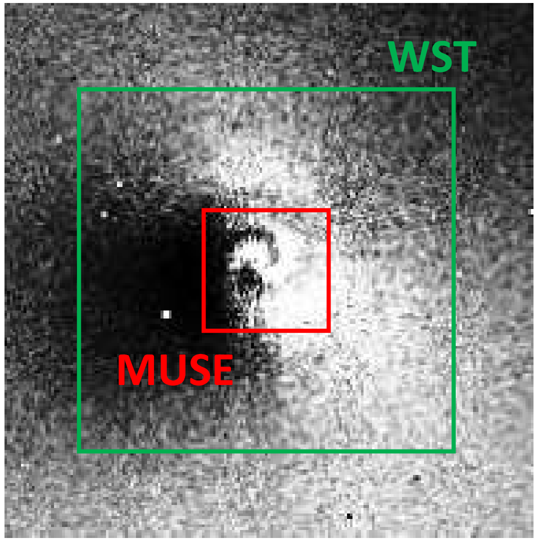


Feldman et al., 2004

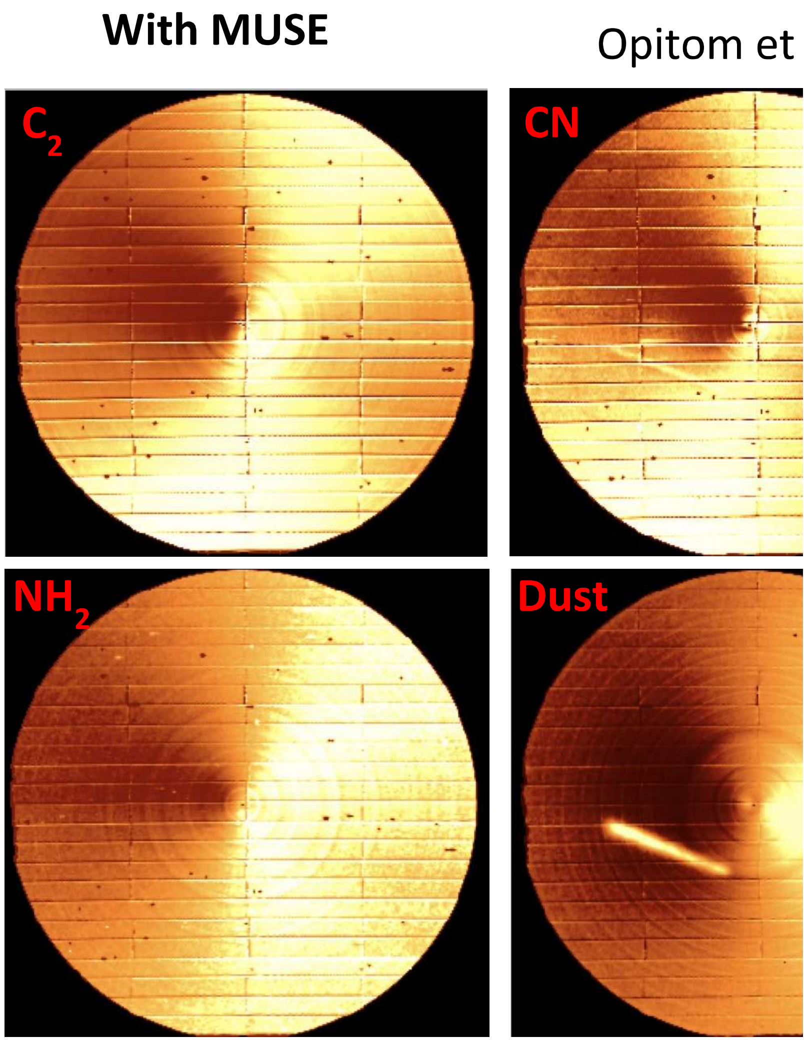
Origin of species and activity in comets

Using IF…





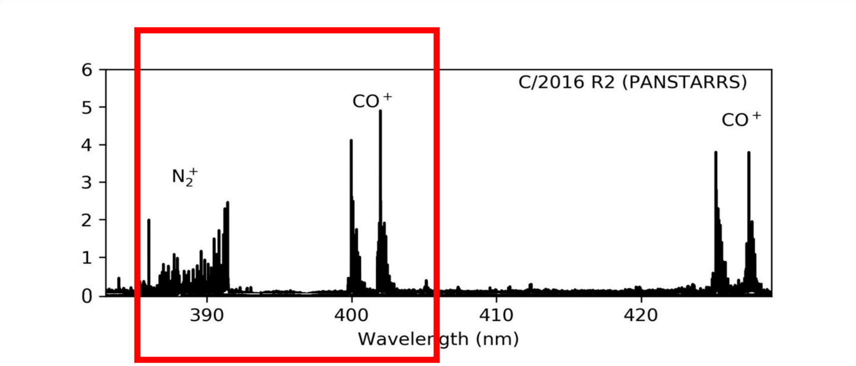
Comet C/2012 F6 in CN filter

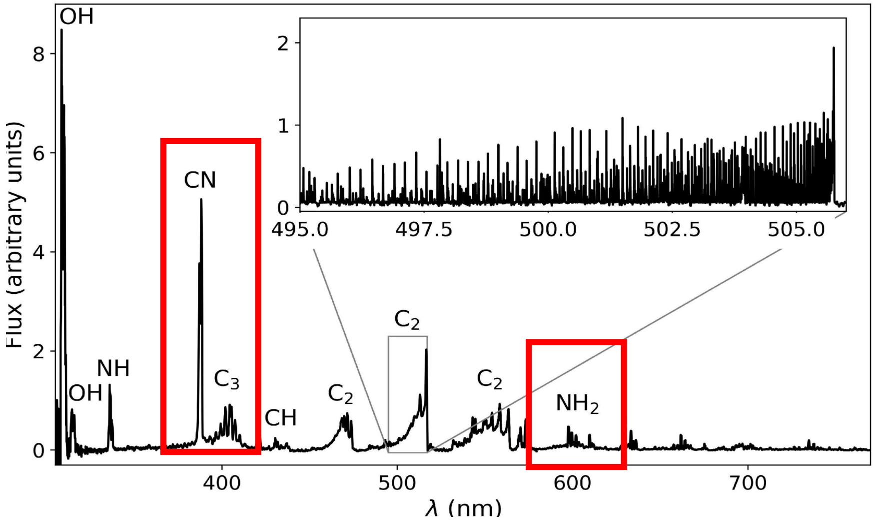


Large FoV IFUs are ideal to study how species in the coma of comets are produced and understanding cometary activity

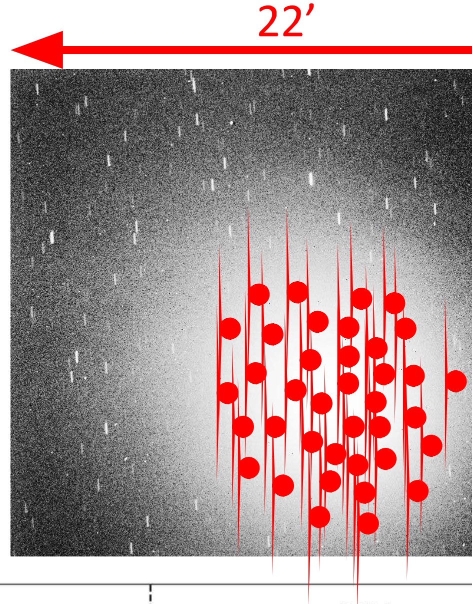
Isotopic ratios in comets

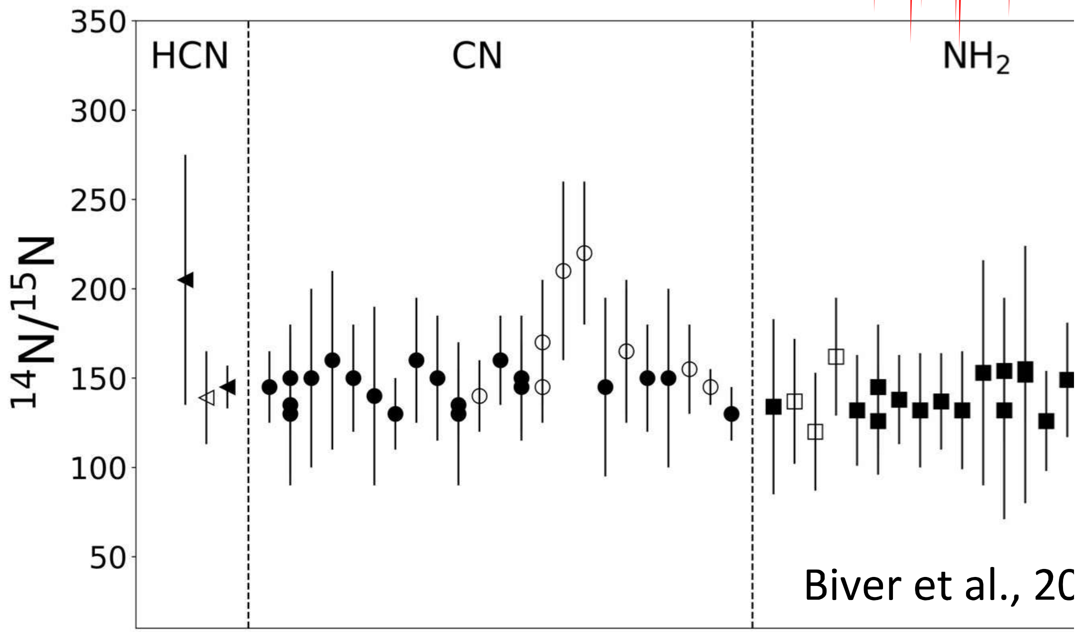
Excellent indicators of formation conditions but difficult to measure
-> Potential to measure isotopic ratios of N and C on a homogeneous sample of object (and to measure them from N_2 and CO from the ground for the first time)





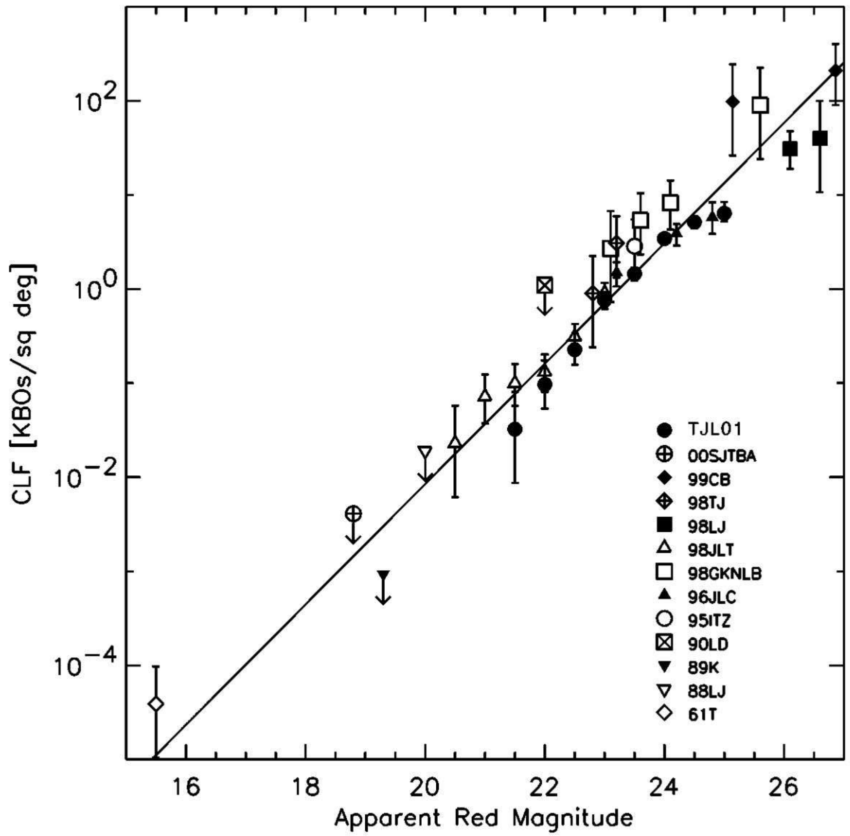
Using HR M





KBOs spectroscopy

Using IFS



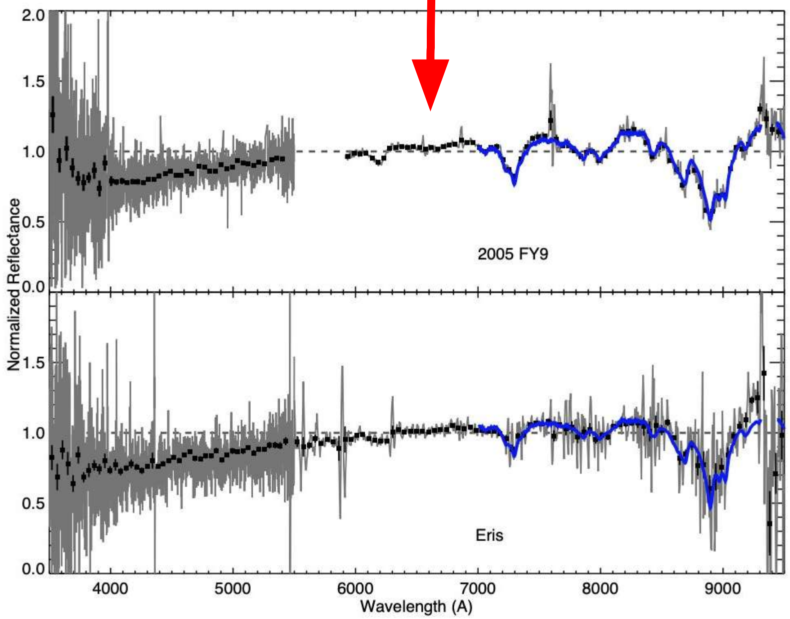
Luu and Jewitt 2002

- Very diverse objects: different surface composition, different reflectivity, different surface densities
- Some are icy objects, while some have a more silicatic composition
- Many have moons
- Most of the objects have to be discovered

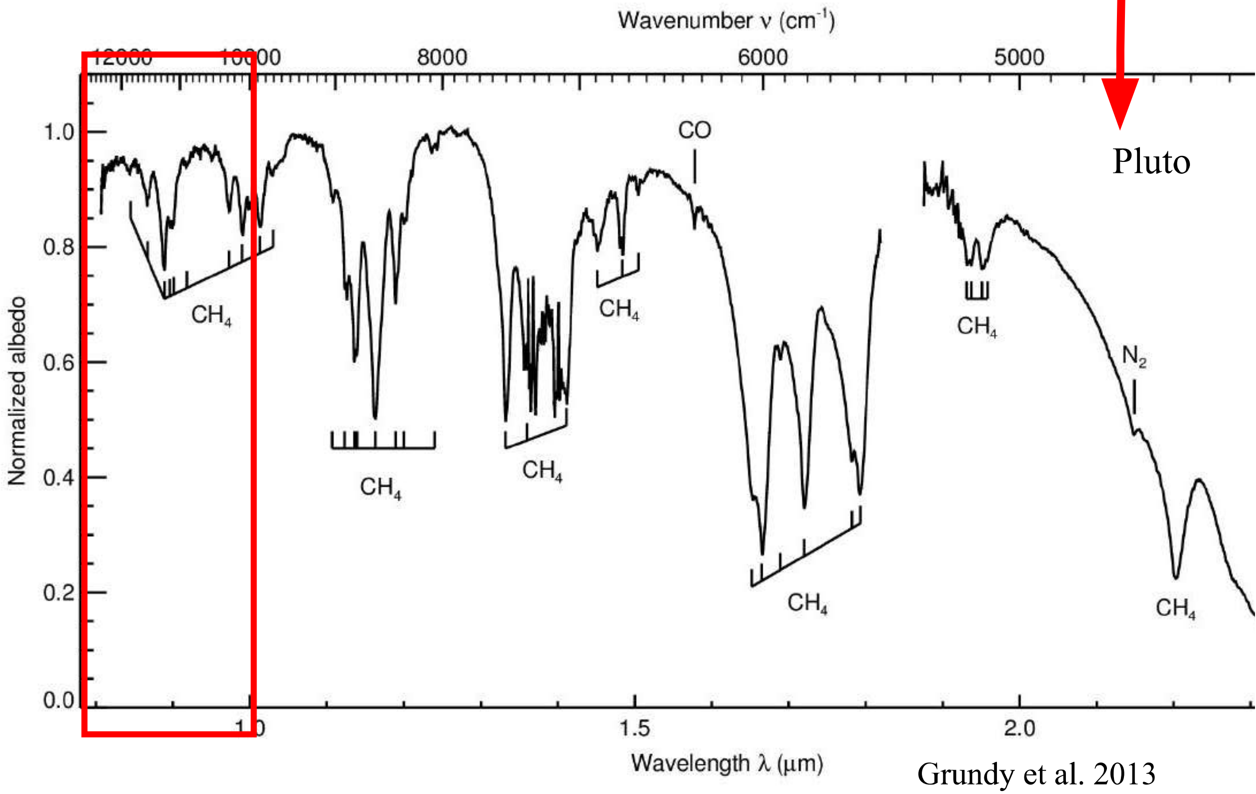
The expected large FoV of WST would allow to spectrally obse **number of KBOs, greatly enhancing our knowledge on thes objects**

KBOs spectroscopy

Being Triton a captured KBO, a similar surface composition was reported for **Pluto** and possibly the **KBOs**. Very similar seasonality observed on Pluto and expected on other big KBOs.



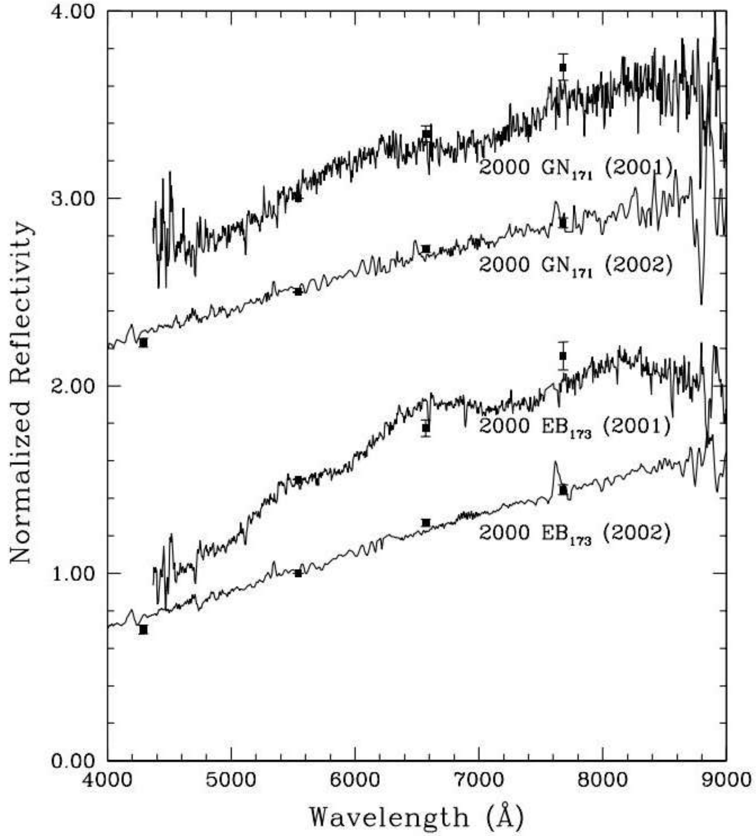
Barkume 2008



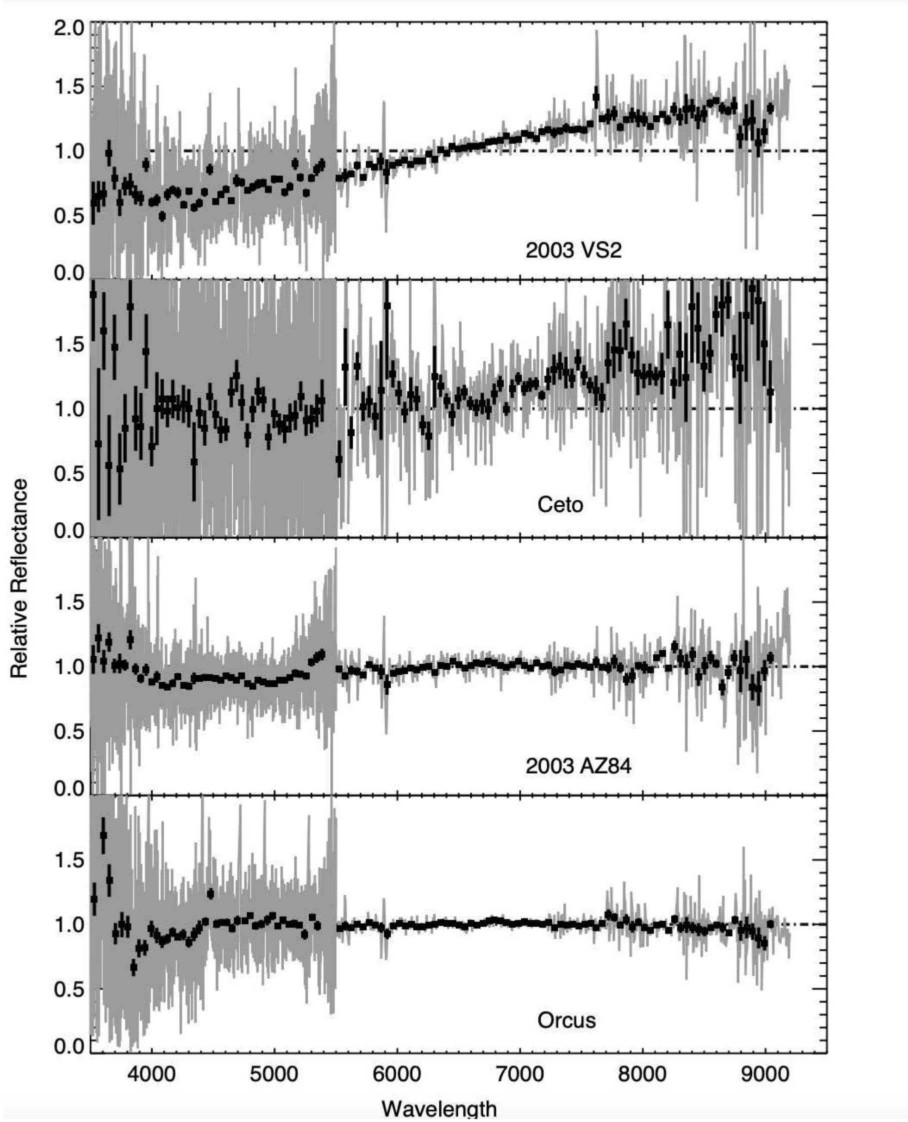
Grundy et al. 2013

KBOs spectroscopy

Using IFS



De Bergh et al. 2004



Barkume 2008

Objects with possibl
aqueous altered min
the surface.

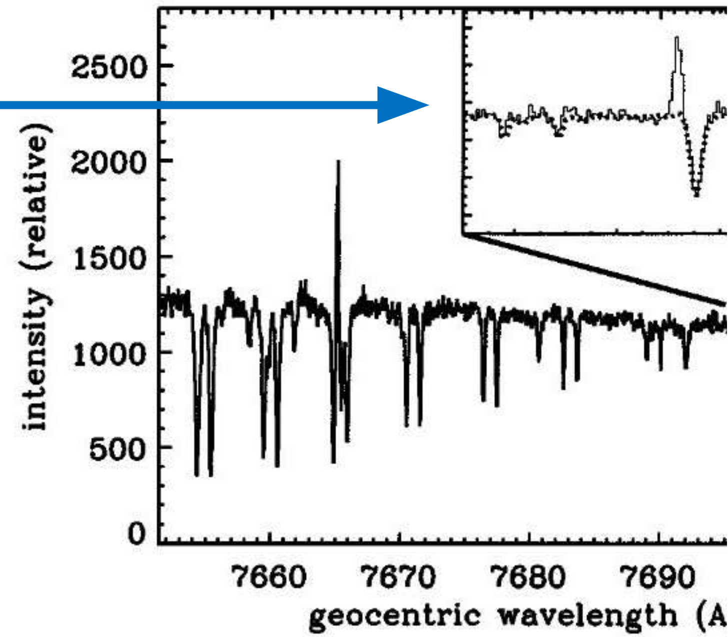
Mid resolution is r
to assess the surfac
composition of thes
objects.

Exosphere of the Galilean satellites

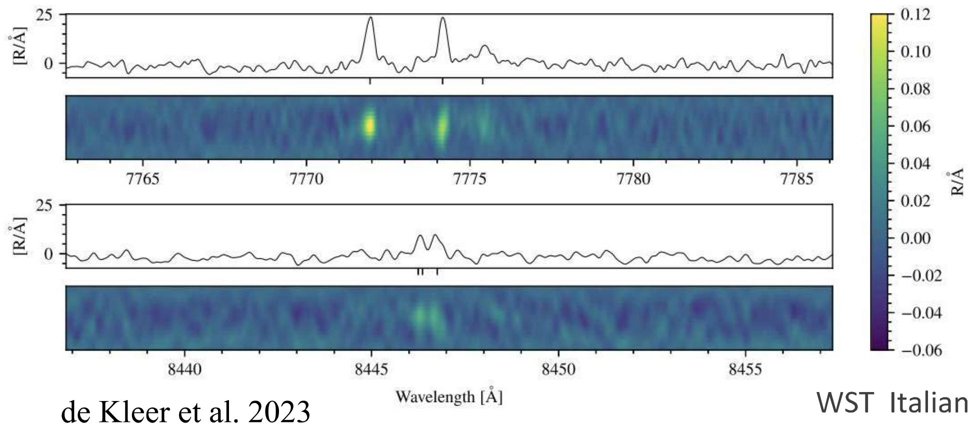
Using IFS

Na	589.592 nm 588.995 nm	Europa	Brown and Hill 1996
K	769.896 nm	Europa	Brown 2001
OI	557.7 nm 630.0 nm 636.4 nm 777.74 nm 844.46 nm	Ganymede Callisto	de Kleer et al. 2023

Brown 200

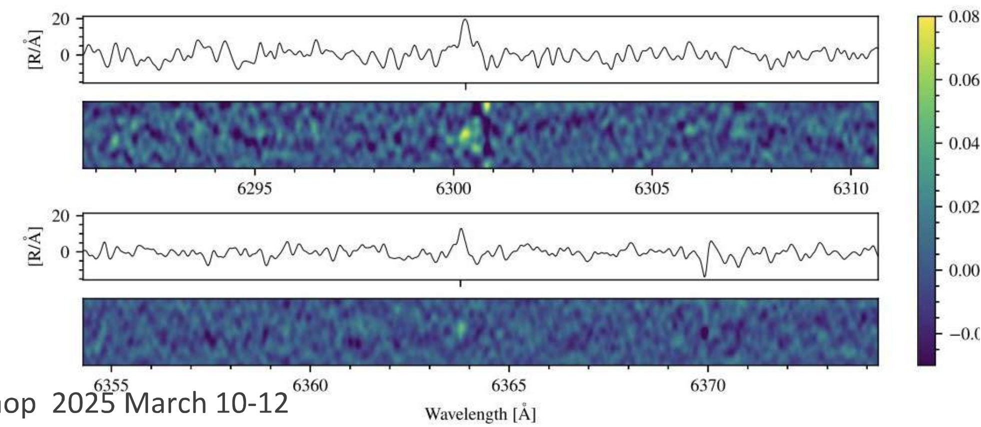


Ganymede



de Kleer et al. 2023

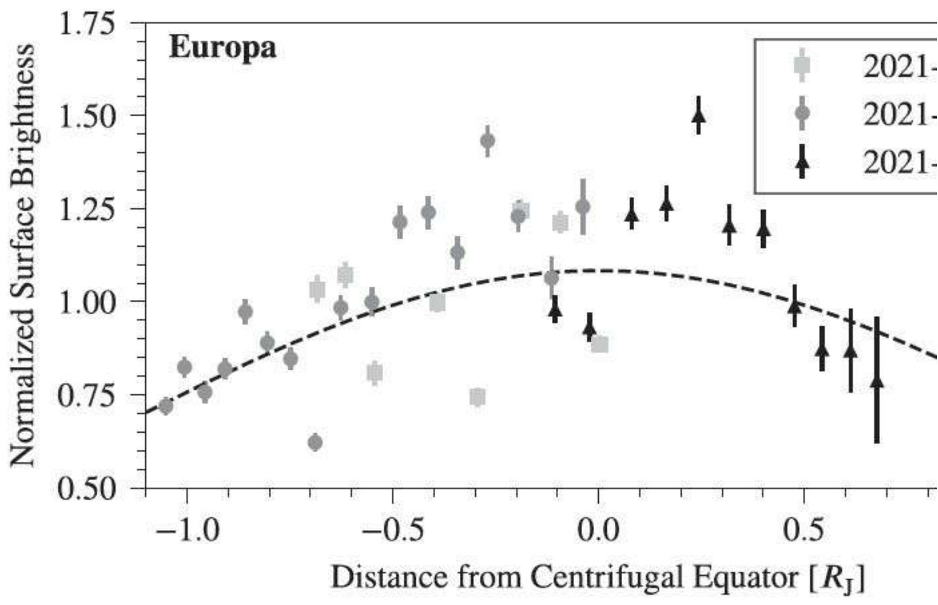
Callisto



Exosphere of the Galilean satellites

Using IFS

Satellite/Date	Column Density ($\times 10^{14}$ cm^{-2})		
	O_2	O	H_2O
Europa			
2021-5-20	4.0 ± 0.1	<0.4	<0.9
2021-6-21	3.7 ± 0.2	1.8 ± 0.8	<0.8
2021-7-16	3.7 ± 0.2	<1.2	<1.1
Average[b]	4.1 ± 0.1	<0.1	1.2 ± 0.5
Ganymede			
1998-11-15	4.5 ± 0.1	<3	<0.6
2018-6-15	3.2 ± 0.3	<8	16 ± 3
2021-6-8	4.8 ± 0.1	<0.8	<0.5
Average[b]	4.7 ± 0.1	<0.3	<0.3
Callisto			
2021-7-4	40 ± 9	…	…



de Kleer et al. 20

Direct implications for exophere composition

Correlation with magnetic latitude

Observational considerations for Inner SS:

IFS

- Ideally: Sample of >50 targets from various families at different distances from the Sun (based on current MUSE results)
- Spectral resolution>500-600
- **Differential tracking needed -> how does this work operationally? ("/h ->'/h speed)**

MOS

- Ideally: Sample of >30 targets from v
families
- **Spectral resolution ≥ 40,000**
- Might be doable without differential t

- Spectral coverage: minimum 370-700nm (but **bluer very interesting**)
- Extended objects -> Large FoV is essential (IFU > 3'x3')
- **Most of the observations can be done during bright time**
- Time sensitive, but flexible on timescale of weeks

Observational considerations for Outer SS:

IFS

KBOs

- Ideally: Sample of >50 targets
- Spectral resolution > 2000
- Differential tracking maybe not required (□ ≈ 1"/h)
- **Faint objects (V>24 for the unknown small objects)**
- Spectral coverage: minimum 370-950nm

Galilean moons

- Monthly observations for variability measurements
- **Spectral resolution > 40,000**
- Extended objects
- **Differential tracking**
- **Most of the observations will be with Jupiter close to the targets**
- Spectral coverage: minimum 370-950nm

Conclusion

Significant potential for Solar System science with WST

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But is constraining in terms of **tracking and schedule**