Astro Fit 2
Astronomy Fellowships in Italy

Anadiplosi:*

studio di processi di dispersione di dischi circumstellari per scoprire pianeti. Pianeti su cui cercheremo la vita

Elisabetta Rigliaco
(INAF - OAPD)

JEDI

*Anadiplosi: indica ogni ripetizione di parole in quanto <<ripetizione dell’uguale>> tra due segmenti discorsivi di cui il primo termina con l’espressione che si ripete all’inizio del secondo (fonte: Treccani)

INAF
ISTITUTO NAZIONALE DI ASTROFISICA
NATIONAL INSTITUTE FOR ASTROPHYSICS

Anadiplosis:

ANAlysis of Dispersal Indicators in PLanet-fOrming CircumStellar dISks

Elisabetta Rigliaco

(INAF - OAPD)

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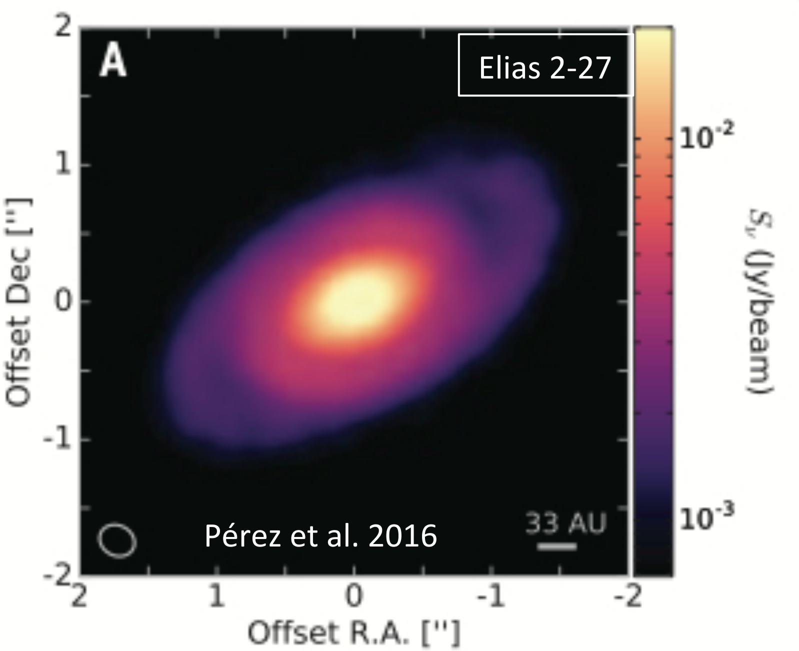
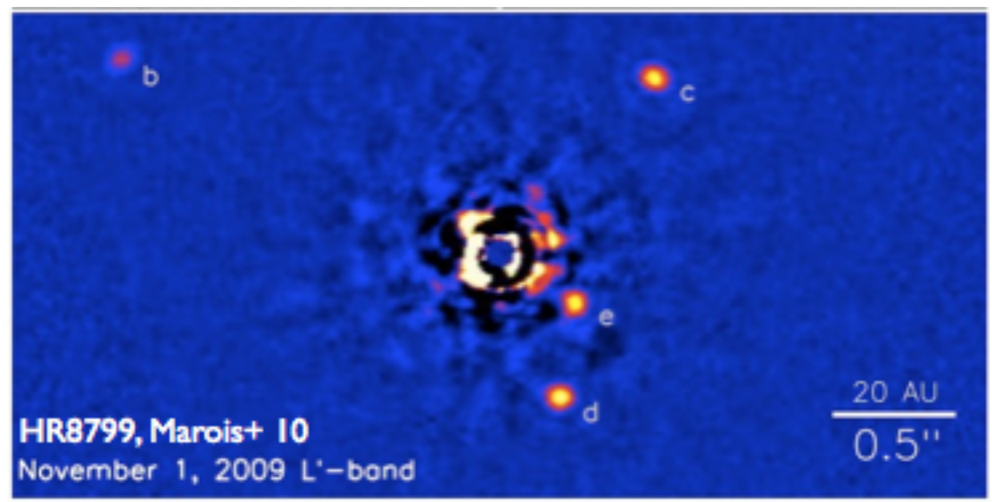
Circumstellar Disk Dissipation

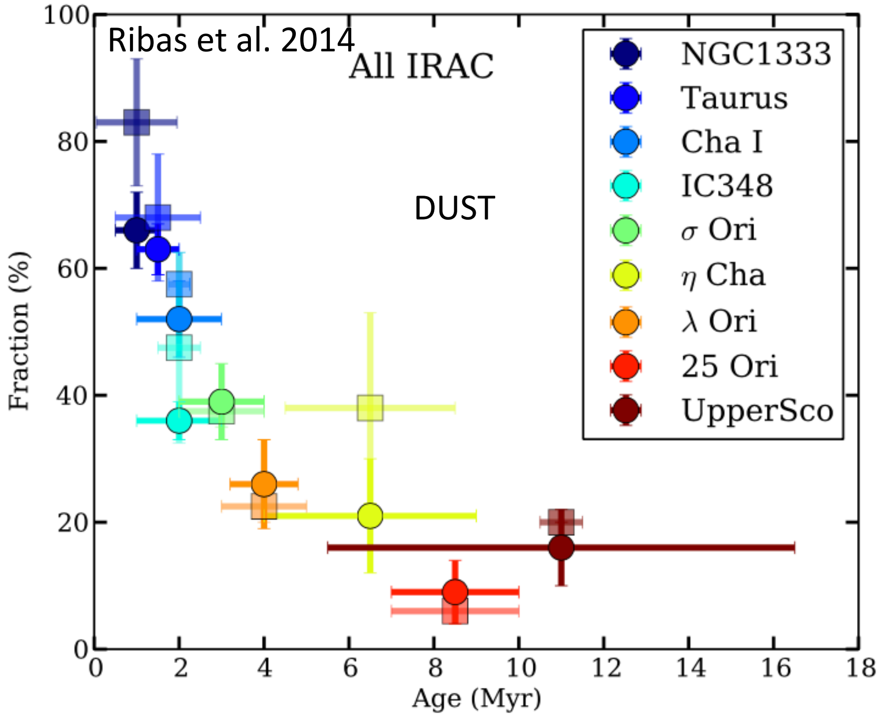


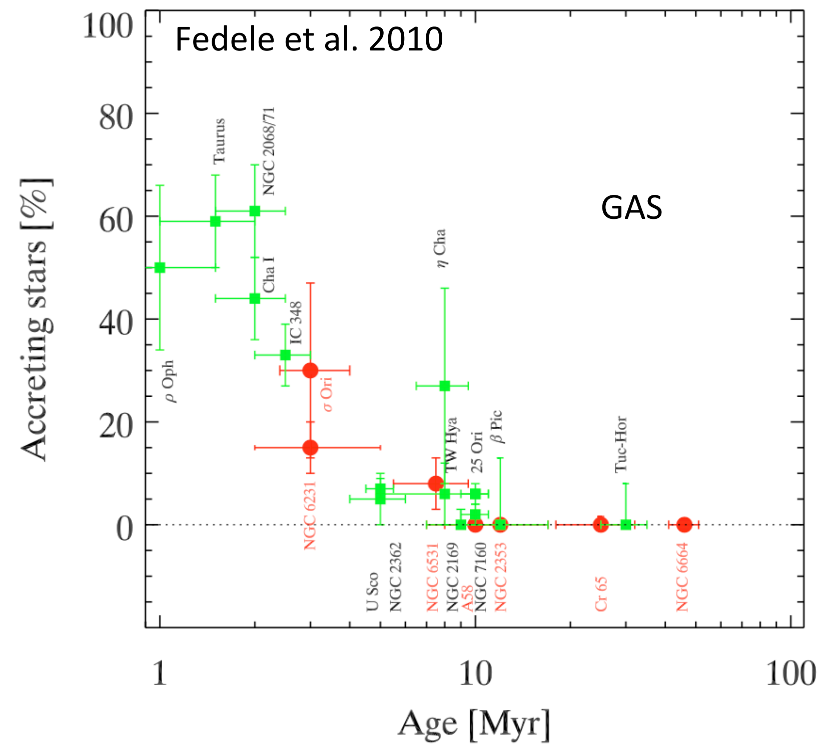


What is the time available for disks to disperse?

What mechanisms contribute to this process?

Timescale for disk evolution





Gas and dust last no longer than a few Myrs

Disk Dispersal Mechanisms

Less efficient

Stellar encounters: binary companion (e.g., Harris et al. 2012), tidal stripping in star clusters (e.g., Hueso & Guillot 2005, Adams et al. 2006)

Jets and stellar winds: mainly efficient in the early stages of star formation (e.g., Königl & Salmeron 2011, Matsuyama et al. 2009)

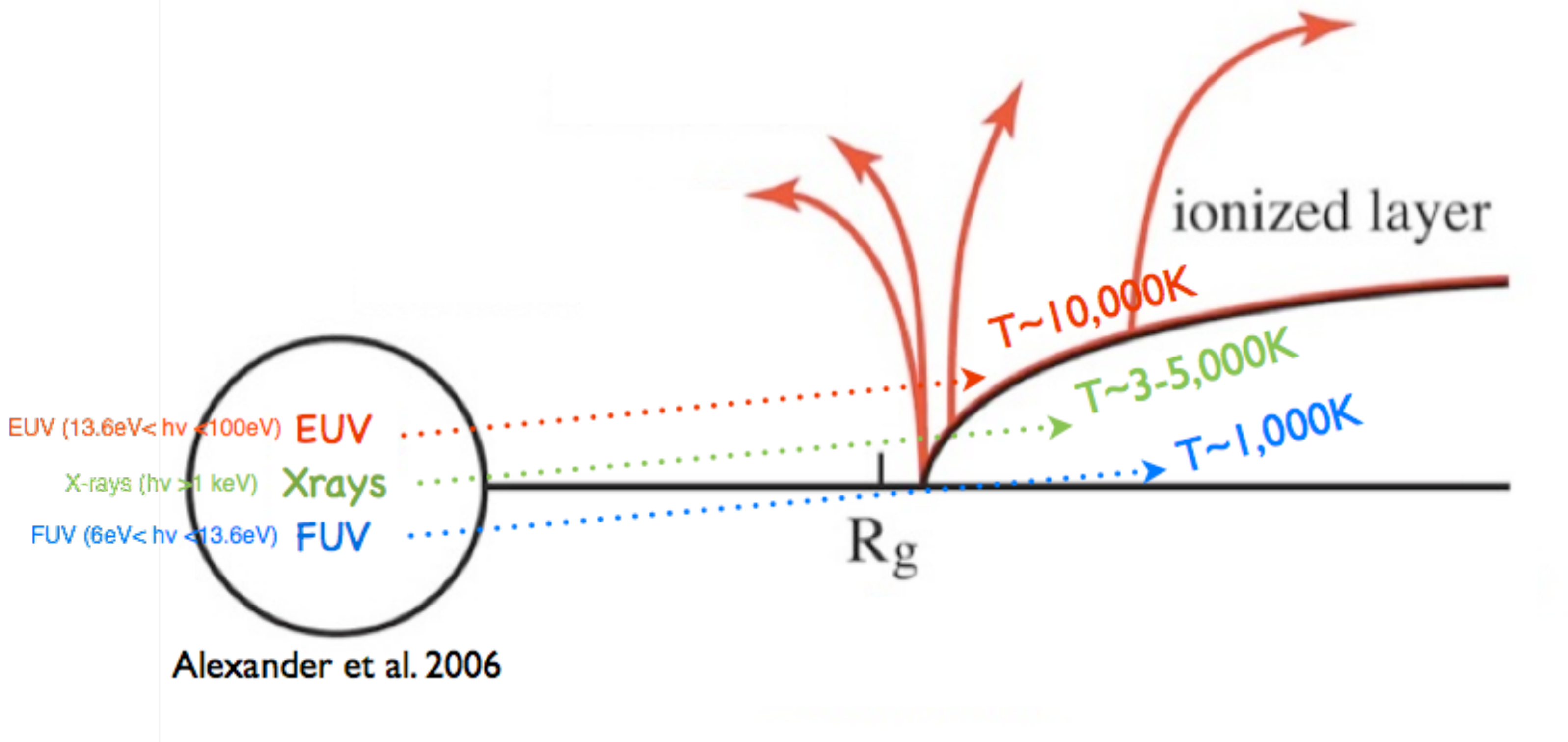
Planet formation: only small fraction of the disk mass ends up in planets (e.g., Wright et al. 2011, Mayor et al. 2013)

More efficient

Magnetospheric Accretion

Photoevaporation

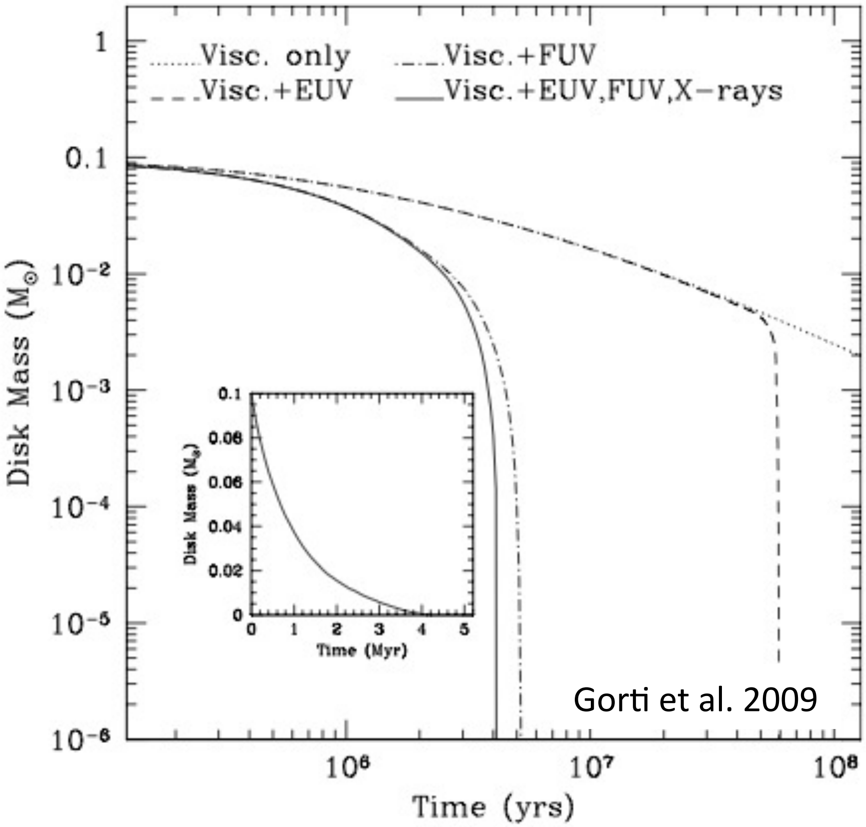
Photoevaporation

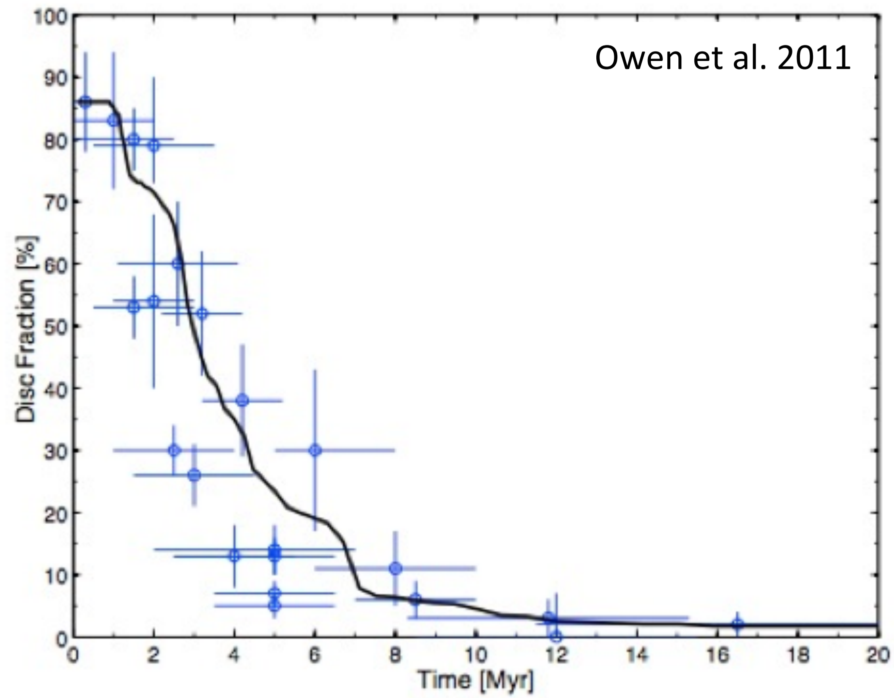


$M_{loss,EUV}$ ~ 10^{-10} M_{sun}/yr (e.g., Alexander et al 2006)
$M_{loss,X\text{-}rays}$ ~ 10^{-8}-10^{-9} M_{sun}/yr (e.g., Owen et al 2011)
$M_{loss,FUV}$ ~ 10^{-8} M_{sun}/yr (e.g., Alexander et al 2006)

For a review: Alexander et al. 2014, Ercolano & Pascucci 2017

Accretion + Photoevaporation

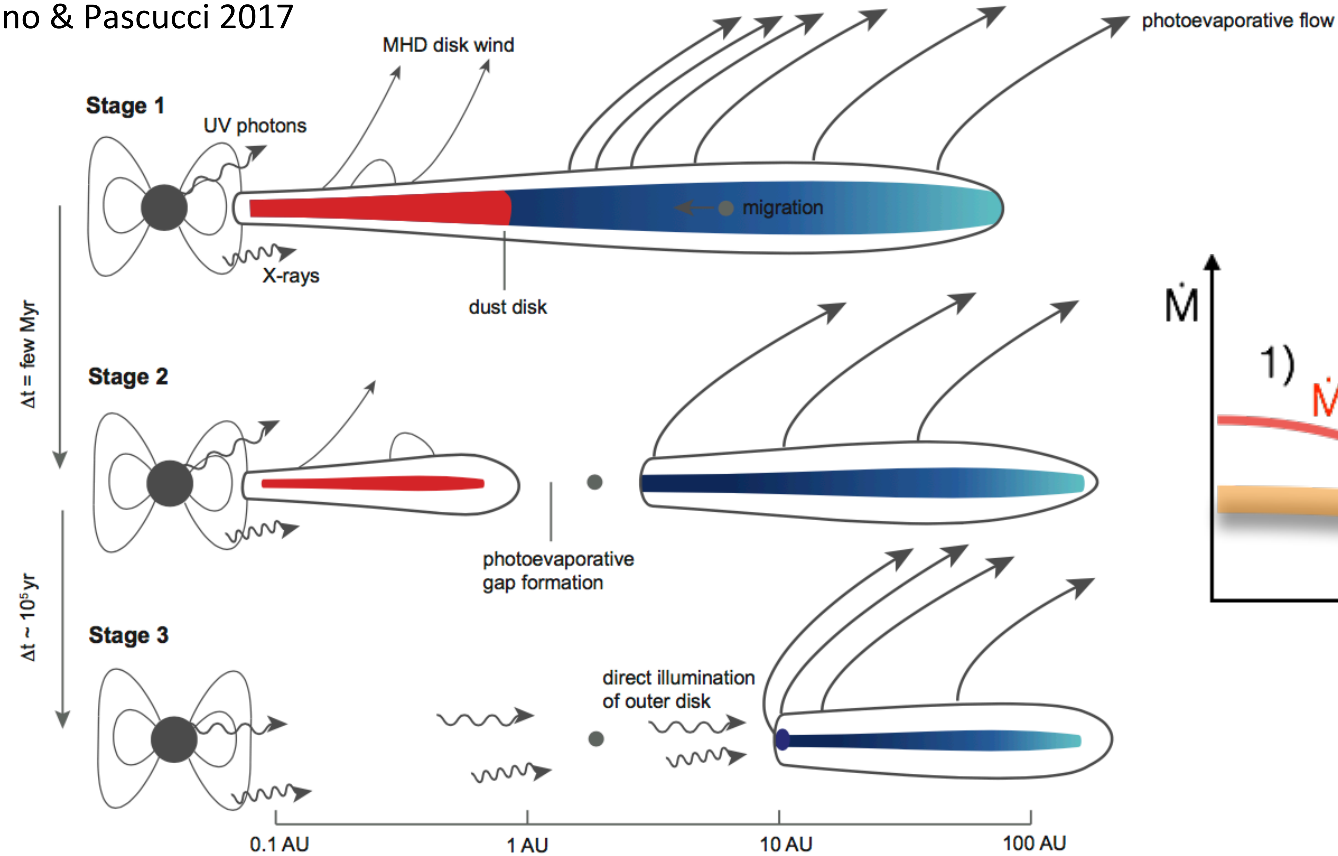


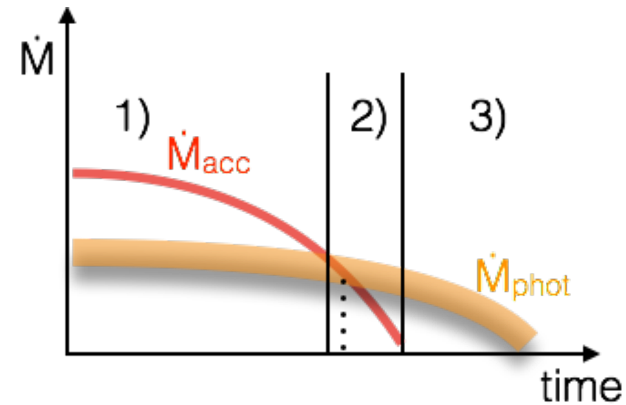


Accretion and photoevaporation must operate concurrently in order to explain the disk lifetimes

Interplay of Accretion & Photoevaporation

Ercolano & Pascucci 2017





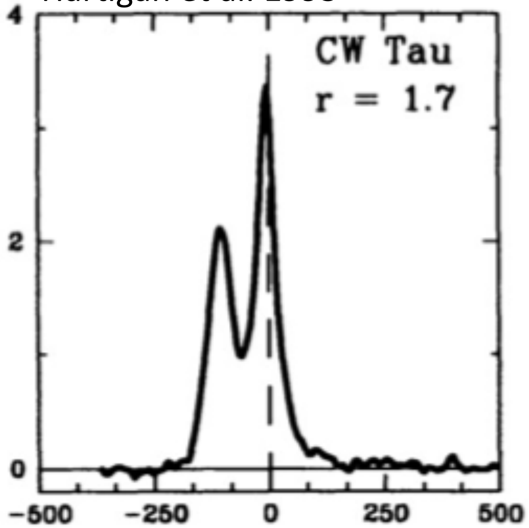
- *How quickly gas and dust disperse dictates the types of planets that will form in a given disk*

- *Understanding the interplay between magnetospheric accretion and photoevaporation is very important for the planetary system formation*

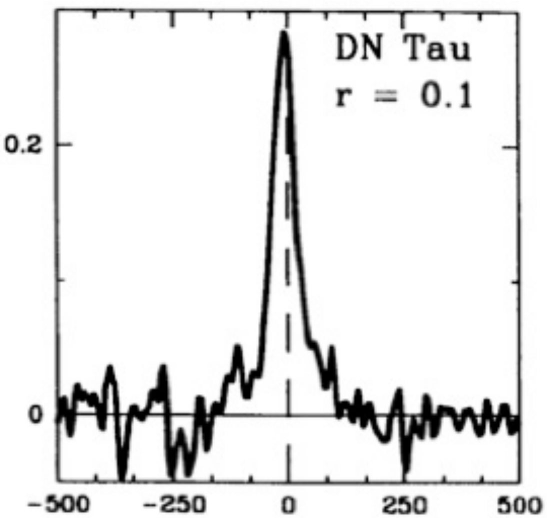
Gas Indicators: Photoevaporation

[OI] @ 6300 Å

Hartigan et al. 1995



High-accretion rate: $\dot{M}_{acc}$~10^{-6} $M_{\odot}$/yr

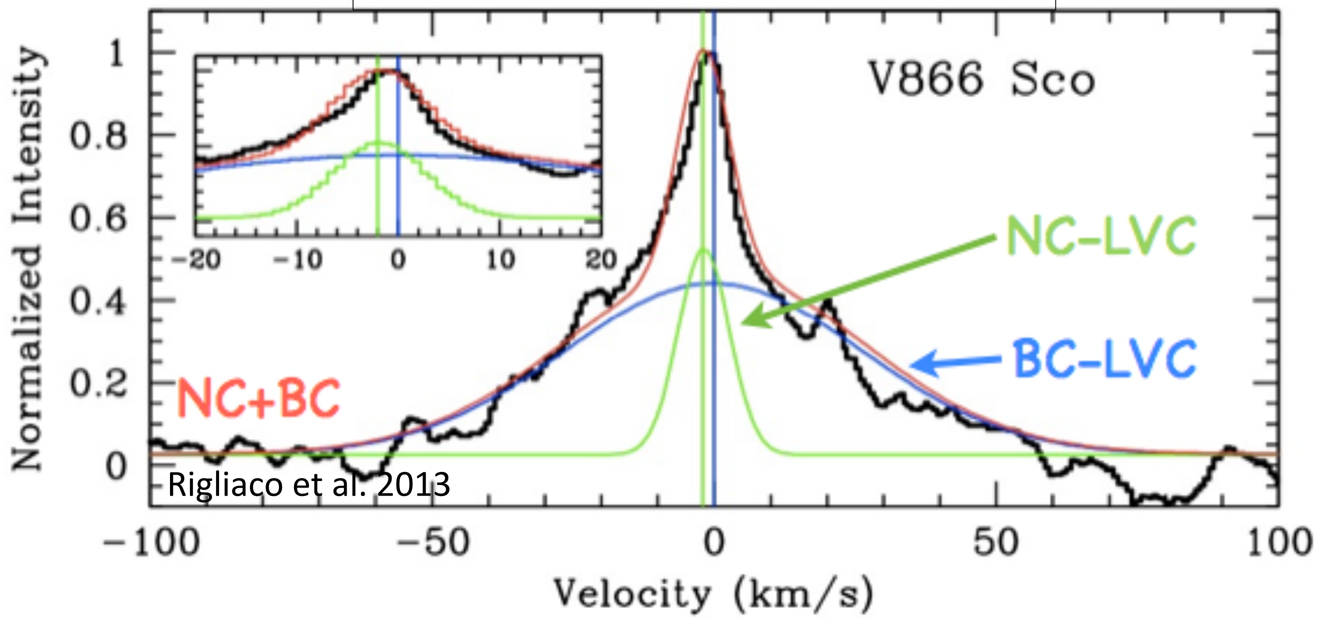


Low-accretion rate: $\dot{M}_{acc}$~10^{-9} $M_{\odot}$/yr

Gas Indicators: Photoevaporation

Measuring the gas component from high-resolution spectroscopy

UVES spectra: resolution 3.5 km/s



Broad Component (BC)
centrally peaked and broad →
bound gas

Narrow Component (NC)
slightly blueshifted and narrow →
unbound gas

The unbound component is tracing a photoevaporating wind

One aim of the ANADIPLOSIS Project:

Extend the analysis of the photoevaporation indicators to a larger sample of objects spanning:

- objects in different evolutionary stages (e.g., collecting high-resolution spectra for Classical T Tauri stars with and without jets)
- objects in different mass range (enlarging the analysis to Herbig Ae/Be stars

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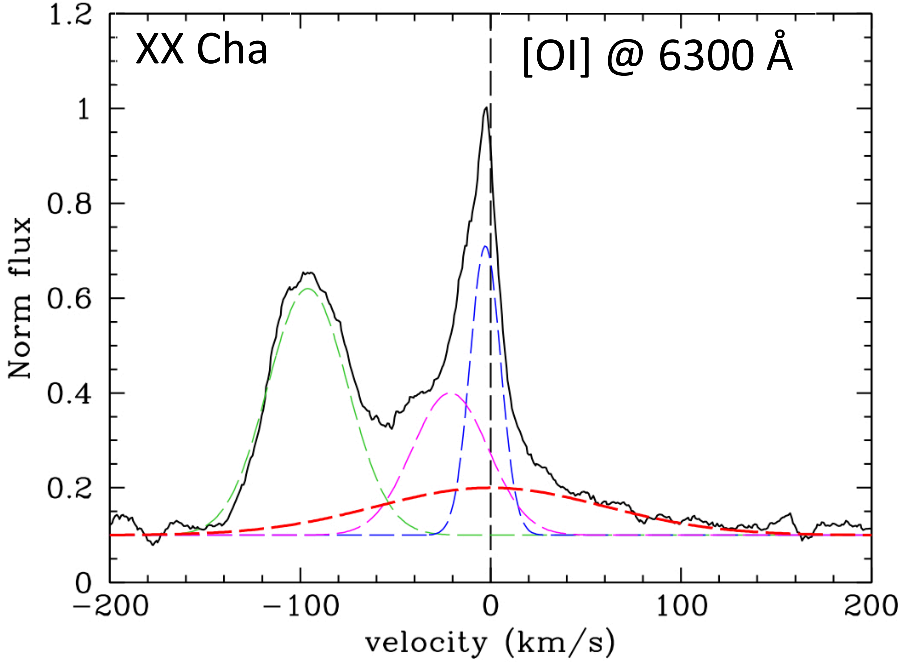
Rigliaco et al. in prep.



HVC, blueshifted by ~100 km/s: diagnostic of gas fast moving in the jet

LVC – NC, blueshifted by ~1-5 km/s: Tracing gas in photoevaporation

LVC – BC, centered to the star rest velocity: Tracing gas in keplerian rotation

Wind component, blueshifted by few tens km/s: tracing stellar wind

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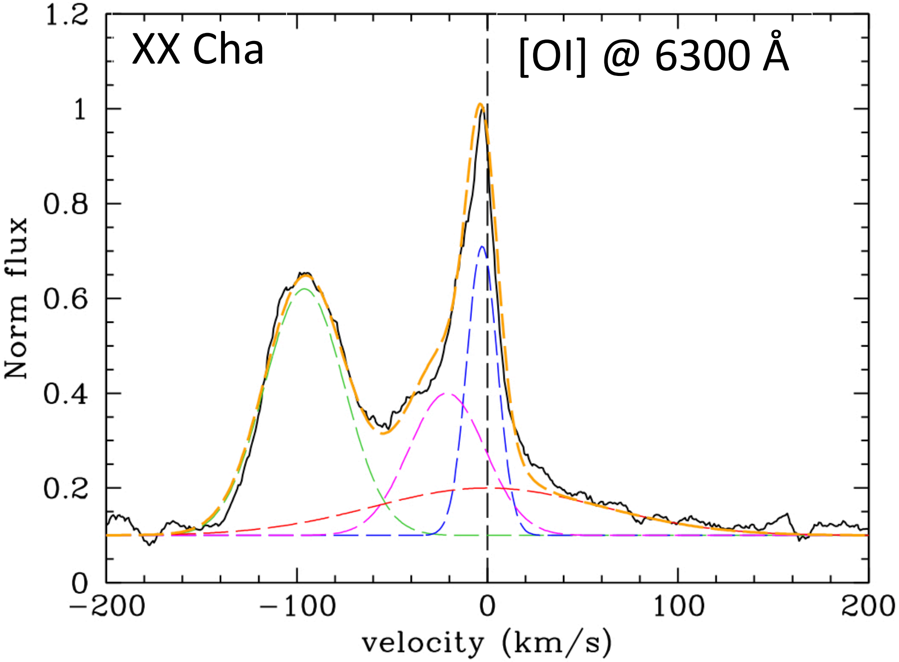

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Sum of all the components

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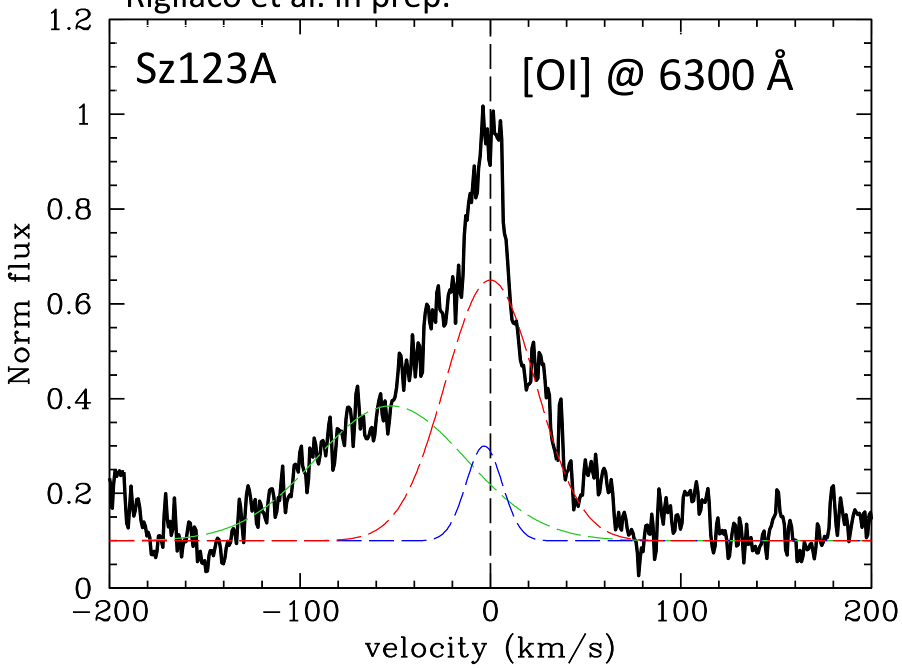

HVC, blueshifted by ~60km/s: diagnostic of gas fast moving in the jet

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LVC – BC, centered to the star rest velocity: Tracing gas in keplerian rotation

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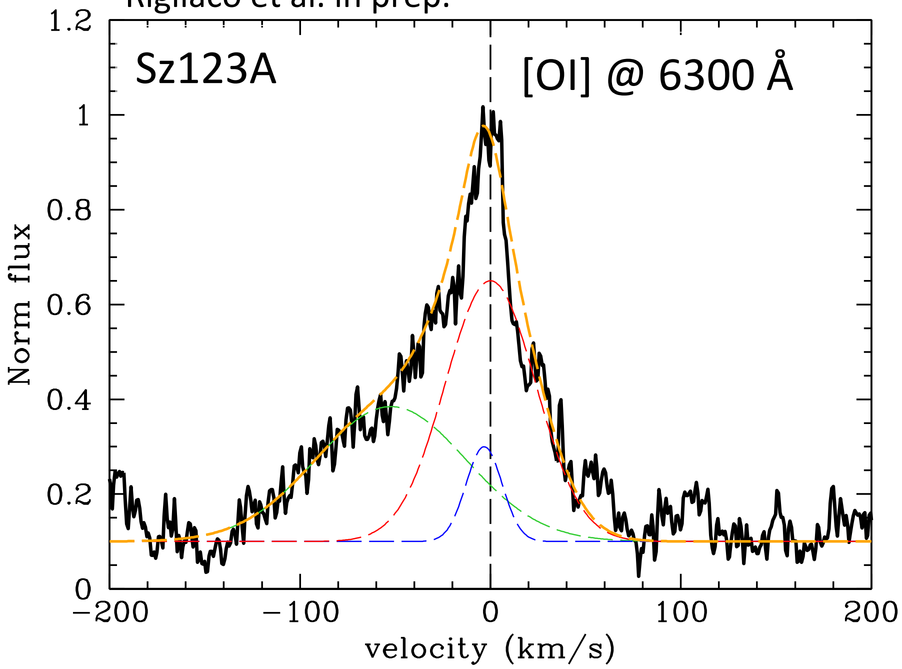

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What can we understand from this analysis:

- If/how the presence of a jet impacts on our measure of the narrow component in the low velocity component
- Spotting other wind components in the line profile
- Comparing with theoretical model we can constrain the rate at which the stars are photoevaporating → When photoevaporation takes over accretion as main disk dispersal process

Summary and Next Speps

- Accretion and photoevaporation operate concurrently, and understanding when one takes over the other is fundamental for the planetary system architecture

- The analysis of the photoevaporation indicators is at the beginning, and enlarging the sample to objects with different properties is fundamental for our understanding of how disks around young stars dissipate

- Combining accretion and photoevaporation rates of gas content to the dust content of the disks are the next steps we are taking to have a full comprehension of the dispersal of disks