EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Faculty of Science
Institut für Astronomie und Astrophysik

Accretion Ejection Connection with Second Generation VLT Instruments

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Deutsche Forschungsgemeinschaft

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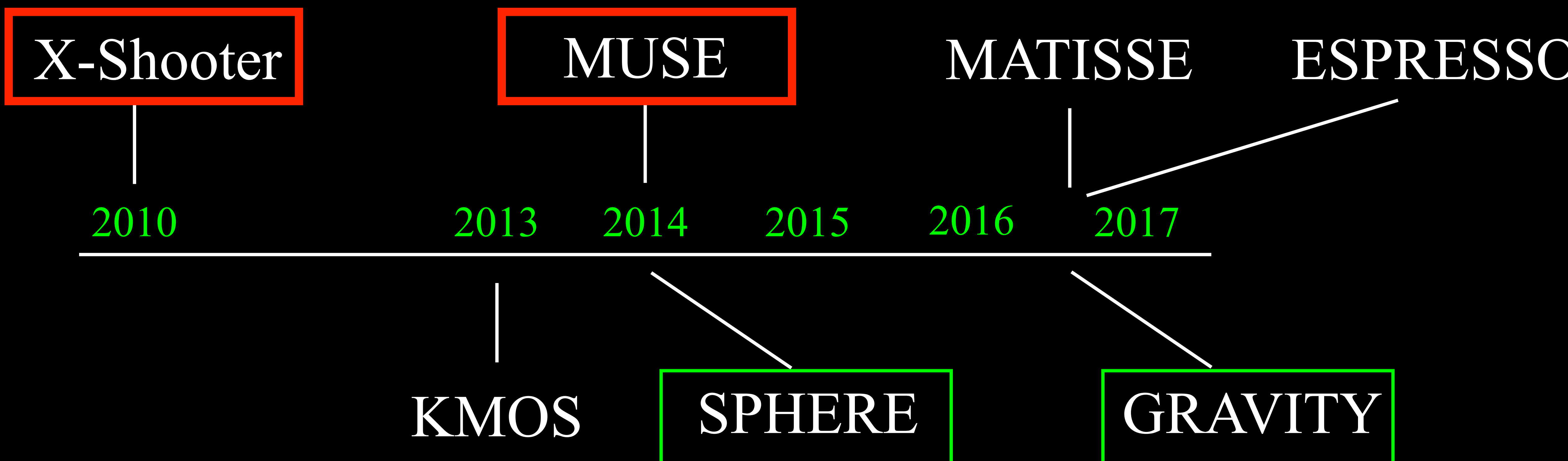
2^{nd} Generation Instruments



2nd Generation Instruments

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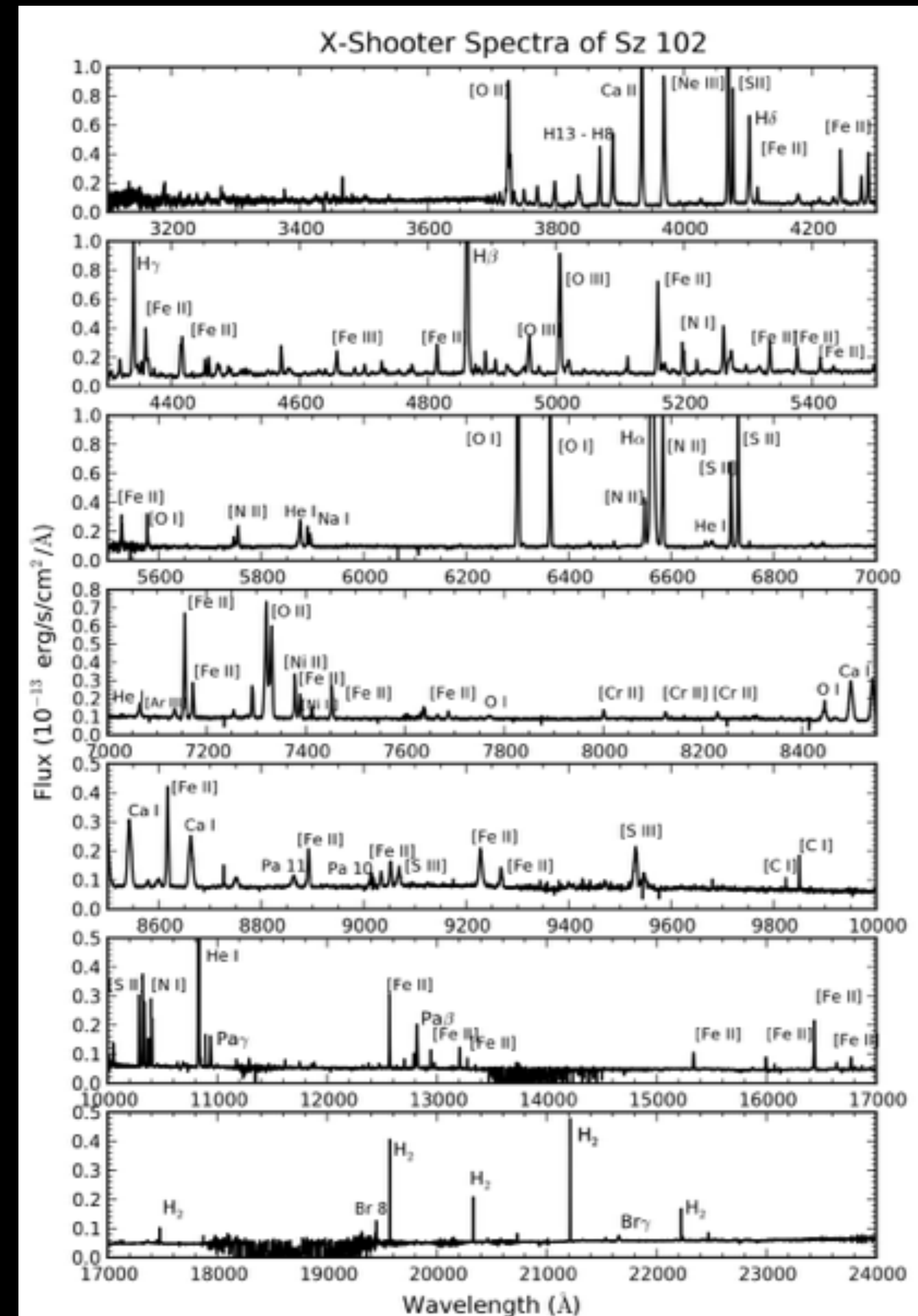
X-Shooter: broad-band spectrograph, UVB, VIS, NIR arms from 300nm to 2.5μm, long-slit / IFU, R = 3300 to 17400 depending on arm and slit-width, seeing limited



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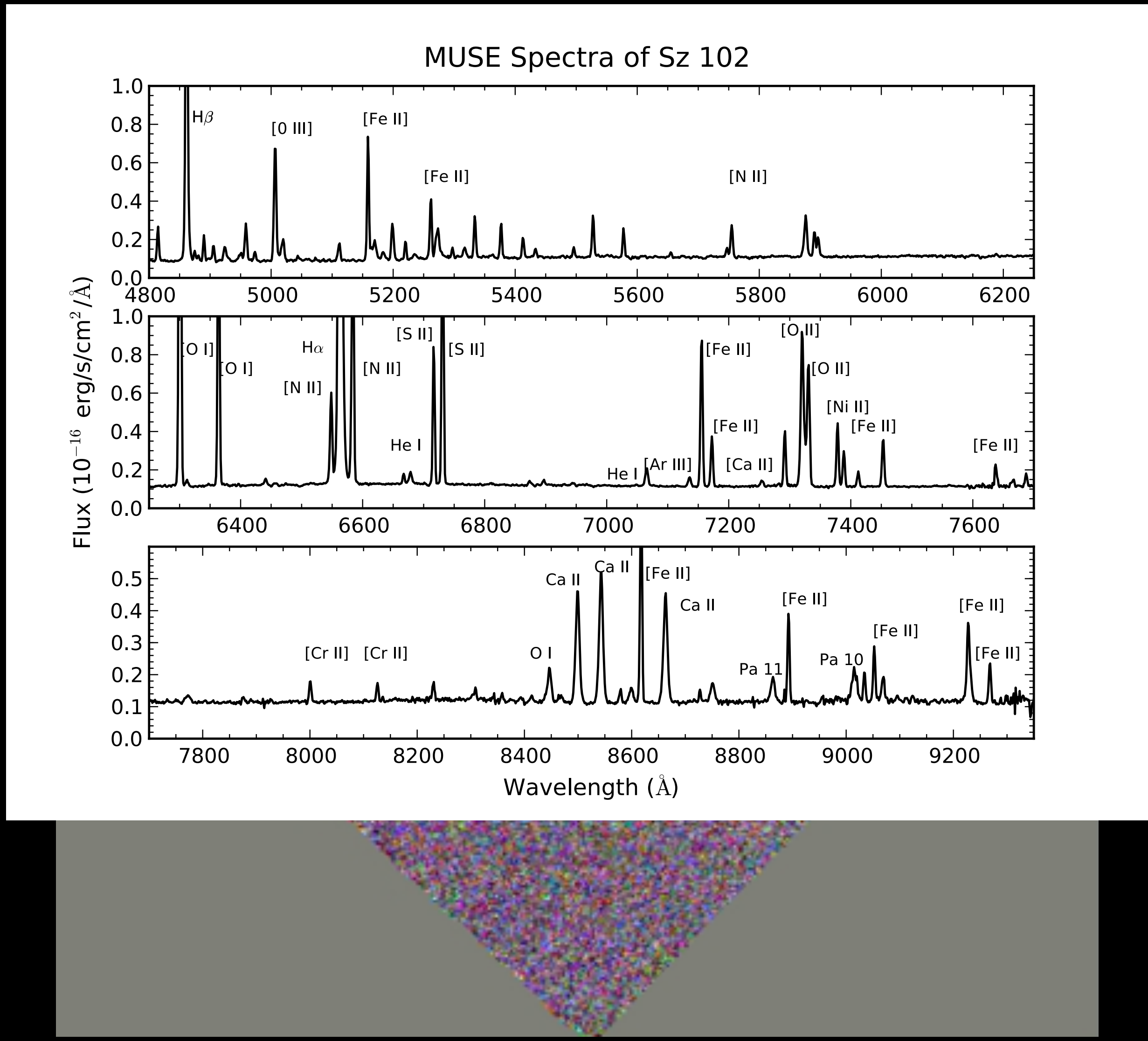

MUSE: Integral-field spectrograph, spectra from 465nm to 930nm R = 3000

WFM: 1’ x 1’ FOV, no AO, pixel scale = 0”.2

WFM + AO : 1’ x 1’ FOV

NFM + AO : 7”.5 x 7”.5 FOV, sampling= 25mas

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Targets

Object	Type	Instrument	
ESO-HA 574	CTTS - very low luminosity	X-Shooter	Bacciotti + 11, Giannini + 13, Whelan + 14a (both)
Par-Lup3-4	Very Low Mass - 0.13 $M_\odot$	X-Shooter	
ISO-Cha I 217	Brown Dwarf - 80 M_{JUP}	X-Shooter	Whelan + 14b
LkCa 15	Transitional Disk	X-Shooter	Whelan + 15 Whelan + 16 in prep
Sz 102	CTTS	X-Shooter MUSE	in prep
HH 399	Irradiated Disk	MUSE	in prep

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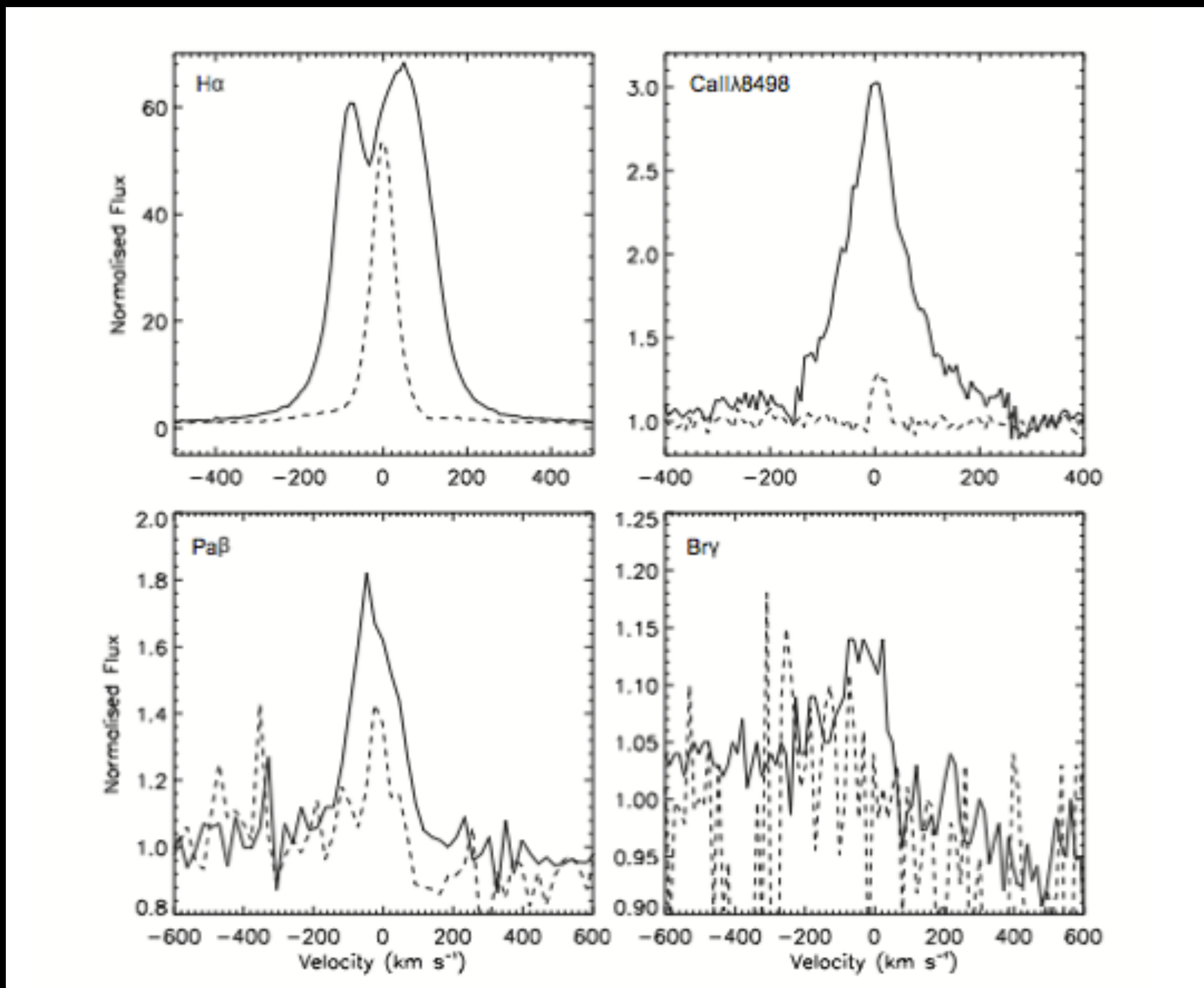
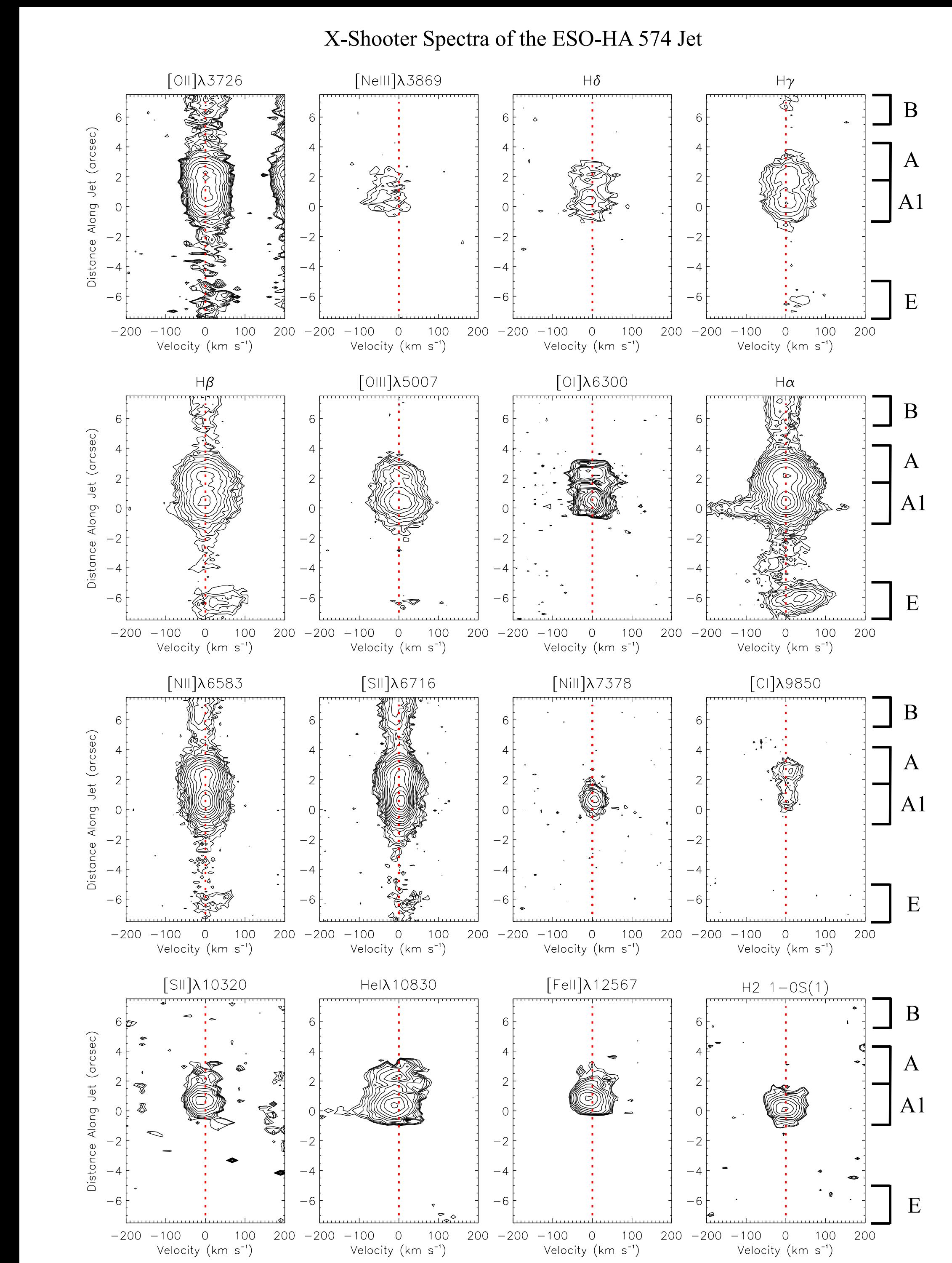
Morphology and Kinematics

Bacciotti +. 2011, Whelan +. 2014a

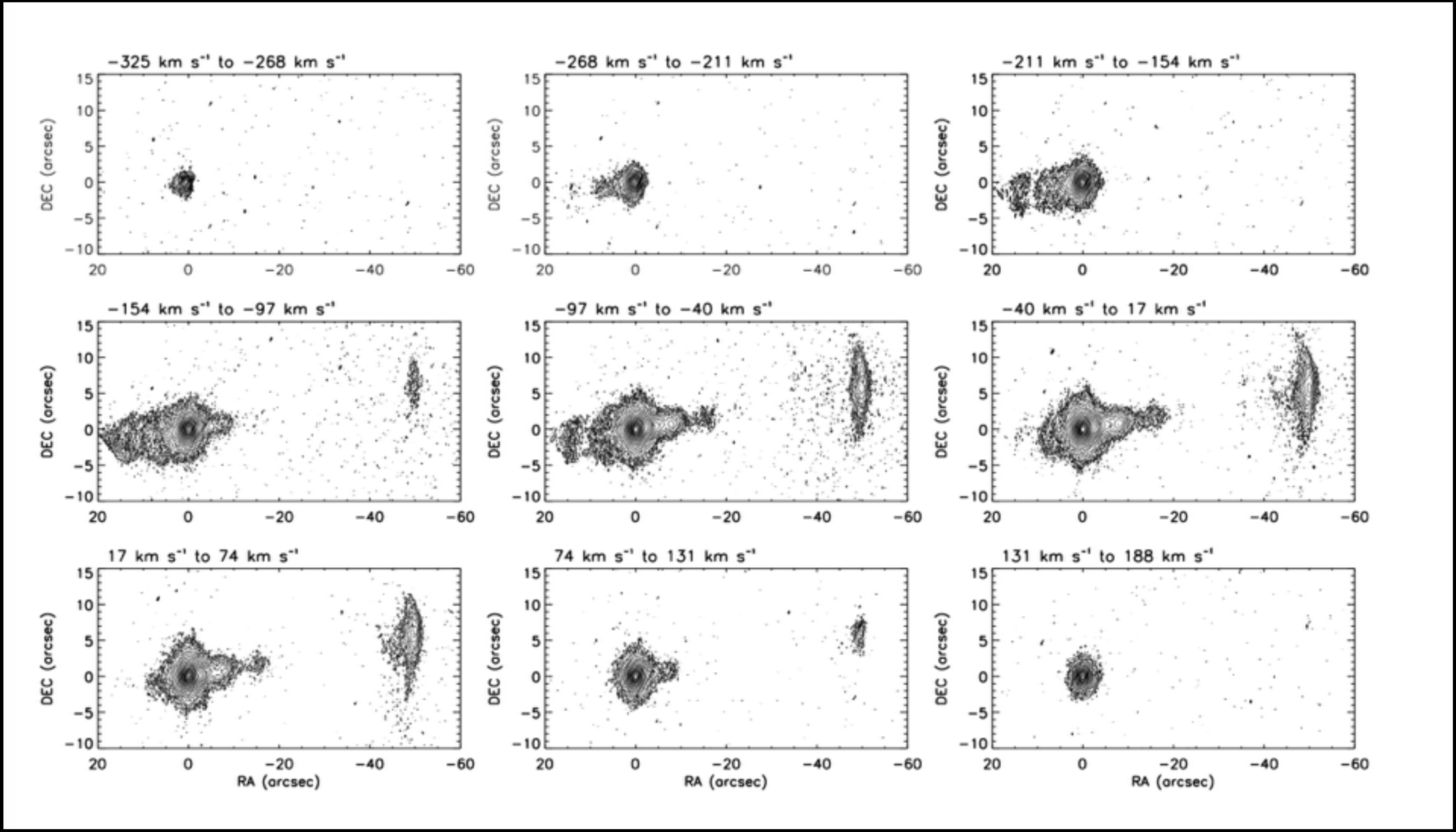




To be observed in Chandra Cycle 17

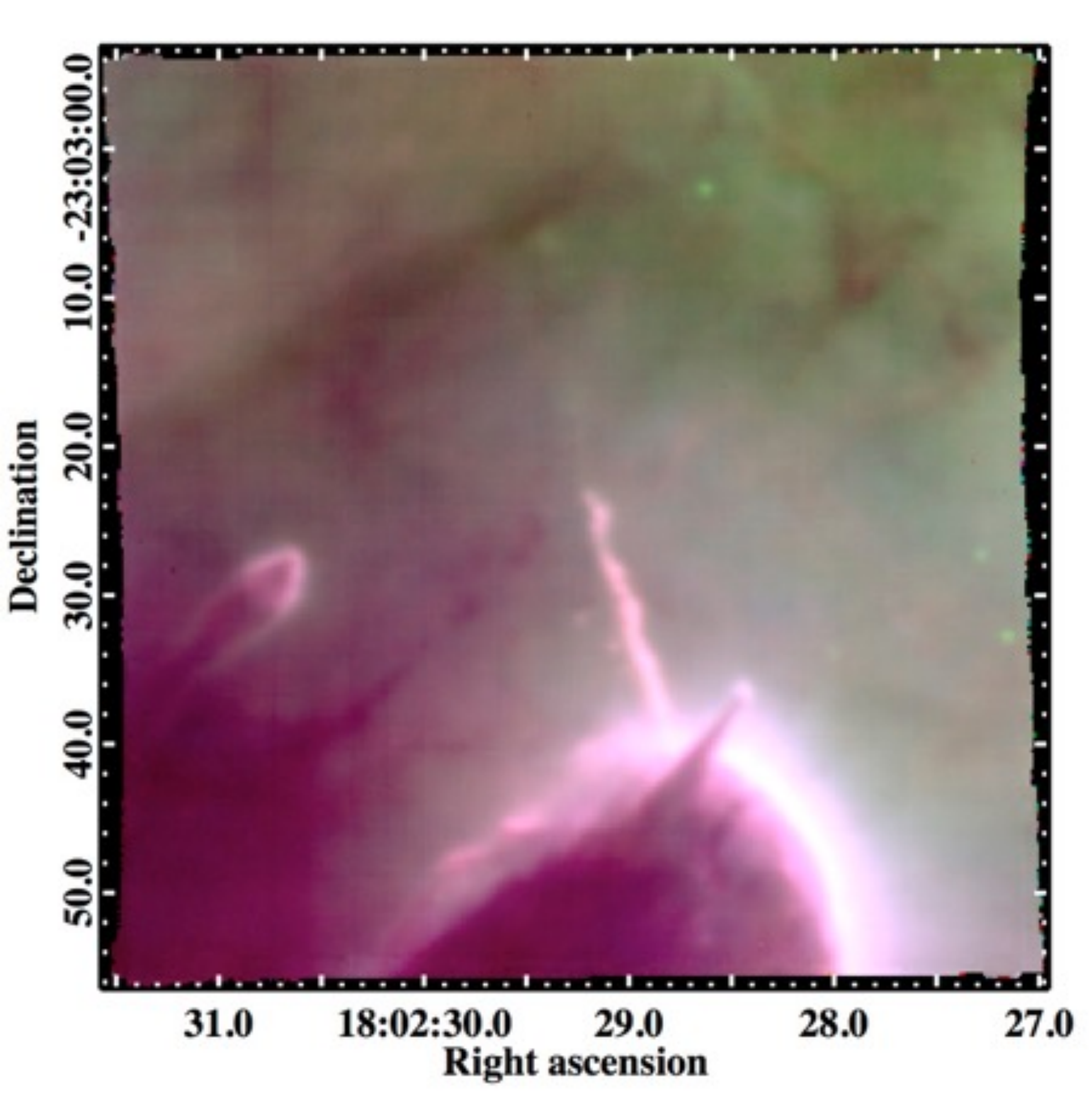
Morphology and Kinematics

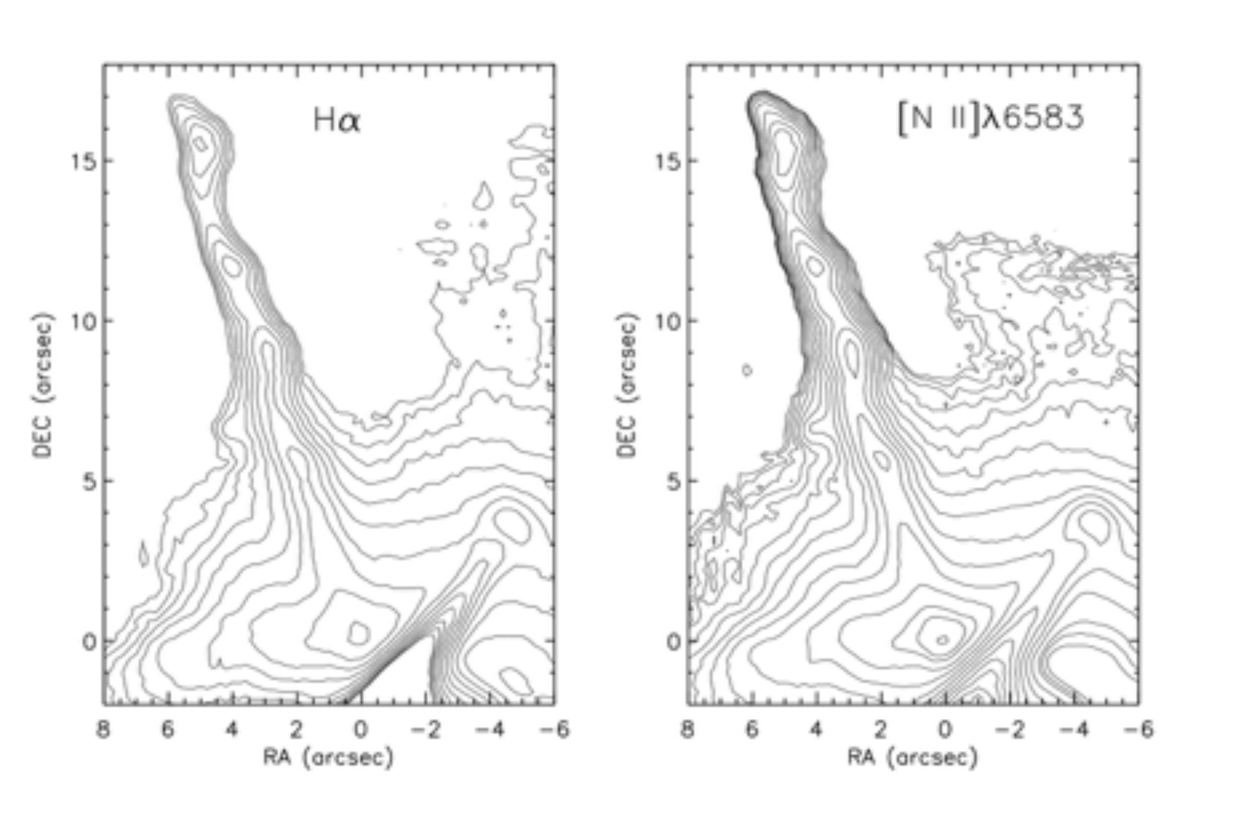
MUSE Observations of SZ 102 in Hα



Morphology and Kinematics

MUSE Observations of HH399

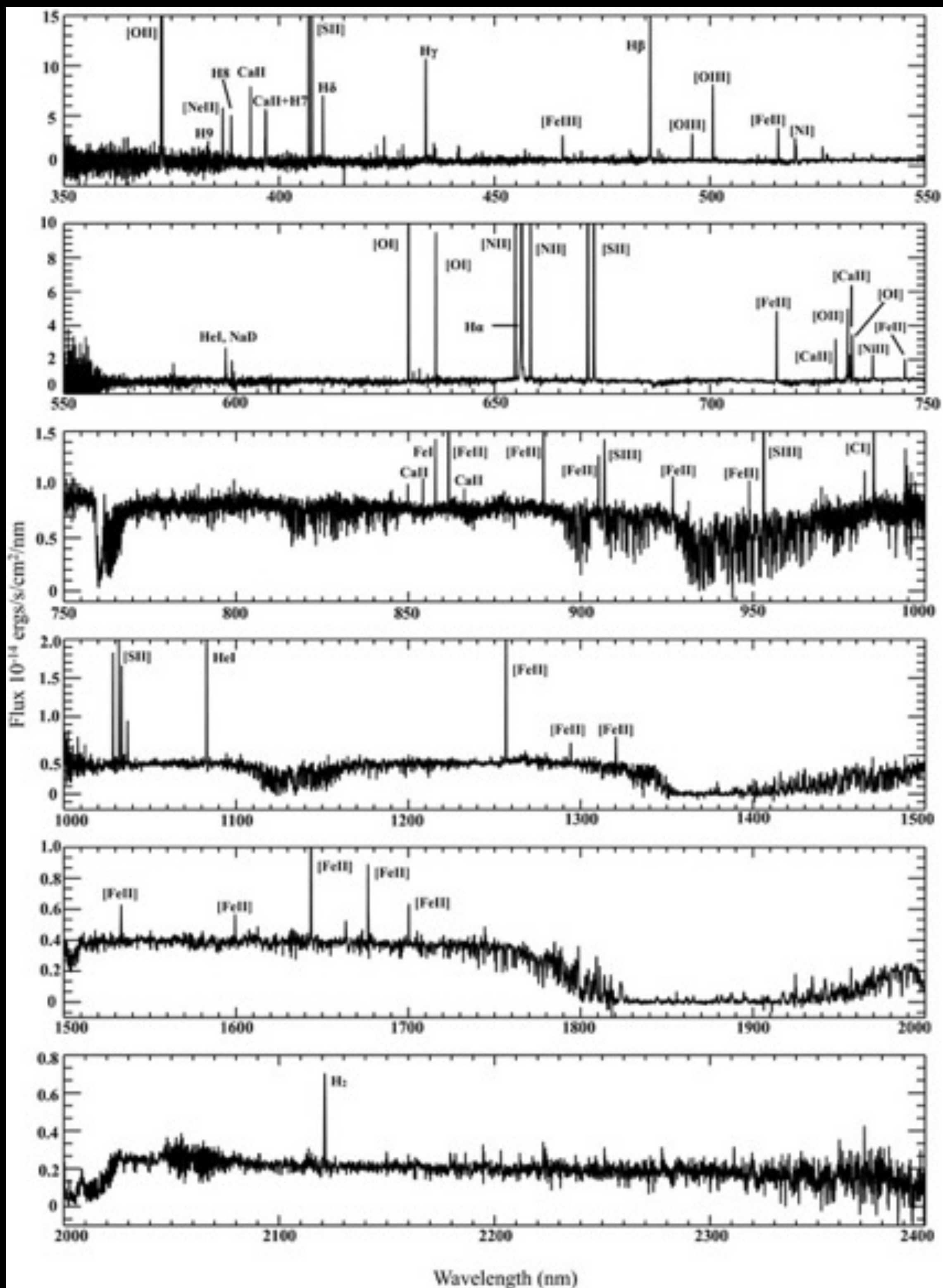


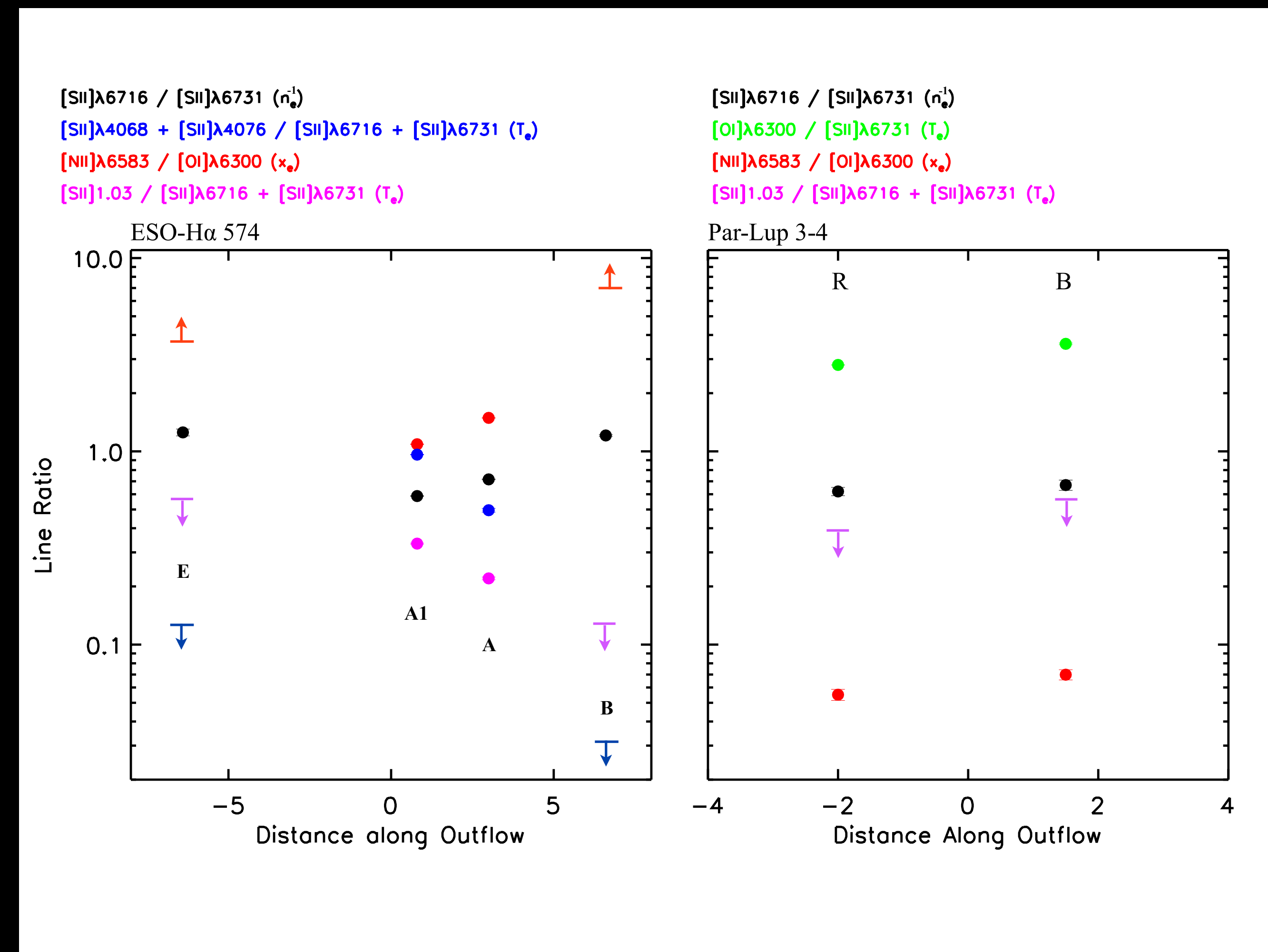


WFM + AO a big bonus for this work

Diagnostics - X-Shooter

Whelan +. 2014a





The Diagnostic Potential of Fe Lines Applied to Protostellar Jets

Giannini et al. 2015ApJ…798...33G

Giannini et al. 2013ApJ…778...71G

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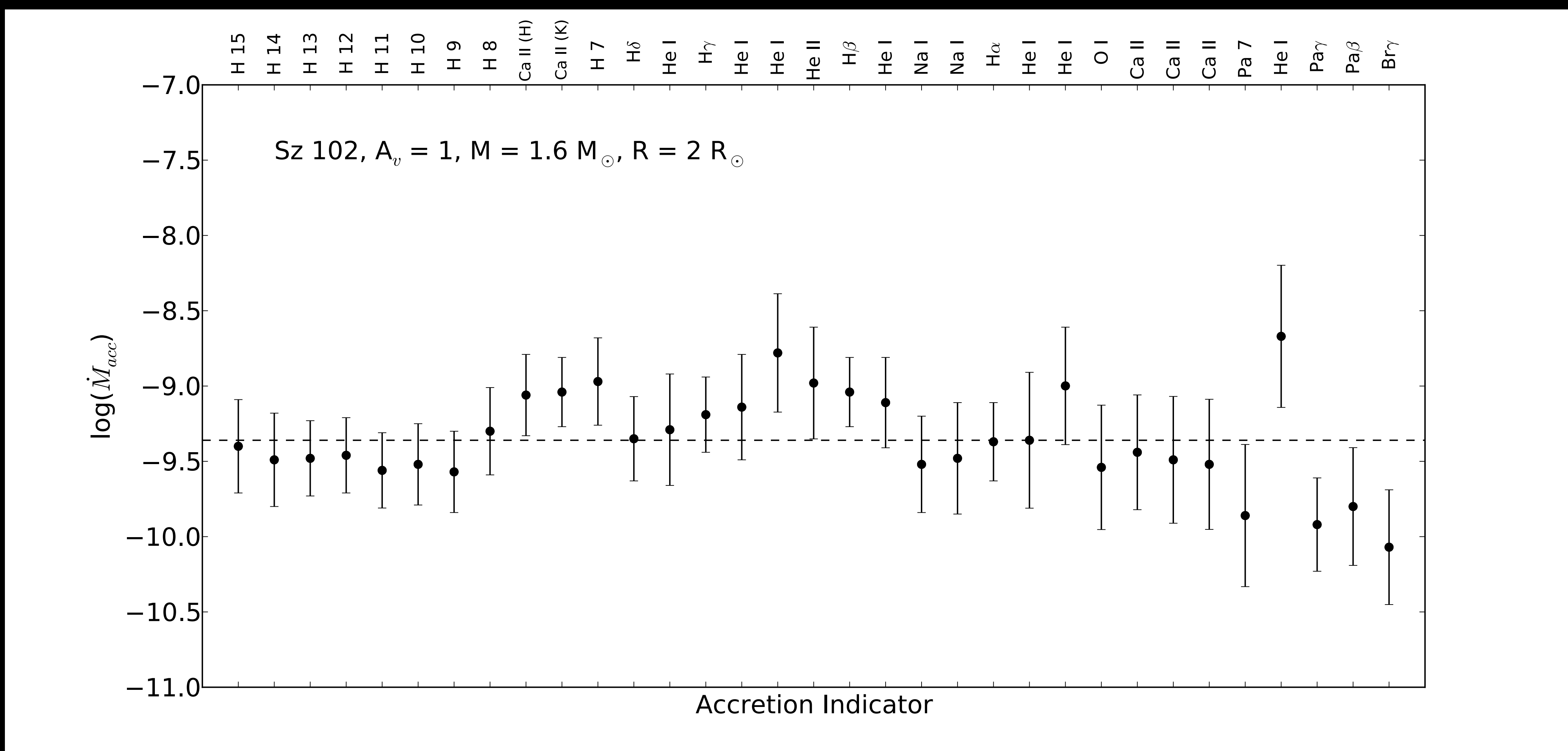
Accretion and Outflow Rates

Alcala + 2014, Stelzer + 2013

Manara + 2015, Rigliaco + 2011, 2012

Spectral Type and Extinction
directly estimated from X-Shooter data



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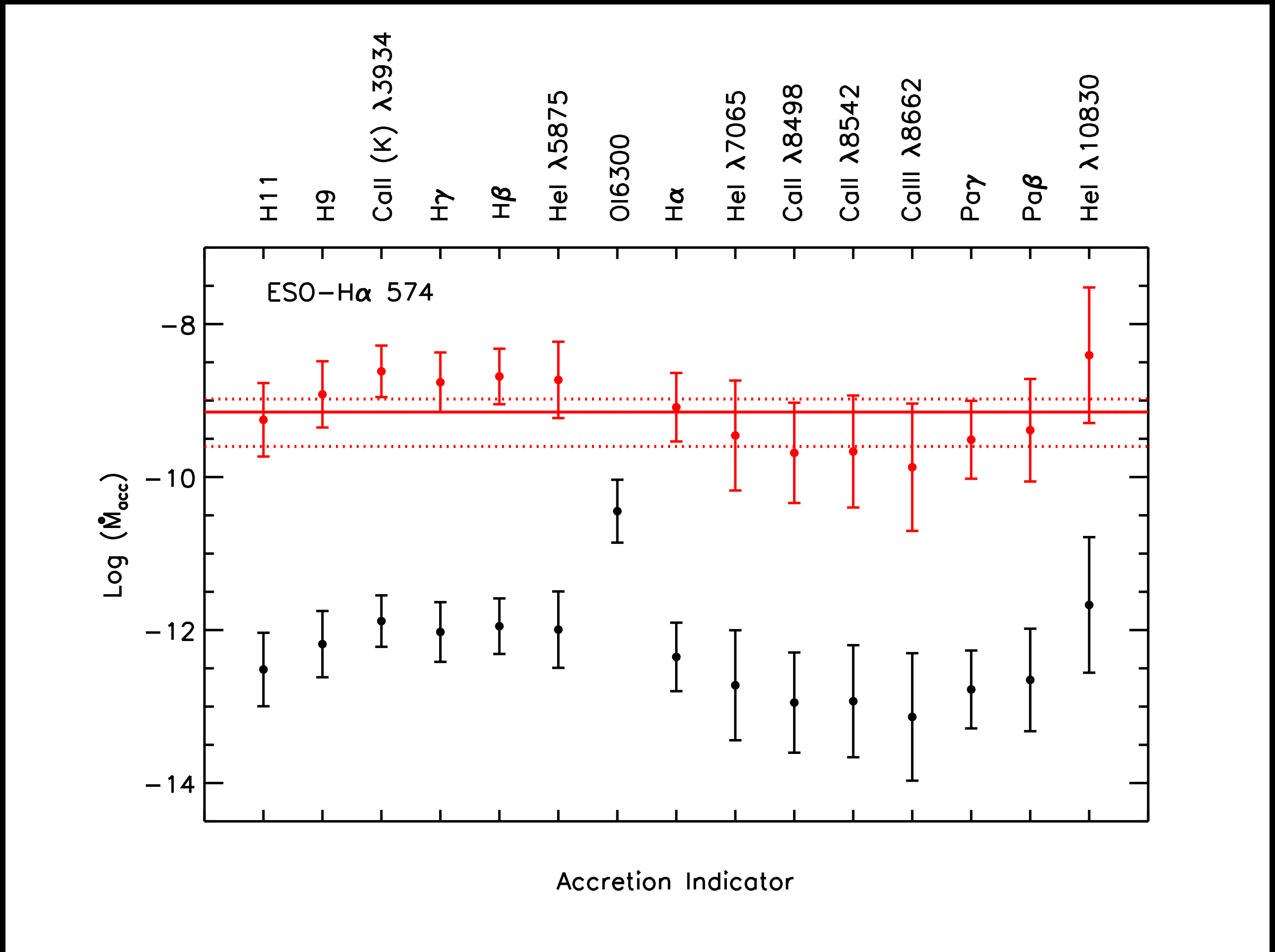
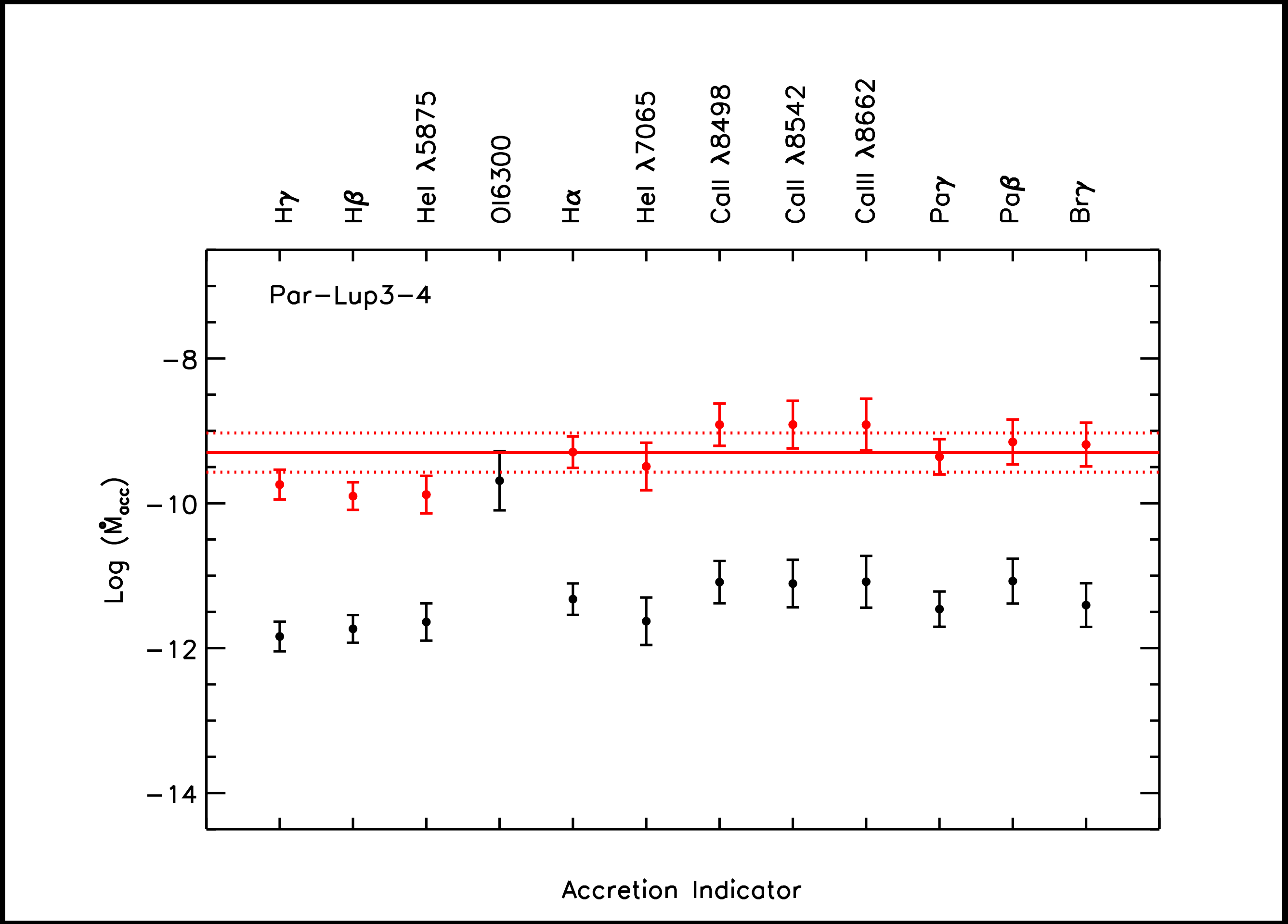
Accretion and Outflow Rates

Whelan +. 2014a

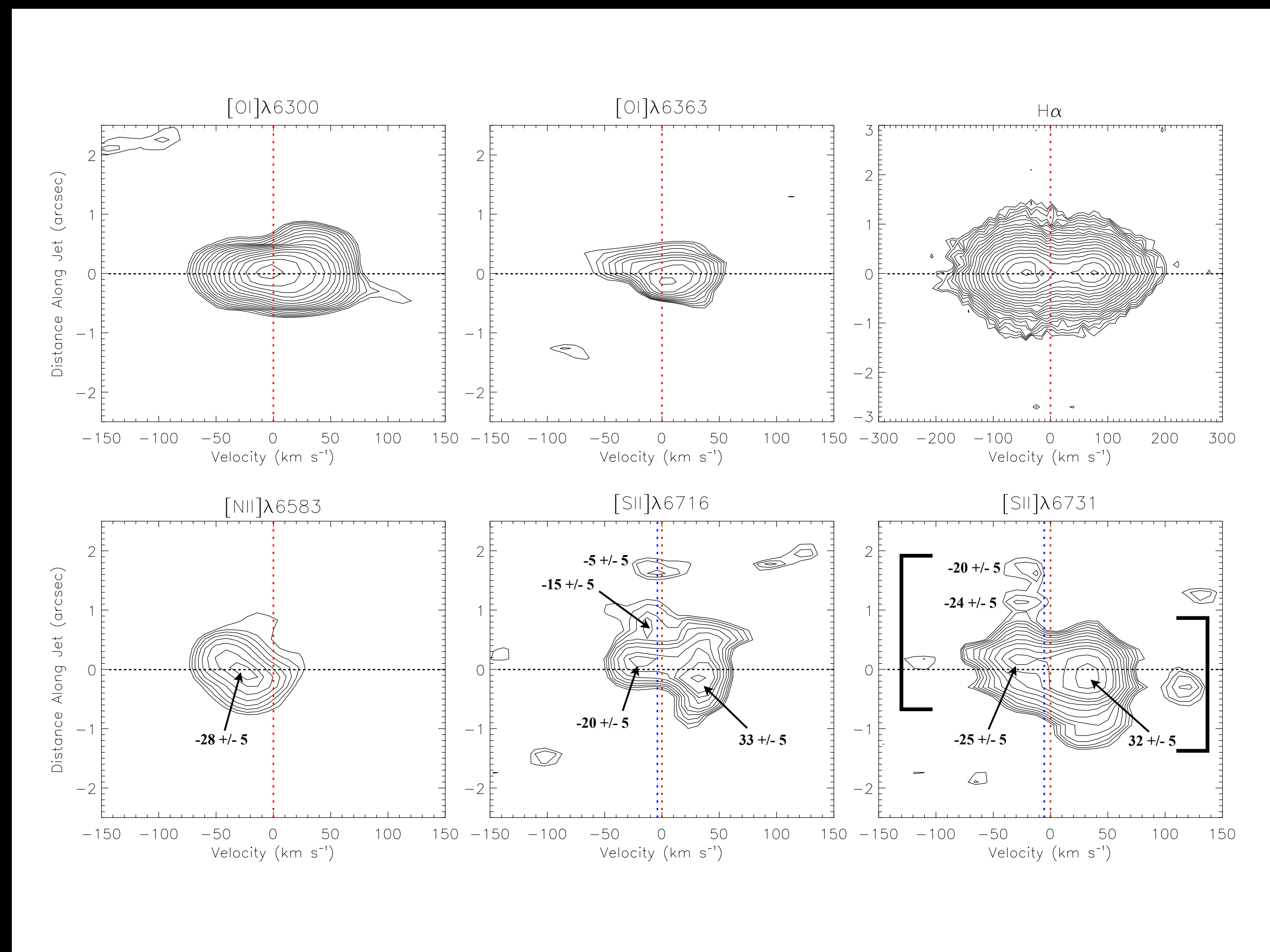




Outflow and Accretion Rates

Whelan +. 2014b

Outflow Efficiency in Brown Dwarfs



Jet extinction can be estimated from
NIR Fe lines

Outflow and Accretion Rates

Whelan +. 2014b

Outflow Efficiency in Brown Dwarfs

Table 2. Jet physical parameters and $\dot{M}_{out}$ for the ISO-ChaI 217 blue and red jets.

A_v (mag)	0.0	1.0	2.5
n_e Blue (cm^{-3})	4610	4700	4920
n_e Red (cm^{-3})	5490	5630	5750
T_e Blue (10^4 K)	2.15	2.24	2.34
T_e Red (10^4 K)	1.63	1.71	1.81
x_e Blue	0.078	0.063	0.048
x_e Red	0.045	0.040	0.034
n_H Blue (10^4 cm^{-3})	6.0 ± 0.8	7.5 ± 1.0	10.3 ± 1.4
n_H Red (10^4 cm^{-3})	12.2 ± 4.4	14.0 ± 5.0	17.0 ± 6.2
Method B			
L_{SII} Blue (10^{-8} $L_{\odot}$)	1.1 ± 0.3	2.3 ± 0.4	5.6 ± 1.0
L_{SII} Red (10^{-8} $L_{\odot}$)	1.4 ± 0.3	2.8 ± 0.5	6.9 ± 1.2
$\dot{M}_{out}$ (10^{-12} $M_{\odot}yr^{-1}$) Blue	0.7 ± 0.2	1.4 ± 0.3	3.3 ± 0.7
$\dot{M}_{out}$ (10^{-12} $M_{\odot}yr^{-1}$) Red	1.2 ± 0.5	2.3 ± 0.9	5.3 ± 2.1
($\dot{M}_{out}$ Blue + $\dot{M}_{out}$ Red)/$\dot{M}_{acc}$	0.05 (+0.07)(−0.02)	0.09 (+0.14)(−0.04)	0.20 (+0.30)(−0.09)

Notes. A_v here refers to the extinction of the jet and the calculations are made for three values of A_v to investigate the dependence on the jet extinction. The mean value of $\dot{M}_{acc}$ ($\dot{M}_{acc}$ mean = 4×10^{-11} $M_{\odot}$ yr^{-1}) is used to calculate $\dot{M}_{out}/\dot{M}_{acc}$ and $\dot{M}_{acc}$ is derived from the fluxes of the accretion tracers listed in Fig. 8 corrected for an on-source extinction 2.5 ± 0.3 mag.

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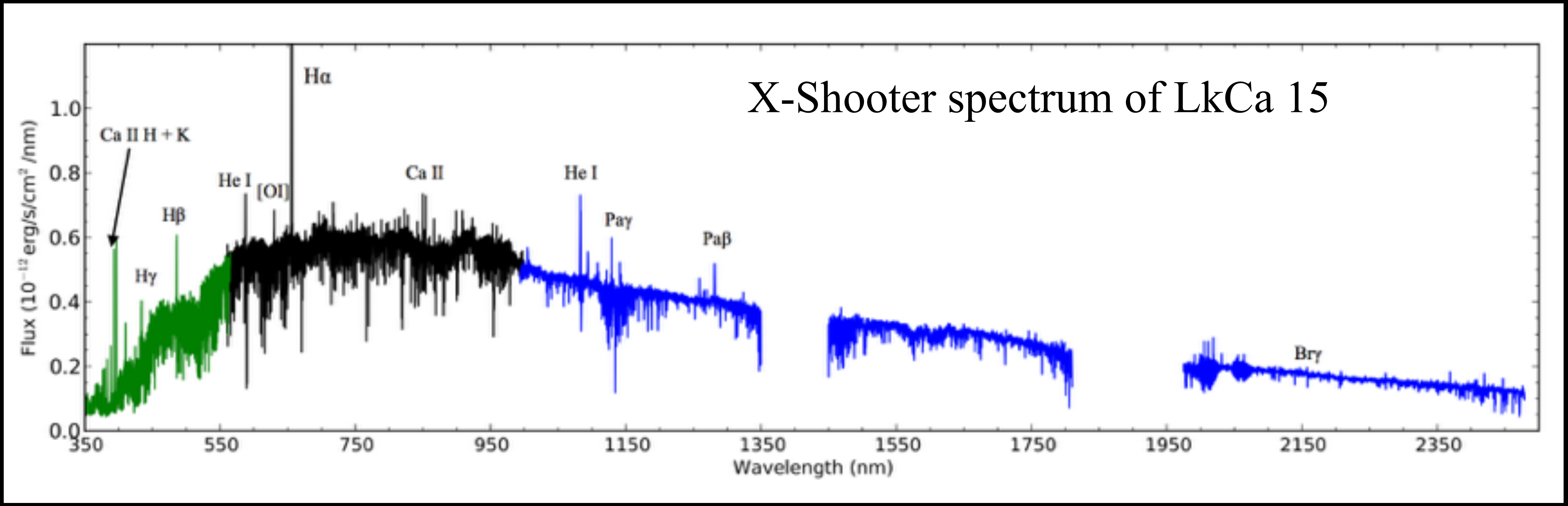
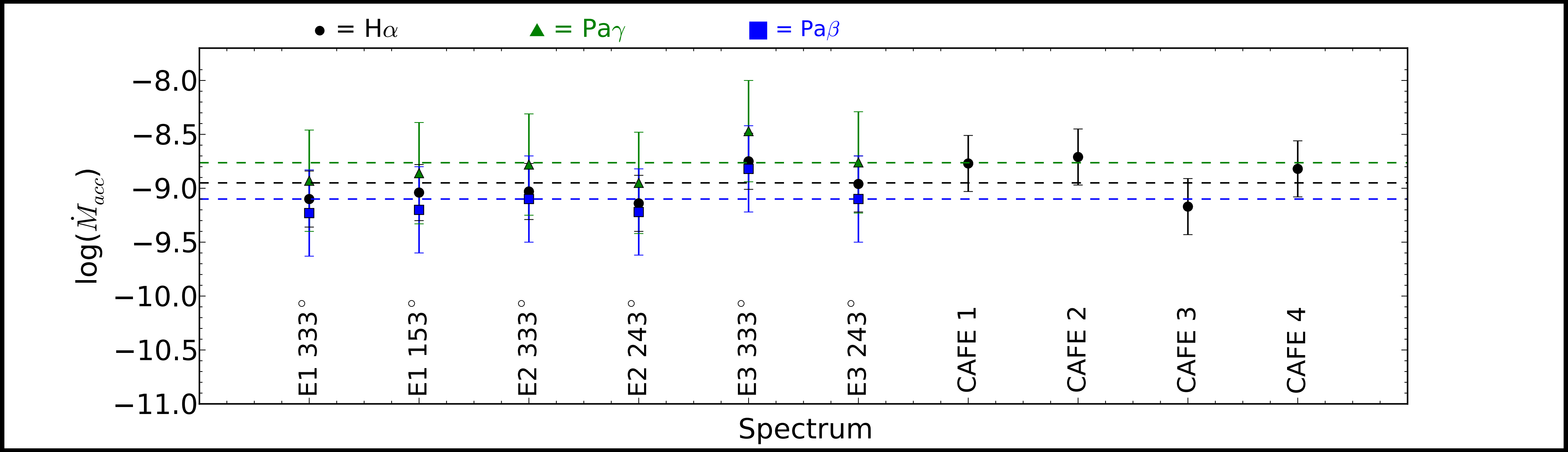
LkCa 15

Whelan +. 2015





Summary

Morphology and Kinematics: Compare kinematics and morphology in many lines eventual high. ang. res. of MUSE will be a big advantage, edge-on disks, precession, proper motions, asymmetries

Diagnostics: Important for jet launching models, X-Shooter ideal for this, access to high excitation lines like [Ne III] or He I 1μm, Fe lines are a new tool. Although MUSE has a shorter wavelength range it brings 2D perspective and high. ang. res.

Outflow and Accretion Rates: X-Shooter dominates here as can use the broadband to estimate A_v source, A_v jet and spectral type. Many lines can be used to estimate M_{acc} . Sensitive enough to easily detect BD jets.