ACCRETION AND OUTFLOW ACTIVITY IN YOUNG CLUSTERS AND THE PROBLEM OF SKY SUBTRACTION

Rosaria (Sara) Bonito

Dipartimento di Fisica e Chimica
Universita' degli Studi di Palermo
INAF-Osservatorio Astronomico di Palermo

Loredana Prisinzano INAF - OAPa
Mario Guarcello INAF - OAPa
Elisabetta Rigliaco ETH Zurich
Germano Sacco INAF - OAA
Giusi Micela INAF - OAPa
... (project on wiki)

YOUNG CLUSTERS IN GES

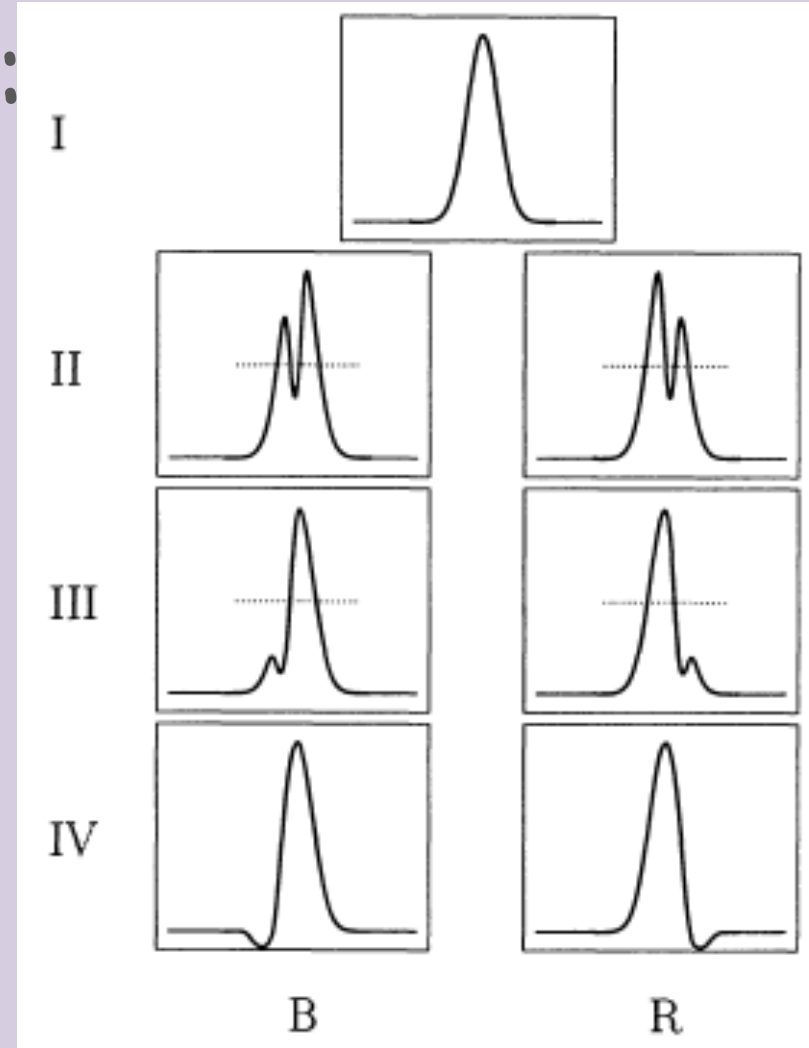
- Study of accretion/outflow activity in young cluster members (Hα and forbidden emission lines, FELs)

- Method for Objects with Hα emission and strong Nebular contribution to Accretion/outflow activity (OHaNA) (several GES clusters: NGC 2264, NGC 6530 – Prisinzano et al. 2007, NGC 6611 – Bonito et al. 2013, ...)

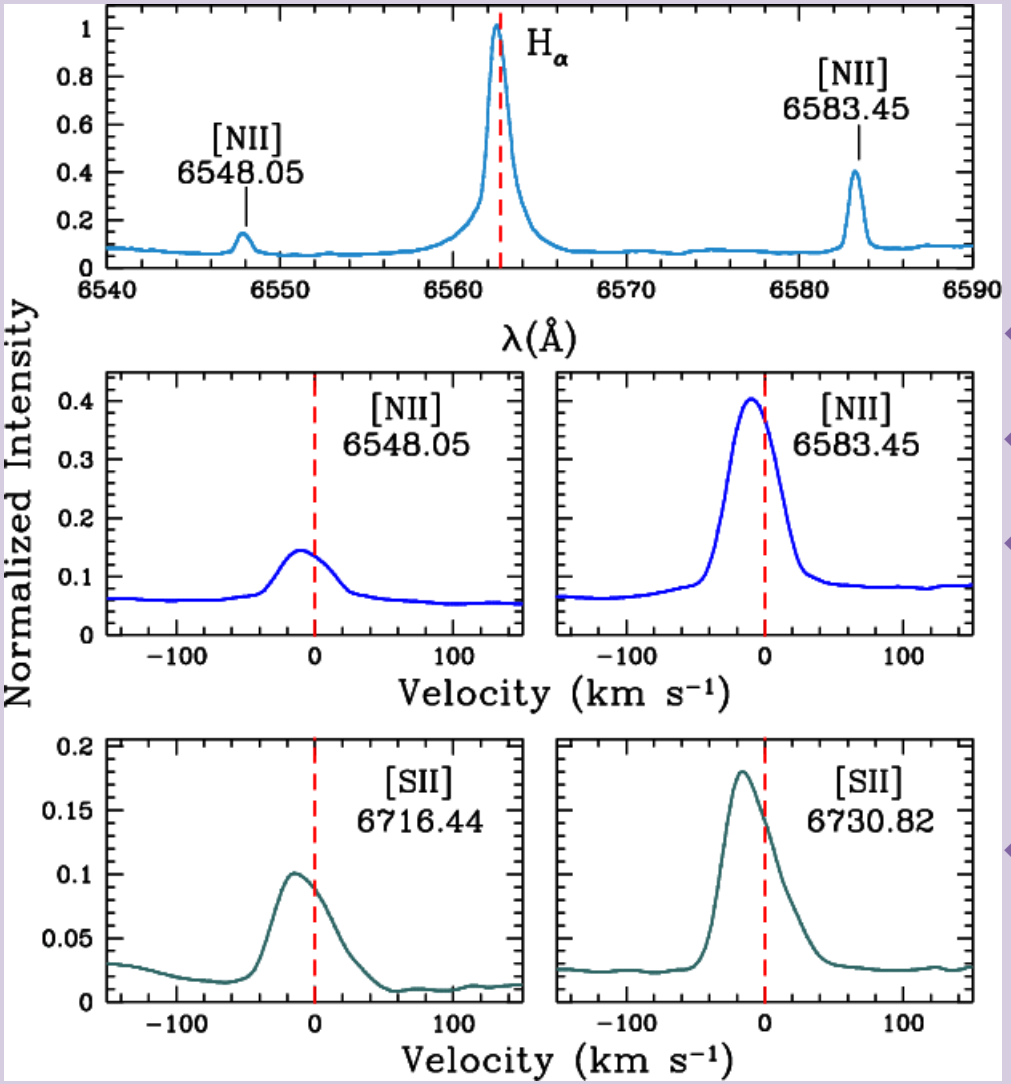
Hα EMISSION LINE AND ACCRETION/OUTFLOW

- proxy accretion/outflow: Hα emission line

(Reipurth et al. 1996)



FORBIDDEN EMISSION LINES (FELs) AND OUTFLOW



σ Ori
(Rigliaco et al. 2009)

- identify outflow
- implications on Hα profile
- physical properties from line ratio (n_e, $\dot{M}_{wind}$, ...)
- variability analysis

SELECTED OBJECTS

- GES + Chandra + COROT data
  - CSI 2264 project (P.I. G. Micela – J. Stauffer)
  - M. Guarcello

    (with E. Flaccomio: Guarcello et al. in prep.)

- Spurious lines due to sky subtraction
- Herbig Haro objects (protostellar jets)

SELECTED OBJECTS

(More selected: "gir" Vs. "gar")

cNAME	Ha_class*	Ha_intr*
06411725+0954323	E	1
06410577+0948174	E	1
06405884+0930573	EE	1
06411678+0927301	EE	1
06403164+0948233	EE	1
06405159+0928445	E	1
06413656+0921514	N	NULL
06404487+1014114	EE	1
18040429-2425040	EN	1
18042795-2427599	E	1

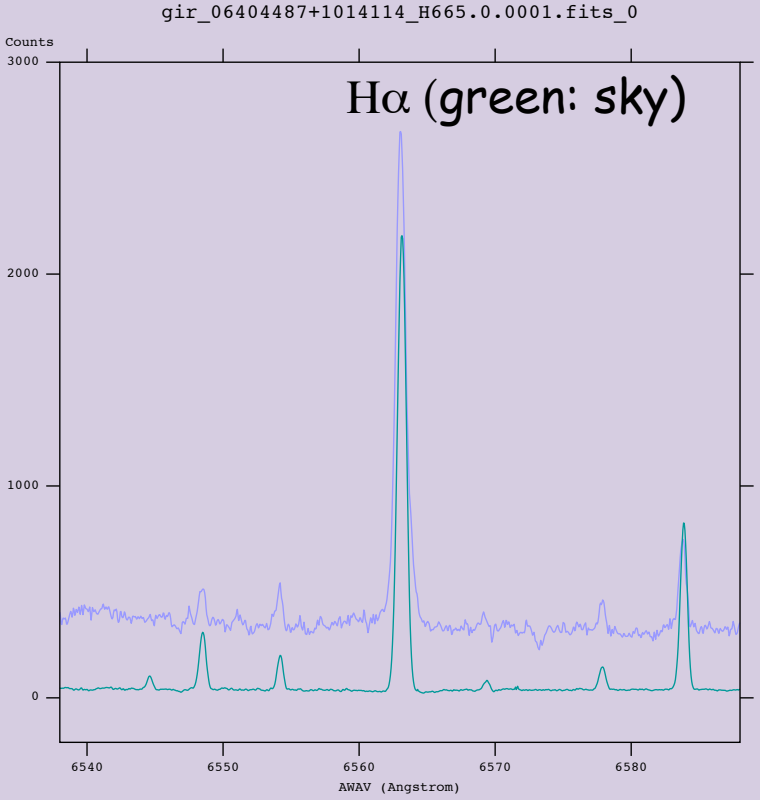
(*see also T. Zwitter's talk andTraven et al. in prep.)

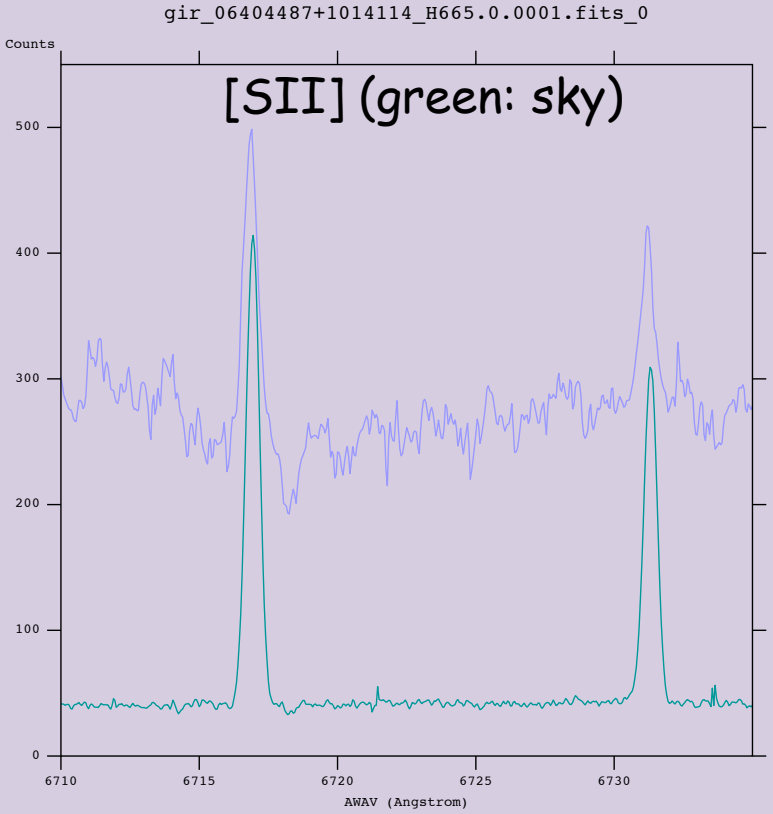
SELECTED OBJECTS

cNAME	Ha_class	Ha_intr	
06411725+0954323	E	1	
06410577+0948174	E	1	
06405884+0930573	EE	1	
06411678+0927301	EE	1	X-ray
06403164+0948233	EE	1	
06405159+0928445	E	1	
06413656+0921514	N	NULL	Nebular
06404487+1014114	EE	1	HH jet
18040429-2425040	EN	1	HH jet
18042795-2427599	E	1	E

SKY SUBTRACTION & EMISSION LINES

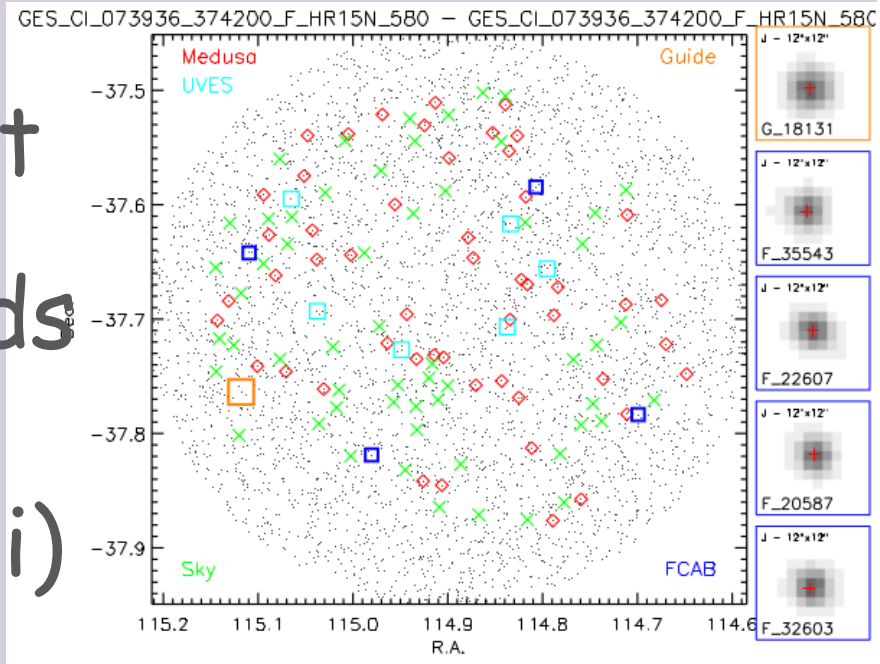
- Nebular contribution to both Hα and FELs
  - Strongly varying in space and time
  - Narrower than stellar (Hα)





STRATEGY

- sky fiber near each object
  - possible for sparse fields (e.g. NGC 2451 A & B OBs Bonito & Franciosini)

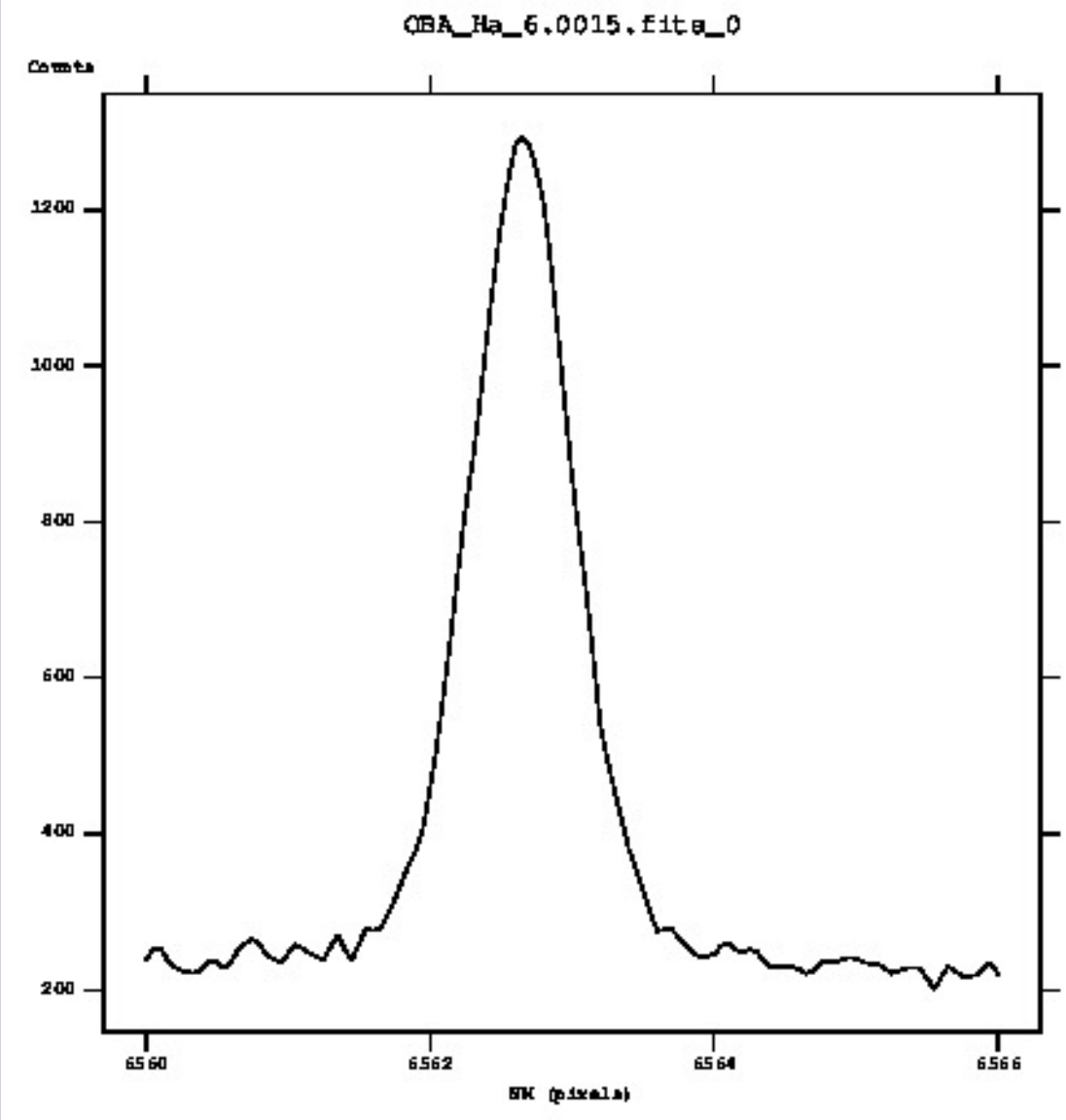


- FWZI method (as EW and $H\alpha_{10\%}$ cannot be derived)

Automatic procedure

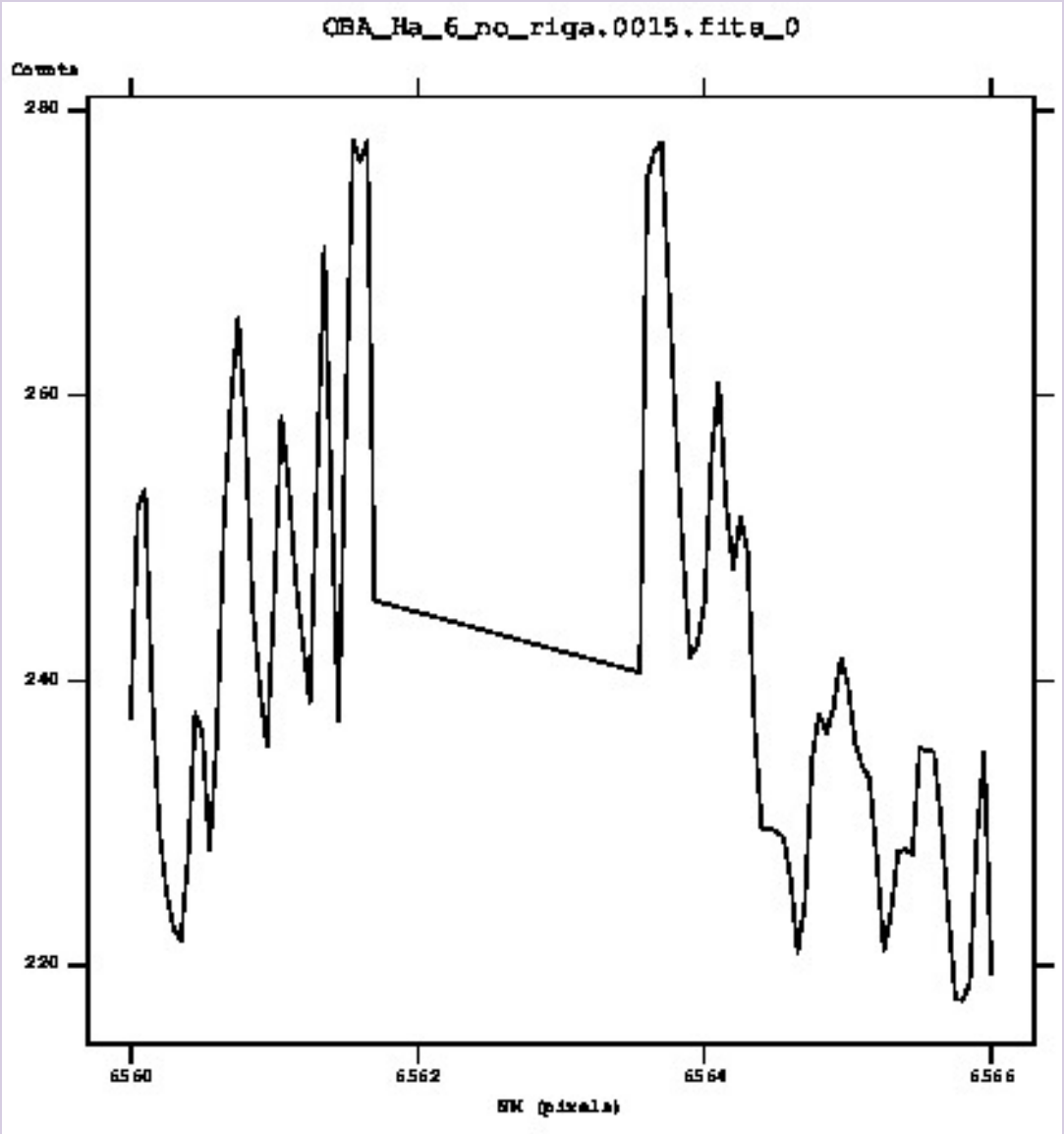
FWZI METHOD (1)

- Zoom around Hα in sky spectra



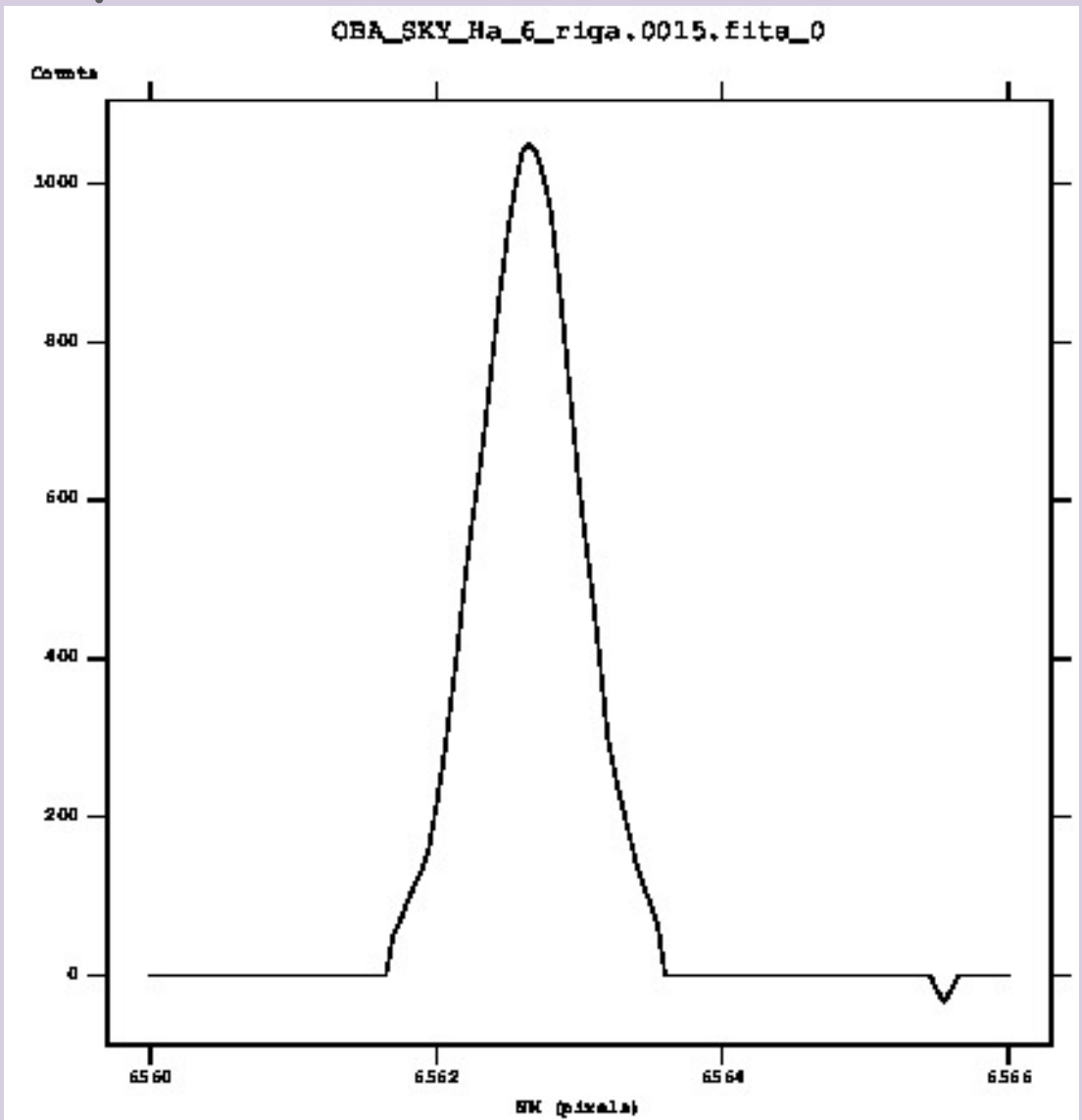
FWZI METHOD (2)

- Normalize: spectrum without the emission line



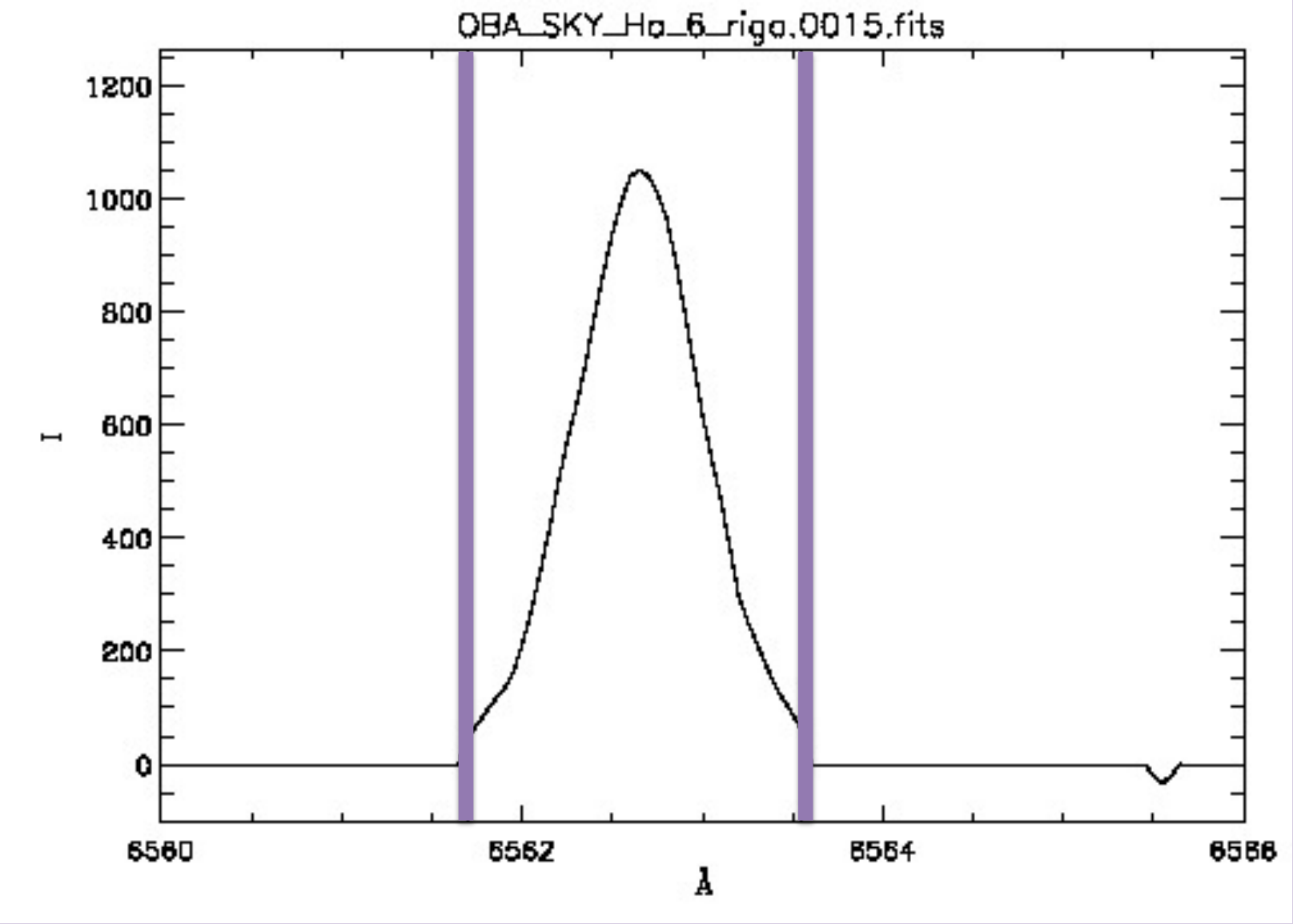
FWZI METHOD (3)

- Difference or ratio original spectrum/spectrum without the emission line



FWZI METHOD (4)

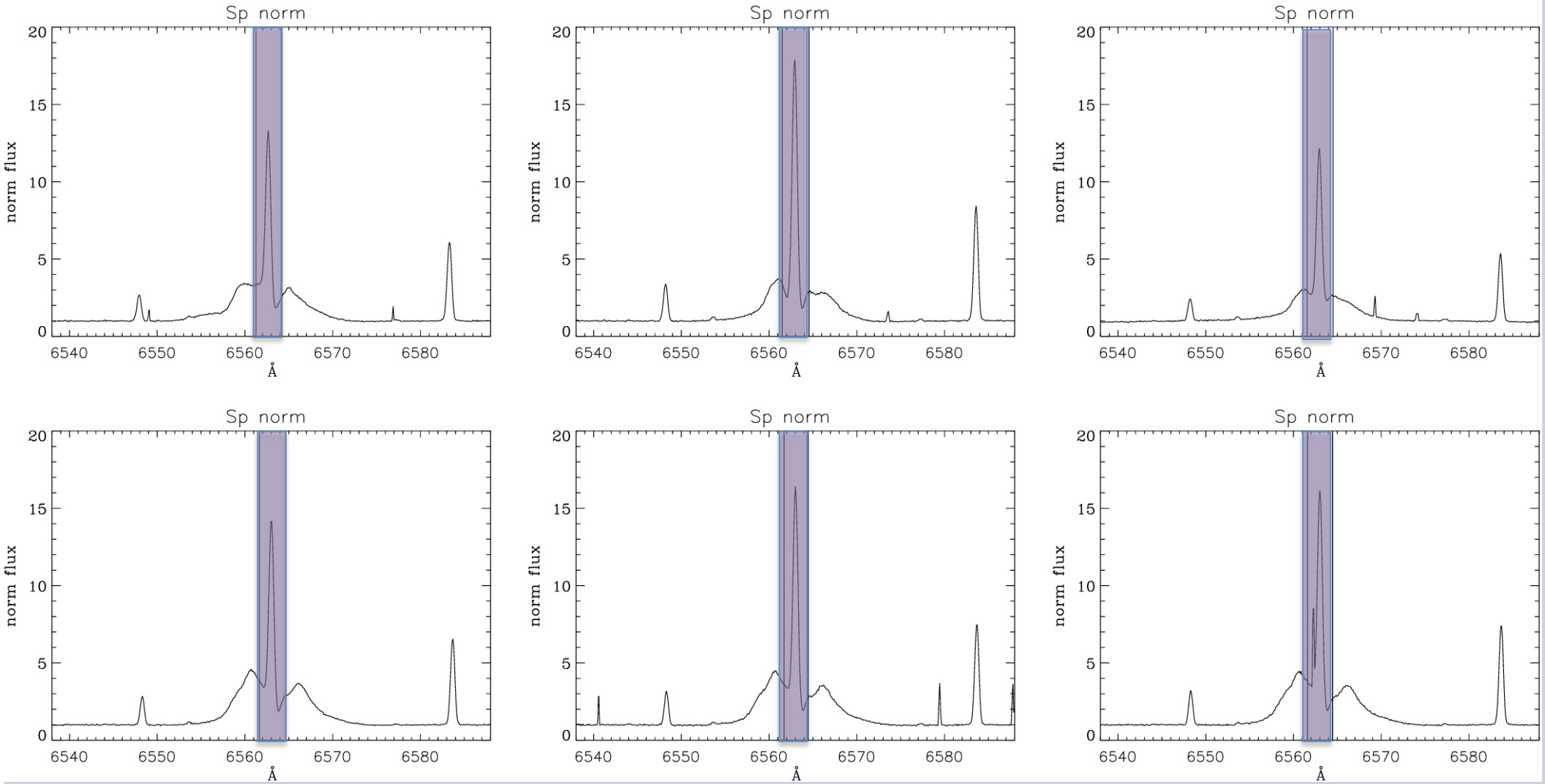
- FWZI(Hα) sky < 3 Å



FWZI(Hα) & ACCRETION

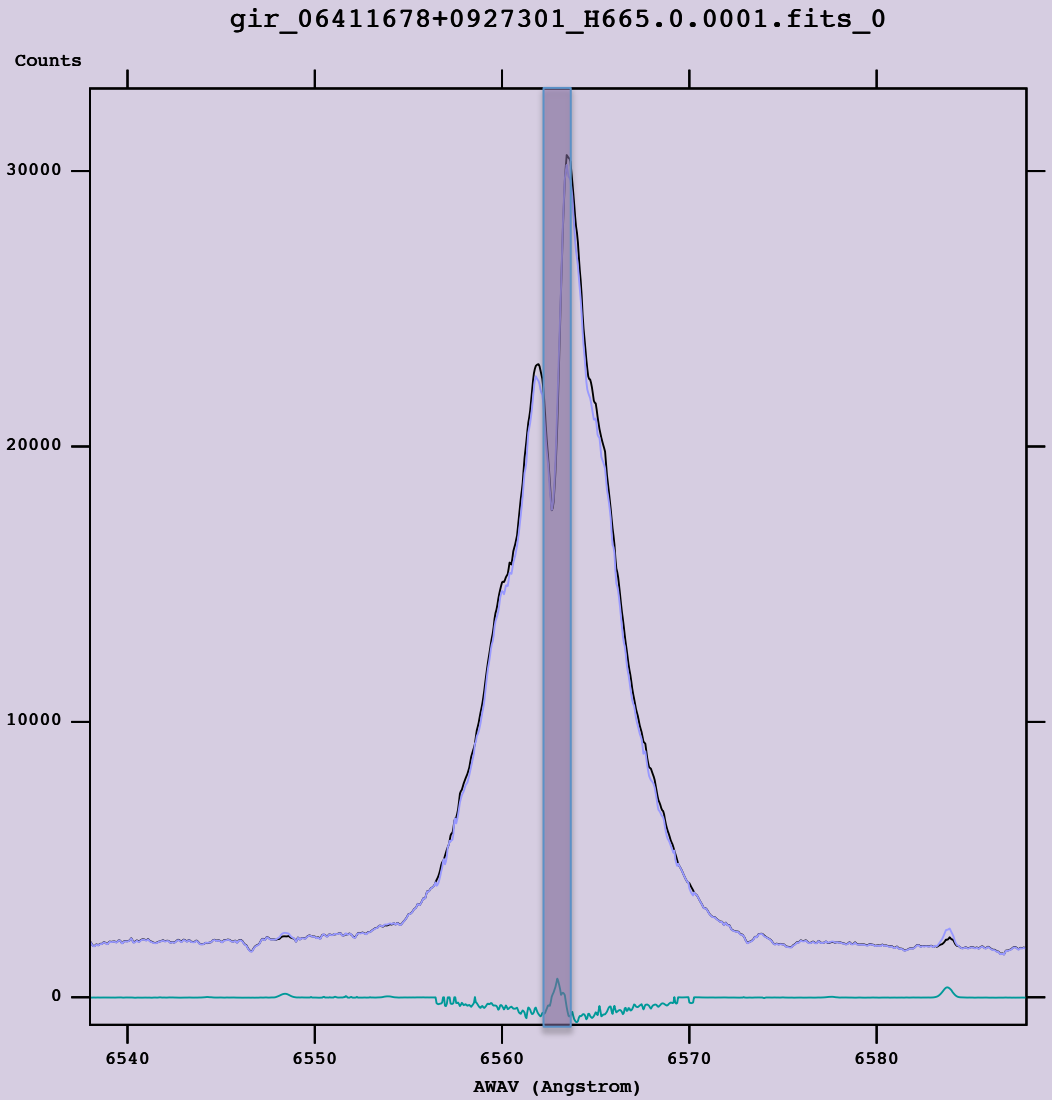
- FWZI(Hα) star >> FWZI(Hα) sky

(NGC 6611, Bonito et al. 2013)



FWZI(Hα) & ACCRETION

- FWZI(Hα) star >> FWZI(Hα) sky



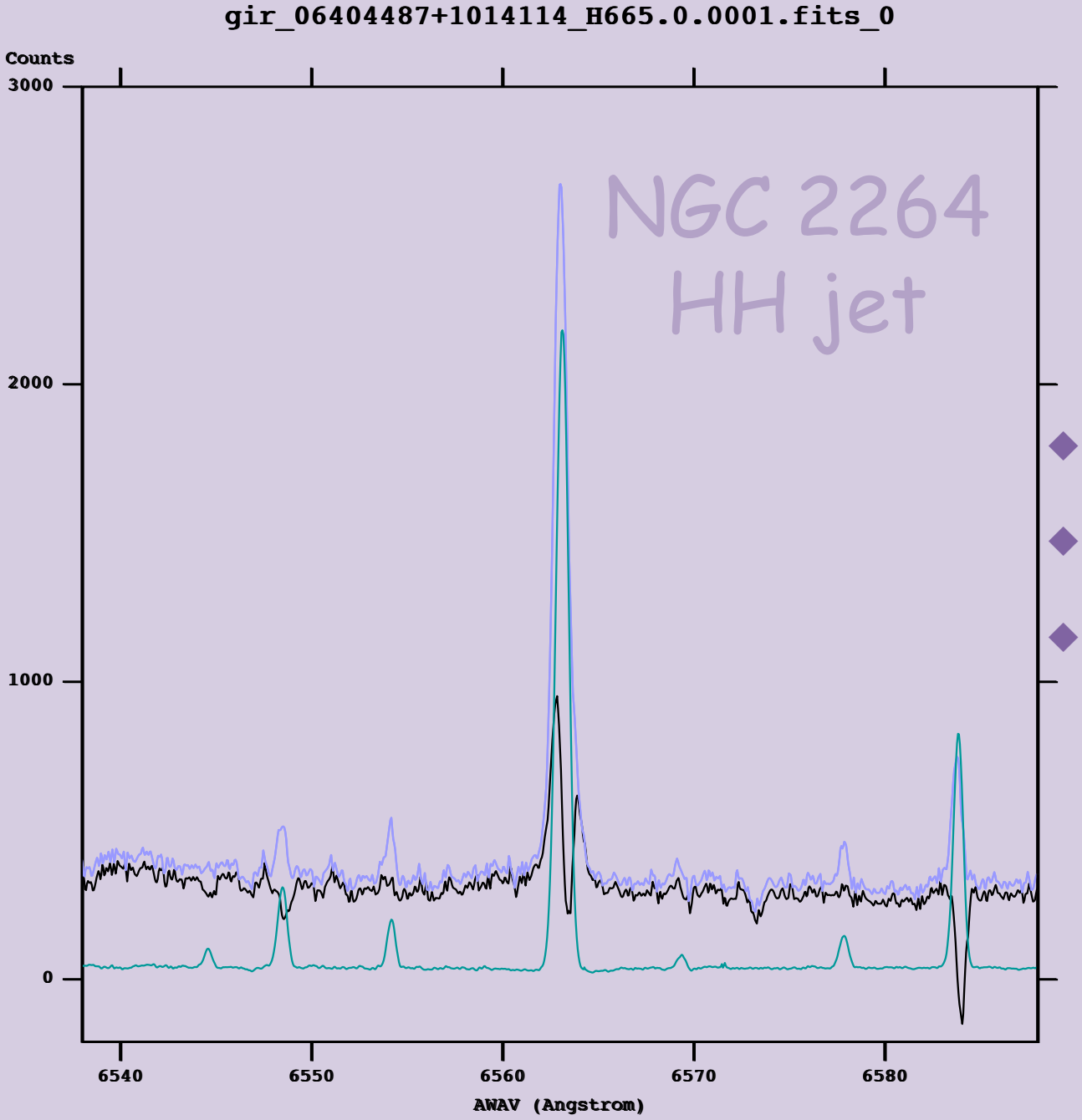
NGC 2264: X-ray

(Bonito et al. in prep.)

SKY SUBTRACTION: SPURIOUS LINES

- Hα absorption line:
  - ✓ implication on accretion/outflow activity
- [SII] and [NII] absorption lines:
  - ✓ implication on outflow activity
- Ca I absorption line near Li:
  - ✓ implication on age and membership

SKY SUBTRACTION AND Hα + [NII]

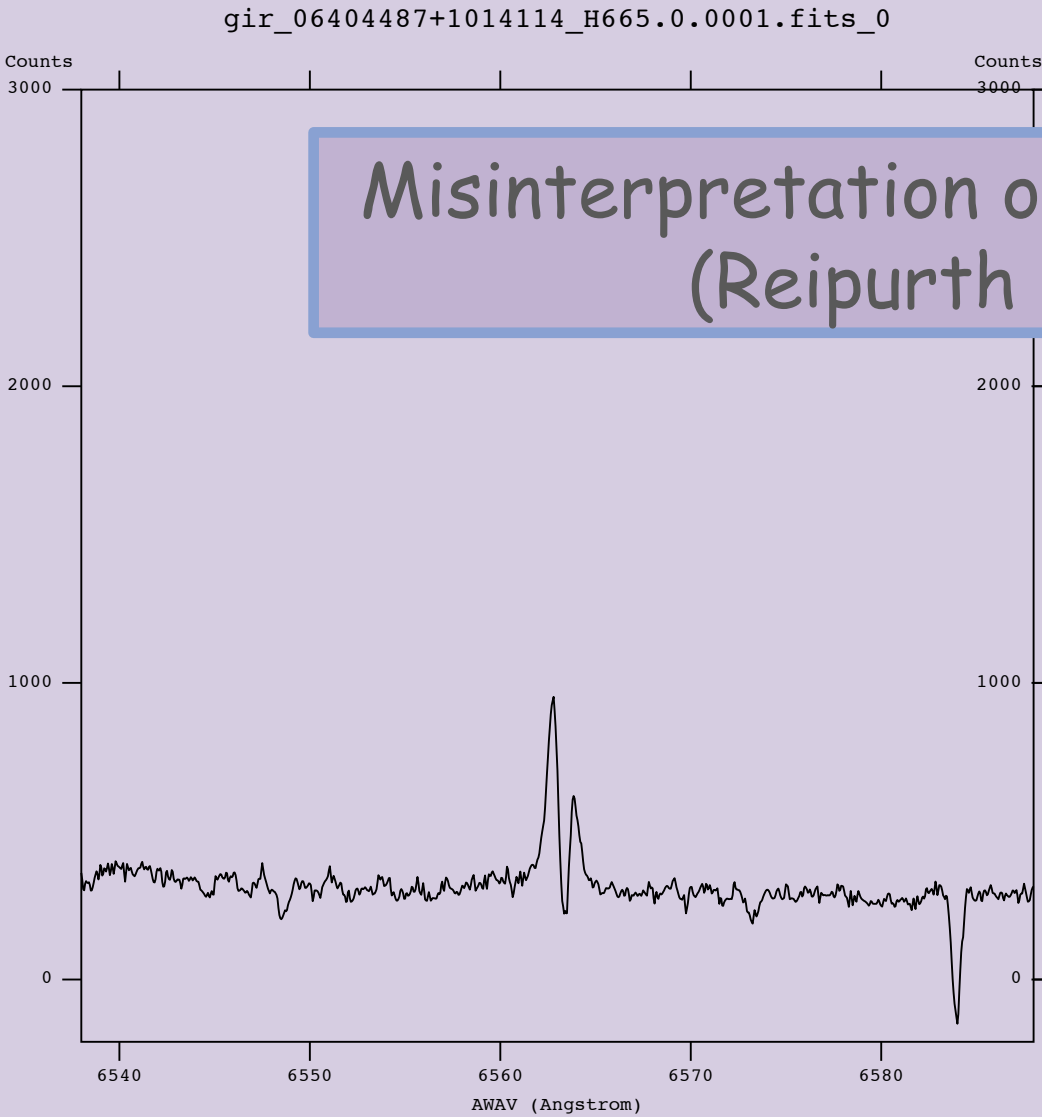


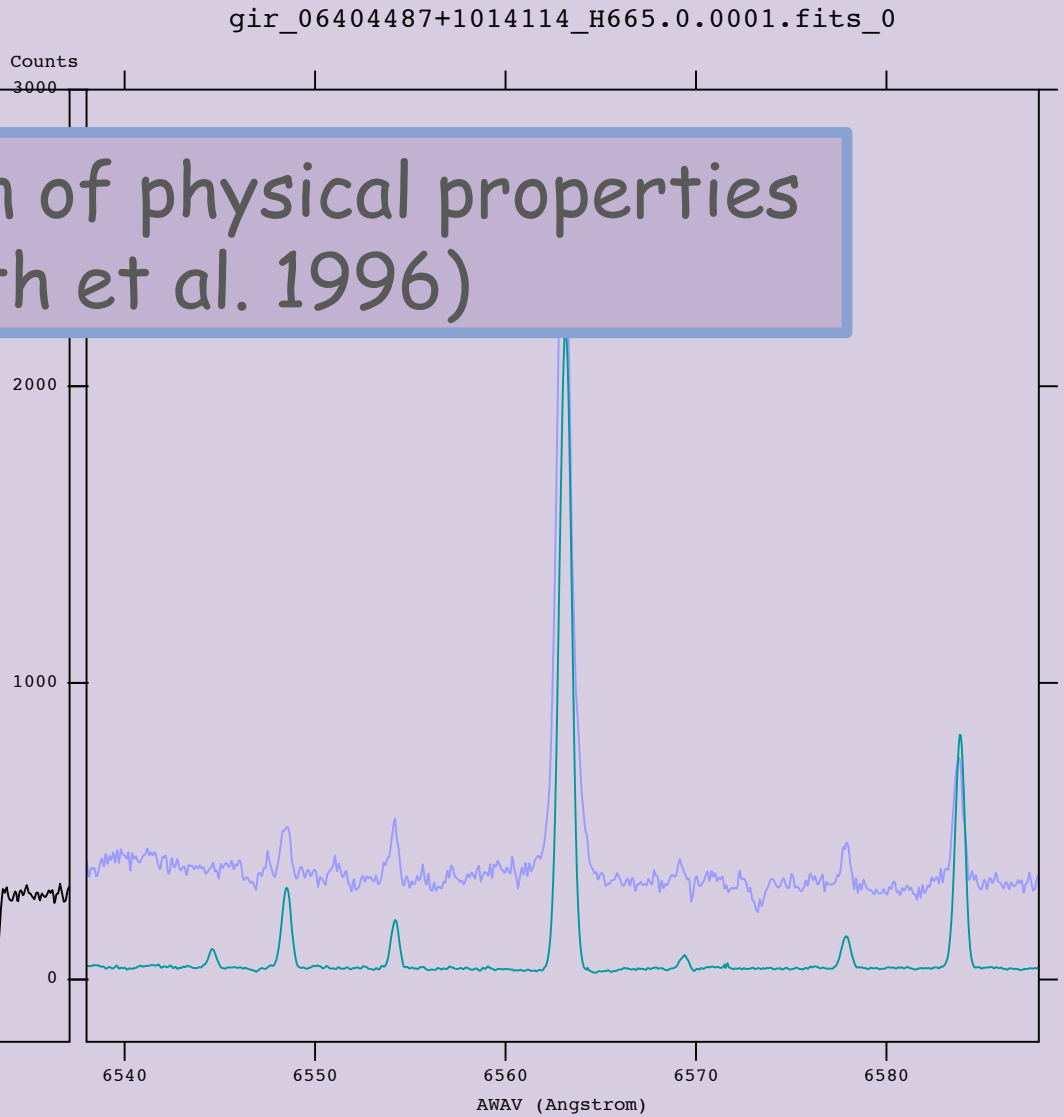
- GES spectrum
- Original spectrum
- SKY spectrum

(Bonito et al. in prep.)

SKY SUBTRACTION AND Hα + [NII]

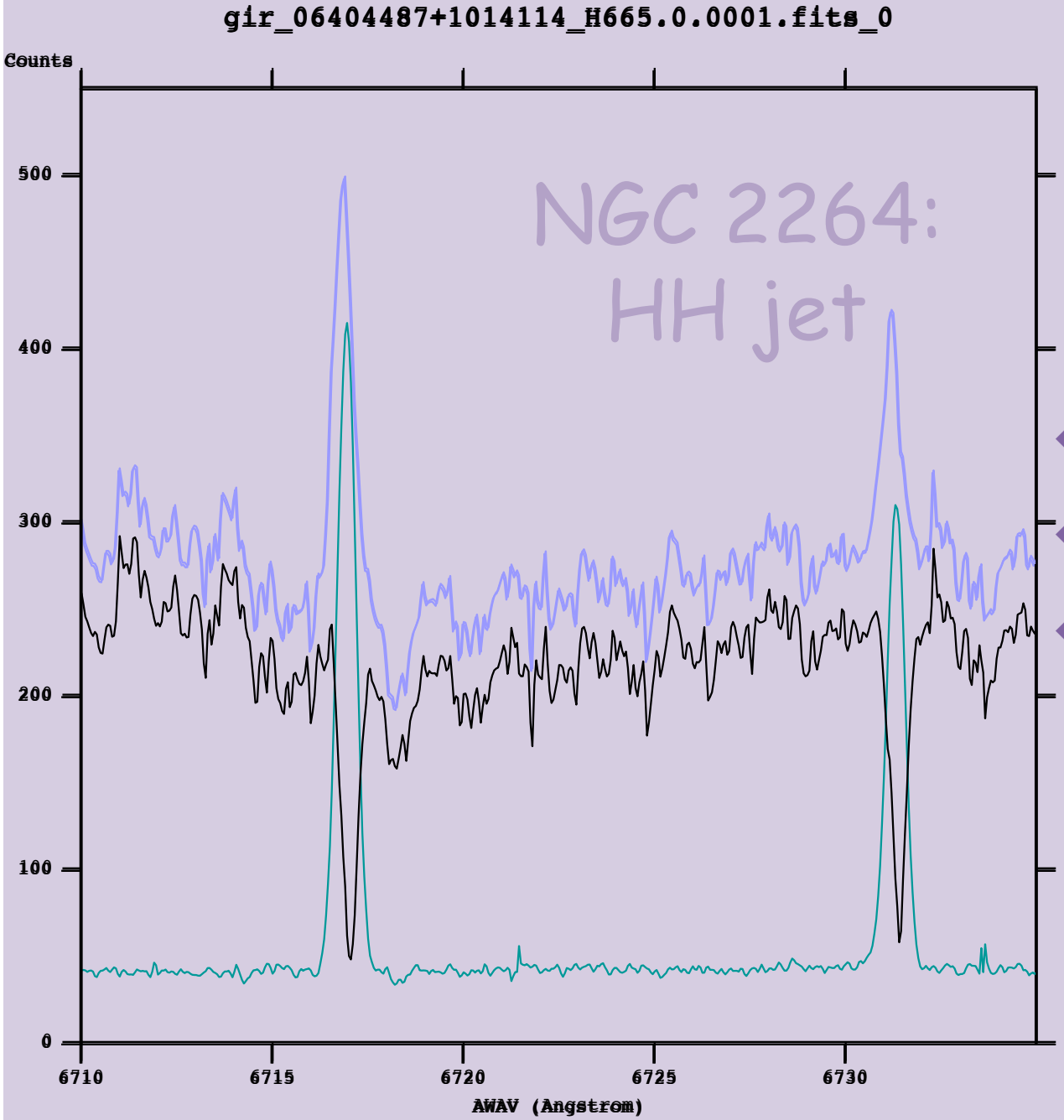
- GES spectrum
- Original spectrum
- SKY spectrum





Misinterpretation of physical properties
(Reipurth et al. 1996)

SKY SUBTRACTION AND [SII]

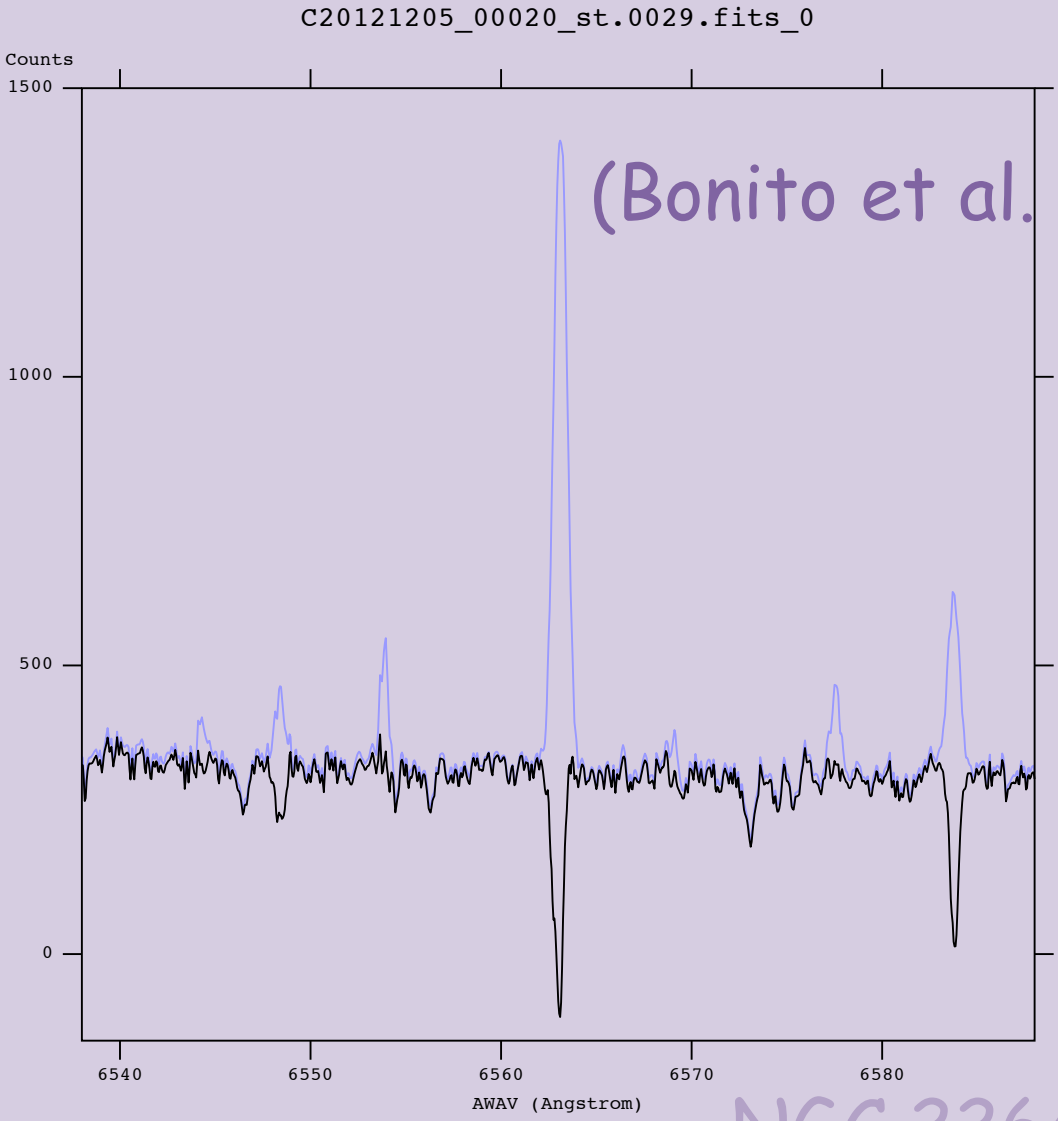


- GES spectrum
- Original spectrum
- SKY spectrum

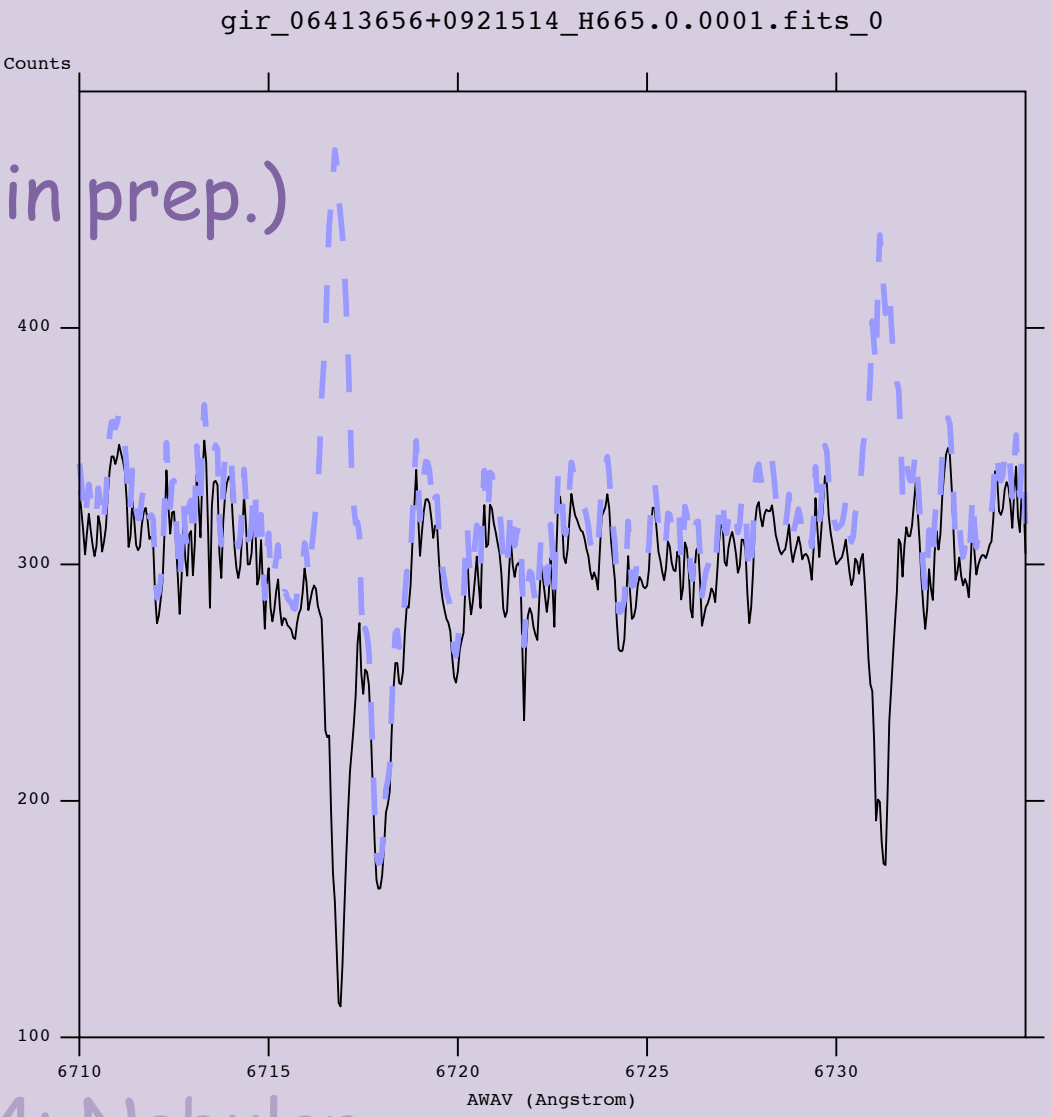
(Bonito et al. in prep.)

SKY SUBTRACTION

- GES spectrum
- Original spectrum



(Bonito et al. in prep.)



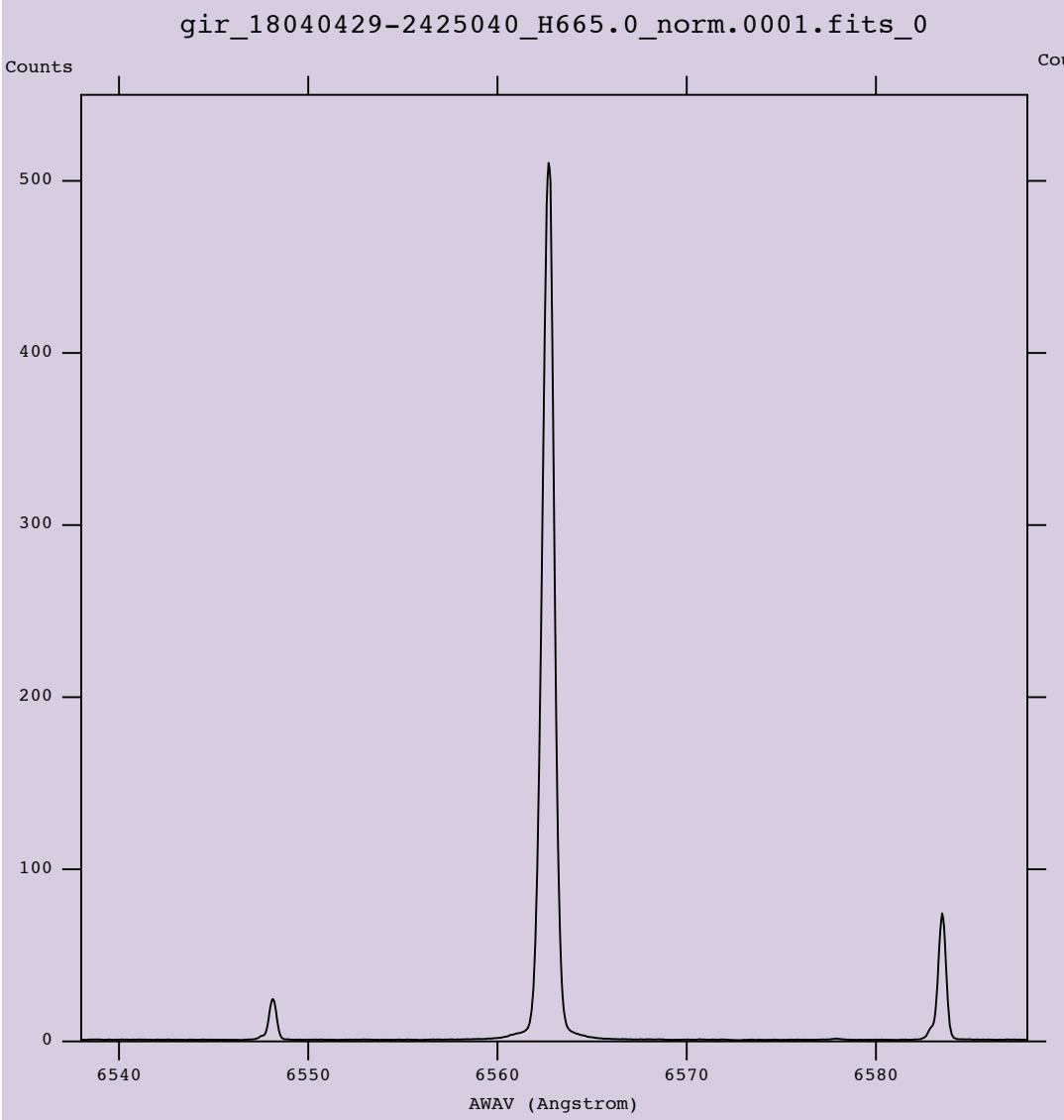
NGC 2264: Nebular

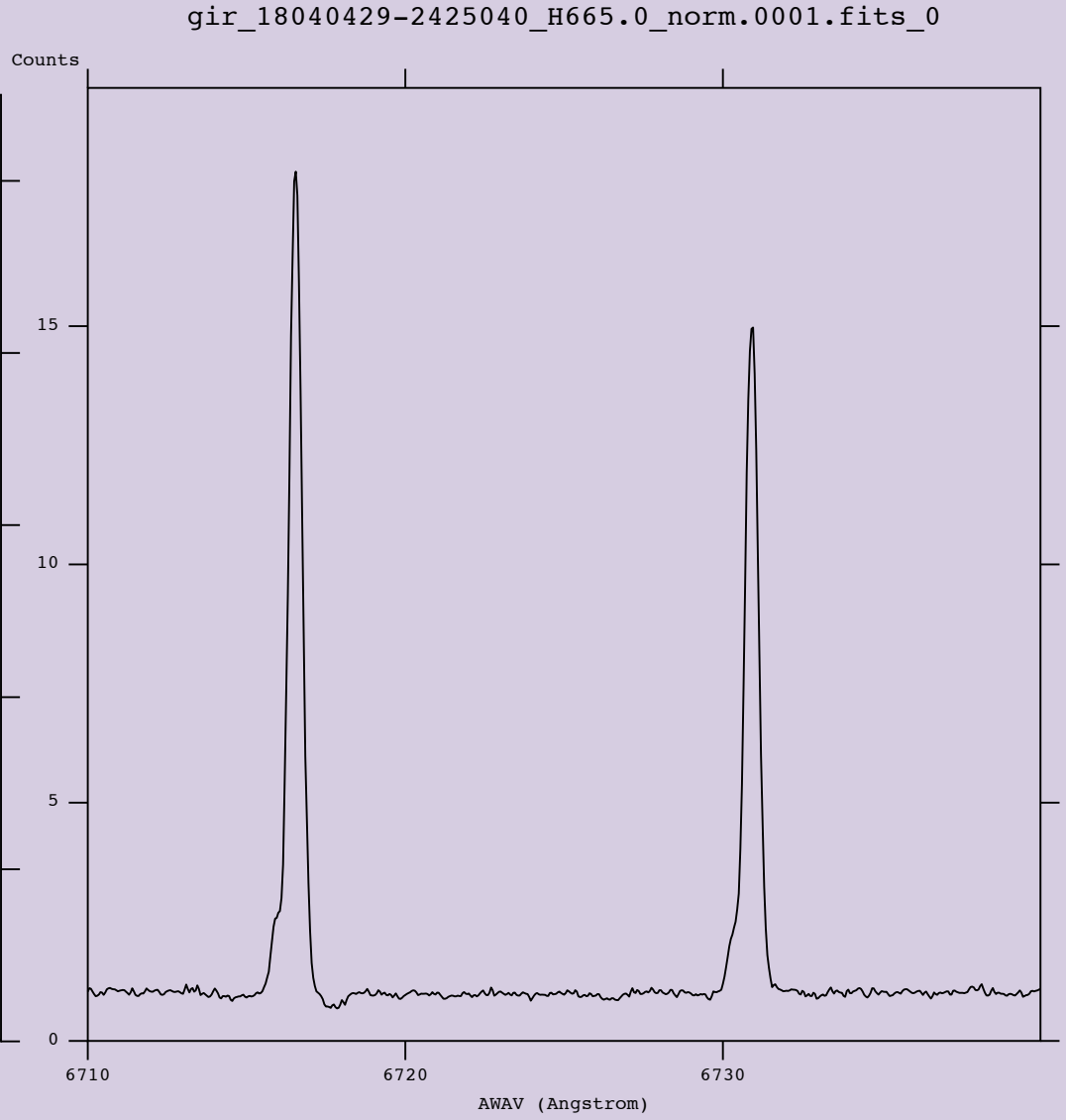
(Ha_class = N, Traven et al. in prep.)

RESULTS

(Bonito et al. in prep.)

NGC 6530
HH jet, EN



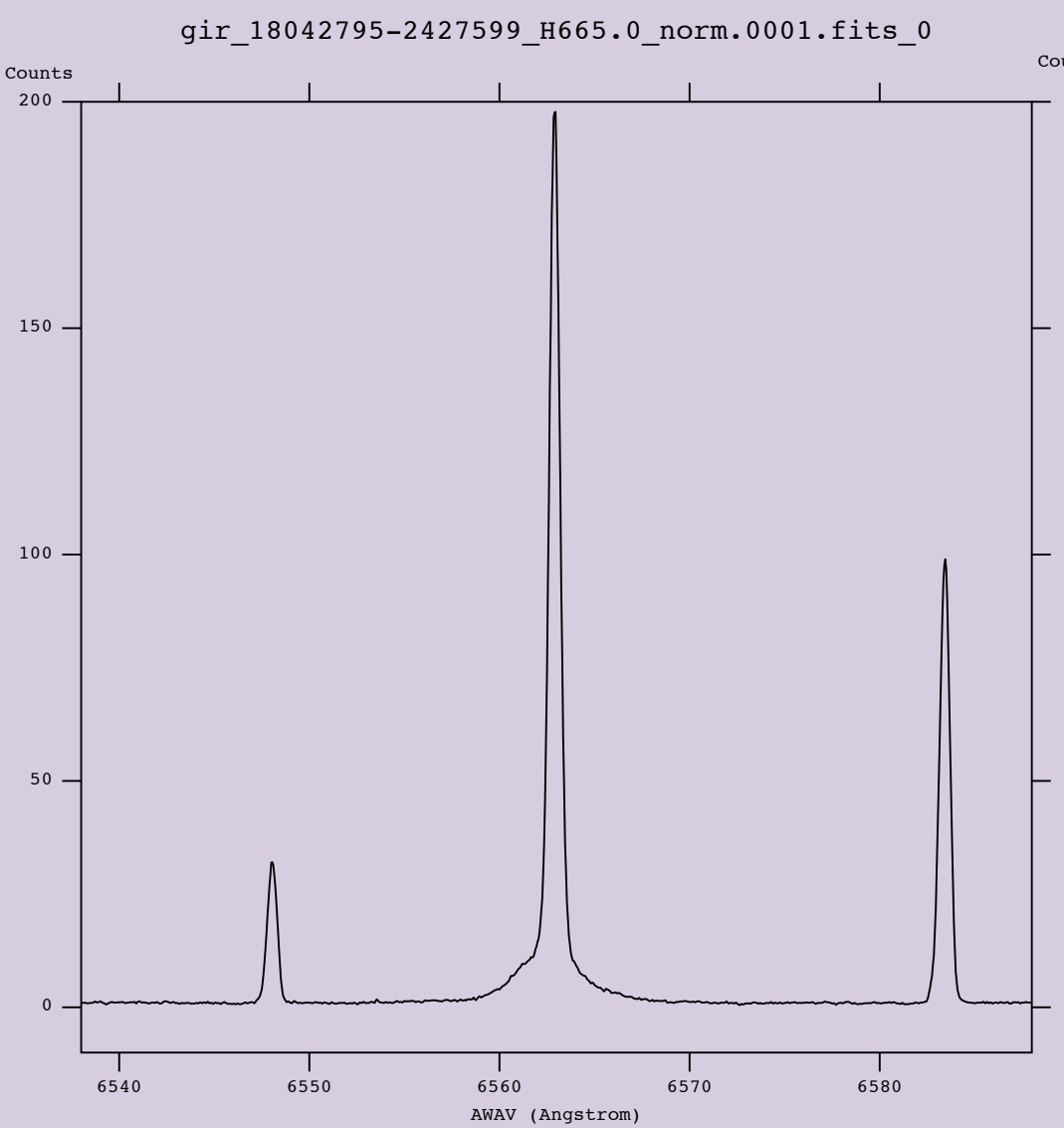


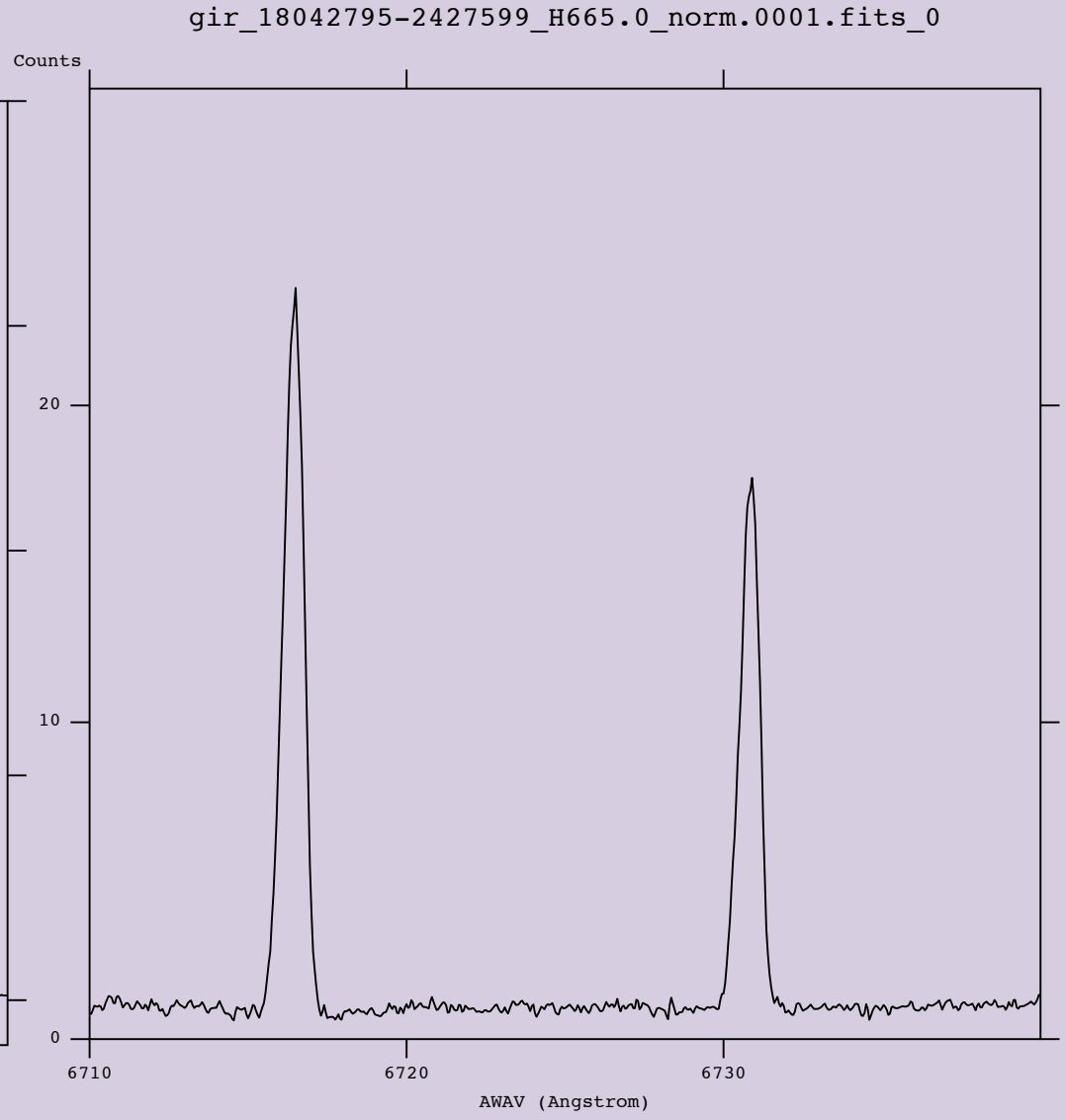
RESULTS

(Bonito et al. in prep.)

NGC 6530

E

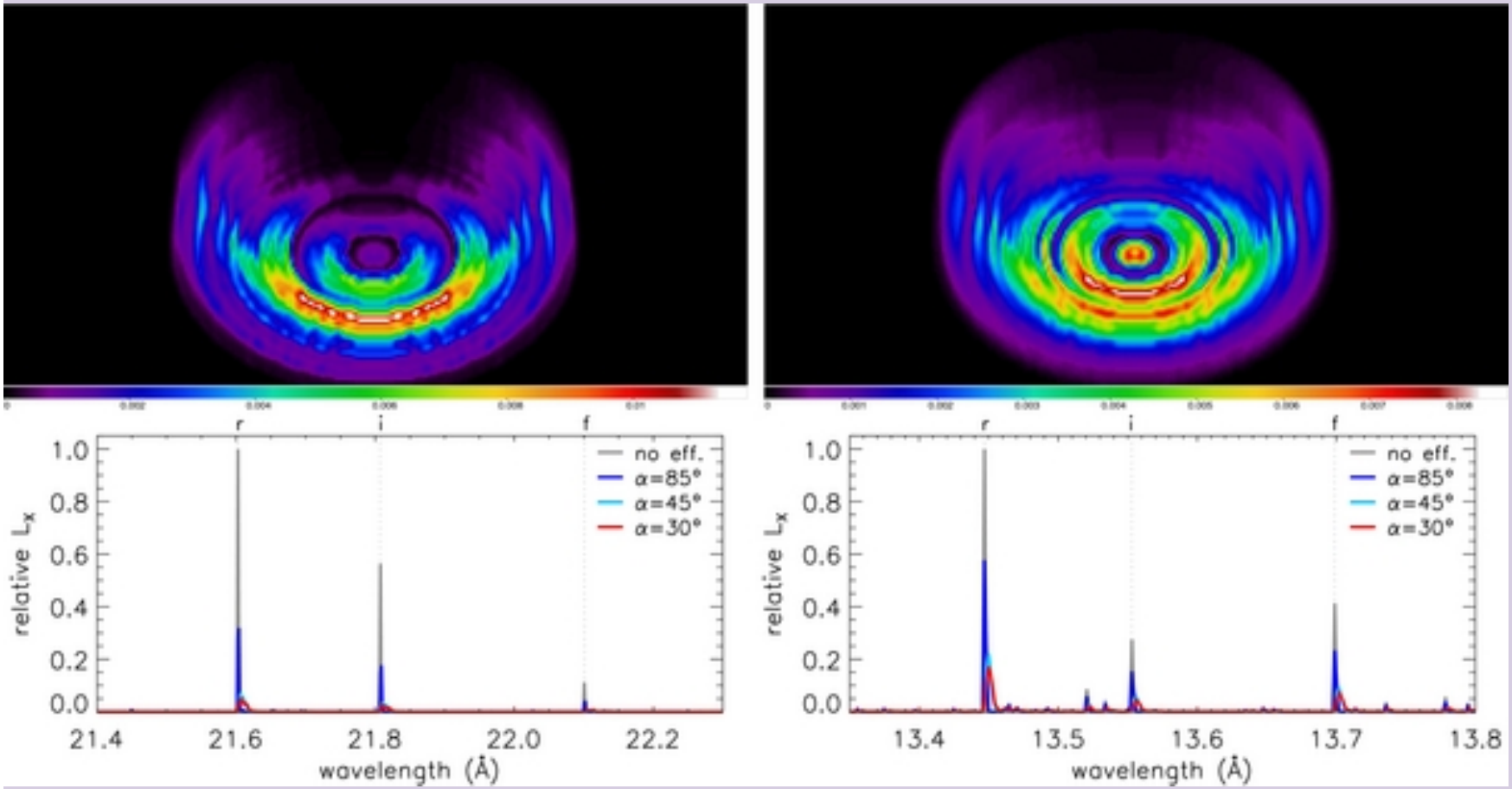




CONCLUSIONS

- Accretion/outflow in GES young clusters
- Sky subtraction
  - FWZI(Hα) method
  - Spurious absorption lines:
    FELs useful both for physics
    (outflow activity) and as a proxy
    for sky subtraction:
    flag if absorption:
    warning better to use the original spectra

FUTURE PERSPECTIVES



(Bonito et al. 2014, ApJL)

Laboratory formation of a scaled protostellar jet by coaligned poloidal magnetic field
B. Albertazzi, A. Ciardi, M. Nakatsutsumi, T. Vinci, J. Béard, R. Bonito, J. Billette et al.
Science 2014

FUTURE PERSPECTIVES

- Looking for outflows
- FWZI(Hα) method for accretion

please contact me
Rosaria (Sara) Bonito
sbonito@astropa.unipa.it