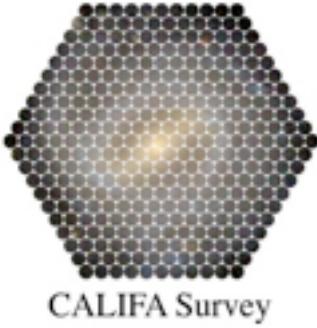
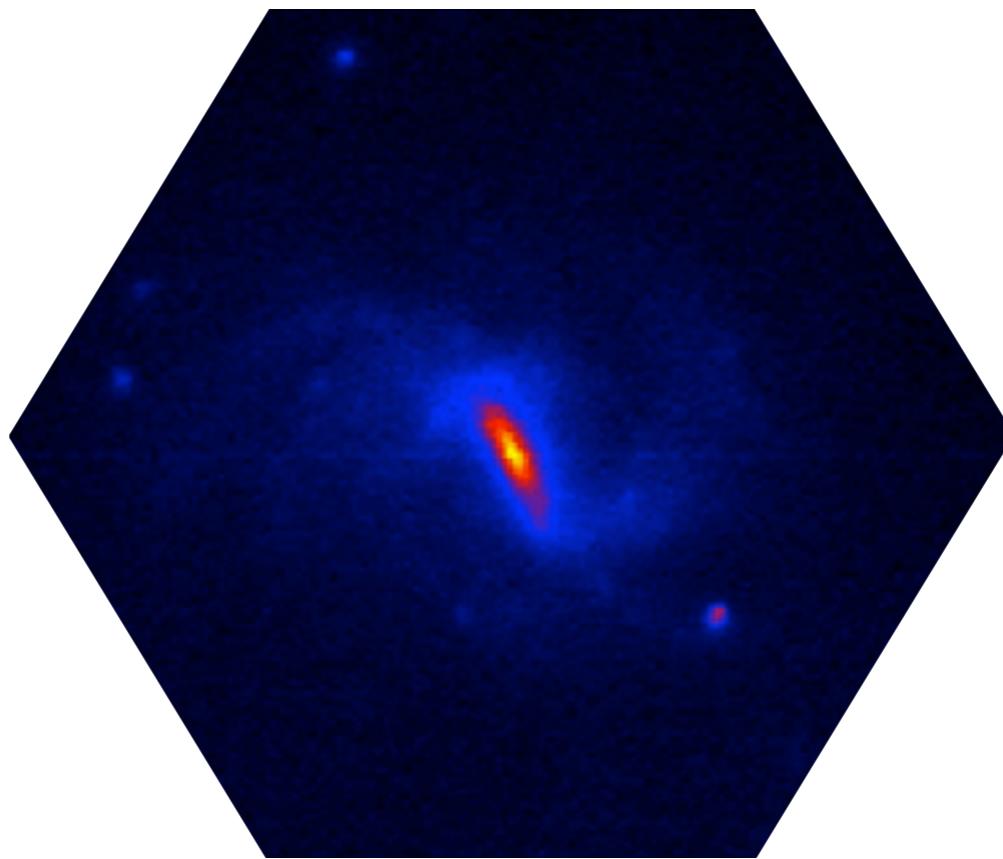


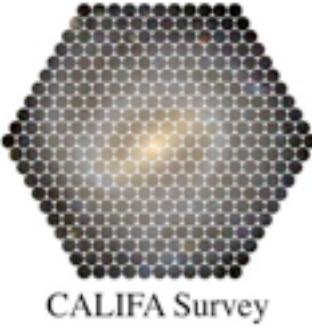
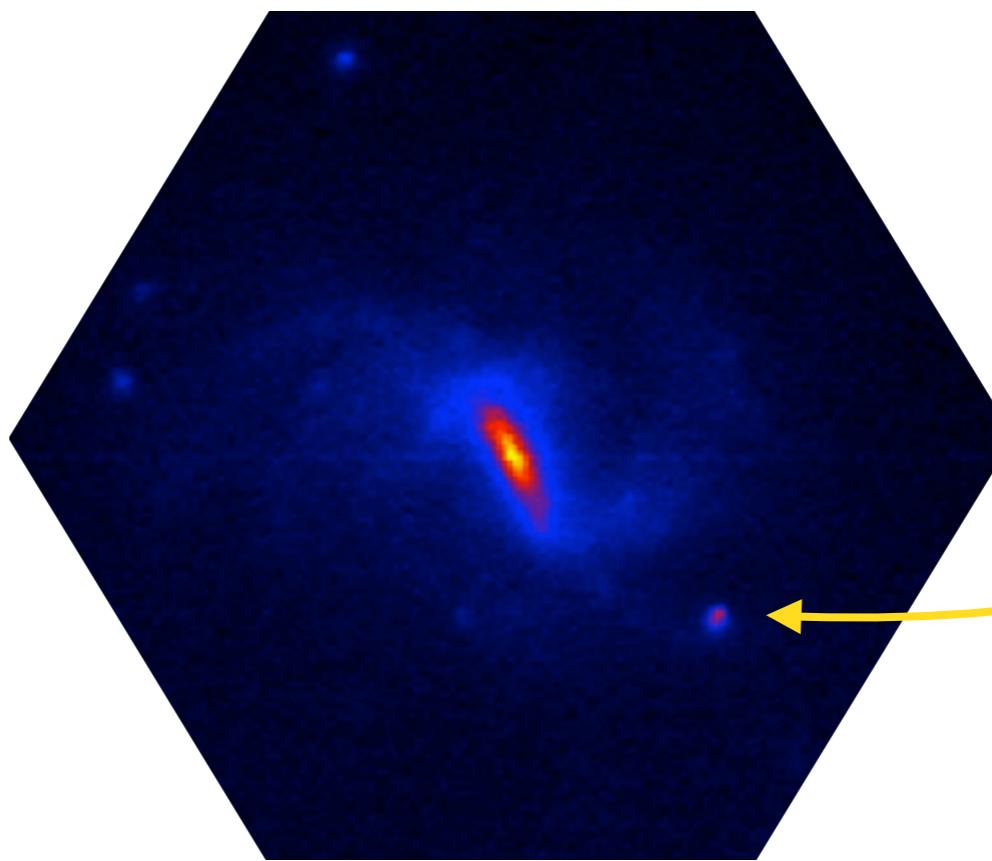
Studying Core Collapsed SNe environment with CALIFA



Lluís Galbany, CENTRA-IST Lisboa
Vallery Stanishev, CENTRA-IST Lisboa
Ana Mourão, CENTRA-IST Lisboa
Myriam Rodrigues, ESO Chile
Hector Flores , Observatoire de Paris



Studying Core Collapsed **and Type Ia** SNe environment with CALIFA



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Motivation

CCSNe

Stellar evolution
(progenitors)

Anderson, Modjaz, Prieto, Leloudas,
Smartt, Soderberg, Follatelli, Pignata...

overall galaxy properties
slits o imaging - local properties

CALIFA - IFS

SNela

Cosmology

Improve standardization
adding host/environment properties

Reduce systematic errors

Sullivan, Kelly, Howell, Lampeitl,
Hamuy, D'Andrea, Gallagher...

most based on global
characteristics (or gradients)

previous study (IFS)
Stanishev+12 (7 SNe)

+
CALIFA - IFS

properties of one single pixel

Sample selection

- Cross-Check for SNe in both NED database (by name) and IAU list (by coordinates)

266 galaxies observed (at least with one grating)

56 hosted **67** SNe (9 with 2 SNe, 1 with 3 SNe) (**35** COMB, **21** only V500)

44 in the field of view: **12** SNIa, **9** SNIbc, **17** SNII (2 b, 1 P, 4 n), **6** untyped

5 SNIa hosts with no emission lines:



NGC4784

UGC10097

NGC6146

NGC6166

NGC6173

Sample selection

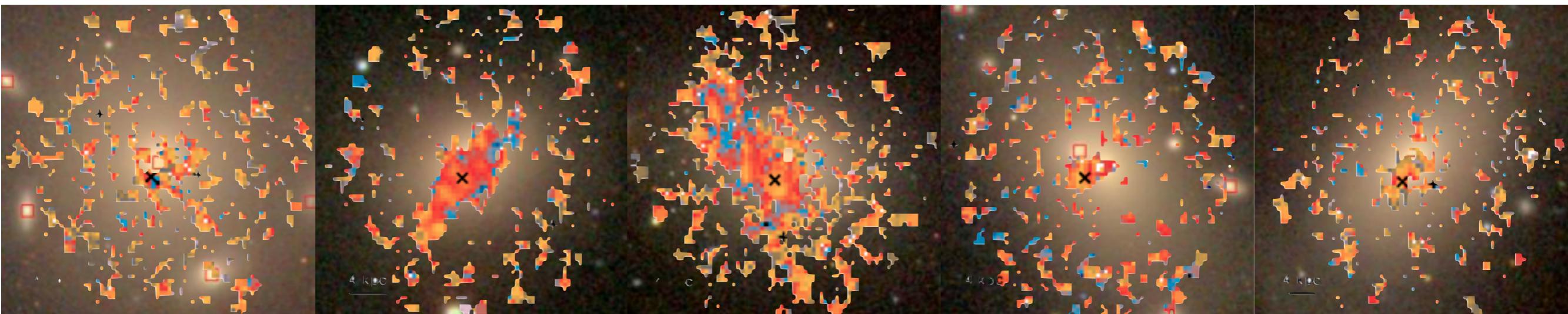
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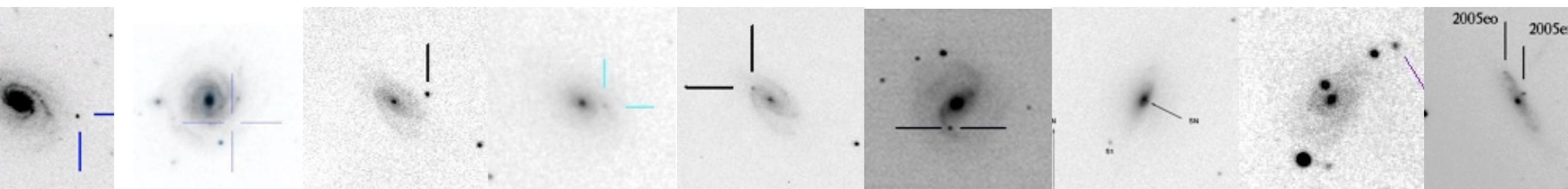
NGC6146

NGC6166

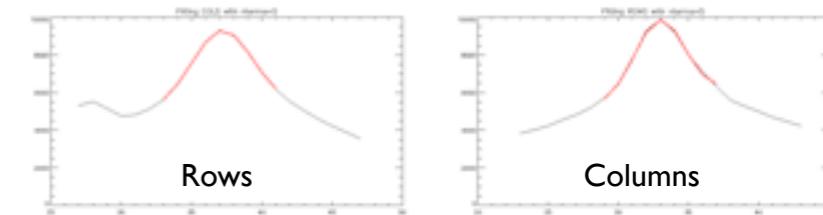
NGC6173

Sample selection

- Cross-Check for SNe in both NED database (by name) and IAU list (by coordinates)
266 galaxies observed (at least with one grating)
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44 in the field of view: **12** SNIa, **9** SNIbc, **17** SNII (2 b, 1 P, 4 n), **6** untyped
5 SNIa hosts with no emission lines: **Sample, 33 SNe: 17 II, 9 Ibc, 7 Ia**
- Search for images with the SN (visually check)

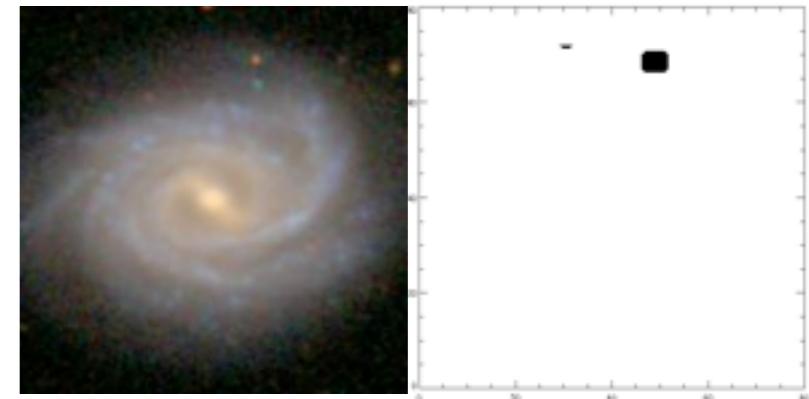


- Fit galaxy center (Σ rows and Σ columns)
- Determine SN position from offset (IAU, literature...)



Reduction

- Use Rubén (et al.) masks when available
- Resample to 1Å, remove sky lines and shift to the rest-frame
- Fit all spectra with STARLIGHT



CB07: 17 Ages 10^6 to $1.8 \cdot 10^{10} M_{\odot}$

4 metallicities 0.004, 0.05, 0.2, 2.5 Z_{\odot} ($Z_{\odot}=0.02$)

S/N window: [4580:4640] Å

Fit range: [3660:7000] Å

MILES stellar library
+ Padova (1994) evol. tracks
+ Chabrier (2003) IMF
+ Marigo (2007)

- Subtract continuum and fit emission lines with MPFIT

[O II]	$\lambda 3727$
[Ne III]	$\lambda 3868$
H ϵ	$\lambda 3970$
H δ	$\lambda 4102$
H γ	$\lambda 4340$
[O III]	$\lambda 4363$
H β	$\lambda 4861$

[Ne I]	$\lambda 4931$
[O III]	$\lambda 4959$
O III	$\lambda 5007$
[O I]	$\lambda 5577$
[He I]	$\lambda 5875$
[O I]	$\lambda 6300$
[S III]	$\lambda 6312$

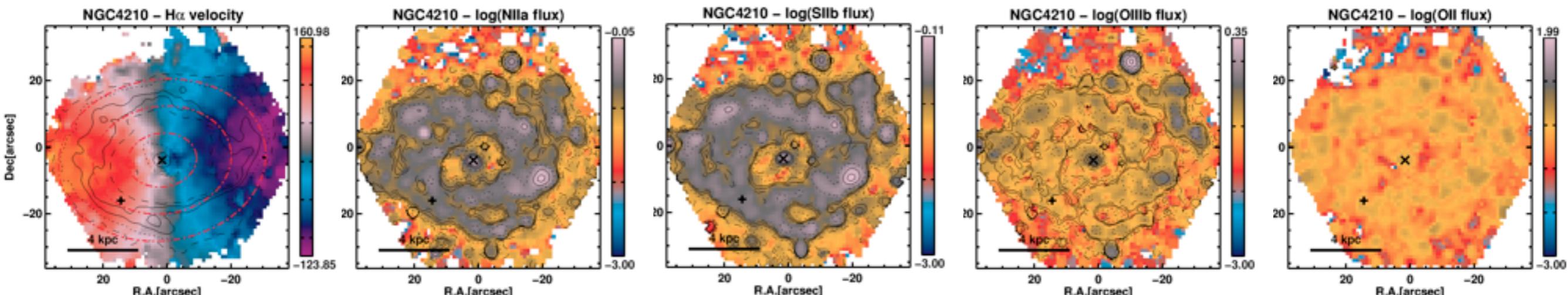
[O I]	$\lambda 6364$
[N II]	$\lambda 6548$
H α	$\lambda 6563$
[N II]	$\lambda 6583$
[S II]	$\lambda 6716$
[S II]	$\lambda 6731$

H α velocity to shift whole spectrum

Balmer decrement to correct for extinction \rightarrow E(B-V)

Line flux, line velocity, gaussian fit parameters

Produce 2D maps for each line



Reduction

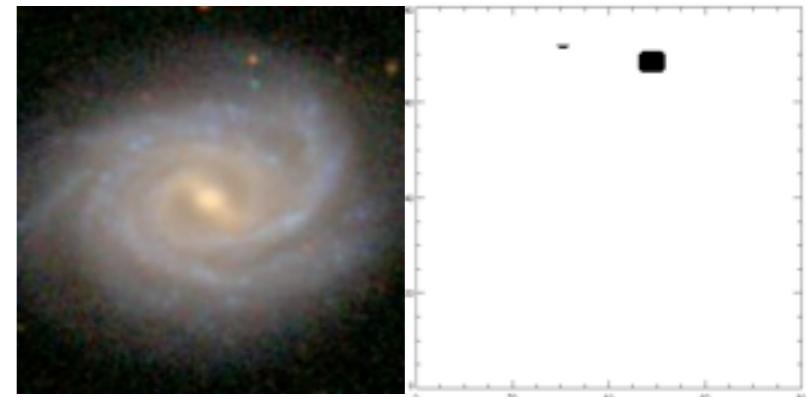
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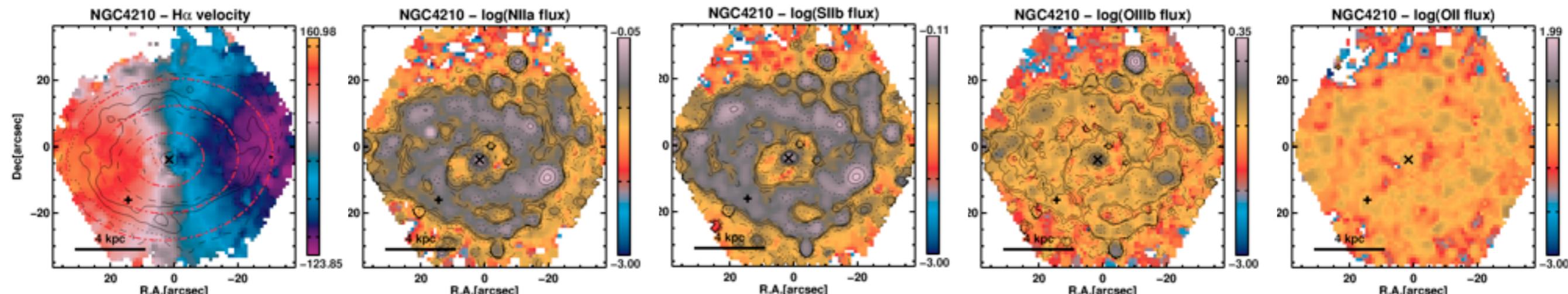
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Measurements

- Electronic density ($N_e = \text{SIIa}/\text{SIIb}$)
- Diagnostic diagram (BPT)
- Several metallicity calibrations

Pettini & Pagel 04 (PP04): [N2](#), [O3N2](#)

Perez-Montero & Contini 09 (PC09): [O3N2_NO](#)

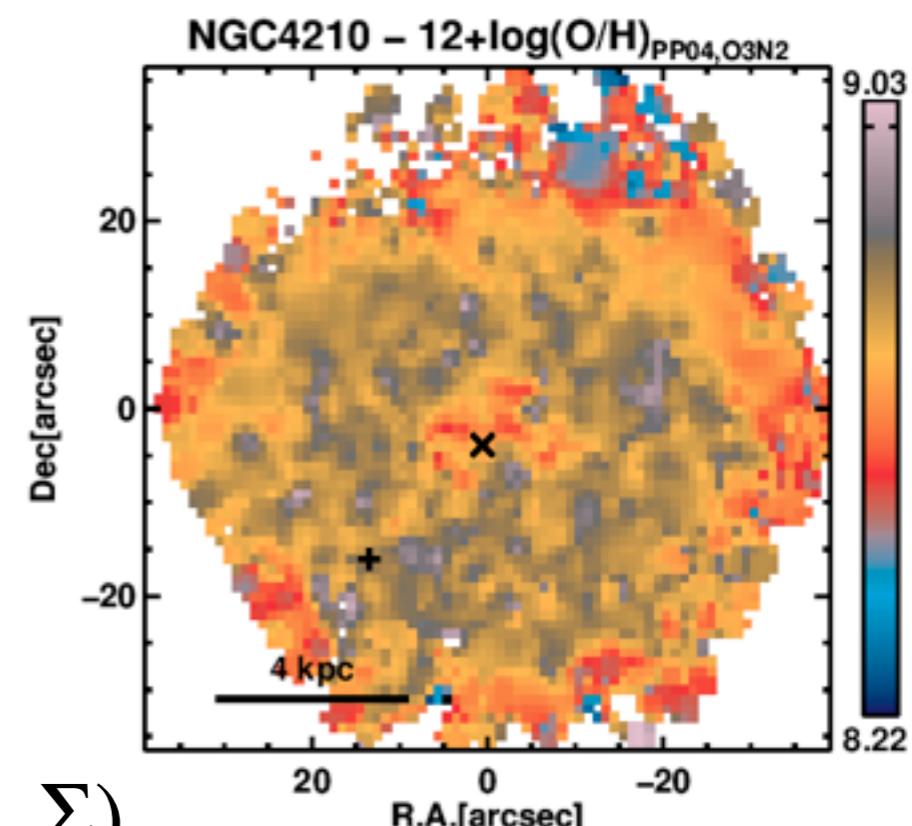
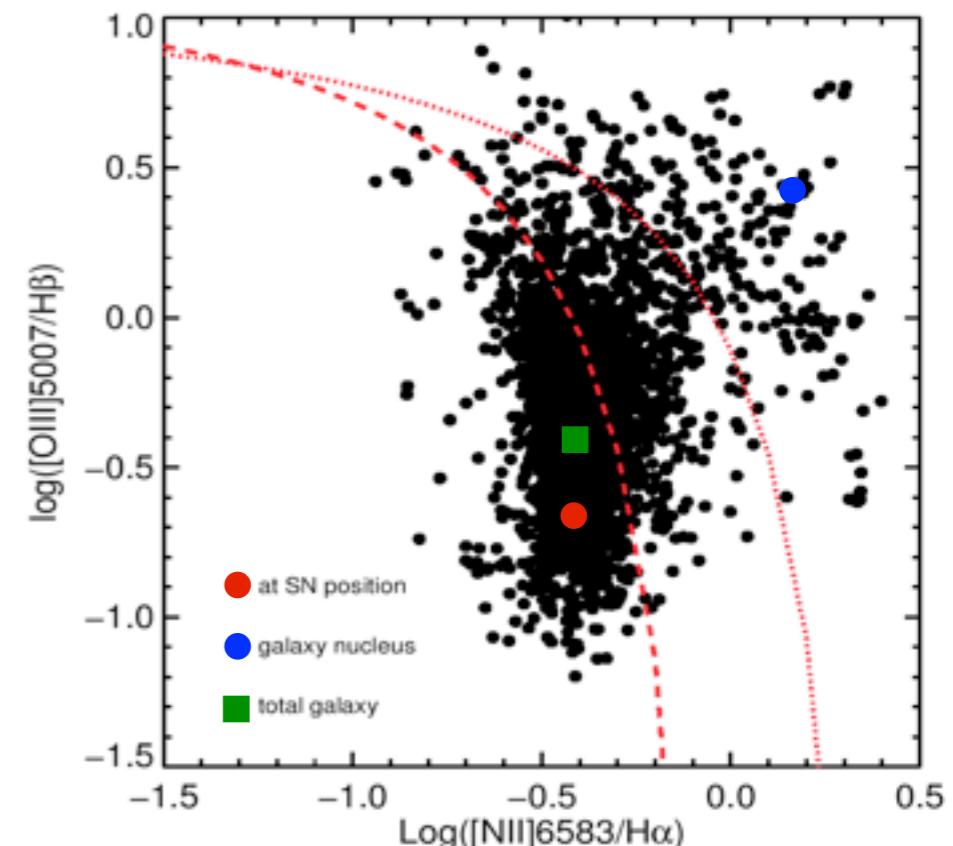
Kobulnicky & Kewley 04 (KK04): [R23](#)

Tremonti+04 (T04): [R23_T](#)

Pilyugin+10: [P10](#)

Pilyugin+11: [P11](#)

- Ionization parameter
- Star formation rate (sqarcsec, sqkpc, Σ)
- Stellar populations parameters from STARLIGHT



Kinemetry

Deprojection

Azimuthal average

Voronoi binning

Integrated spectrum

3" aperture spectrum

Kinometry

Deprojection

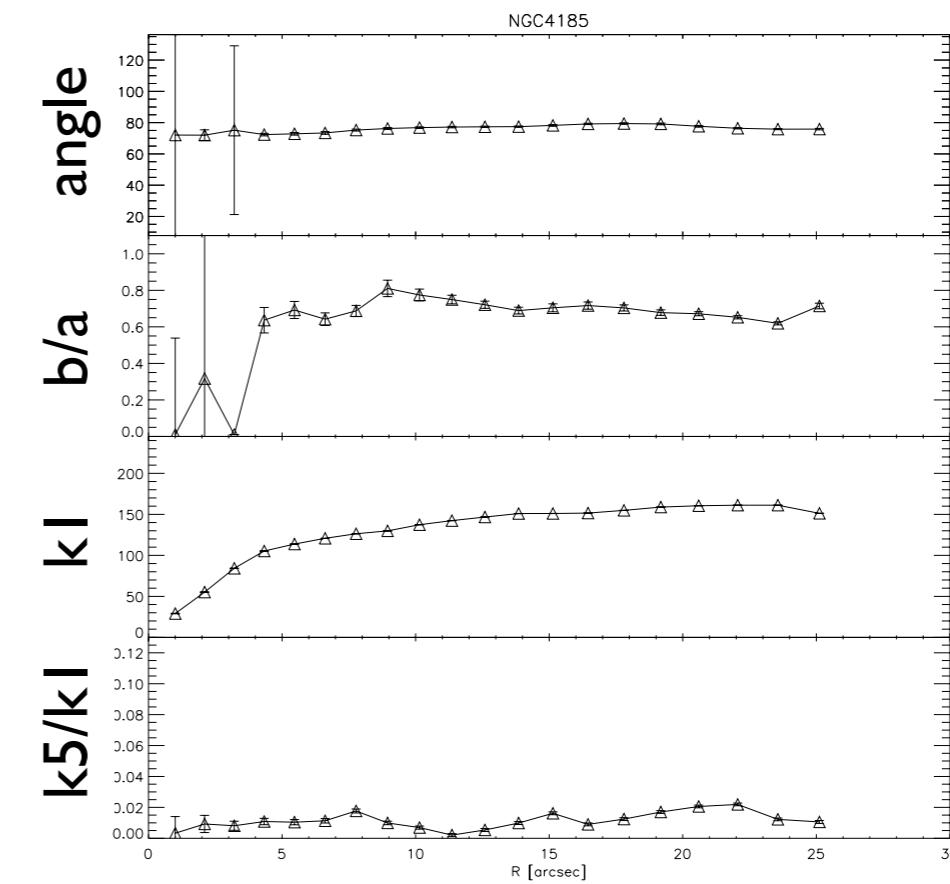
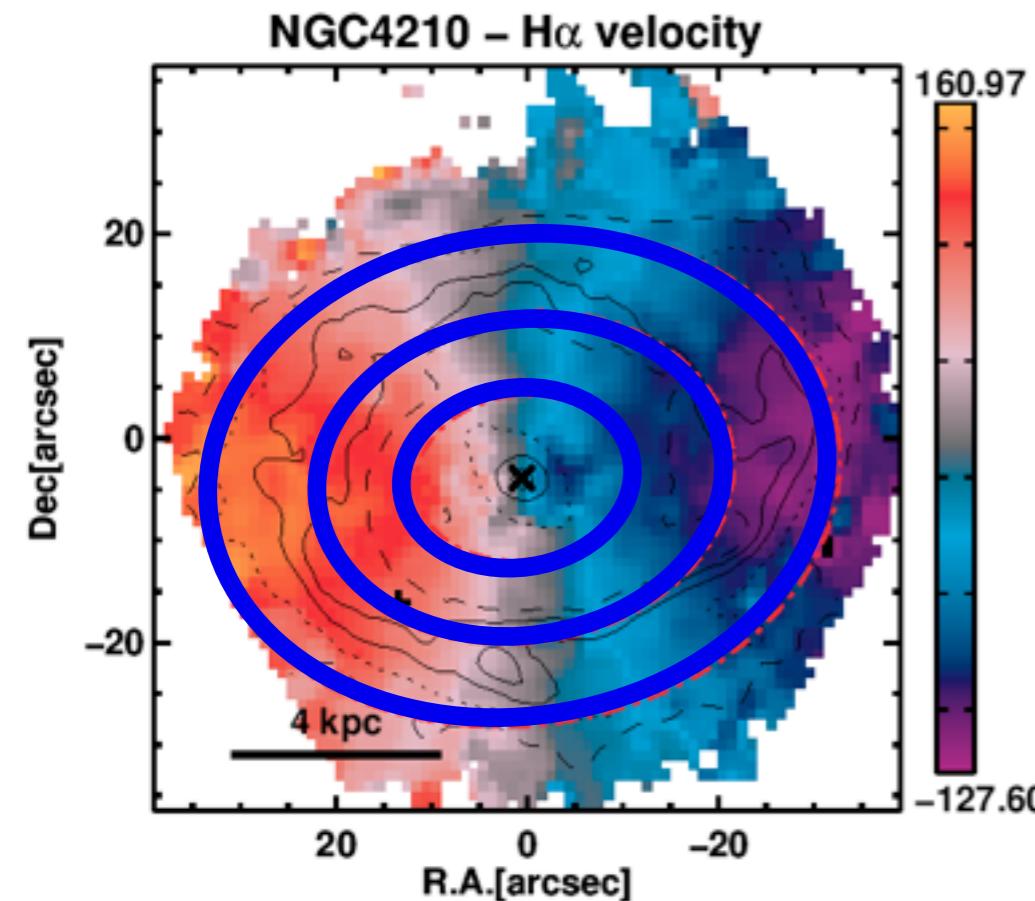
Azimuthal average

Voronoi binning

Integrated spectrum

3" aperture spectrum

Fit ellipses using Krajnovic et al. 2006



Kinemetry

Deprojection

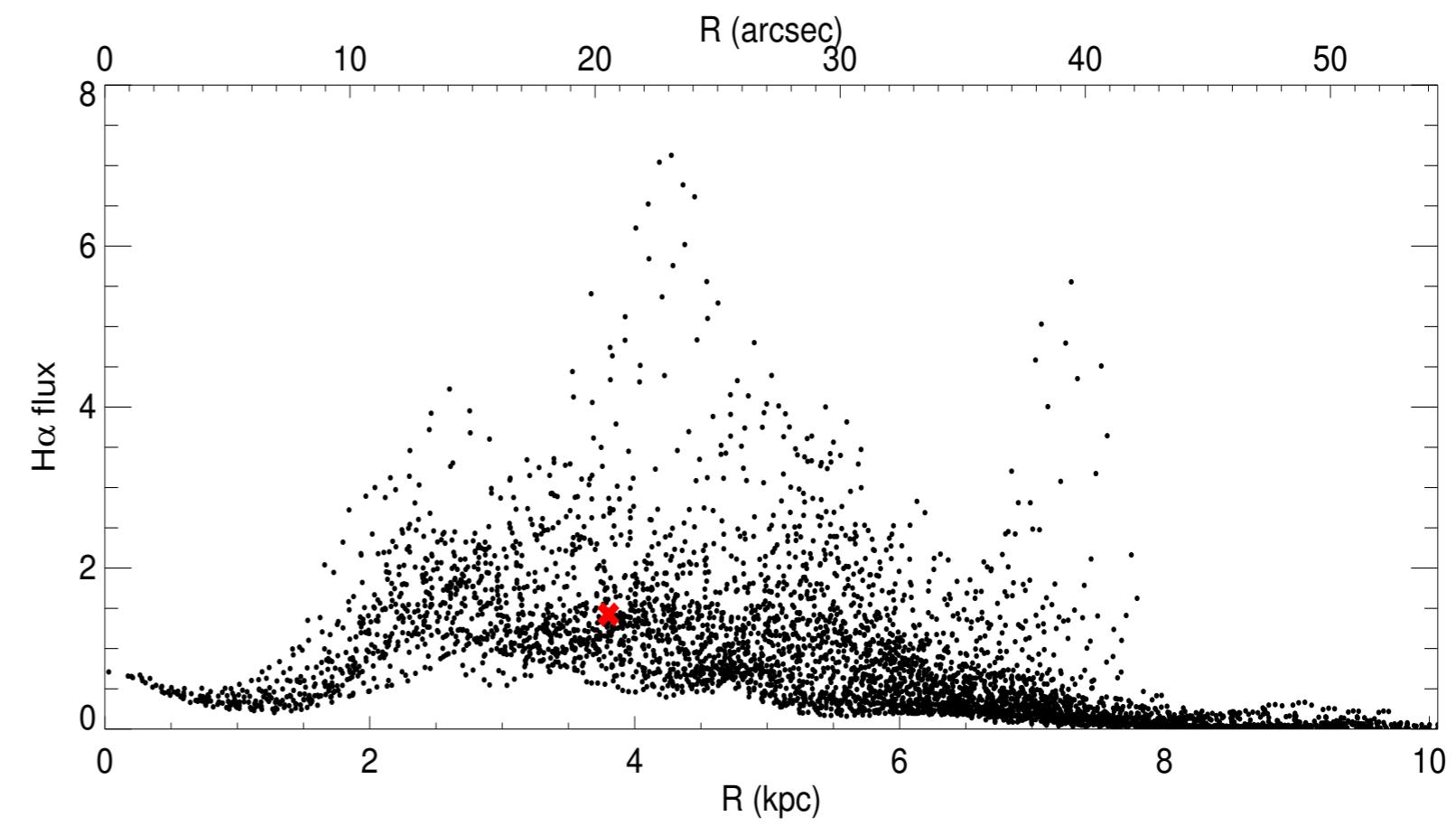
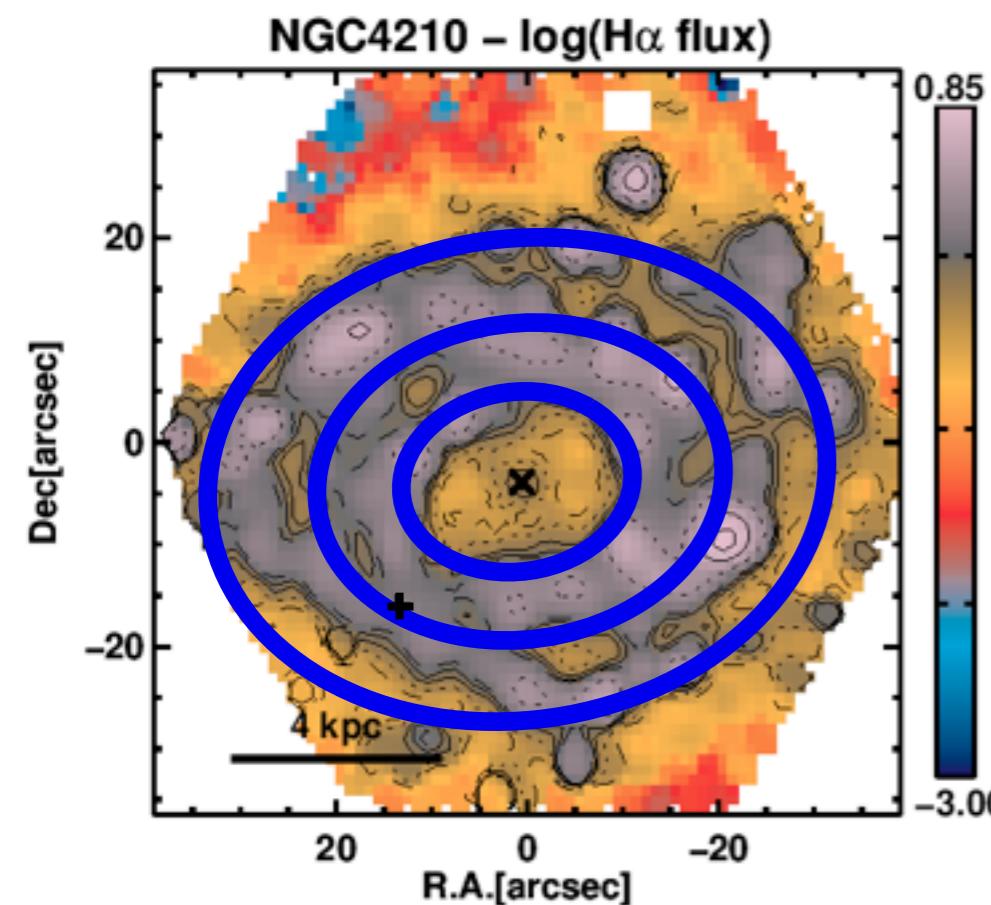
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3" aperture spectrum

Fit ellipses using Krajnovic et al. 2006
Measure distances in the galactic plane



Kinemetry

Deprojection

Azimuthal average

Voronoi binning

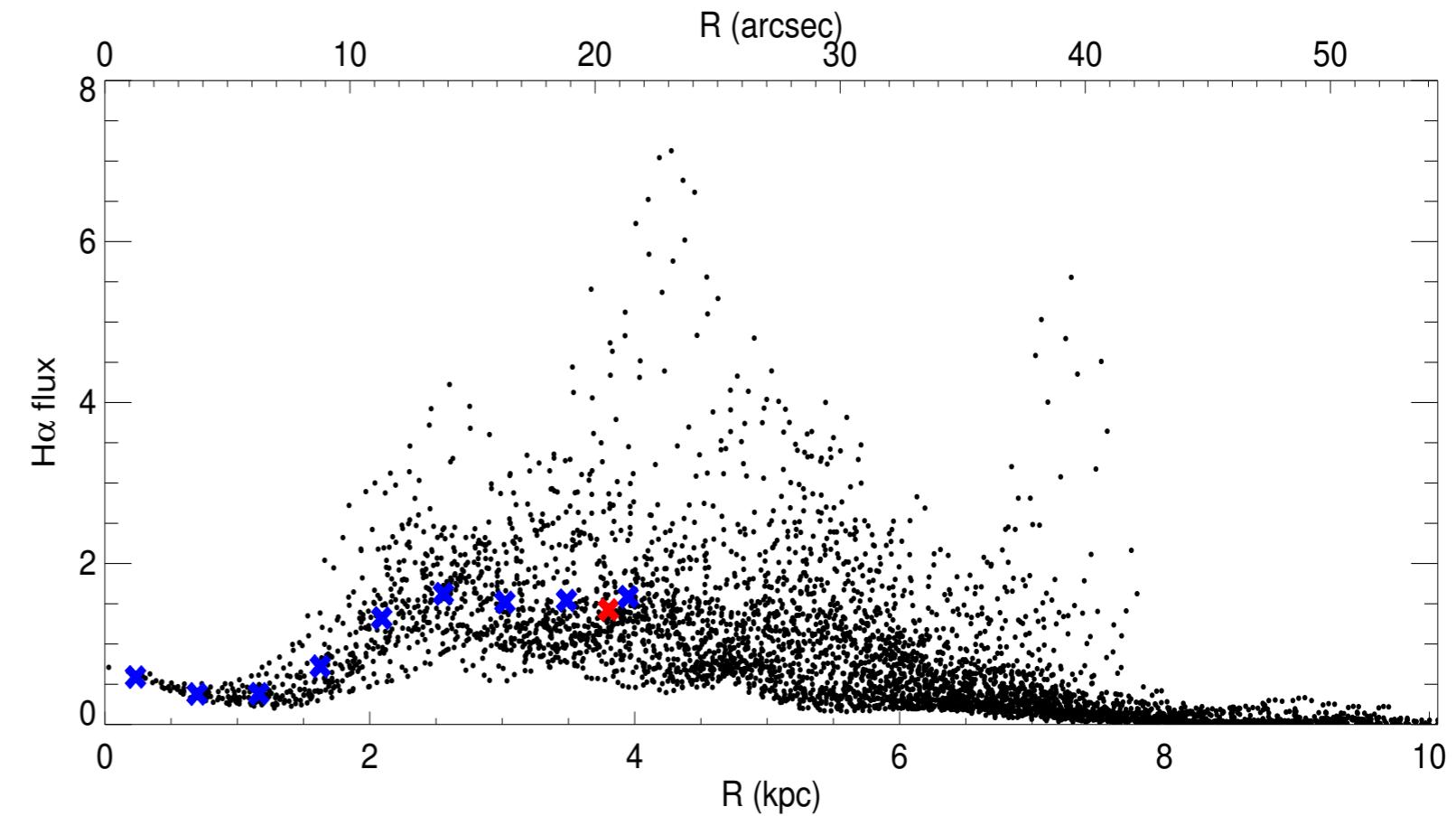
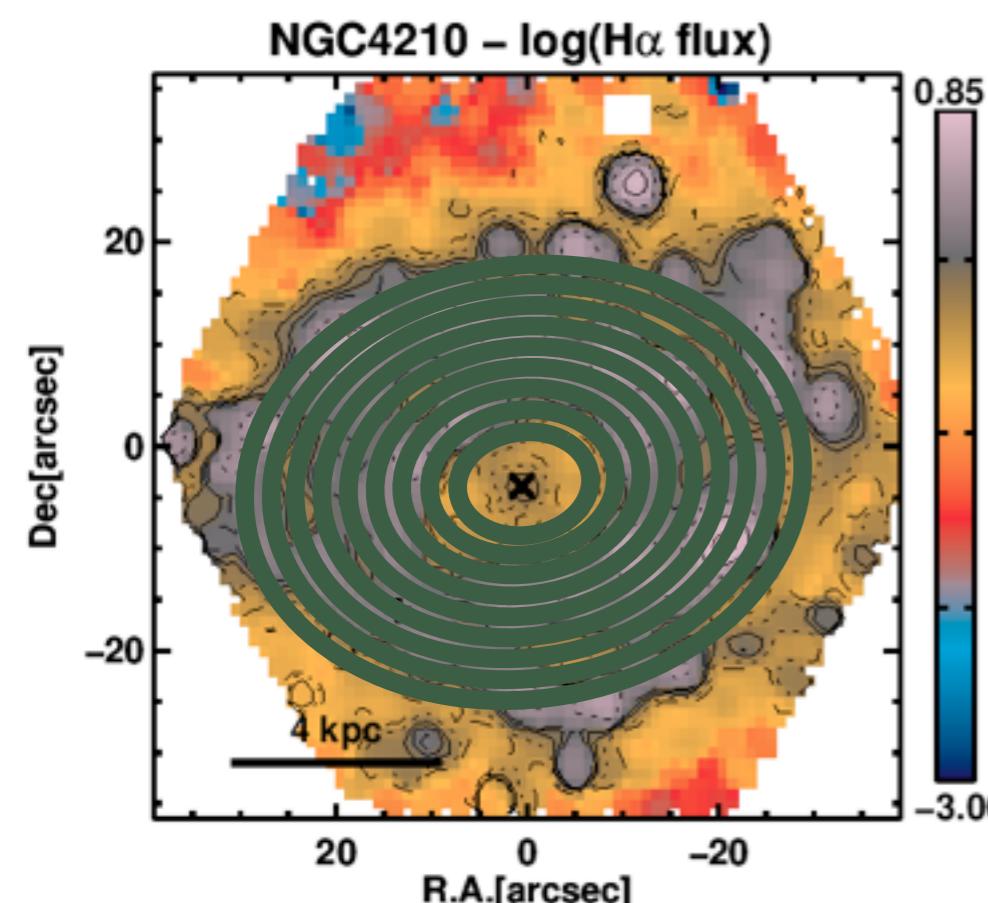
Integrated spectrum

3" aperture spectrum

Fit ellipses using Krajnovic et al. 2006

Measure distances in the galactic plane

Co-add ell. rings centered in the core



Kinemetry

Fit ellipses using Krajnovic et al. 2006

Deprojection

Measure distances in the galactic plane

Azimuthal average

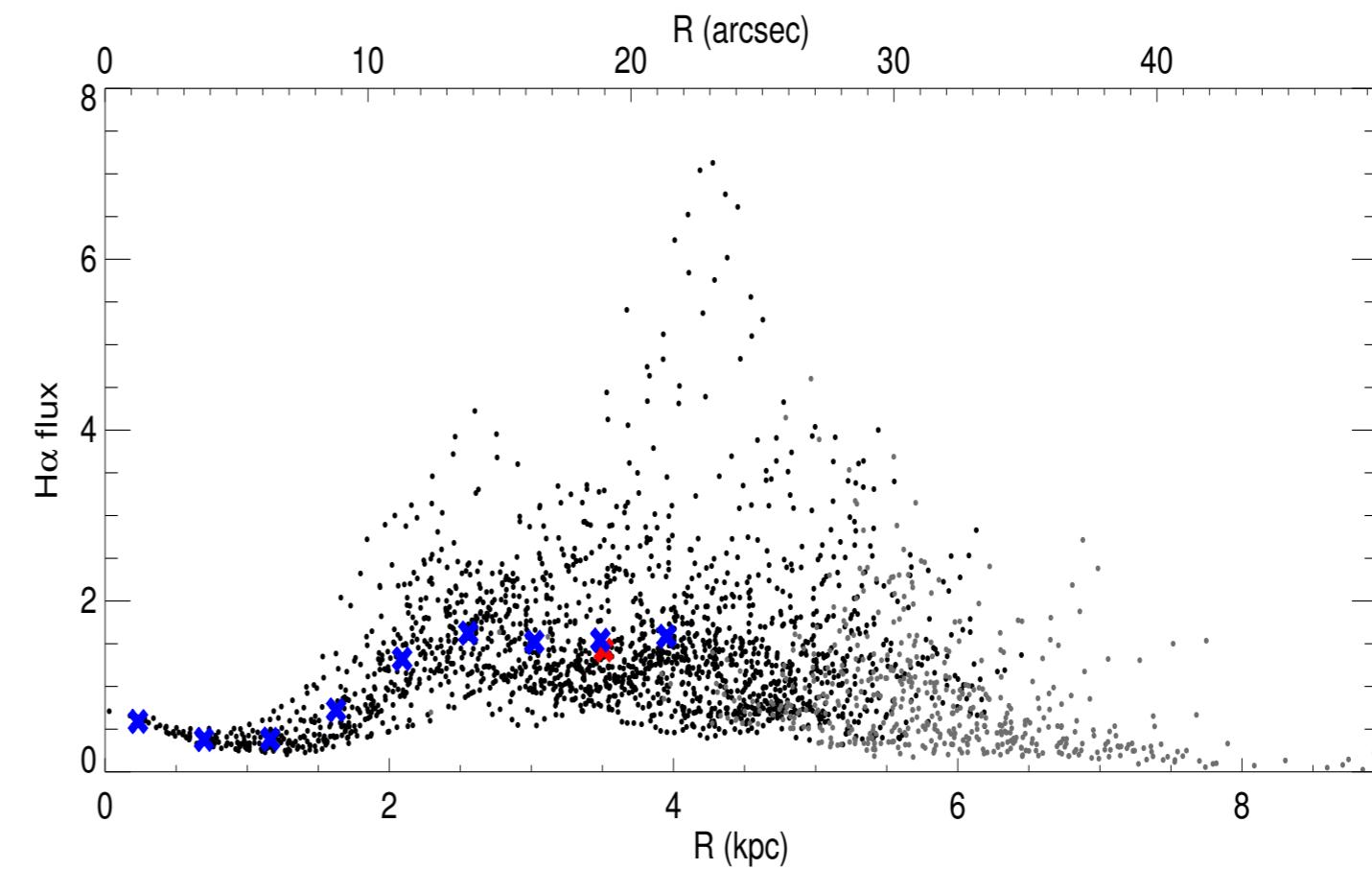
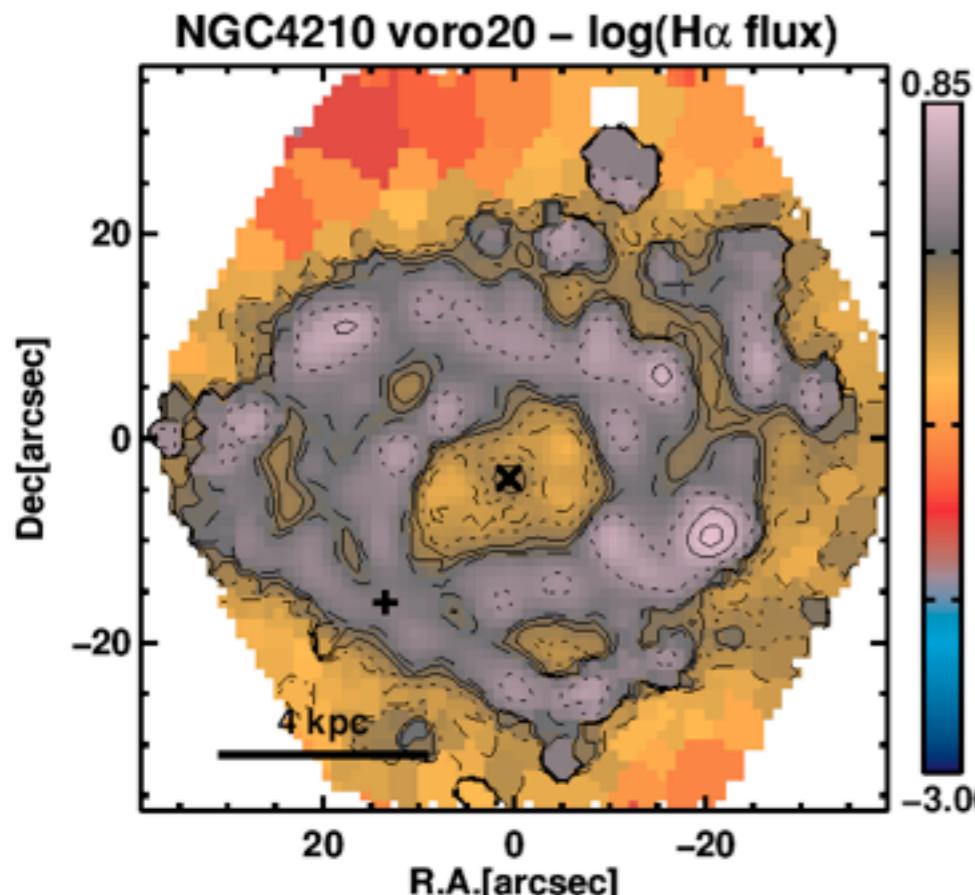
Co-add ell. rings centered in the core

Voronoi binning

Requiring S/N > 20

Integrated spectrum

3" aperture spectrum



Kinemetry

Fit ellipses using Krajnovic et al. 2006

Deprojection

Measure distances in the galactic plane

Azimuthal average

Co-add ell. rings centered in the core

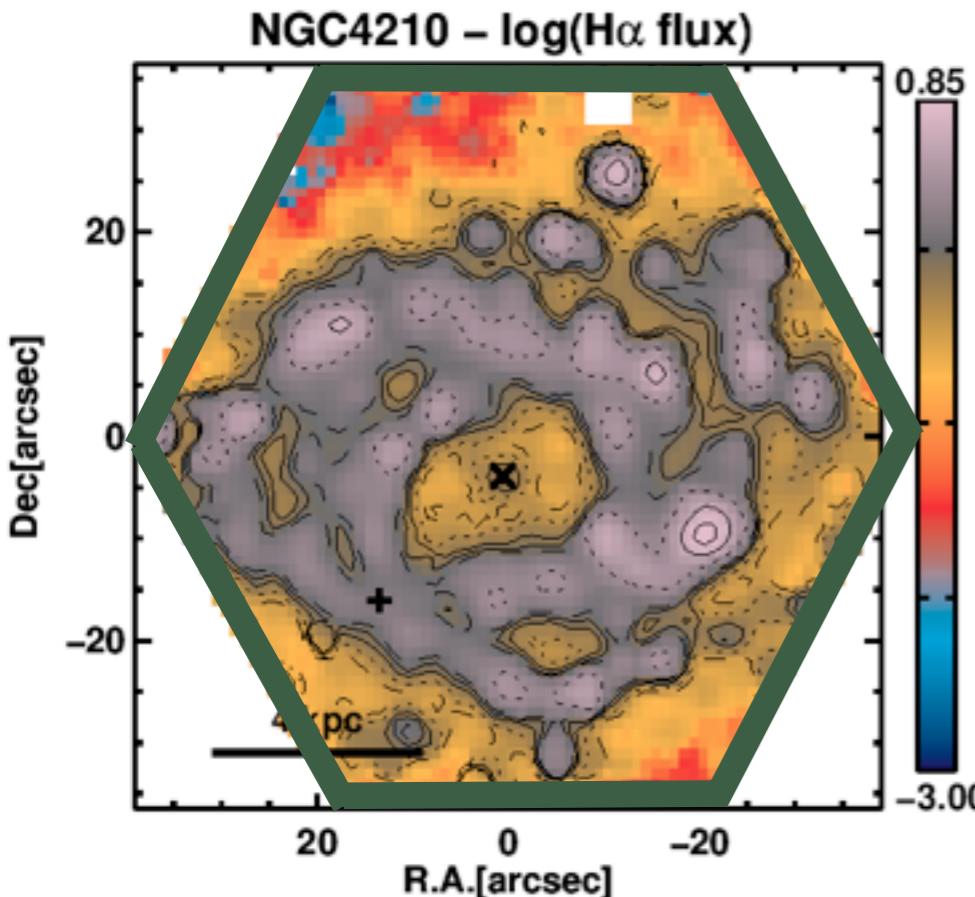
Voronoi binning

Requiring S/N > 20

Integrated spectrum

For high-z (aperture effects)

3" aperture spectrum



Kinemetry

Fit ellipses using Krajnovic et al. 2006

Deprojection

Measure distances in the galactic plane

Azimuthal average

Co-add ell. rings centered in the core

Voronoi binning

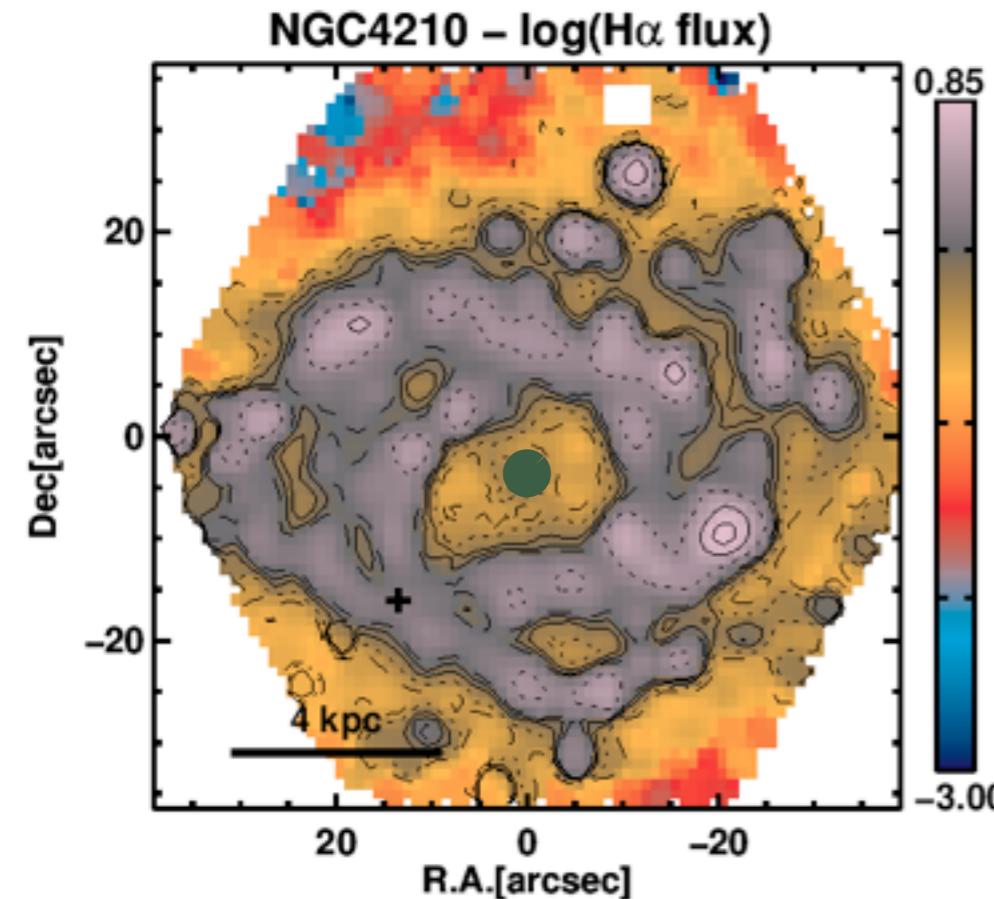
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Integrated spectrum

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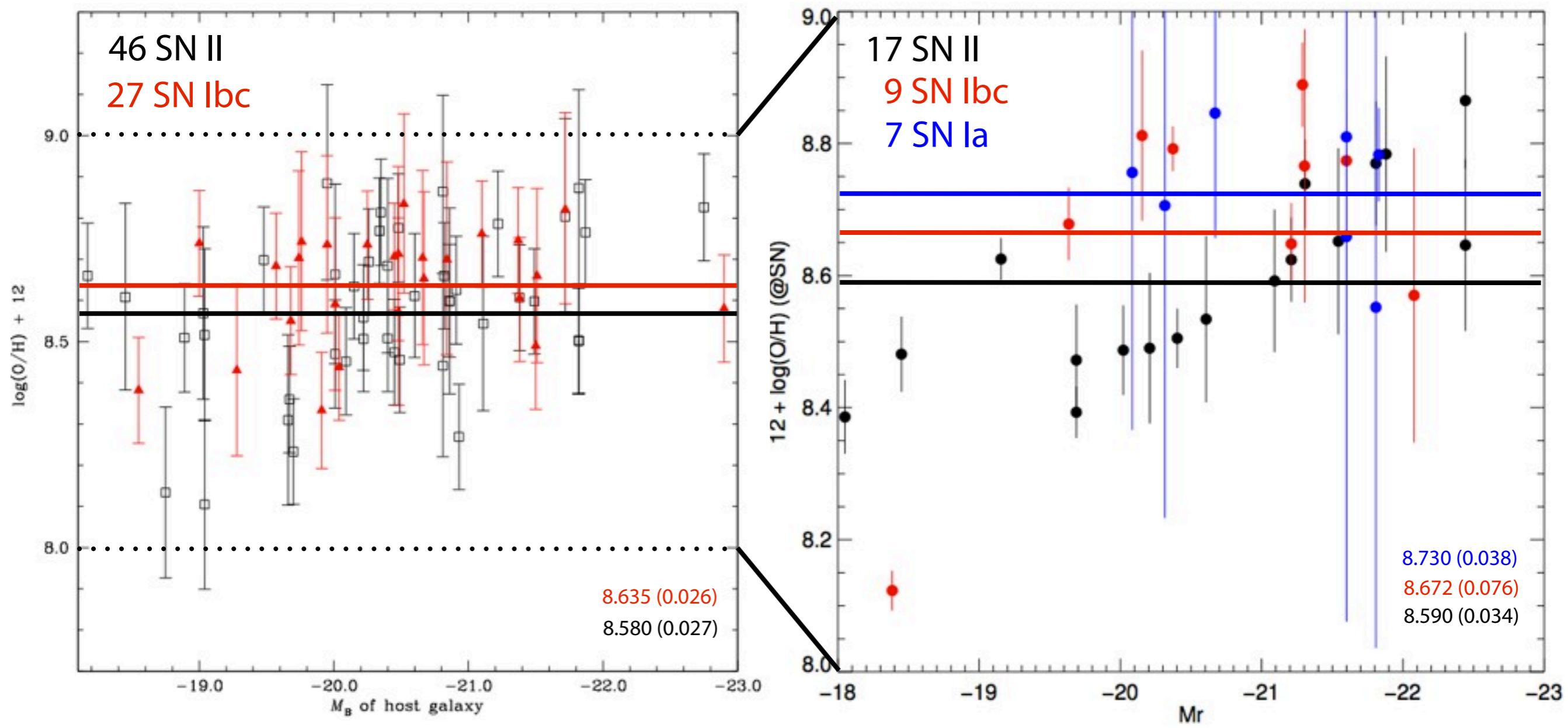
Allow comparisons (SDSS + fiber)



Results...

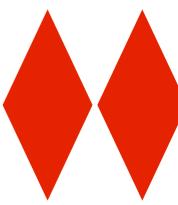
$Z_{\text{Ia}} > Z_{\text{Ibc}} > Z_{\text{II}}$

long slit @SN

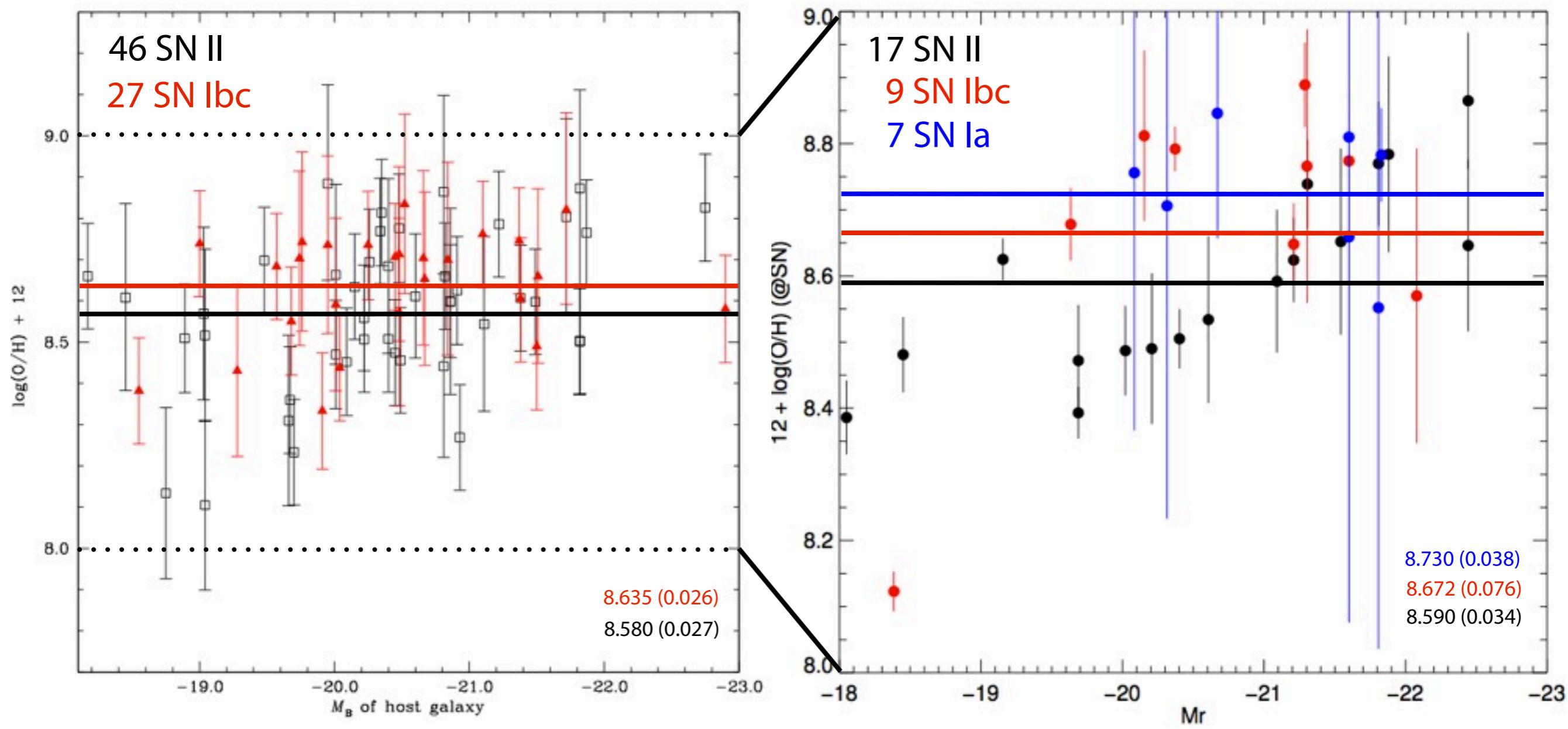


Anderson+10

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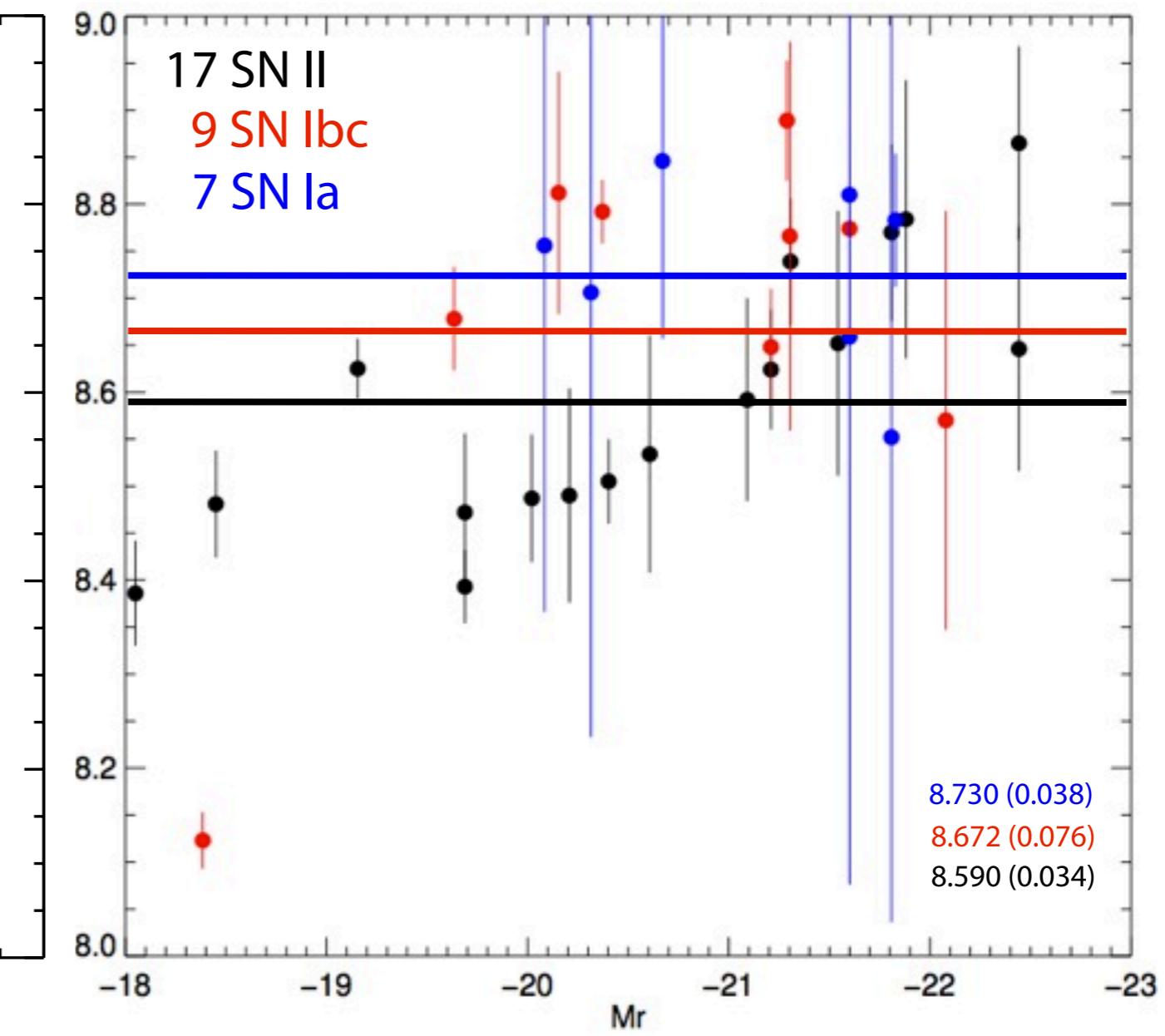
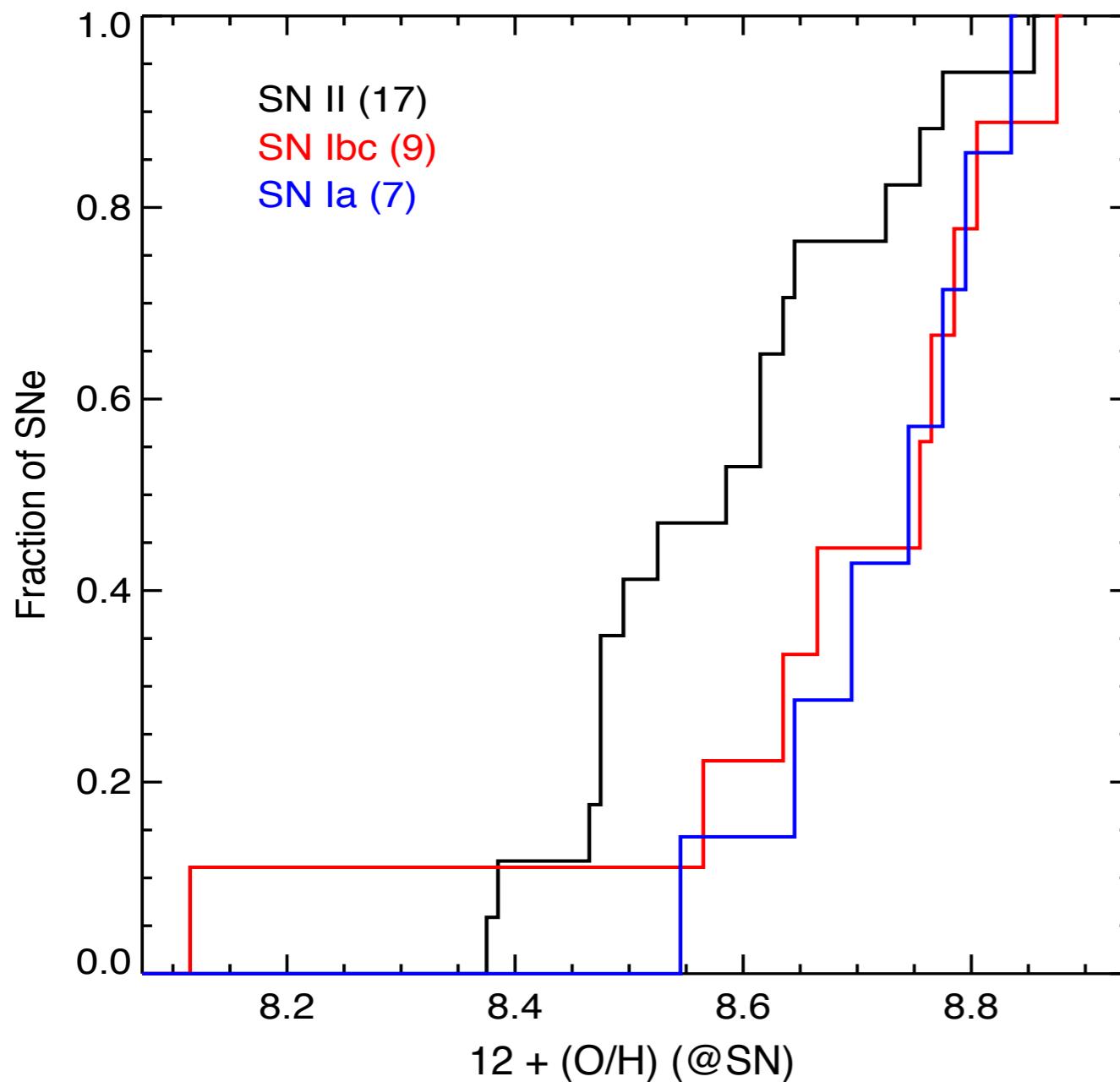


long slit @SN

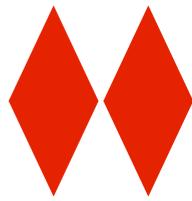


Anderson+10

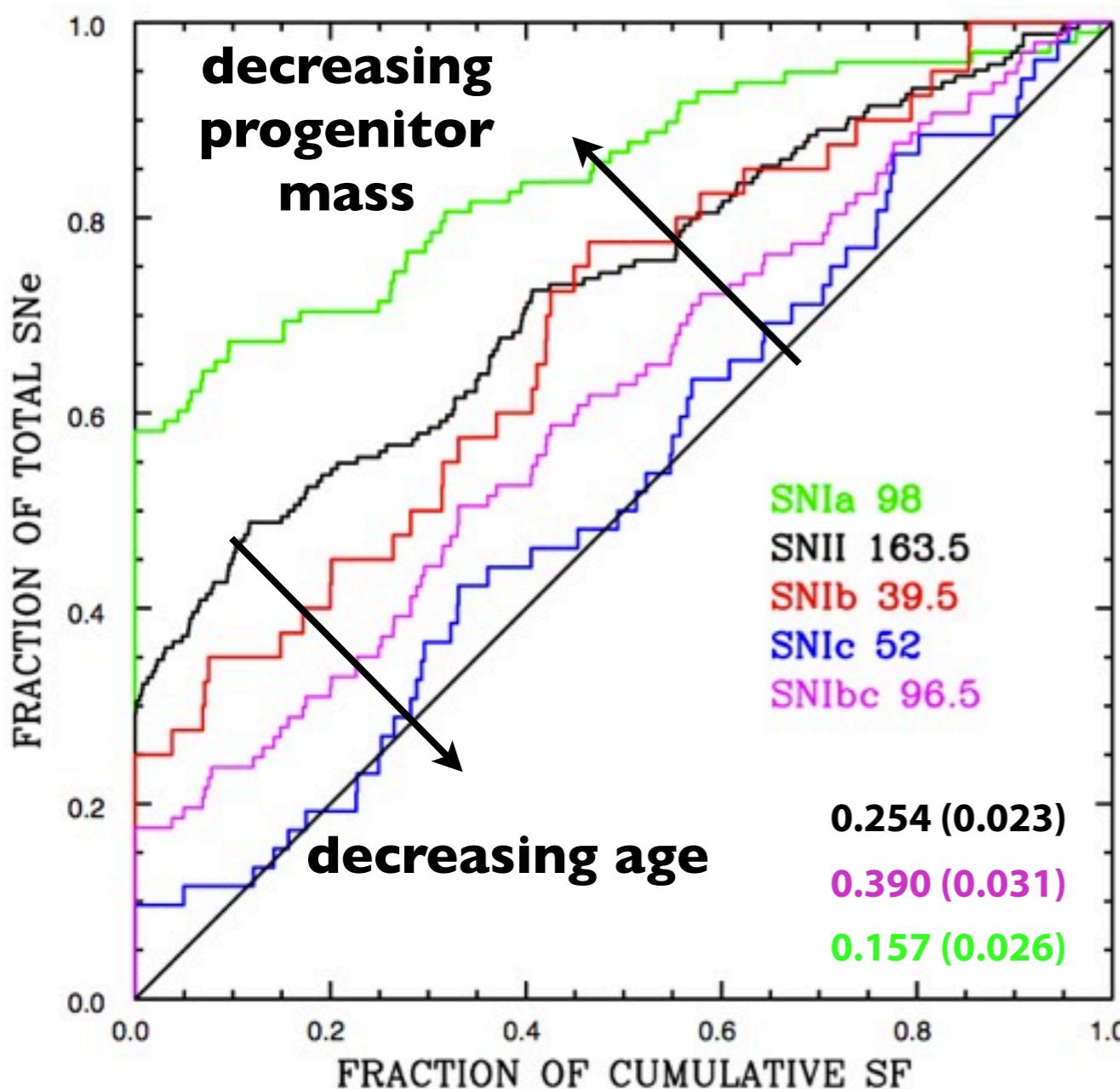
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H α emission (SF)

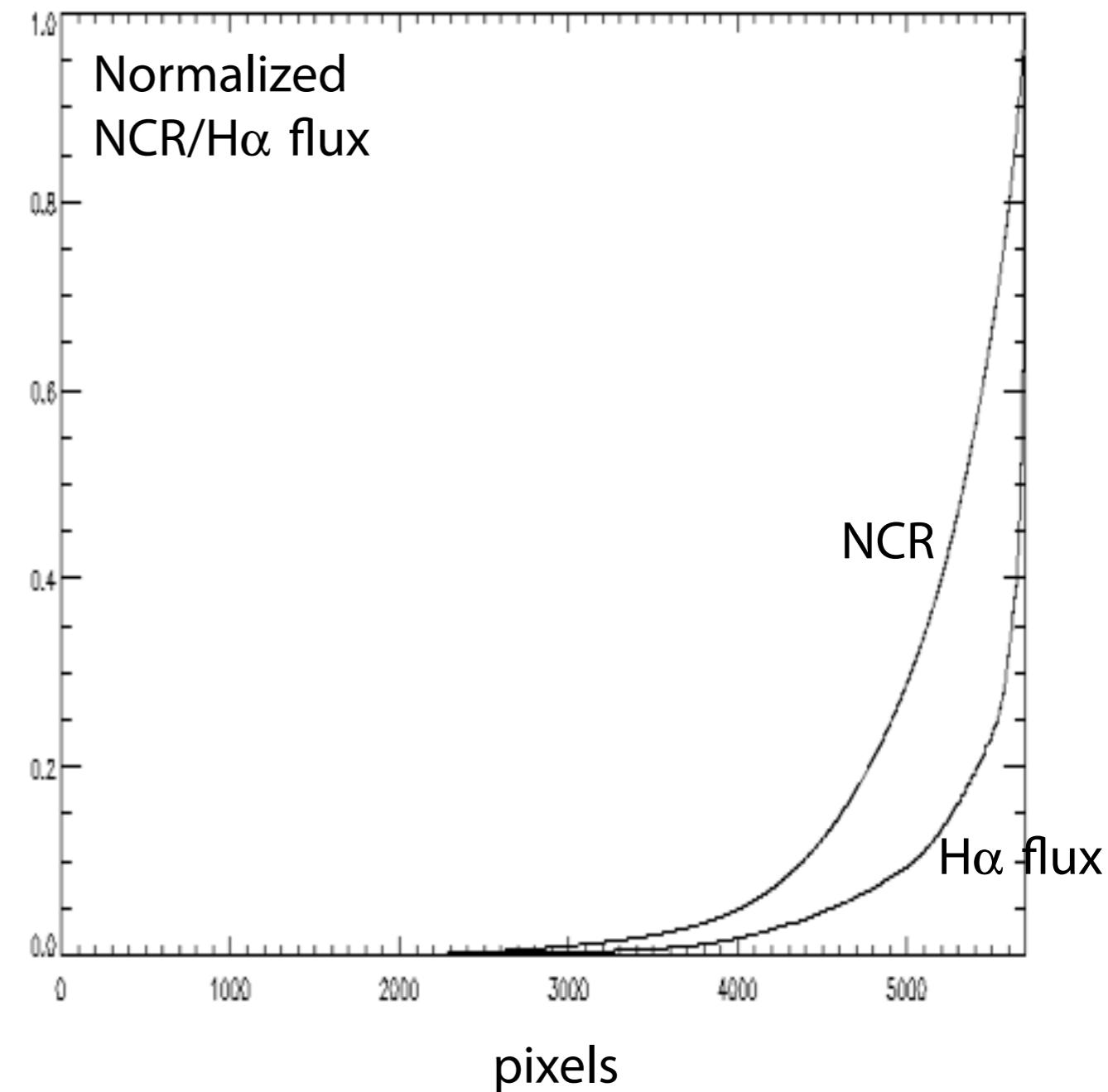


H α imaging

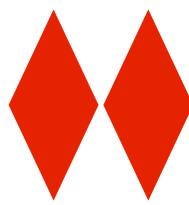


Anderson+12

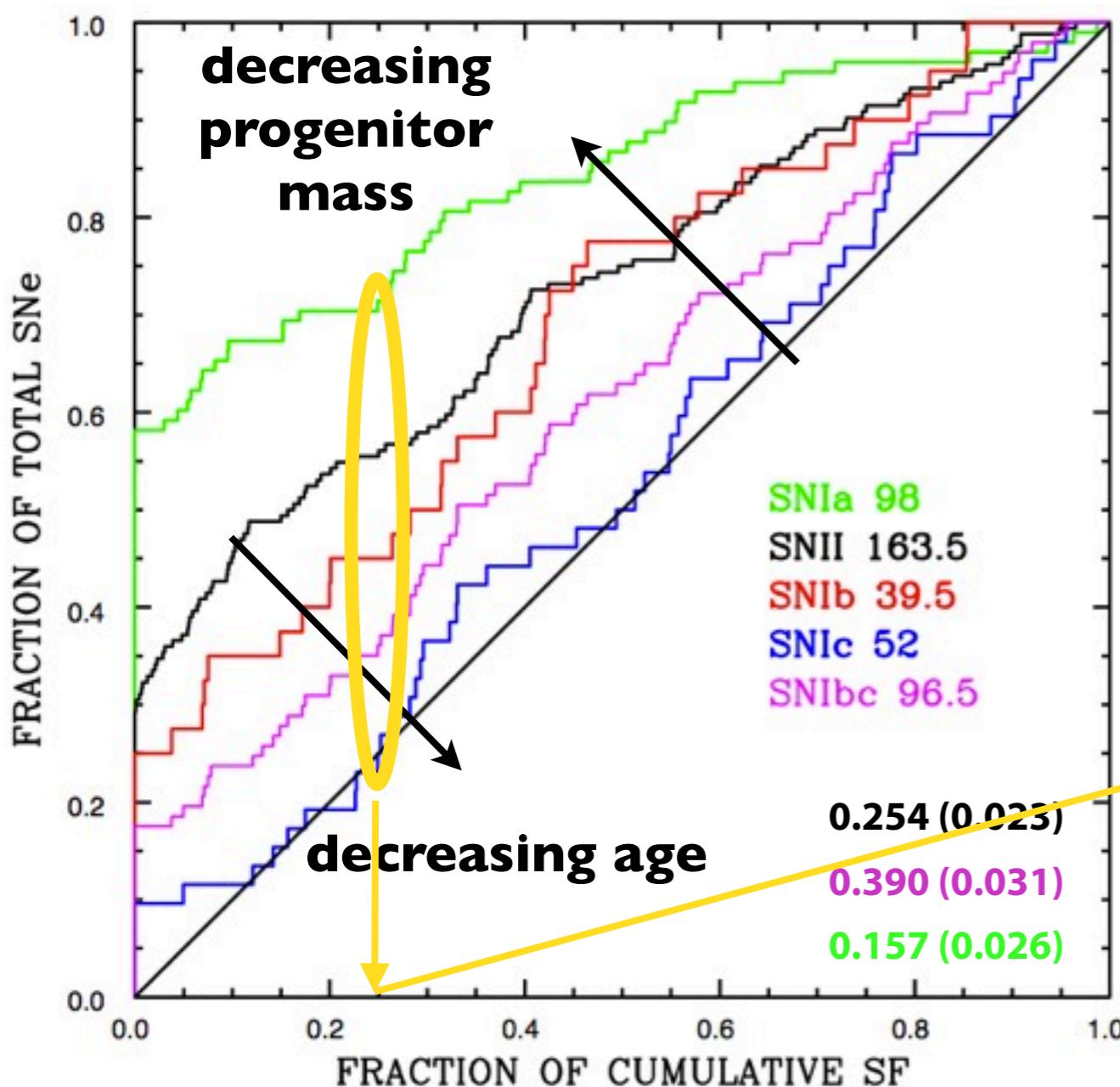
NCR result



H α emission (SF)

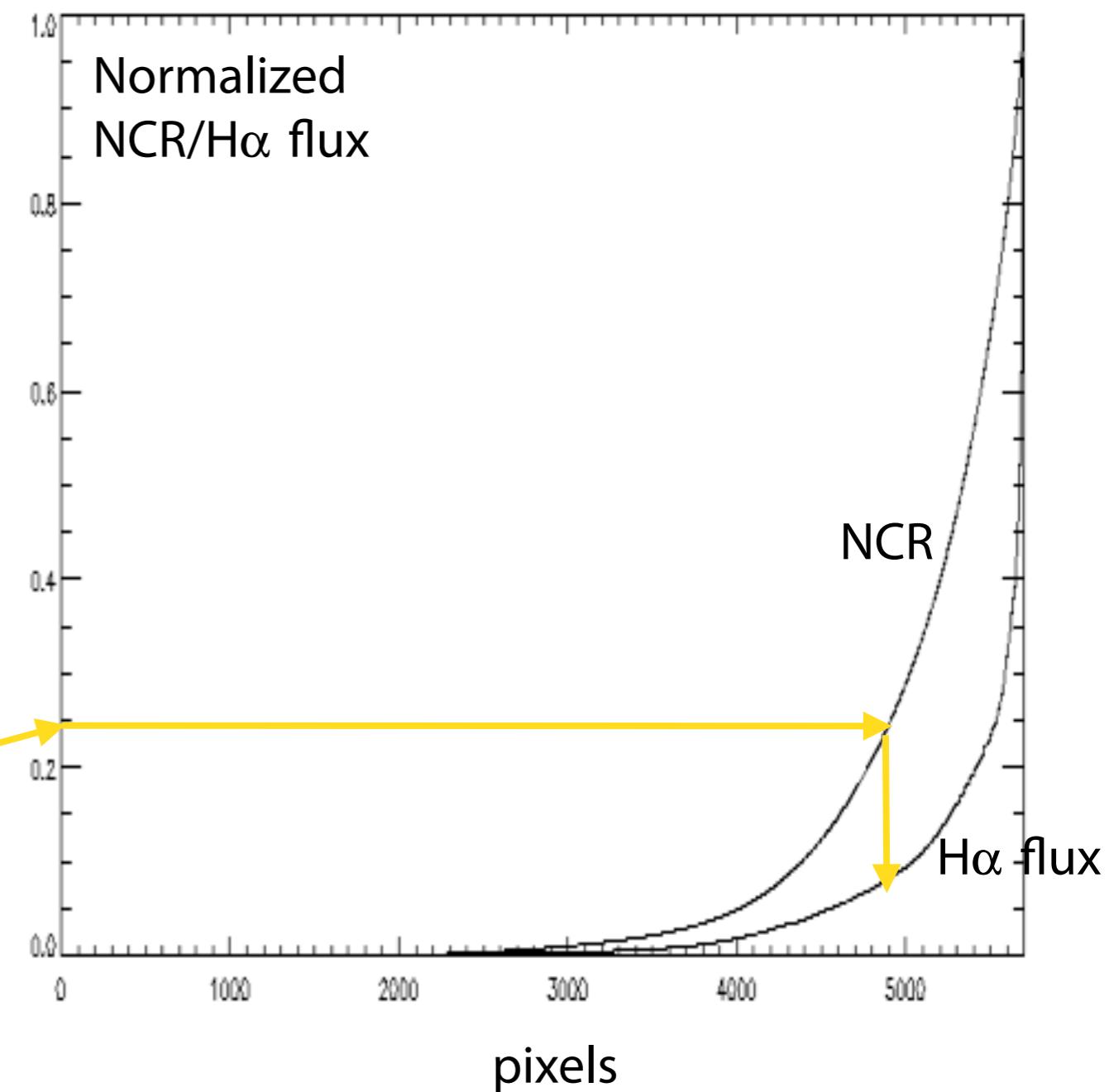


H α imaging



Anderson+12

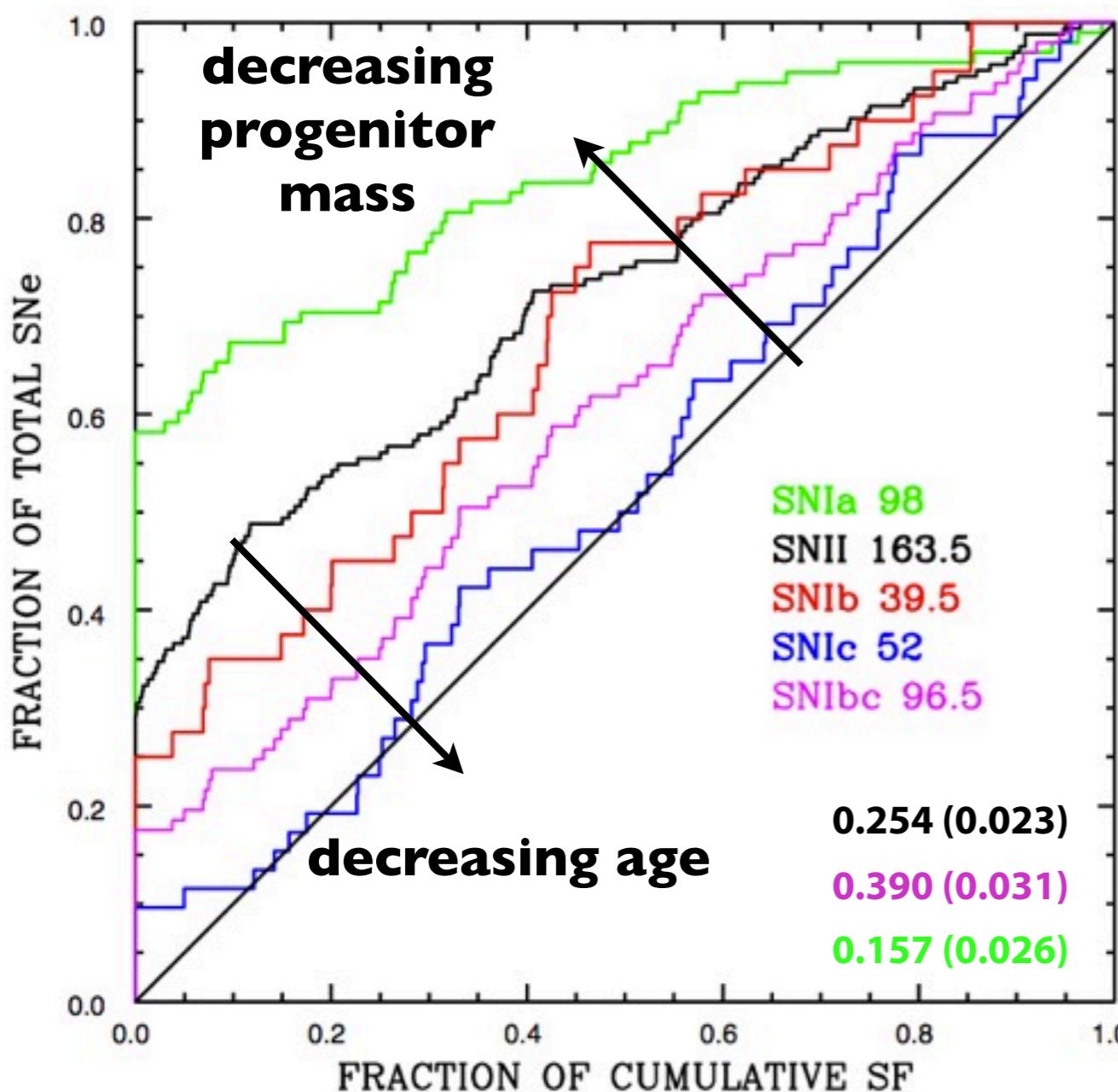
NCR result



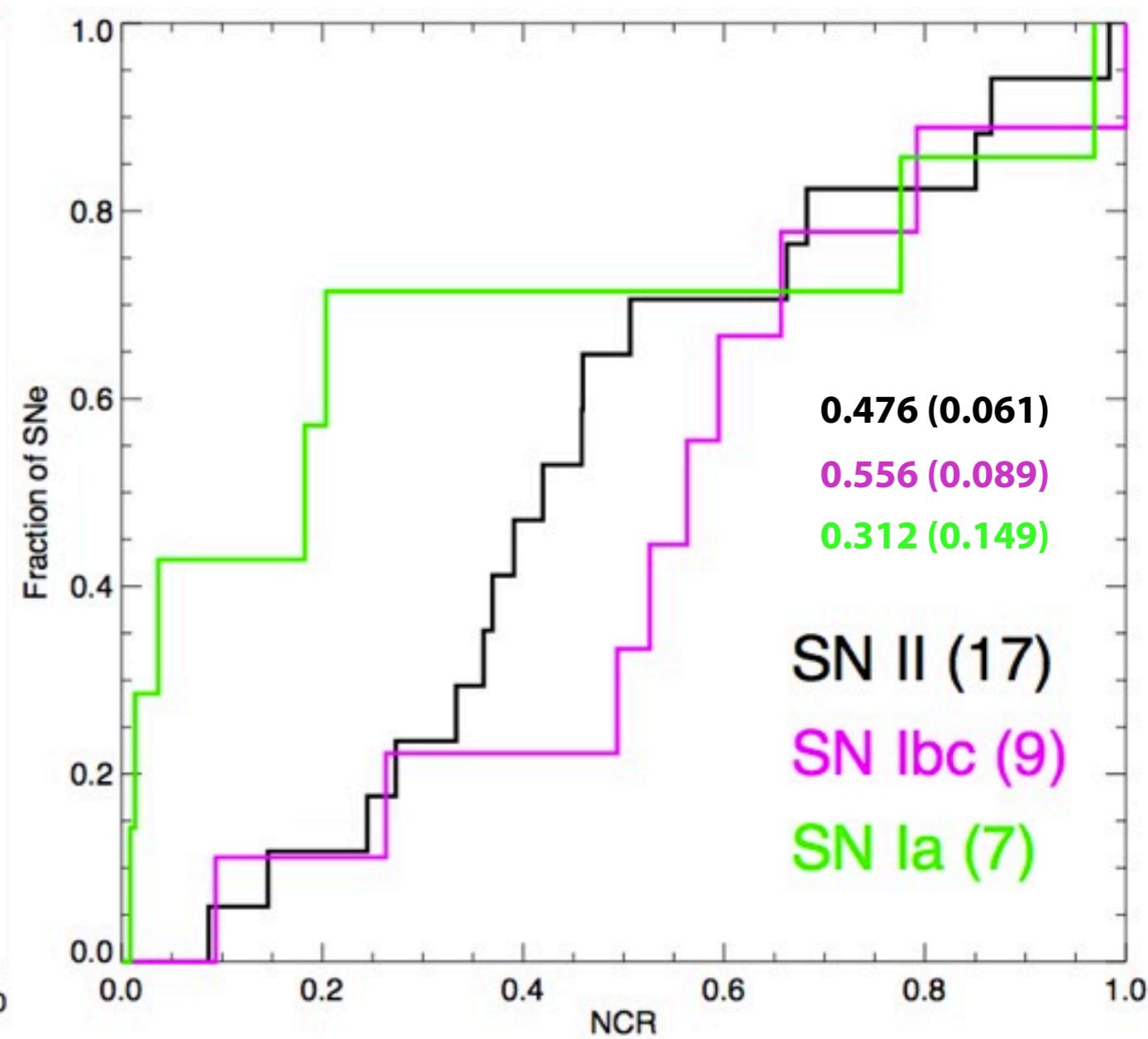
H α emission (SF)



H α imaging



NCR result

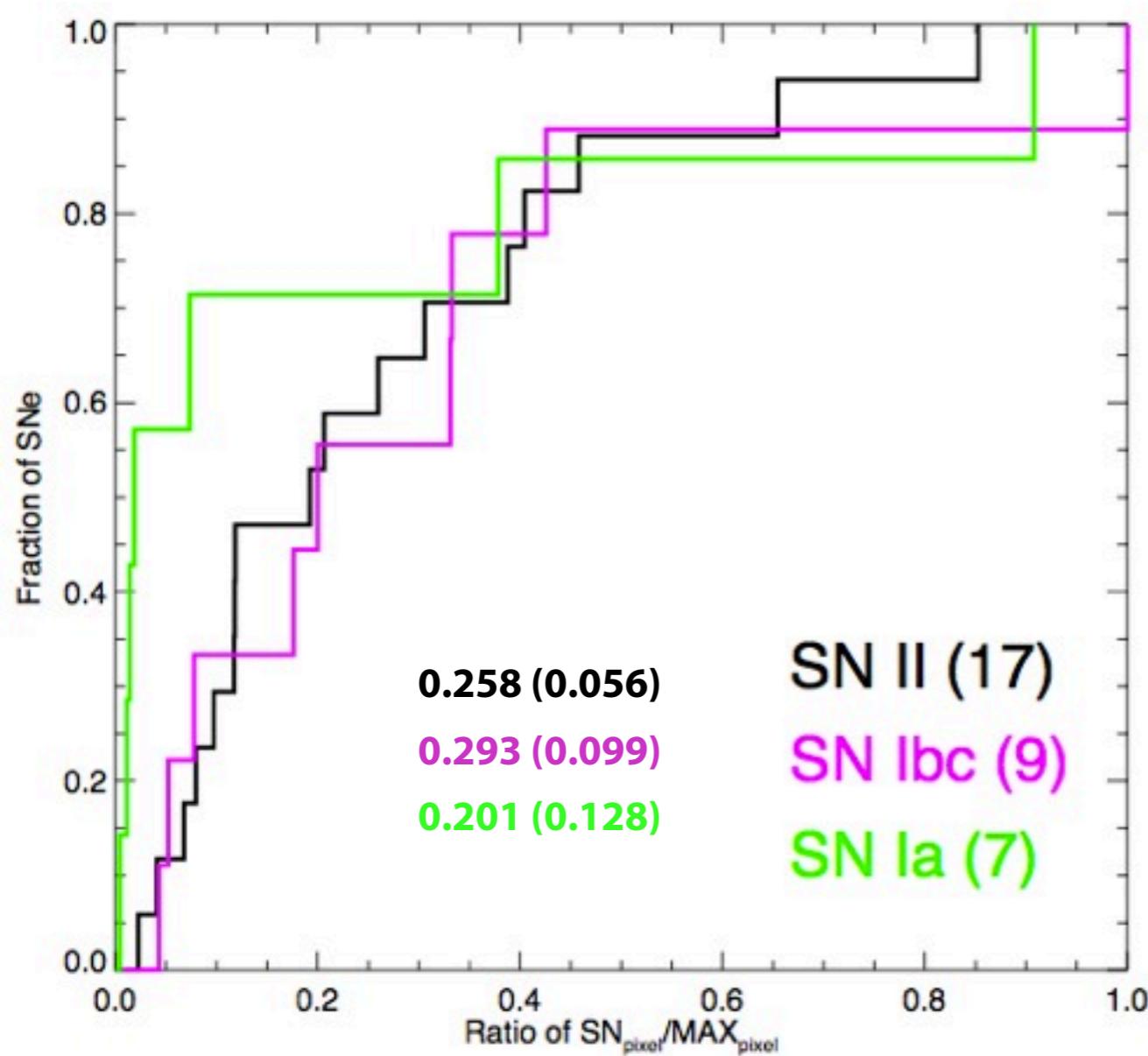


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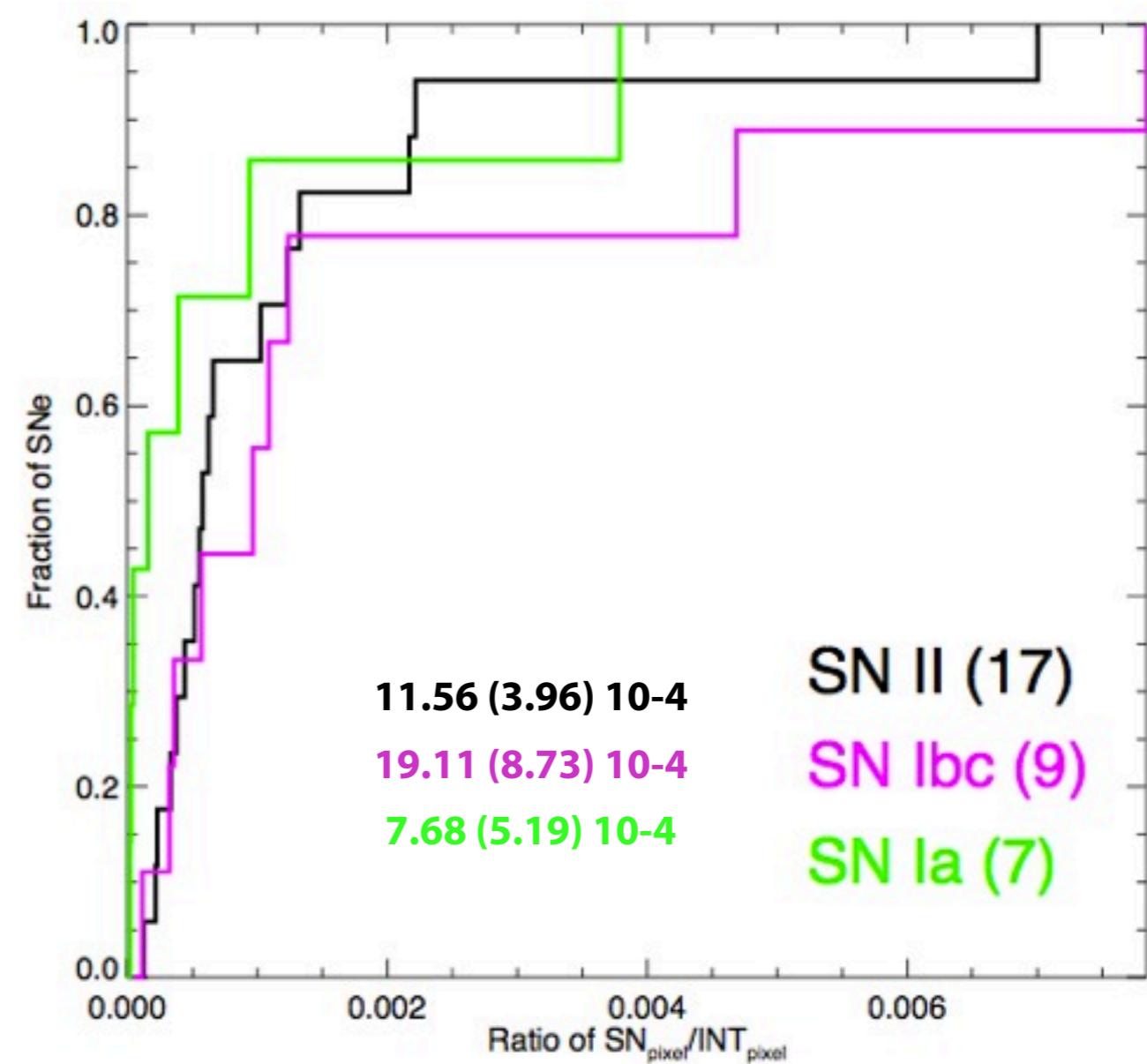
H α emission (SF)



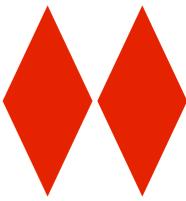
@SN/MAX



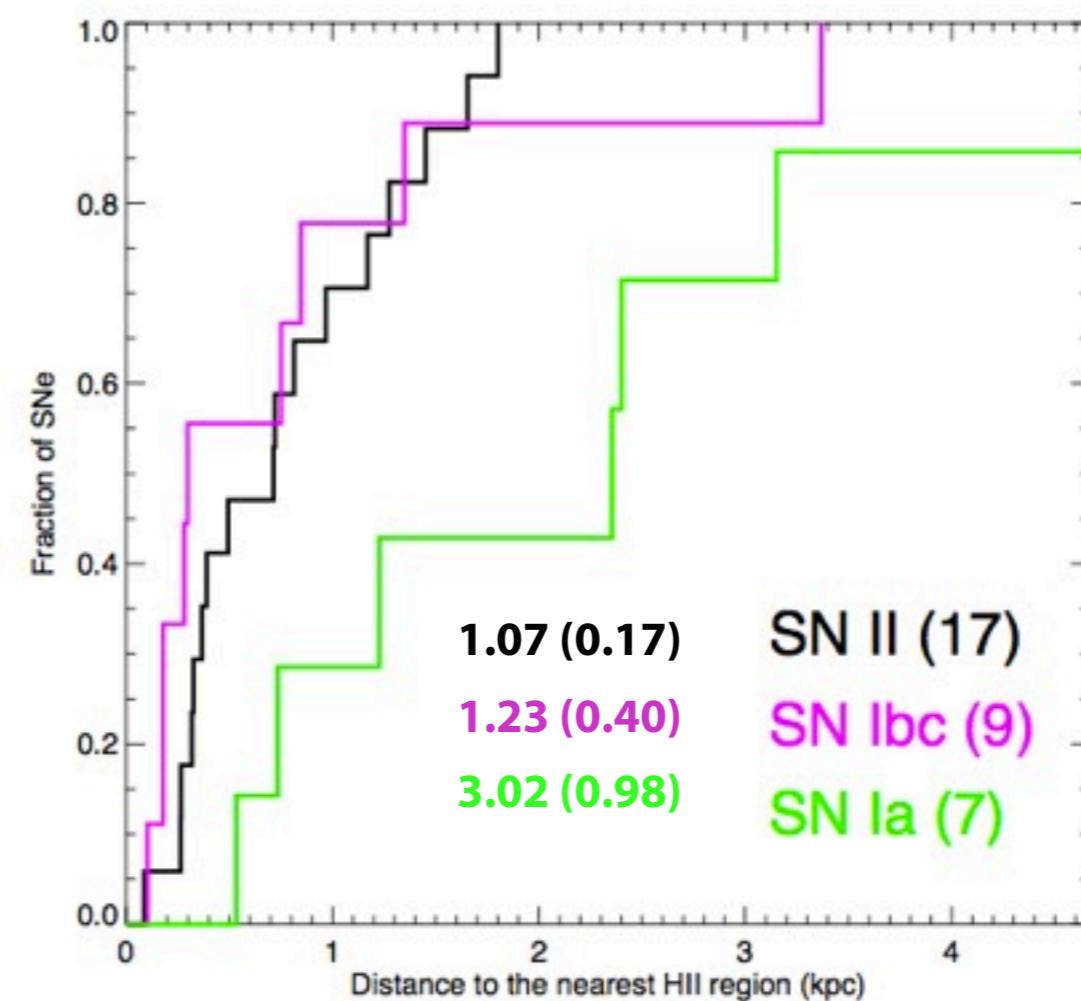
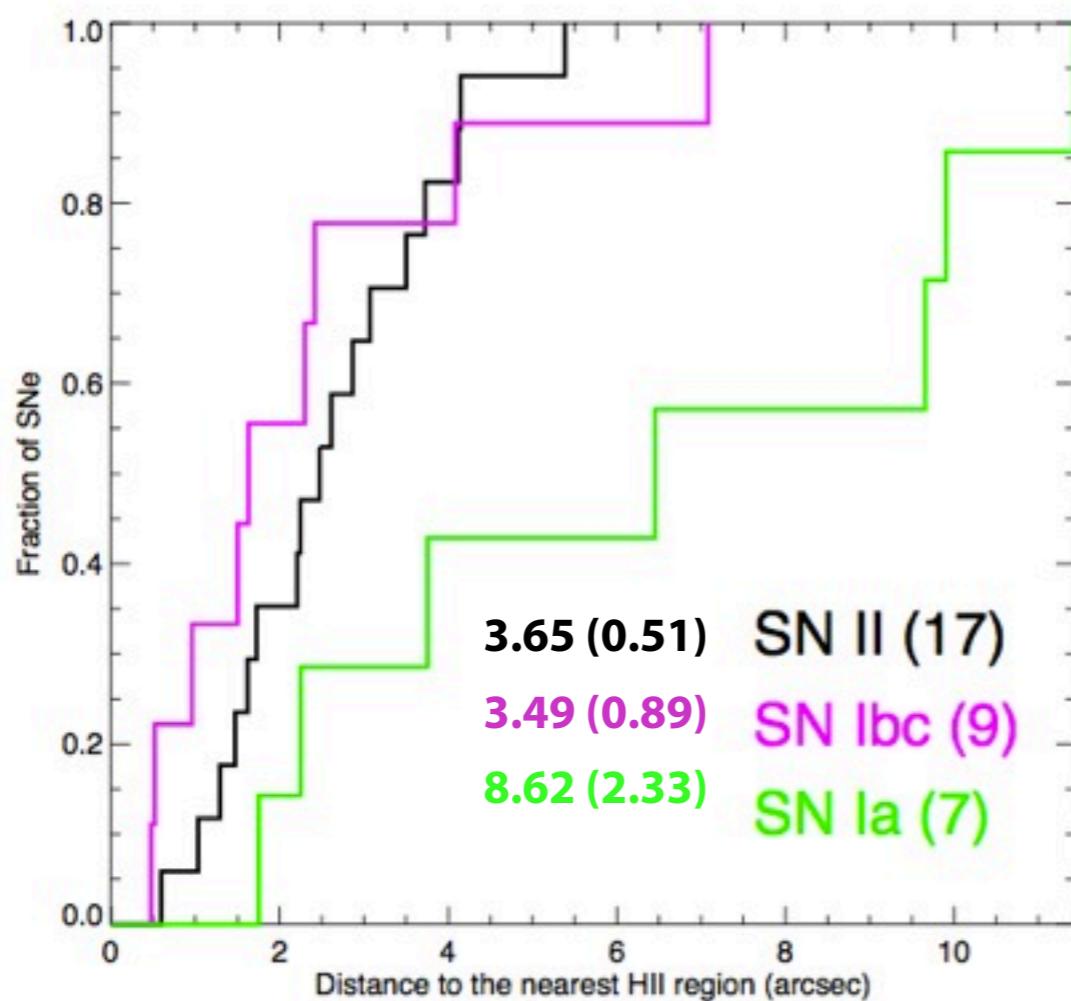
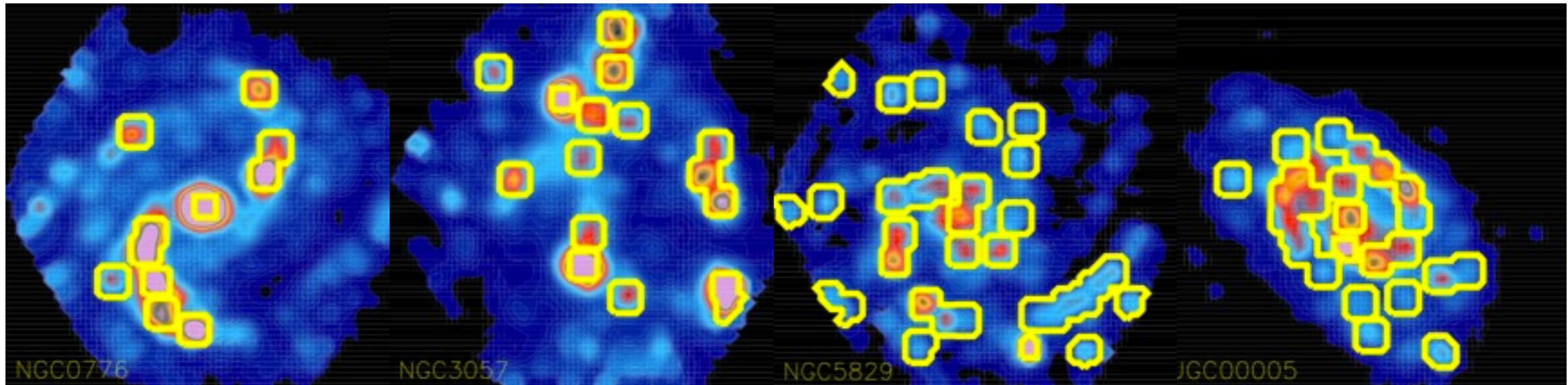
@SN/TOTAL



H α emission (SF)



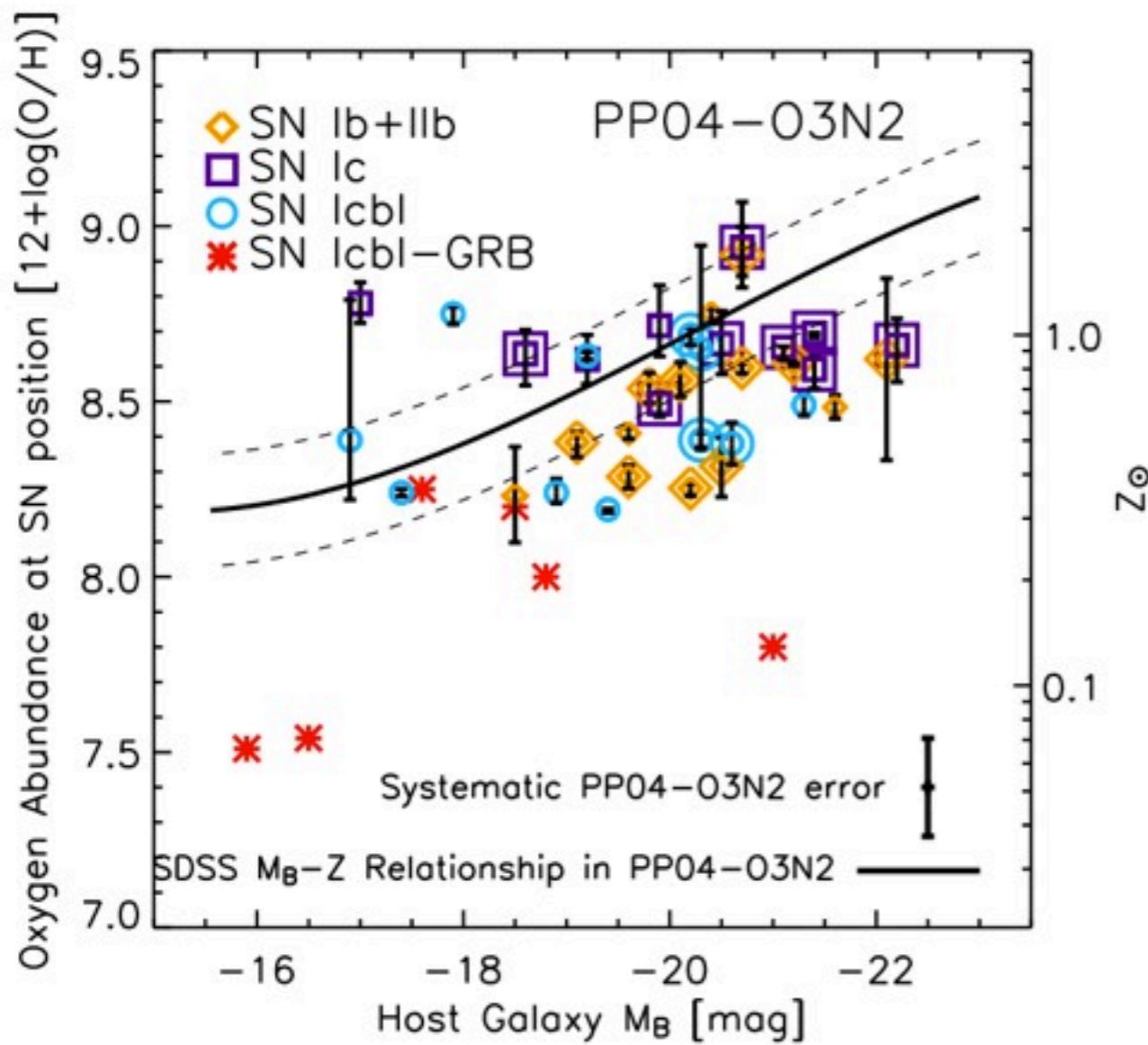
HIIexplorer



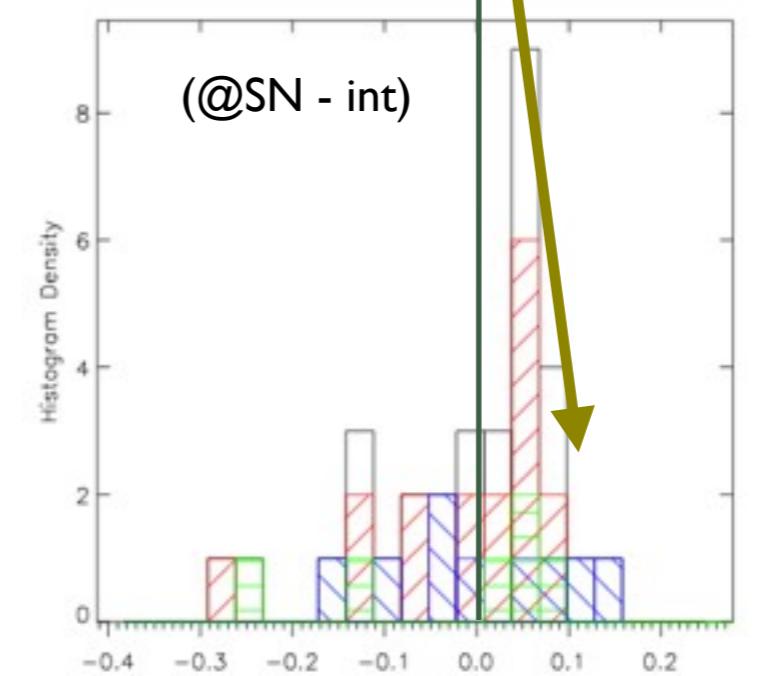
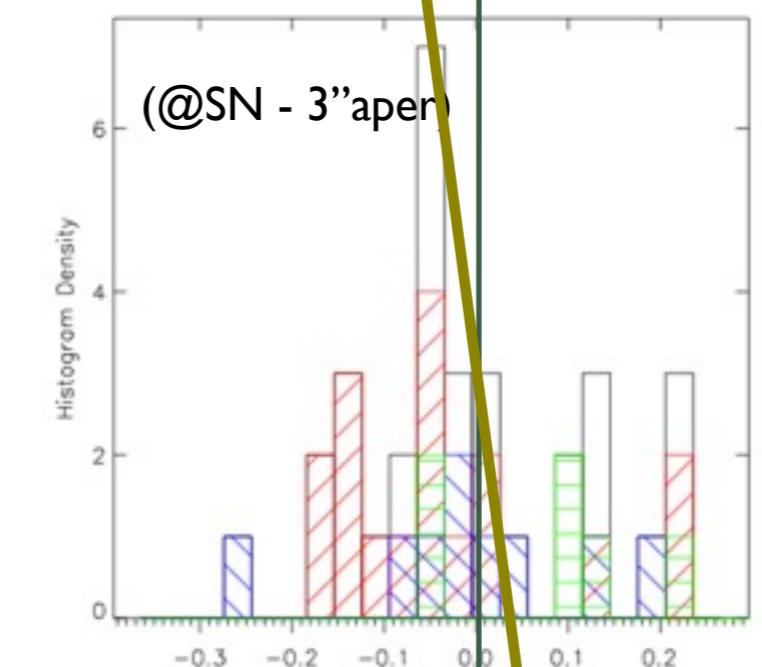
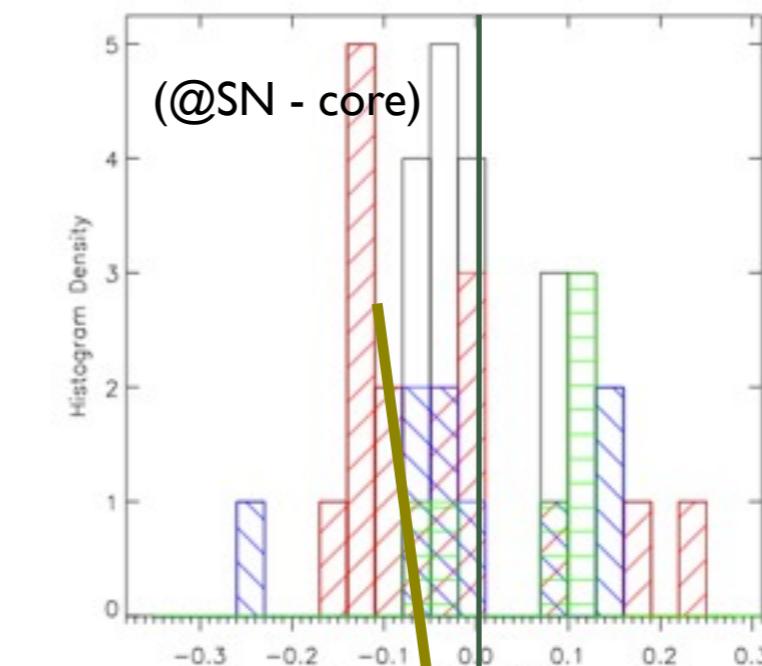
global Z Vs Local Z



long slit @SN

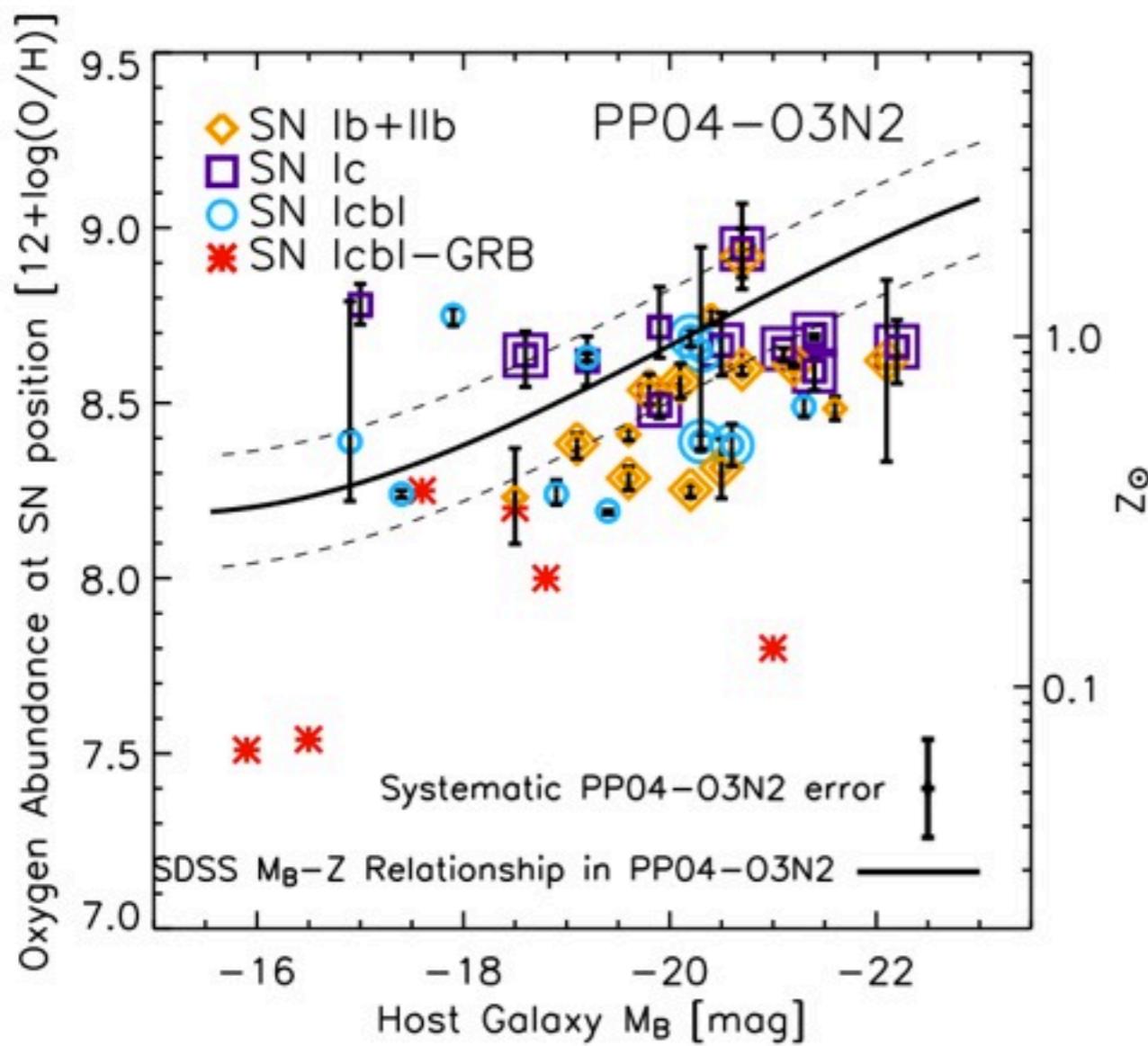


Modjaz+11

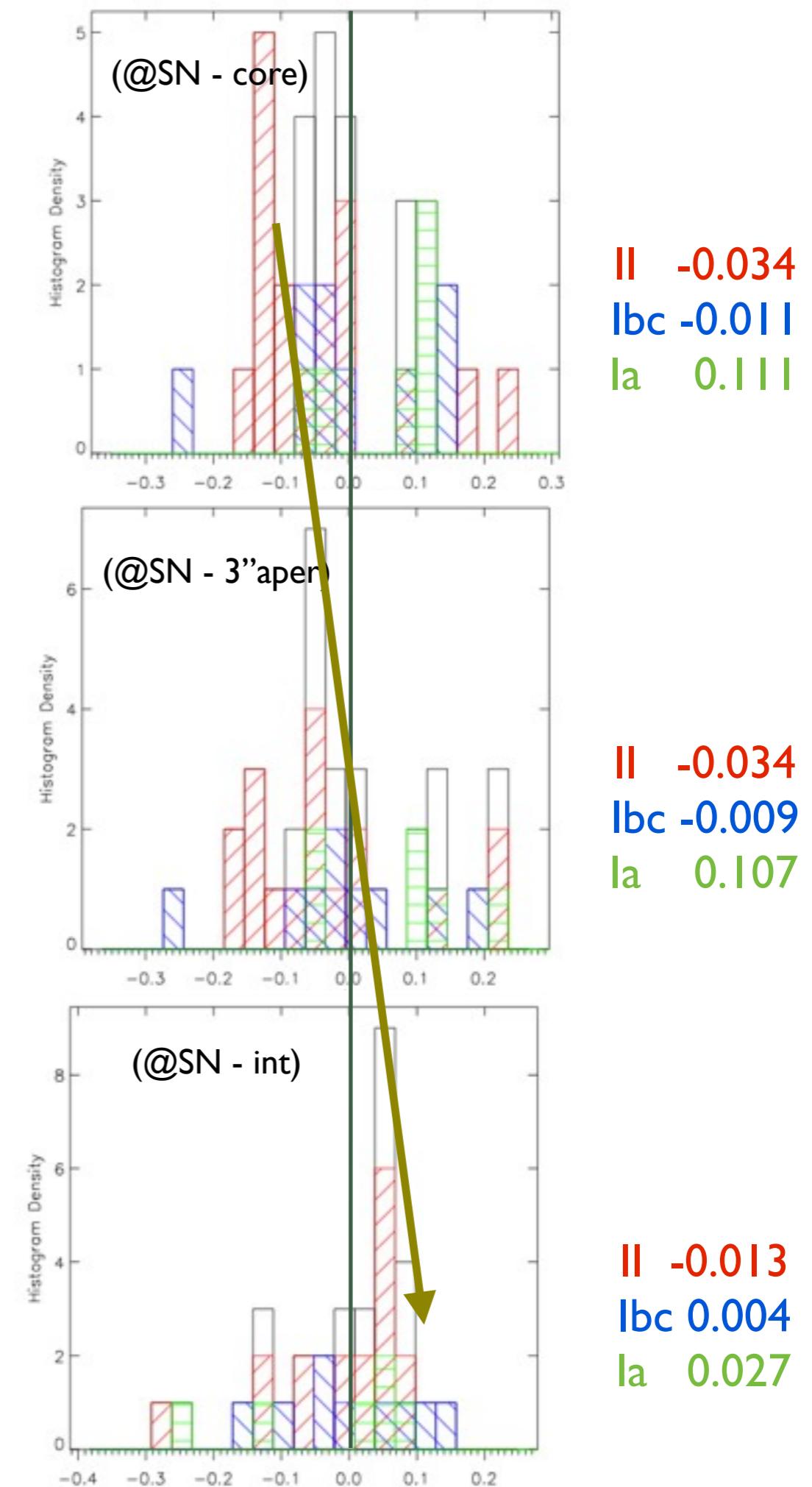


global Z Vs Local Z

long slit @SN



Modjaz+11



Conclusions and TO DOs

- We found some indications on differences between type II, Ibc and Ia SNe
 - mass, age, metallicity
 - progenitors
- we found differences between global and local metallicities
 - ...cosmology (aperture, gradients...)
- Need of more statistics to make strong conclusions
- Need to correlate other parameters
- Suggestions are welcome

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Obrigacias!

more...

