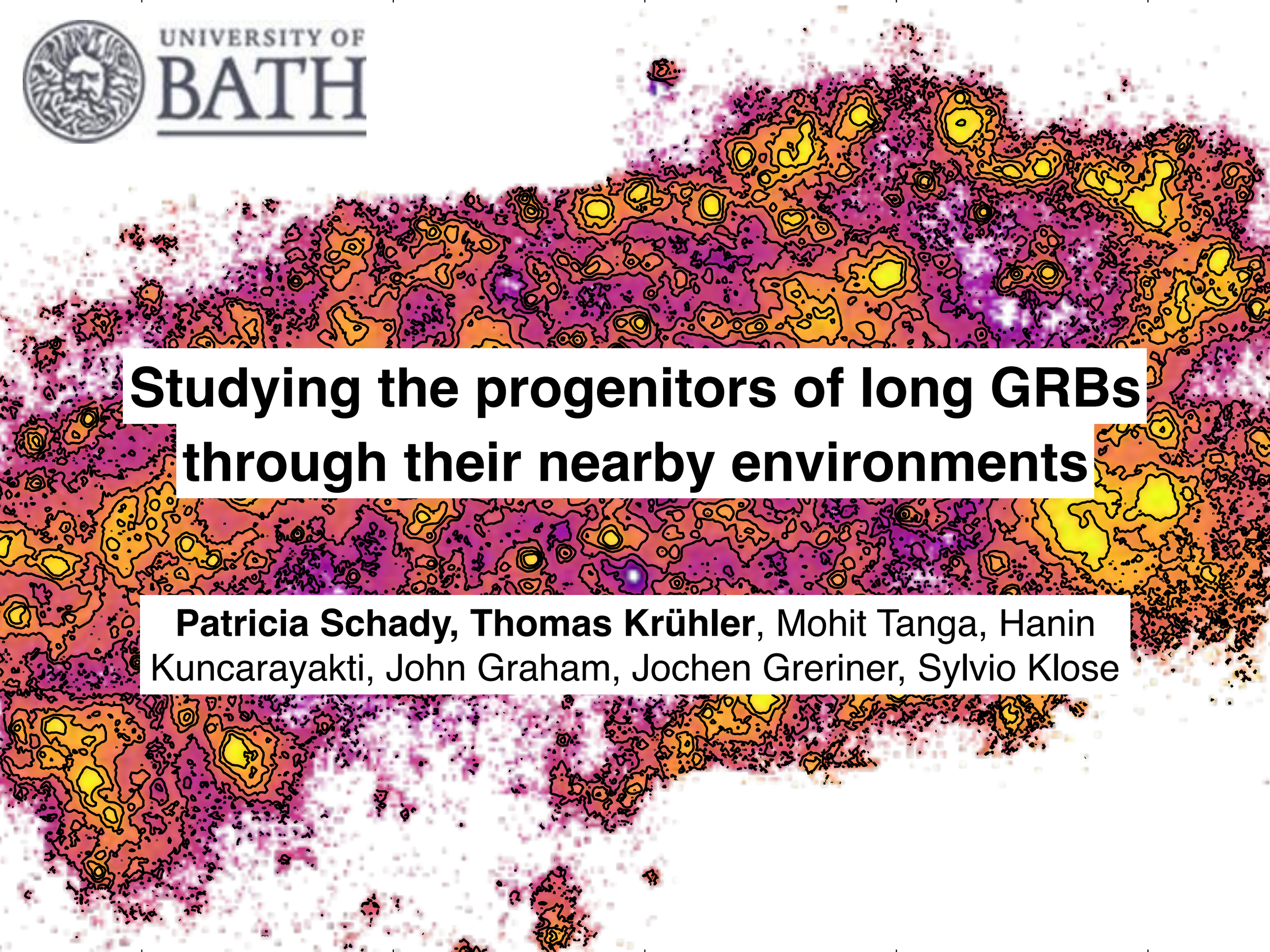
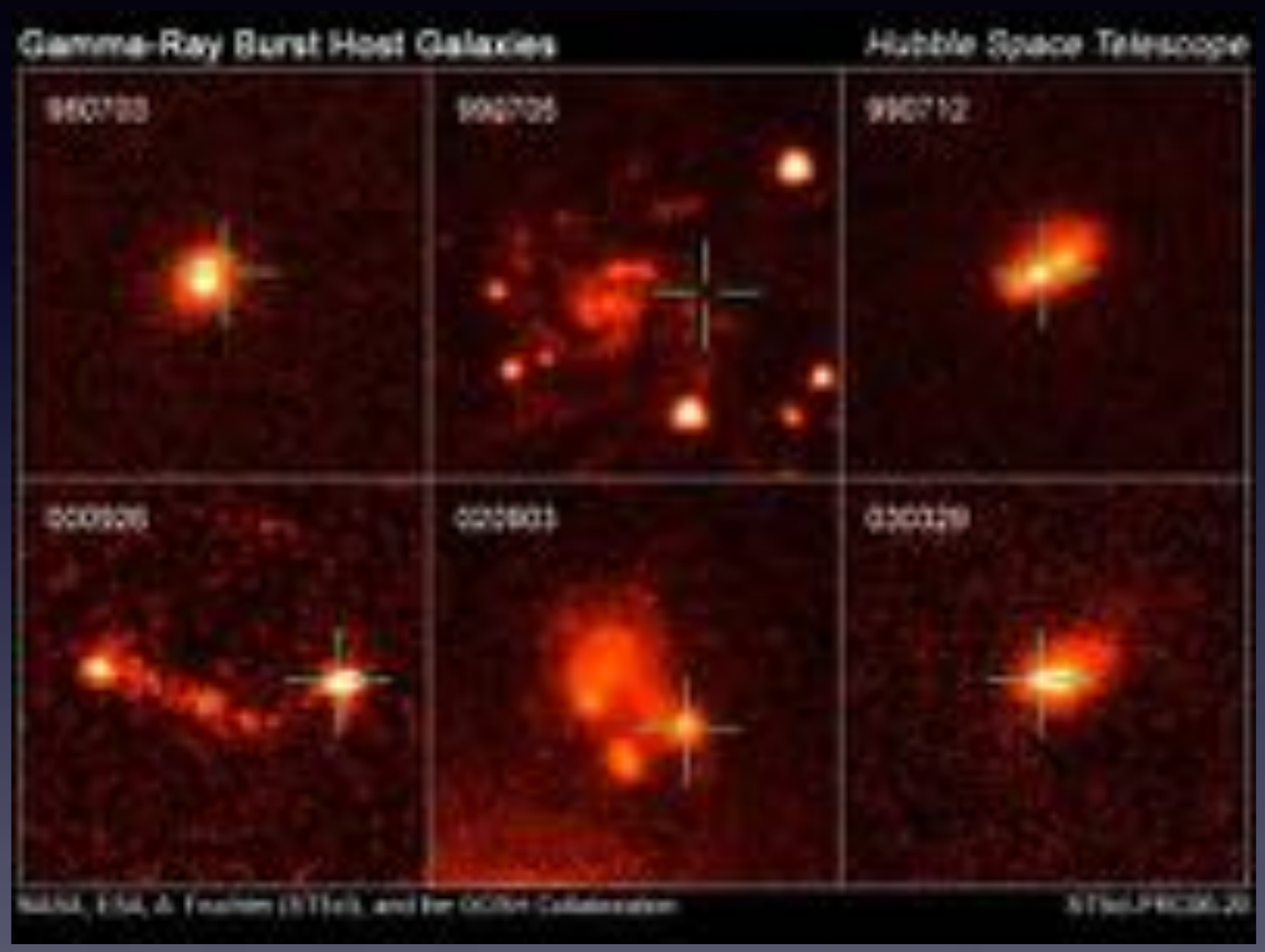
UNIVERSITY OF BATH



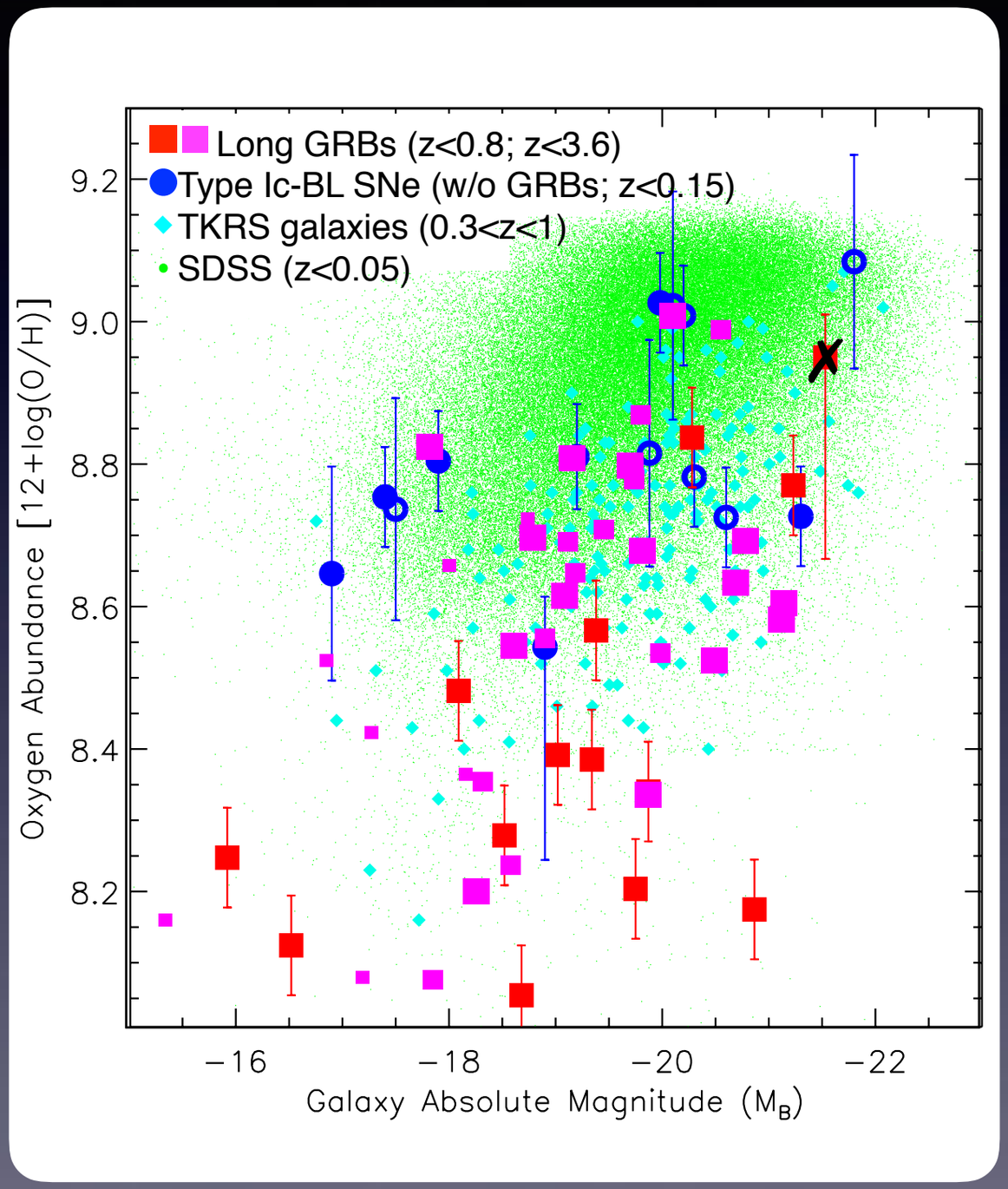
Studying the progenitors of long GRBs through their nearby environments

Patricia Schady, Thomas Krühler, Mohit Tanga, Hanin Kuncarayakti, John Graham, Jochen Greriner, Sylvio Klose

Studying GRB progenitors through their hosts

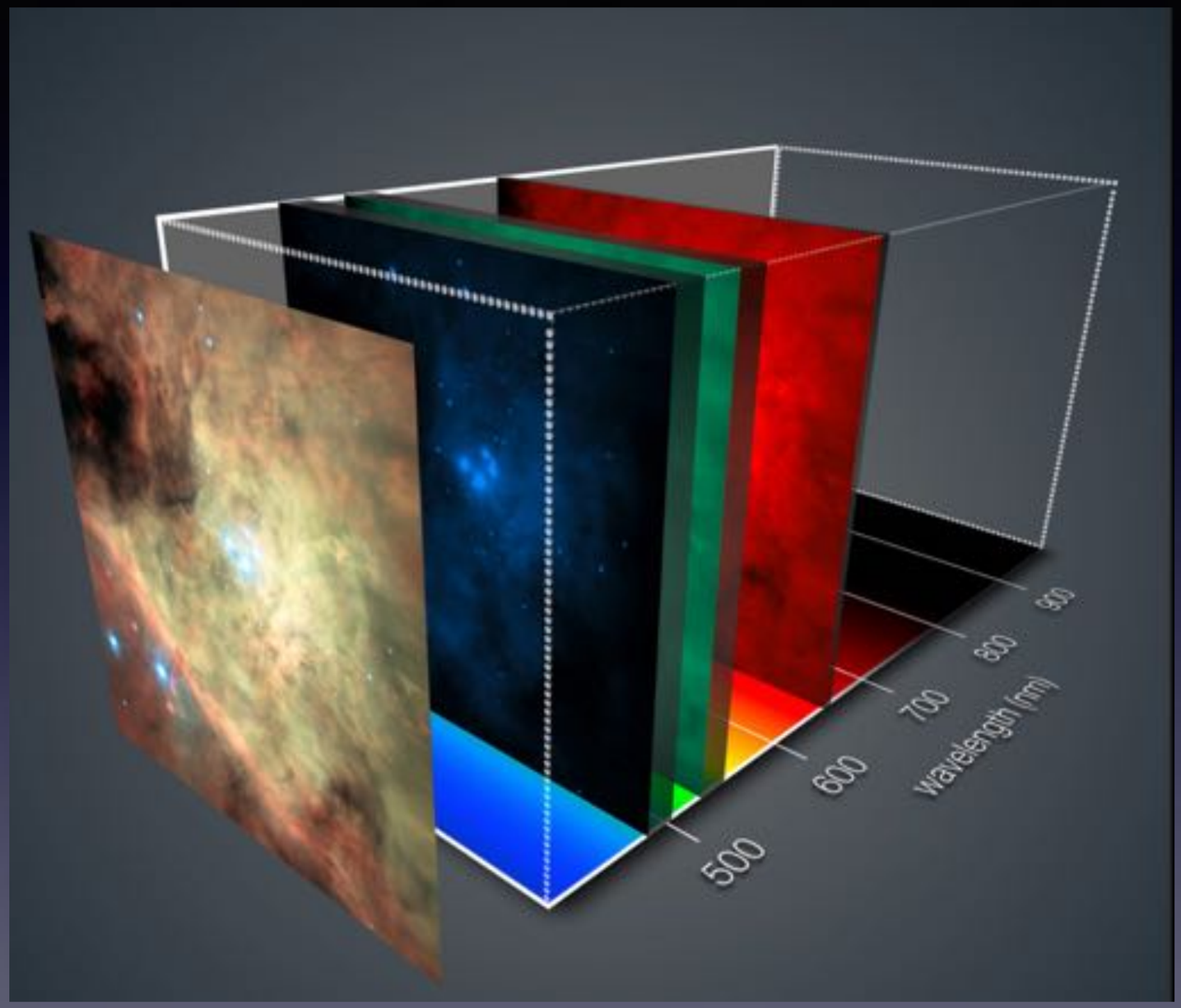


Fruchter+06

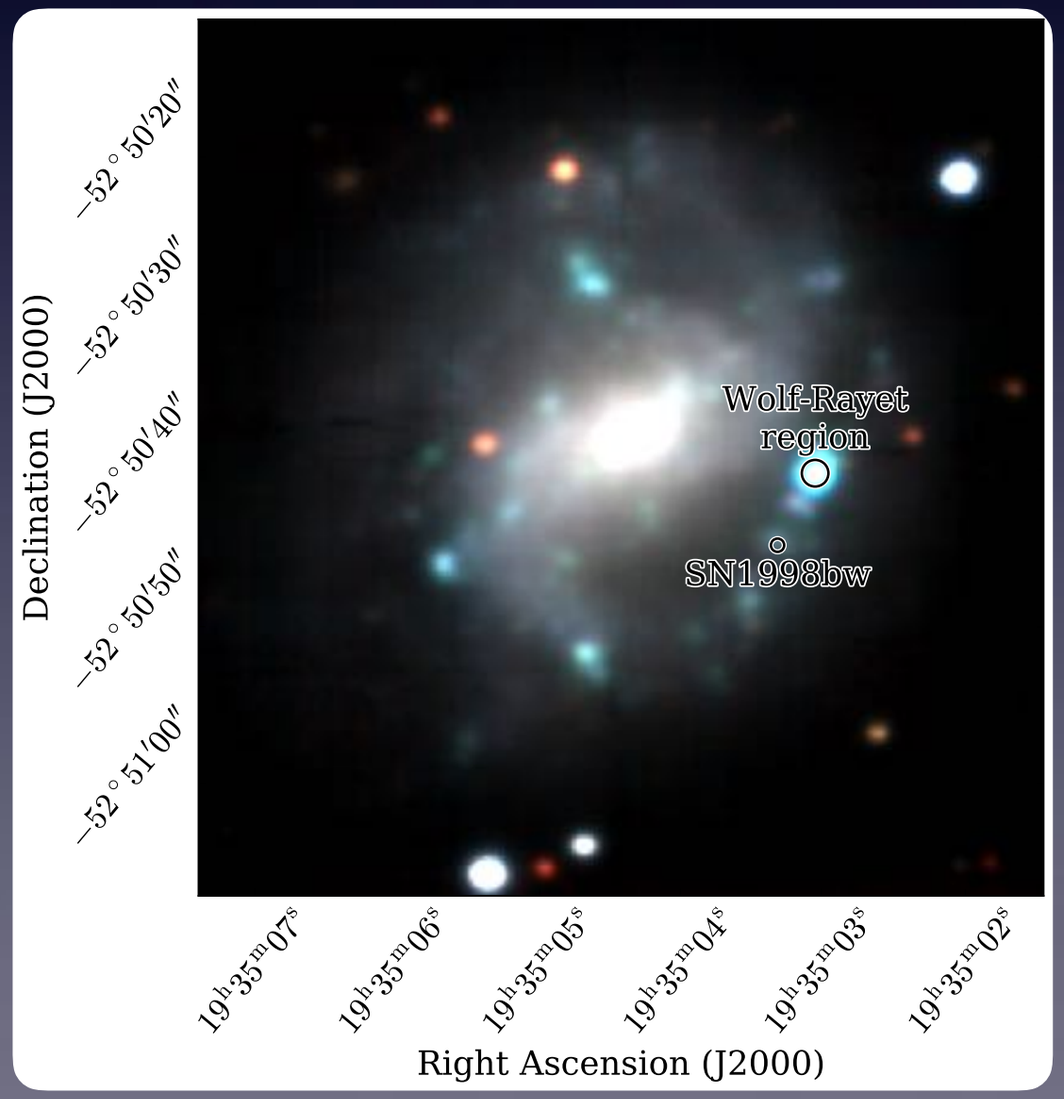


Adapted from Graham&Fruchter, 2013
(see Krühler+15)

Multi Unit Spectroscopic Explorer



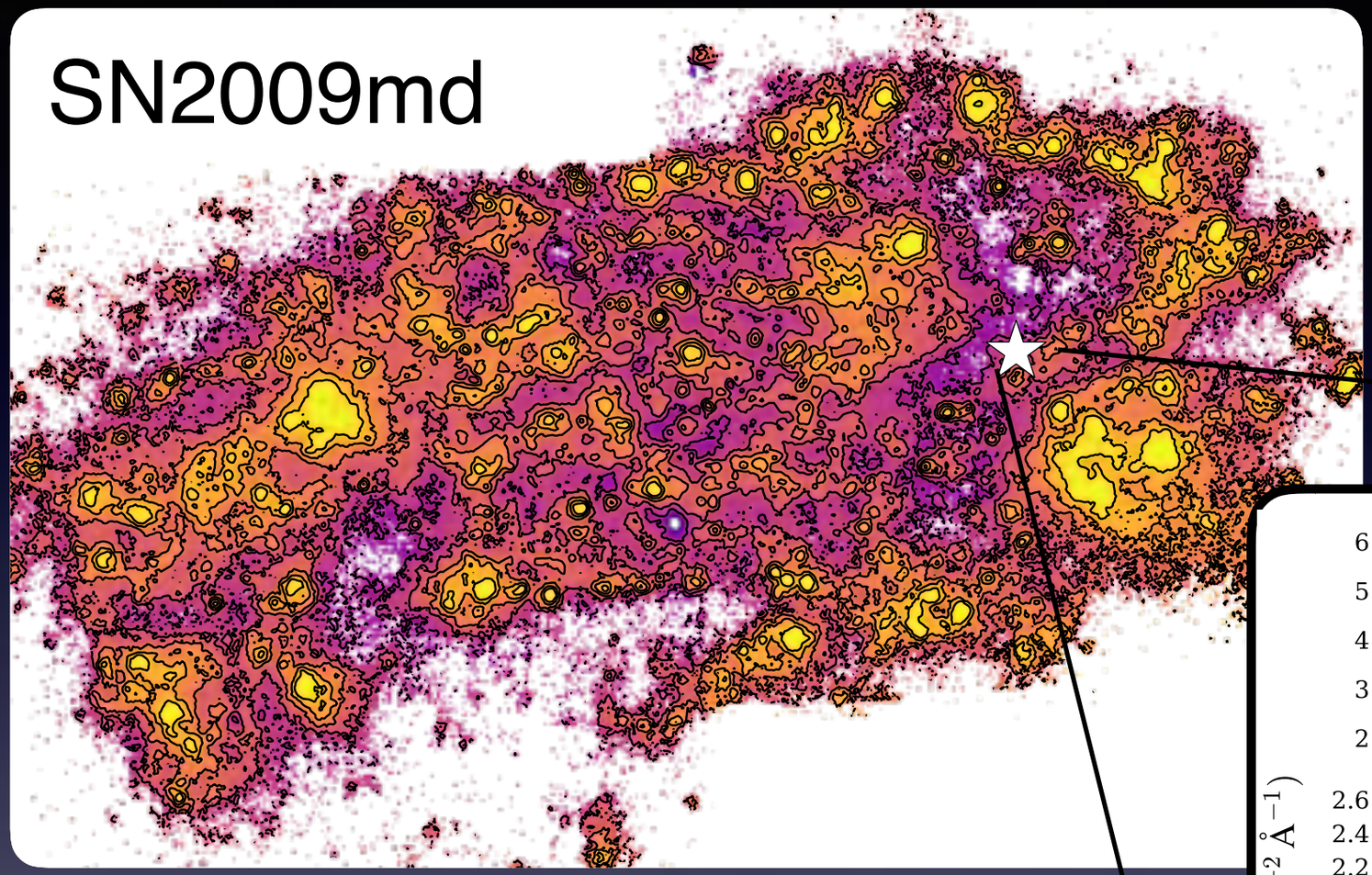
- 1’ x 1’ field of view
- Wavelength range 4800-9300 Å
- Resolving power 1800-3600 Å
- Small spaxel size 0.2” x 0.2”



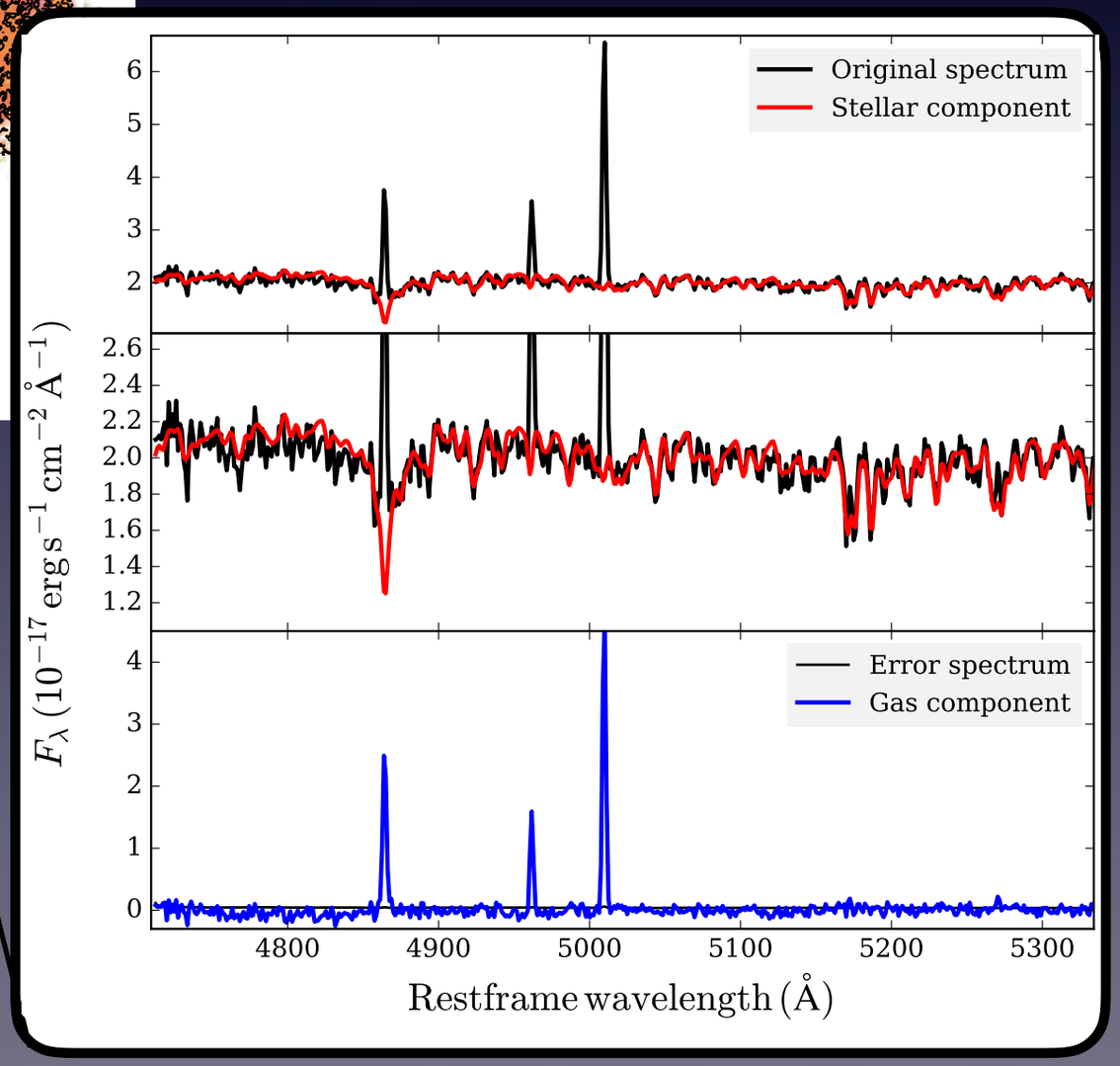
MUSE data cube contains 90,000 spectra or 3600 images

Krühler, HK, PS+17

Probing the environments of SNe

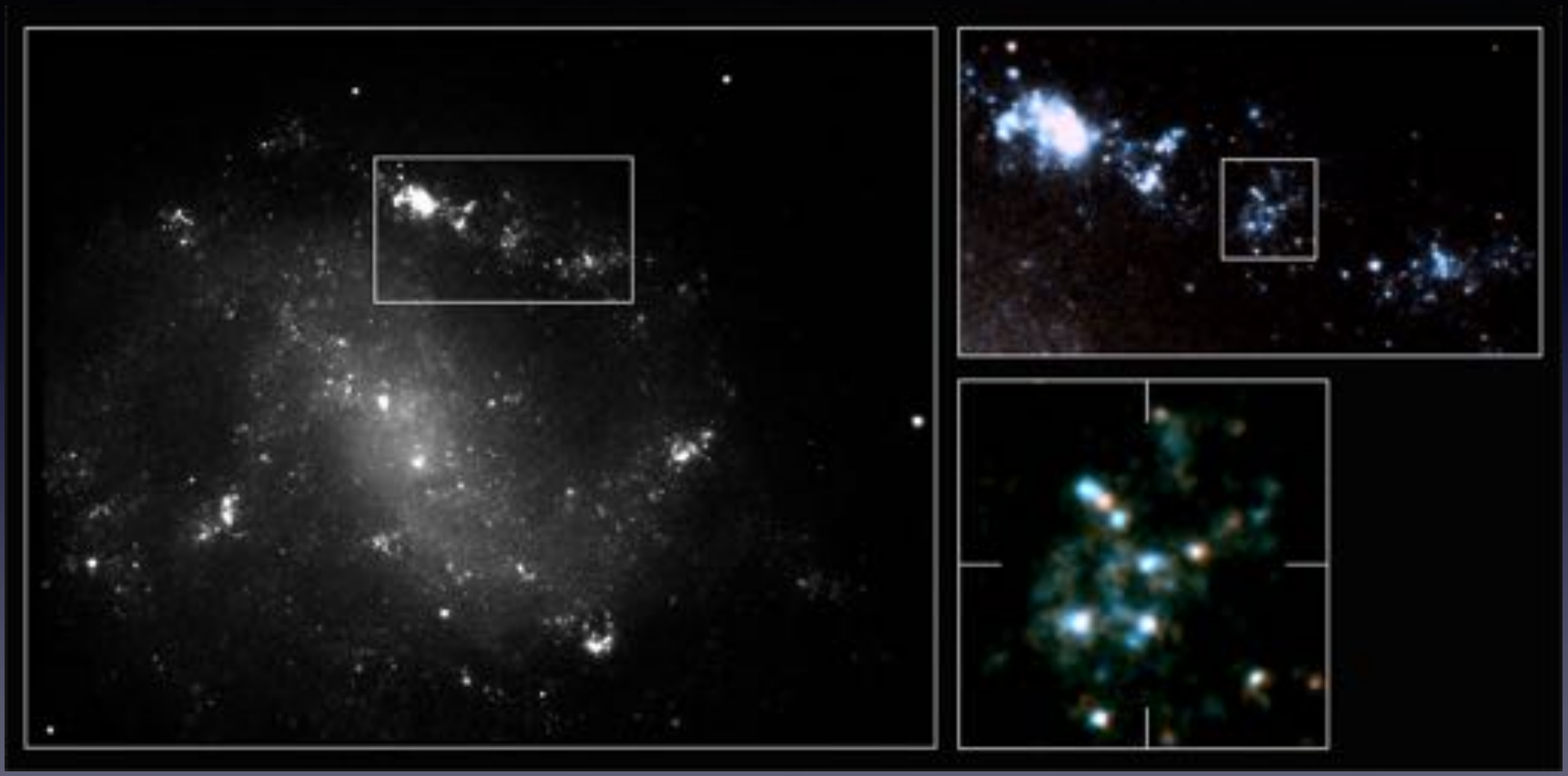


PS+19



Use Hα equivalent width to trace stellar age

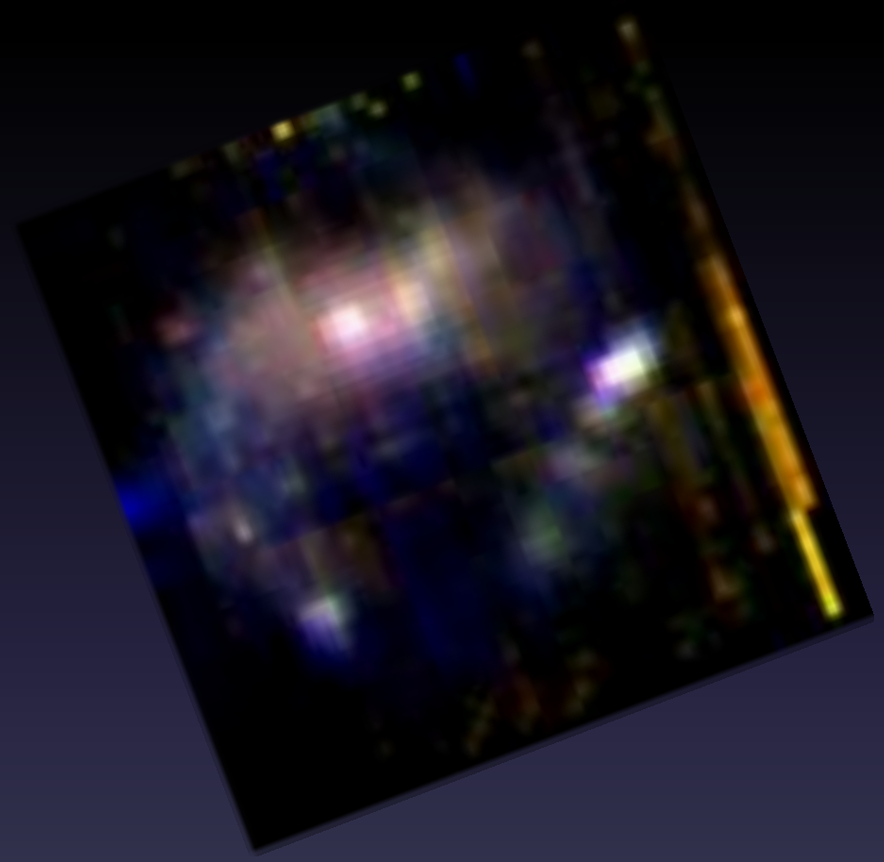
GRB 980425/SN 1998bw



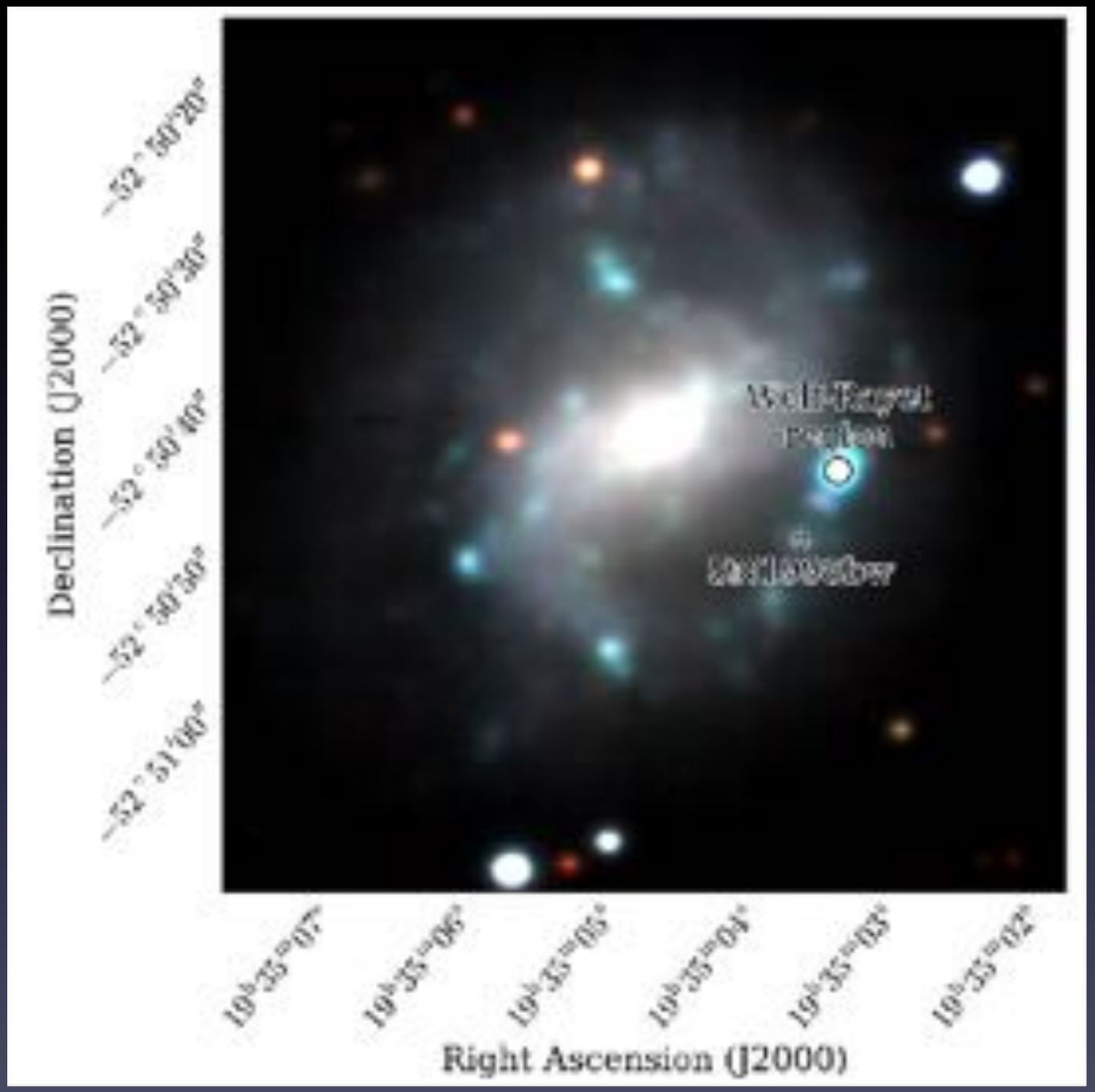
Hjorth & Bloom, 2012

Closest GRB ever detected at z=0.0085

The host galaxy of GRB 980425/SN1998bw



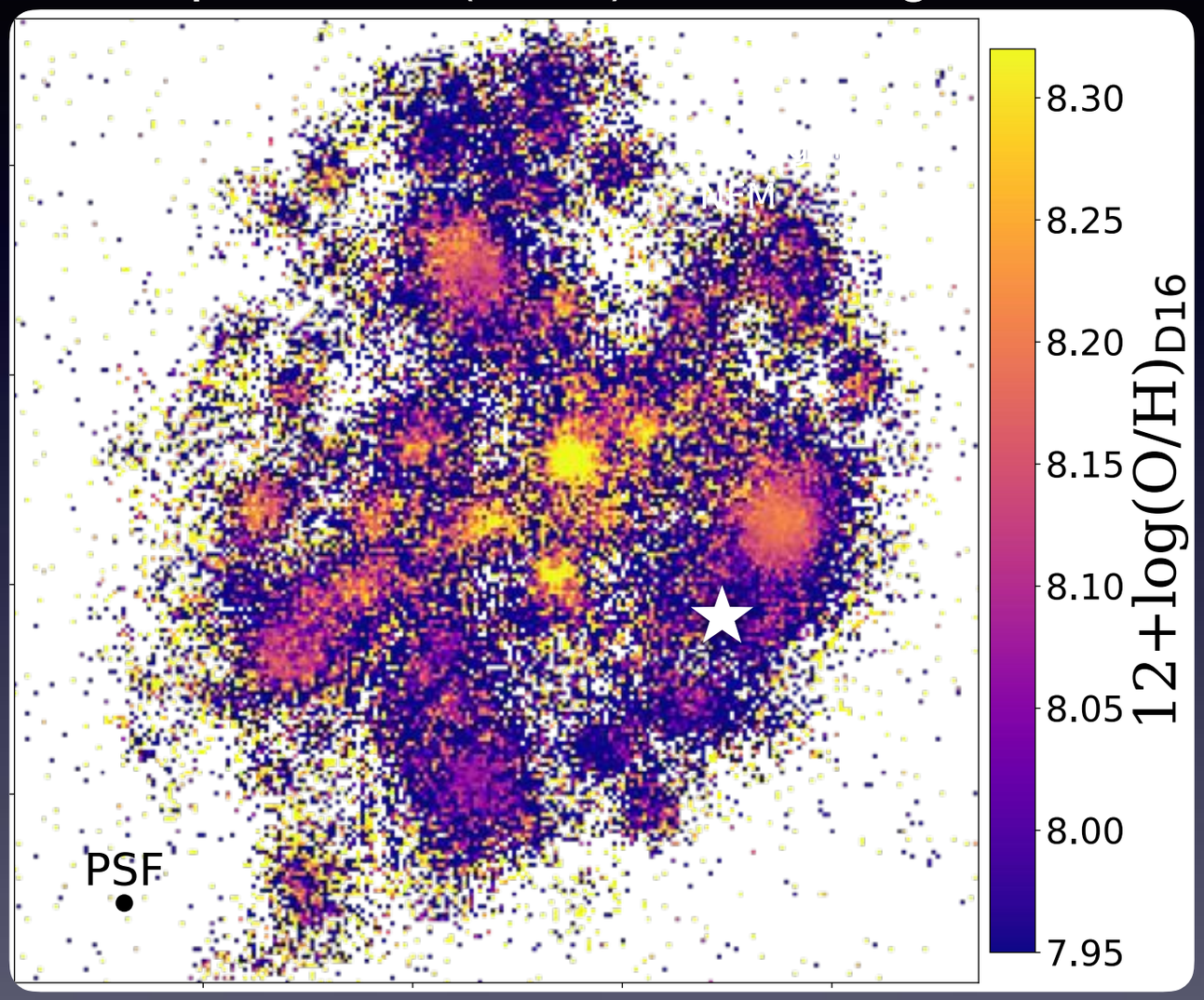
Christensen+08

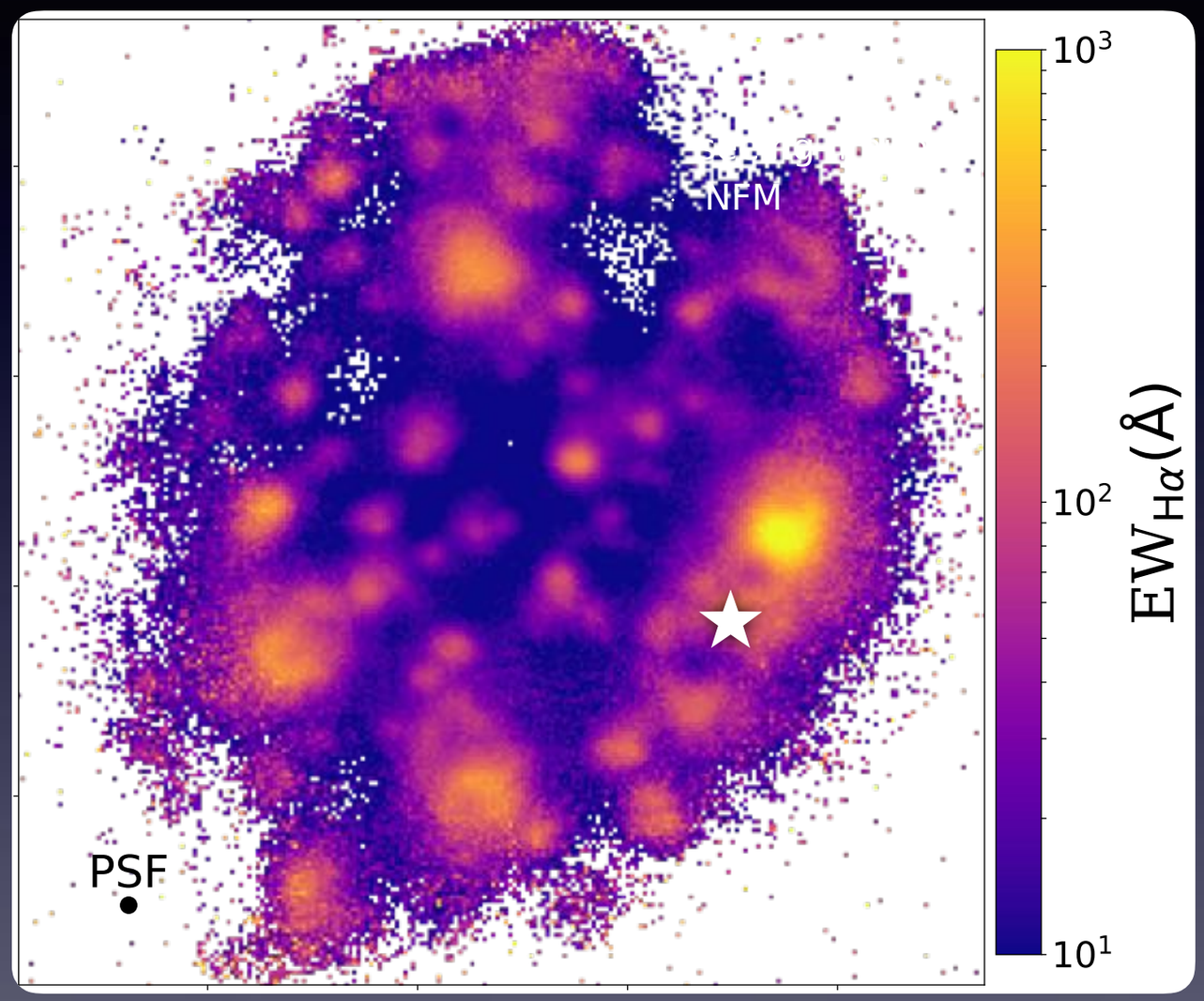


Krühler, HK, PS+17

A MUSE view of GRB980425/SN1998bw

Dopita et al. (2016) N2S2 diagnostic





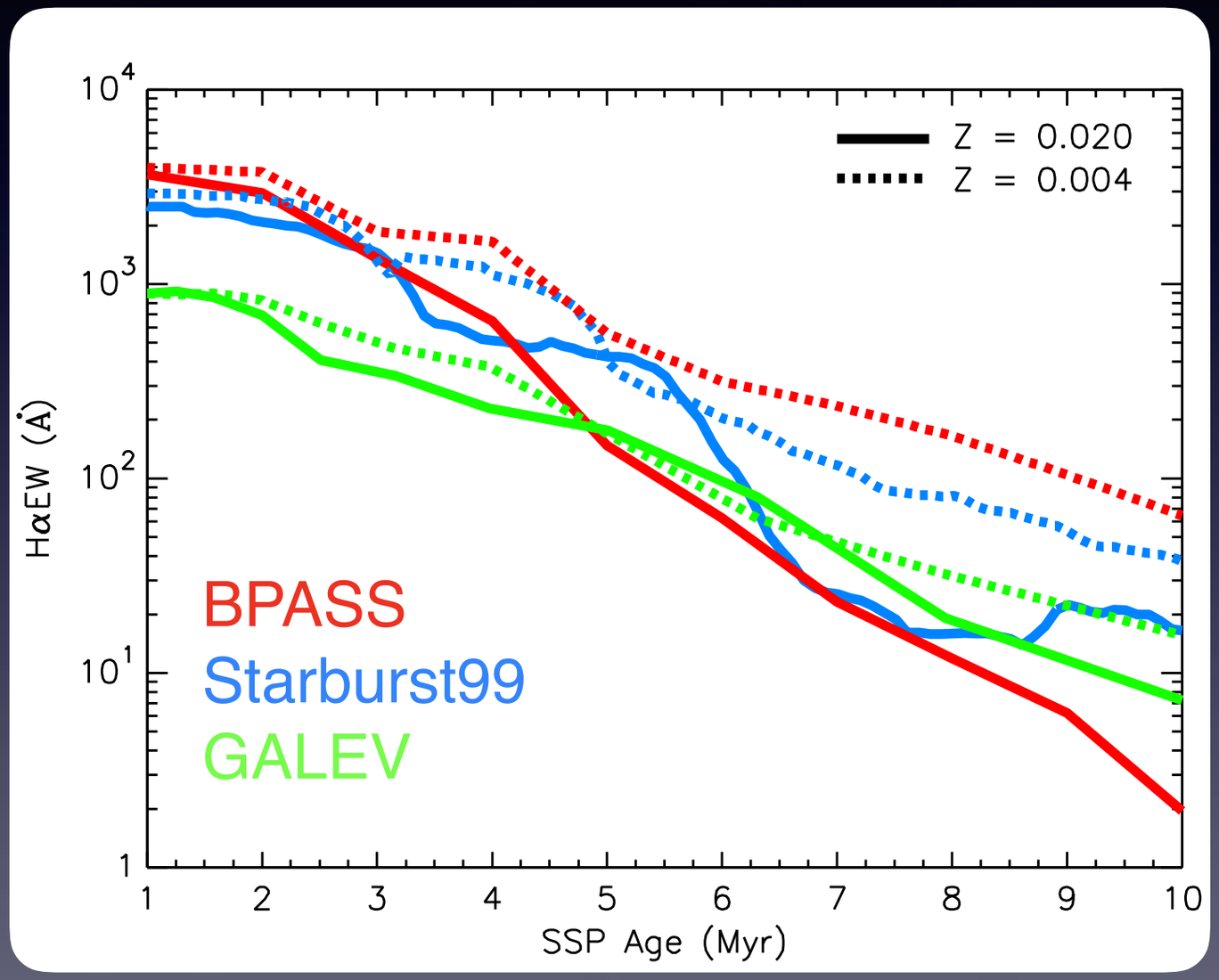
Krühler, HK, PS+17

GRB 980425/SN1998bw happened in a low-metallicity, star forming region of its host galaxy

Using Hα as tracer of stellar age

Hα equivalent width (EW):

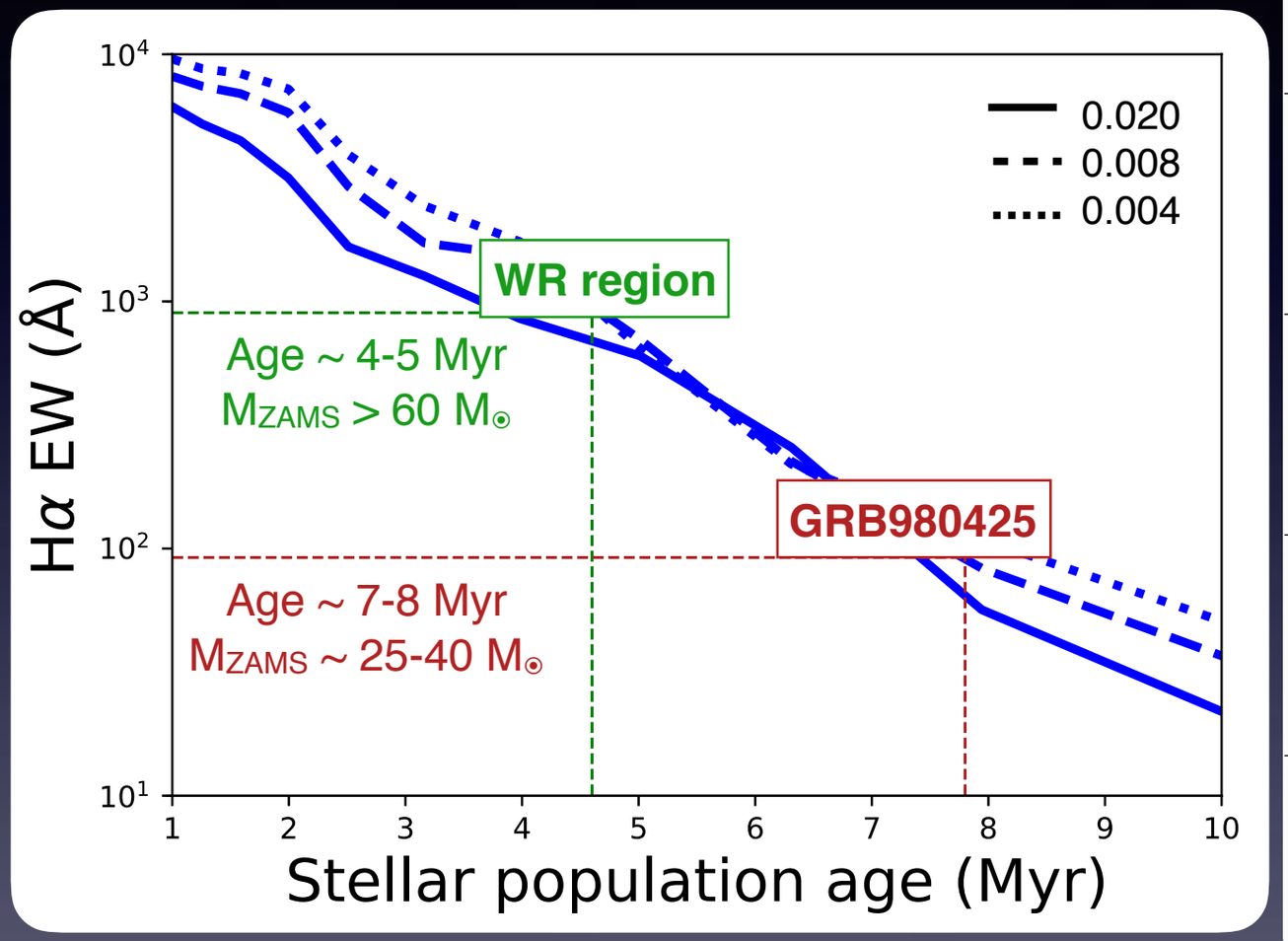
ratio of Hα line flux (young stars) over continuum (old stars)



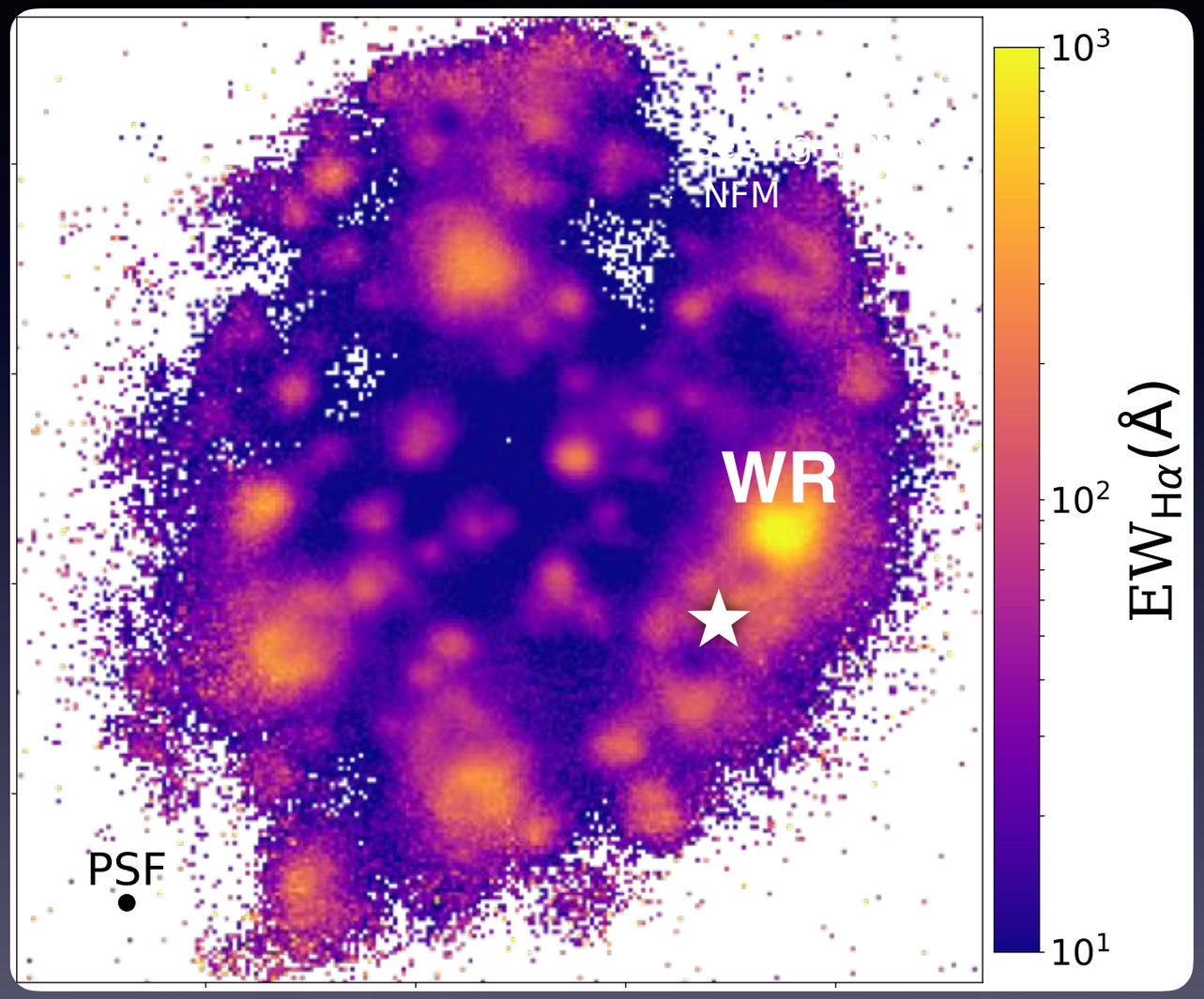
Kuncarayakti+16 (see also Leloudas+11, Kuncarayakti+13a,b, 18)

Hα EW traces stellar age, but *only* if we probe single stellar population

Hα EW and progenitor mass



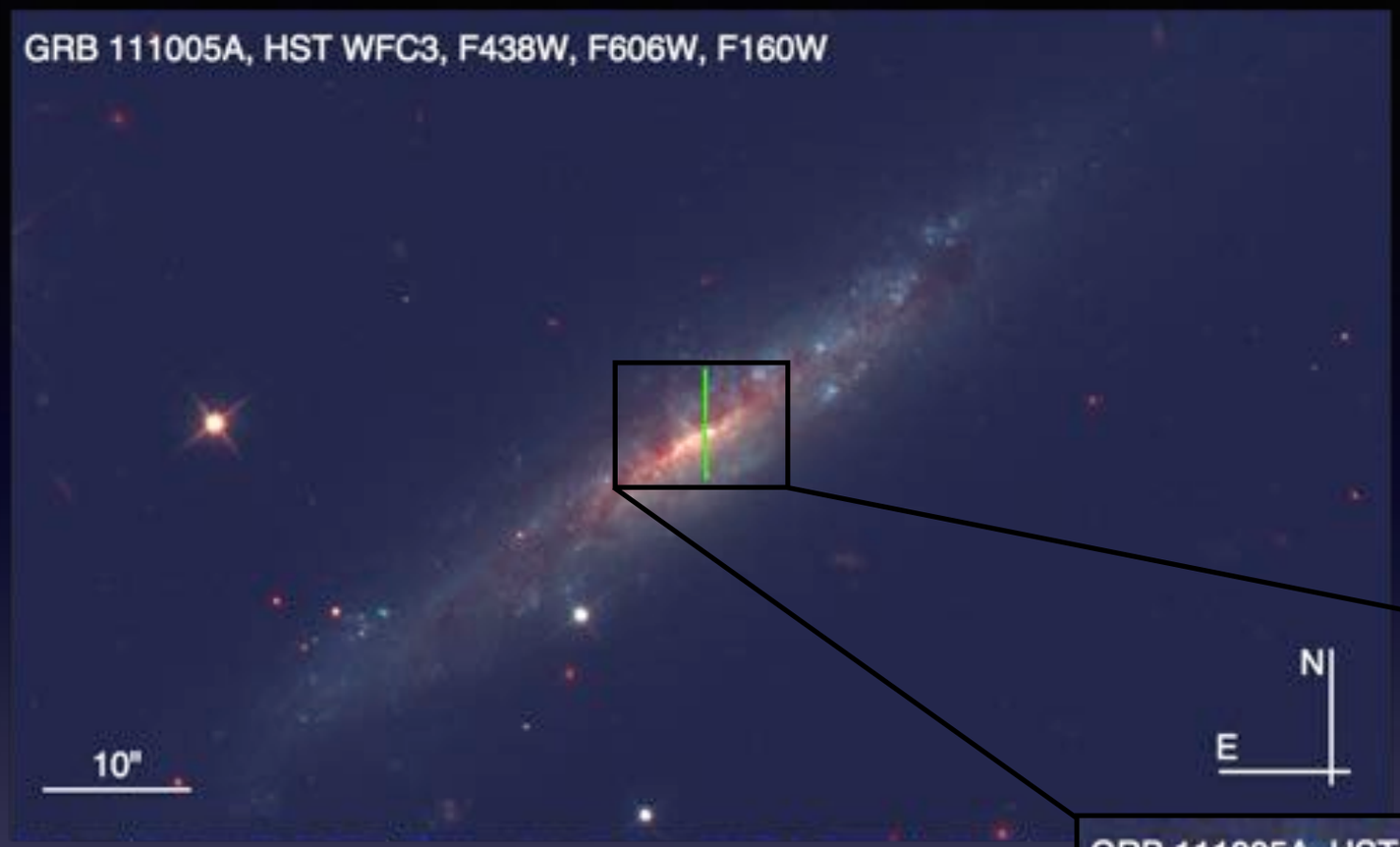
BPASS v2.1 models; Eldridge+17



Krühler, HK, PS+17

GRB 980425/SN1998bw unlikely to have originated in WR region, but progenitor mass consistent with GRB *collapsar* model

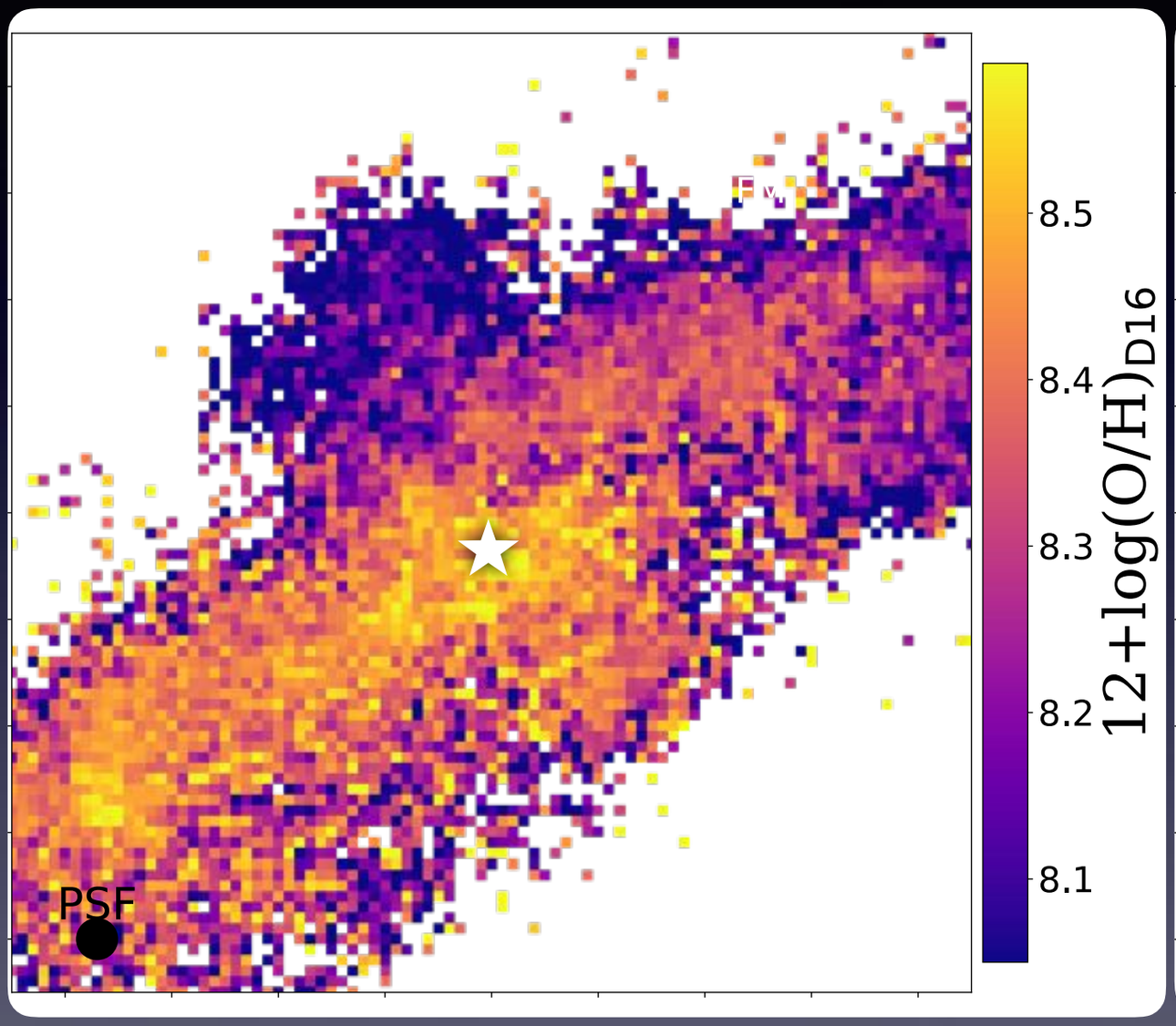
The supernovaless long GRB 111005A

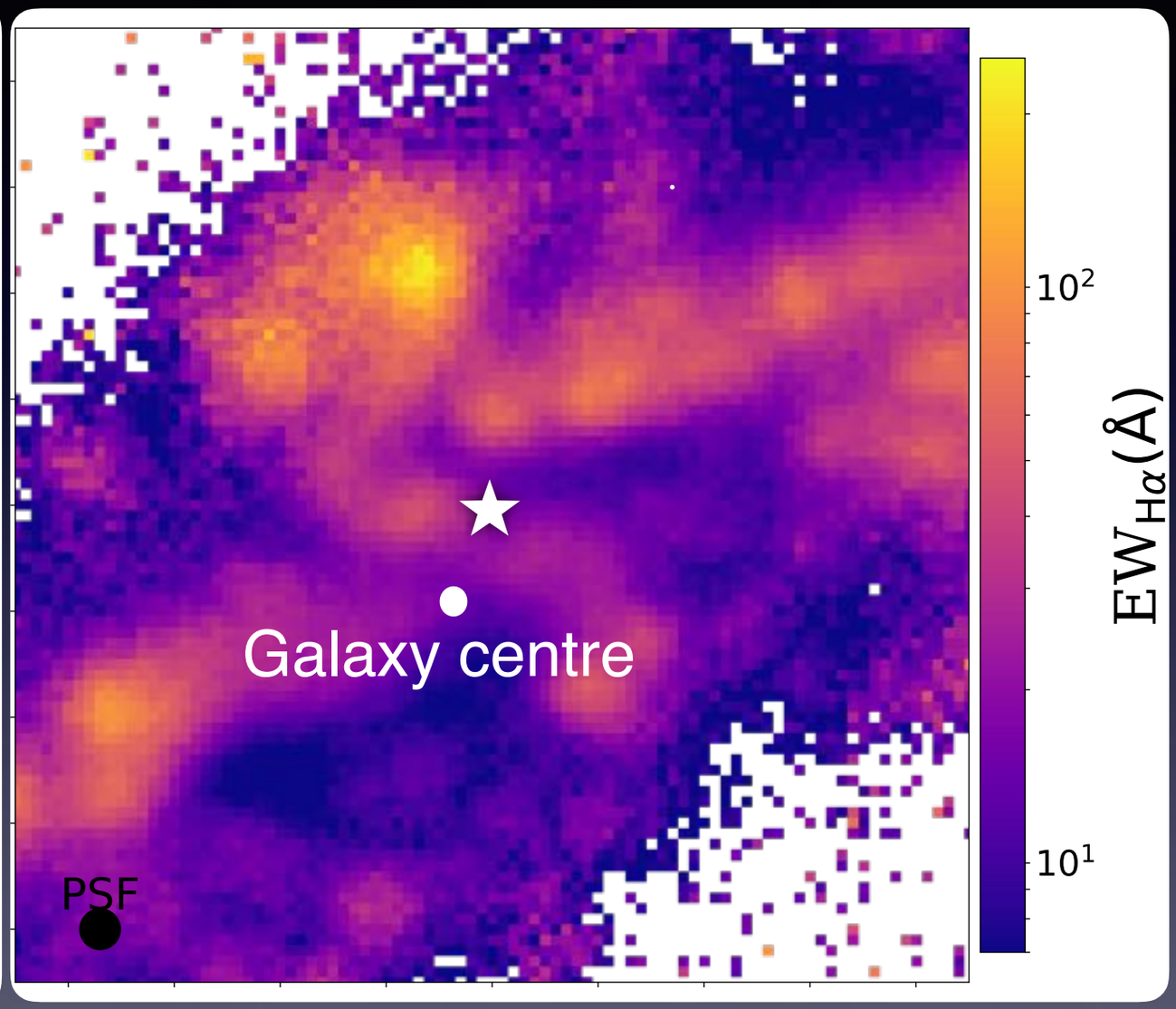


Michałowski+18

- Second closest long GRB detected at z=0.013
- Massive, dusty host galaxy

The case of GRB 111005A

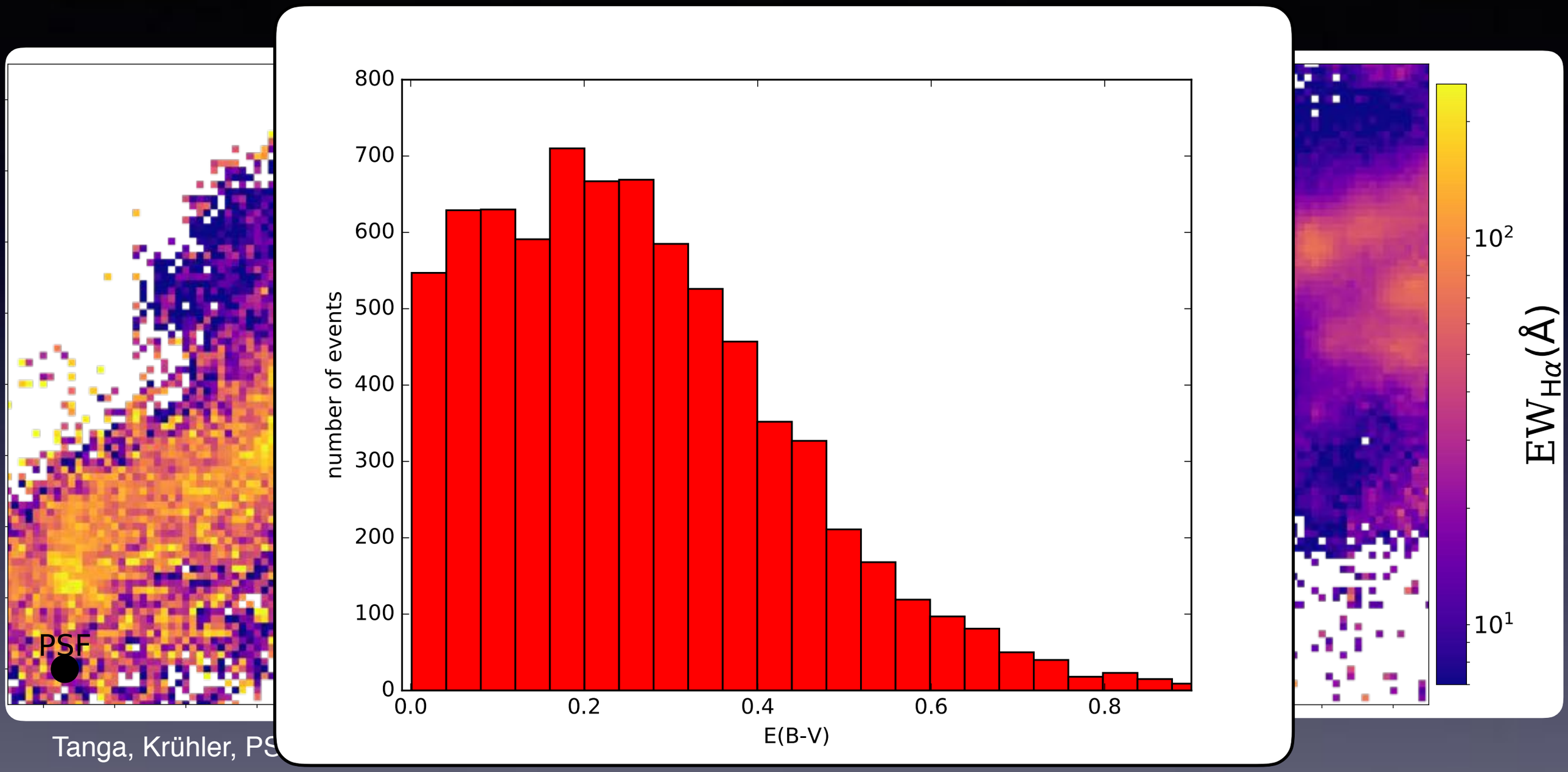




Tanga, Krühler, PS+18

Oxygen abundance at exposition site of GRB 111005A likely to be 12+log(O/H) > 8.6 (0.8 $Z_\odot$)

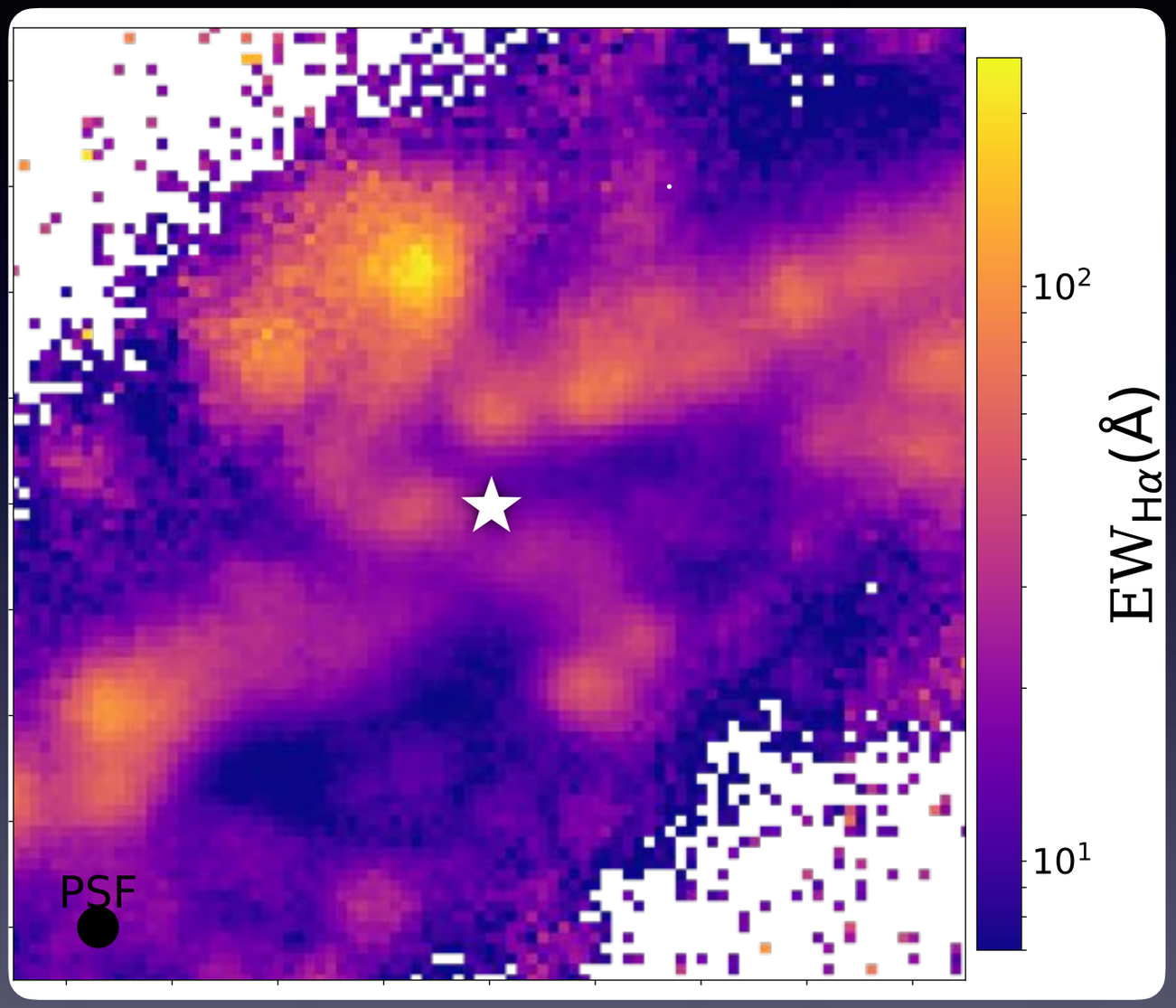
The case of GRB 111005A



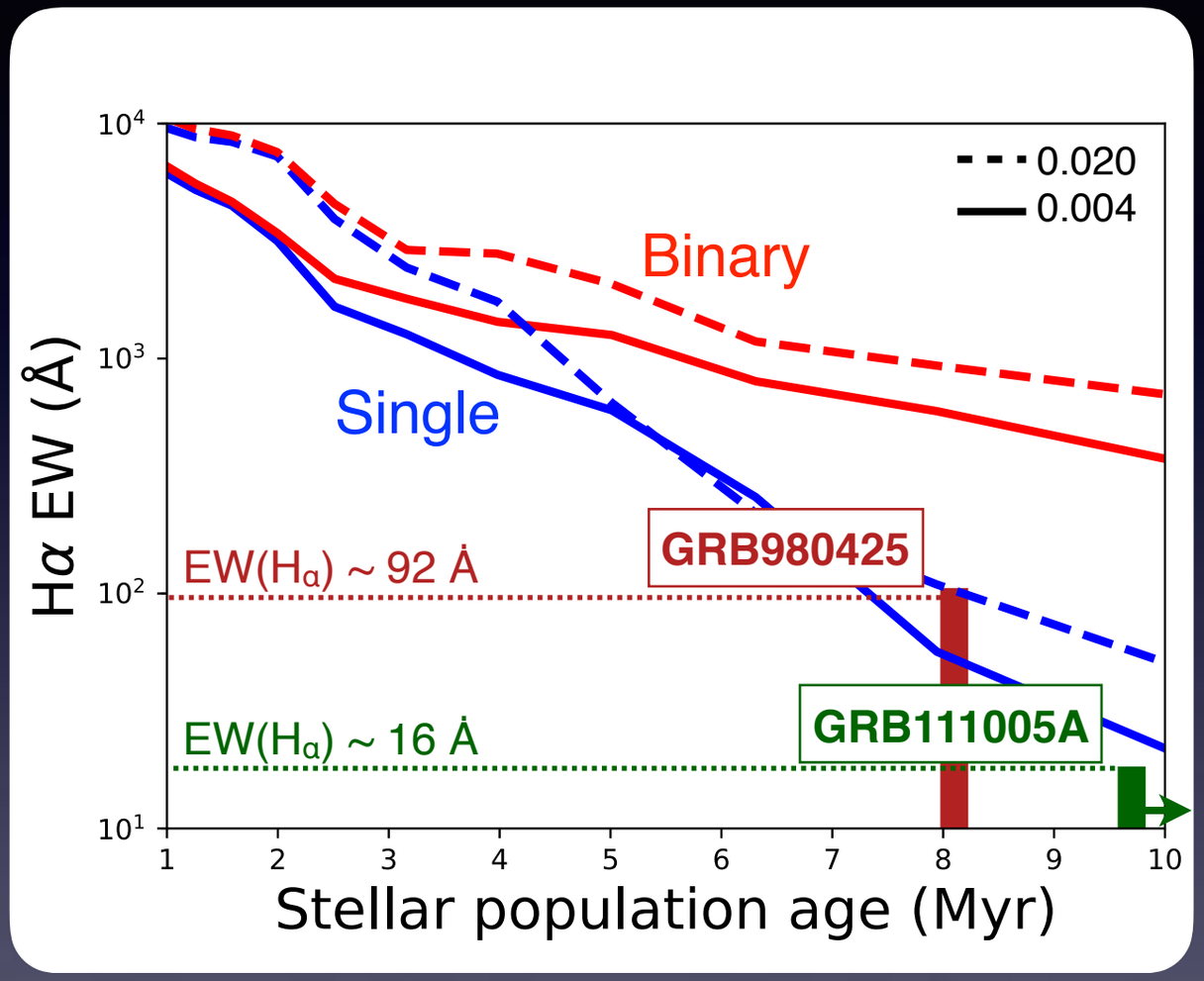
Tanga, Krühler, PS

No spaxels around GRB position have E(B-V)>1, but need E(B-V) > 6 to extinguish SN in the V band.

GRB111005A: a high-Z GRB formation channel



Tanga, Krühler, PS+18



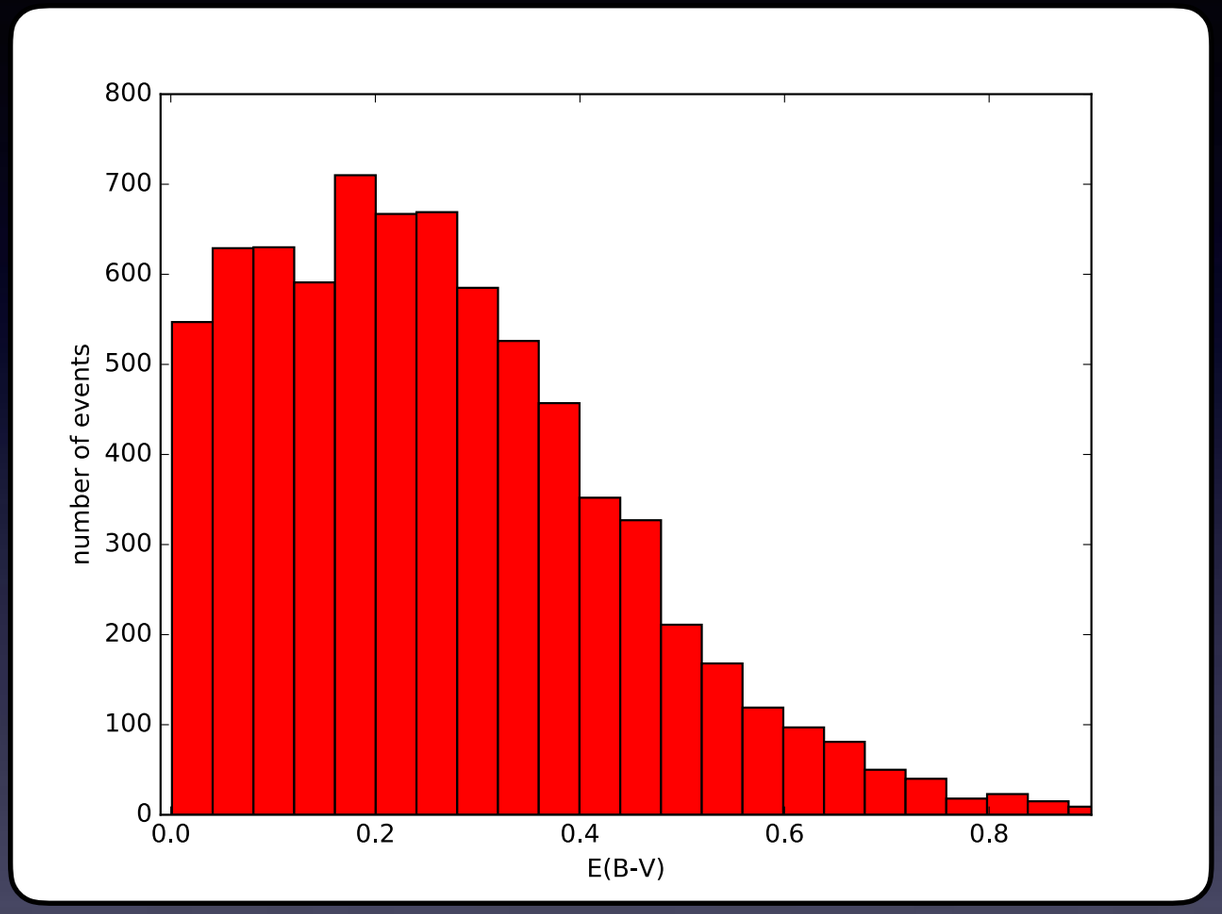
BPASS12; Eldrige & Stanway (2013)

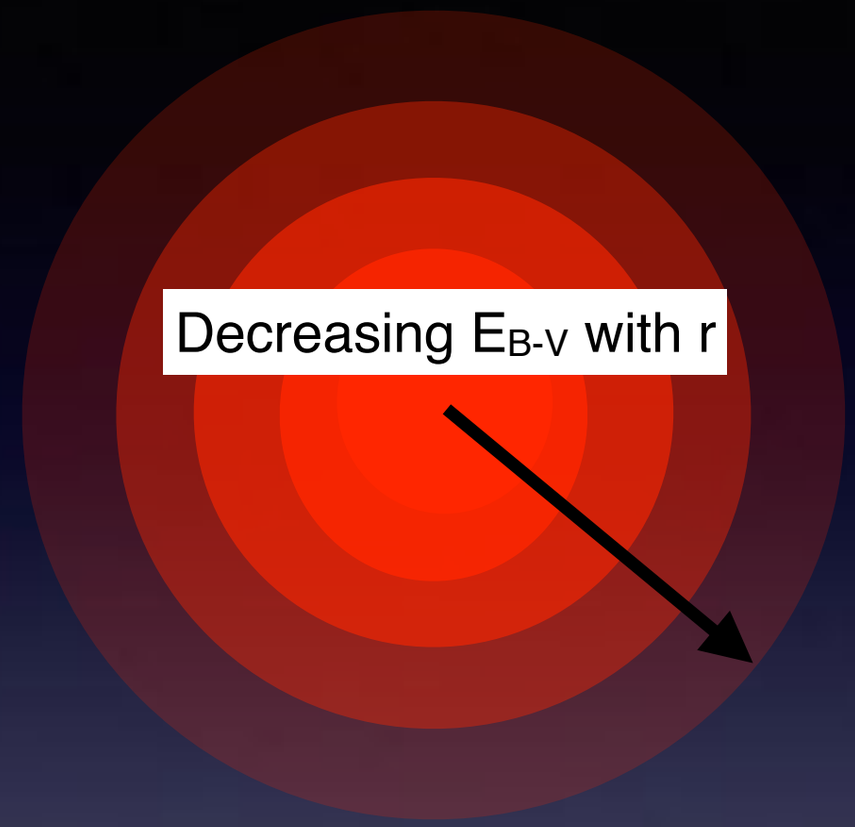
GRB and host galaxy properties very different to 'typical' long GRBs

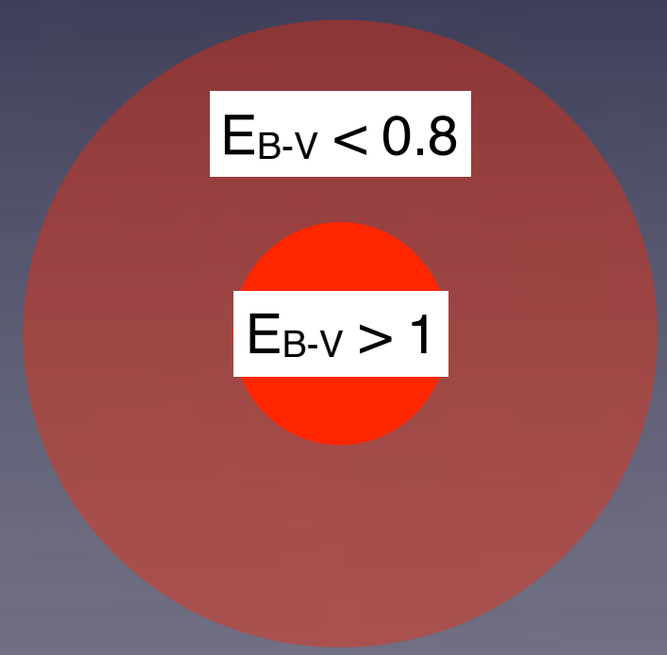
But is this ok…

Dust Radial Distribution

Assume smooth dust distribution



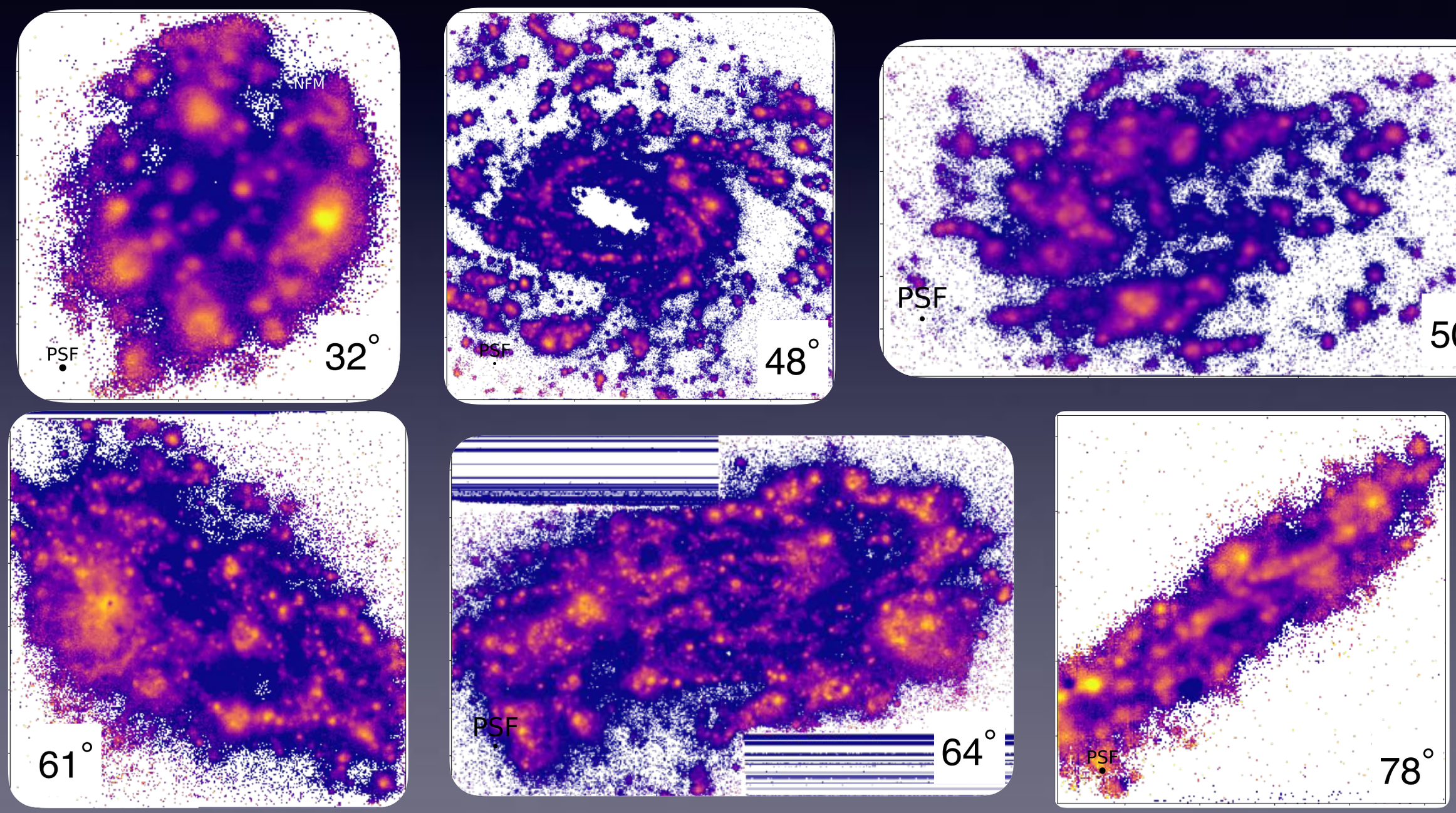




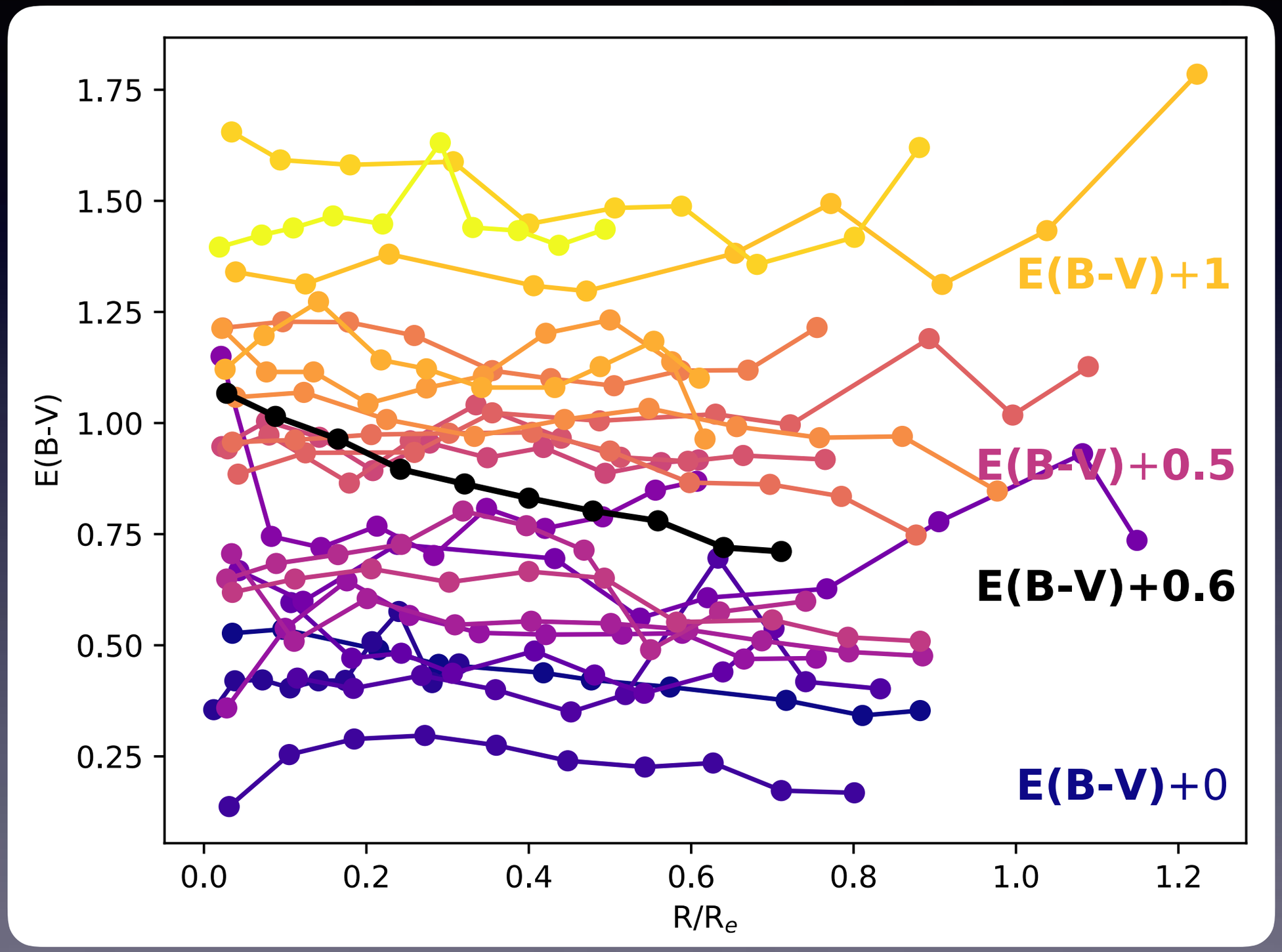
But what if…?

Dust distribution in other galaxies

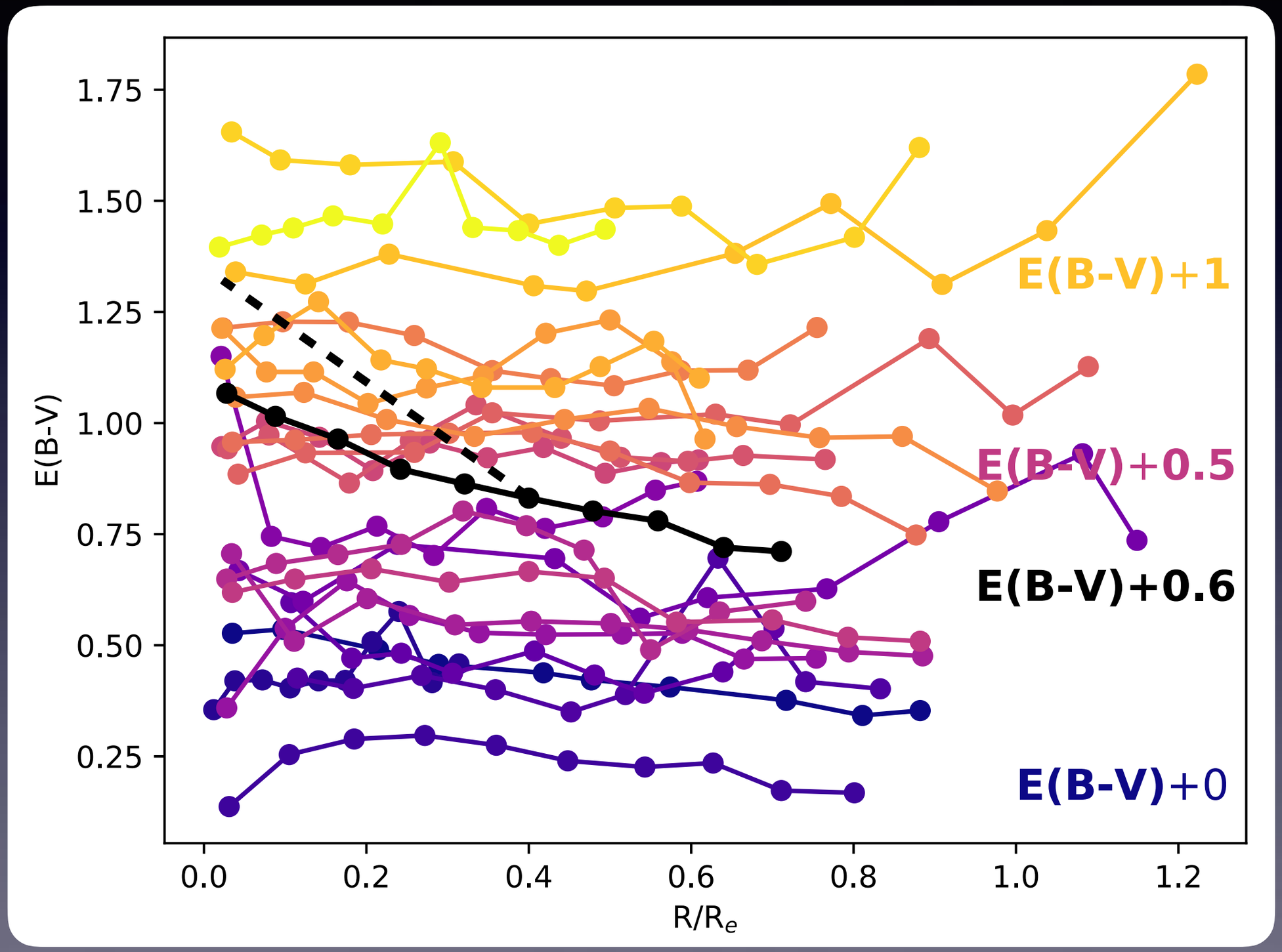
Determine E_{B-V} radial profile from sample of galaxies from AMUSING with similar stellar mass but range of inclinations



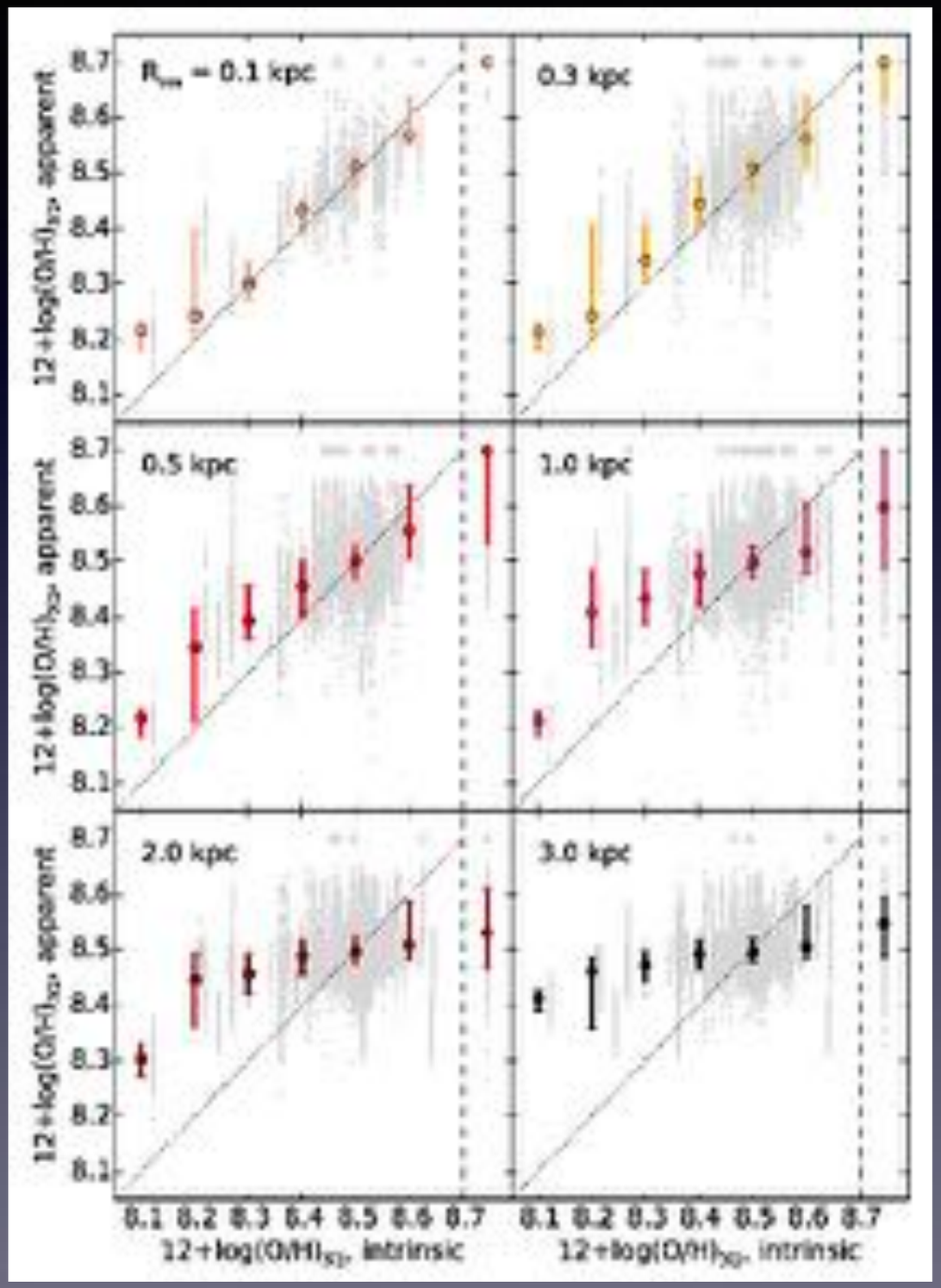
Distribution of dust radial profiles



Distribution of dust radial profiles



Dependence of Z_{gas} on resolution

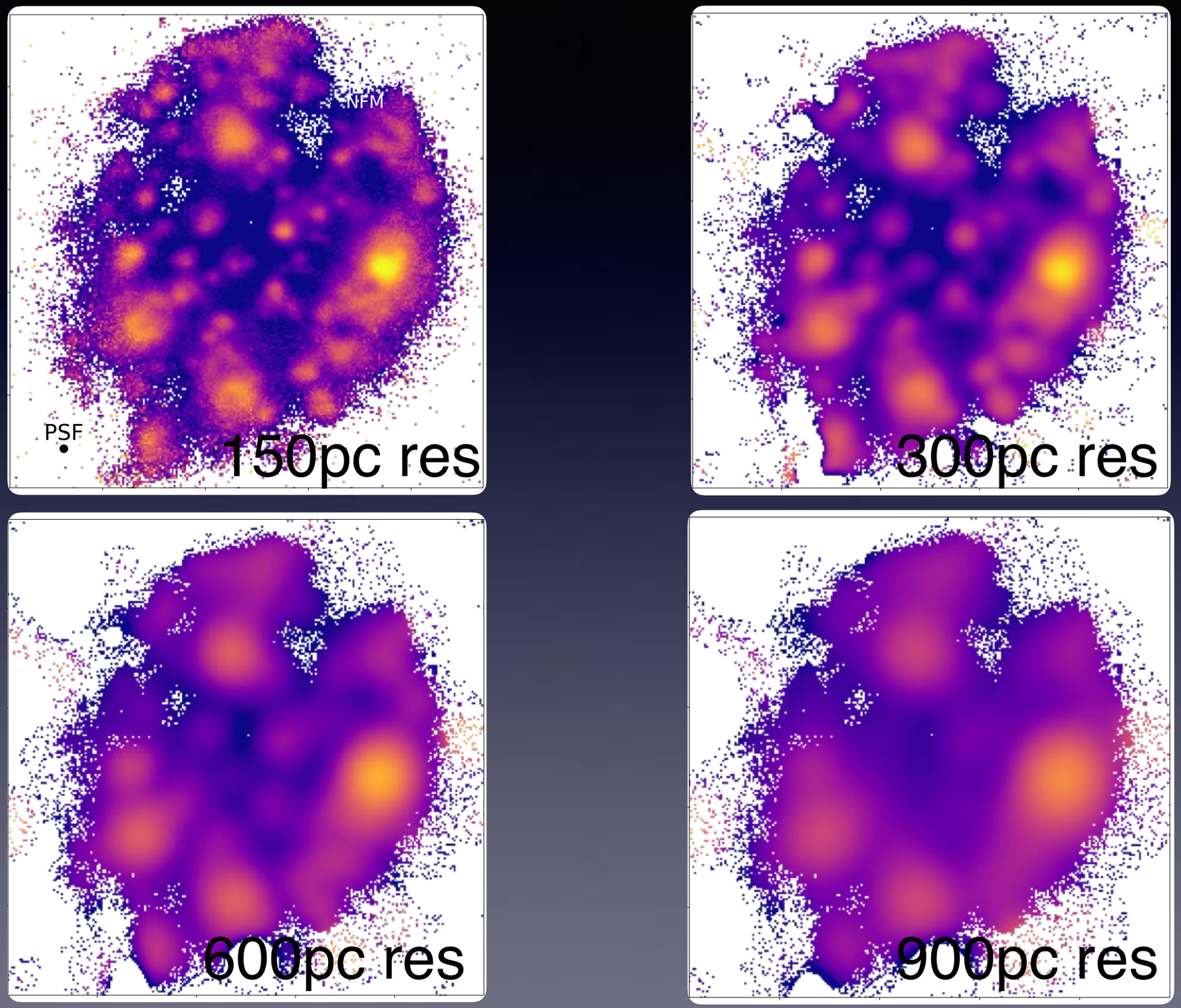


Niino+15

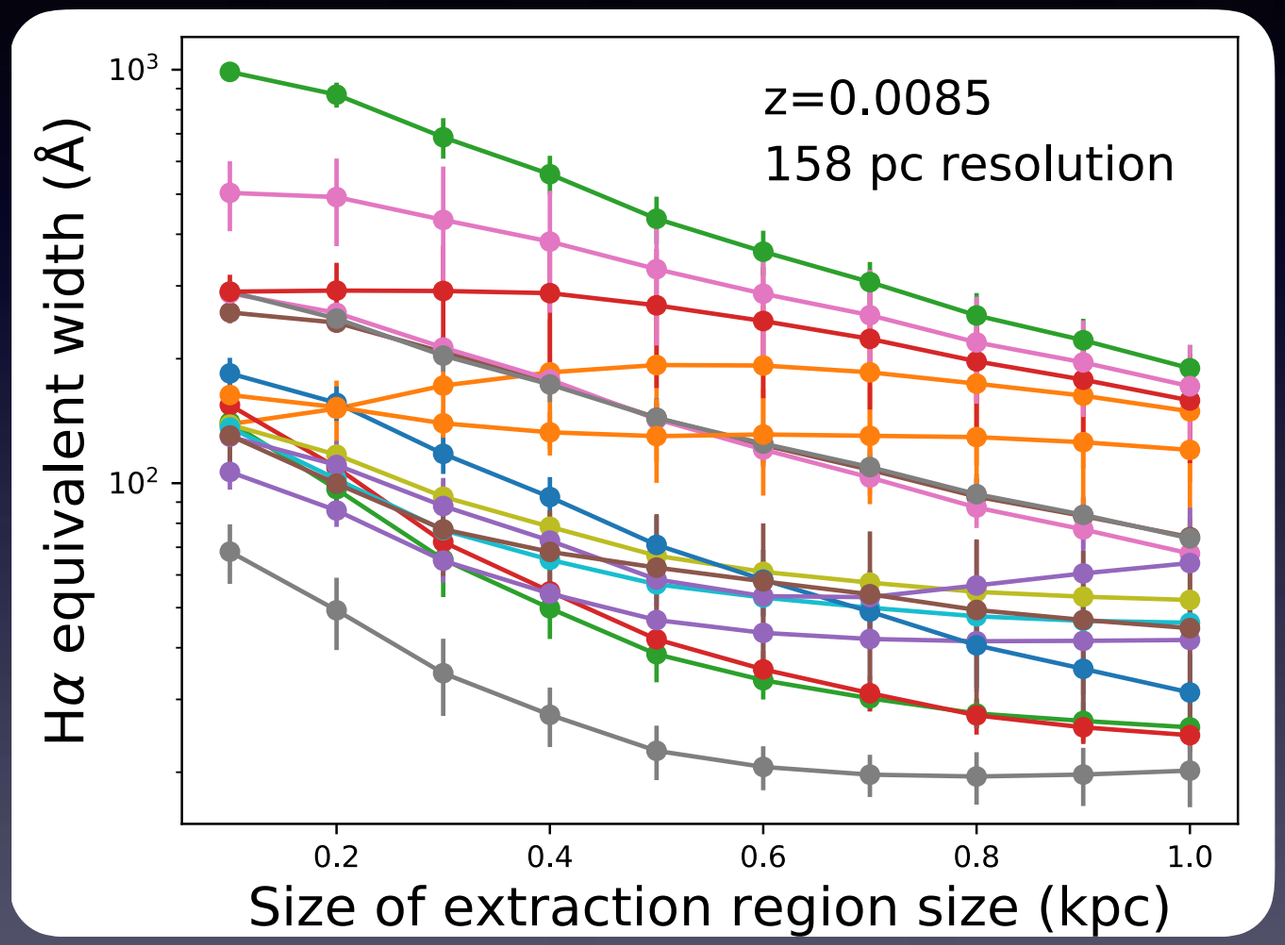
At resolution >500pc, measured Z_{gas} traces galaxy average metallicity

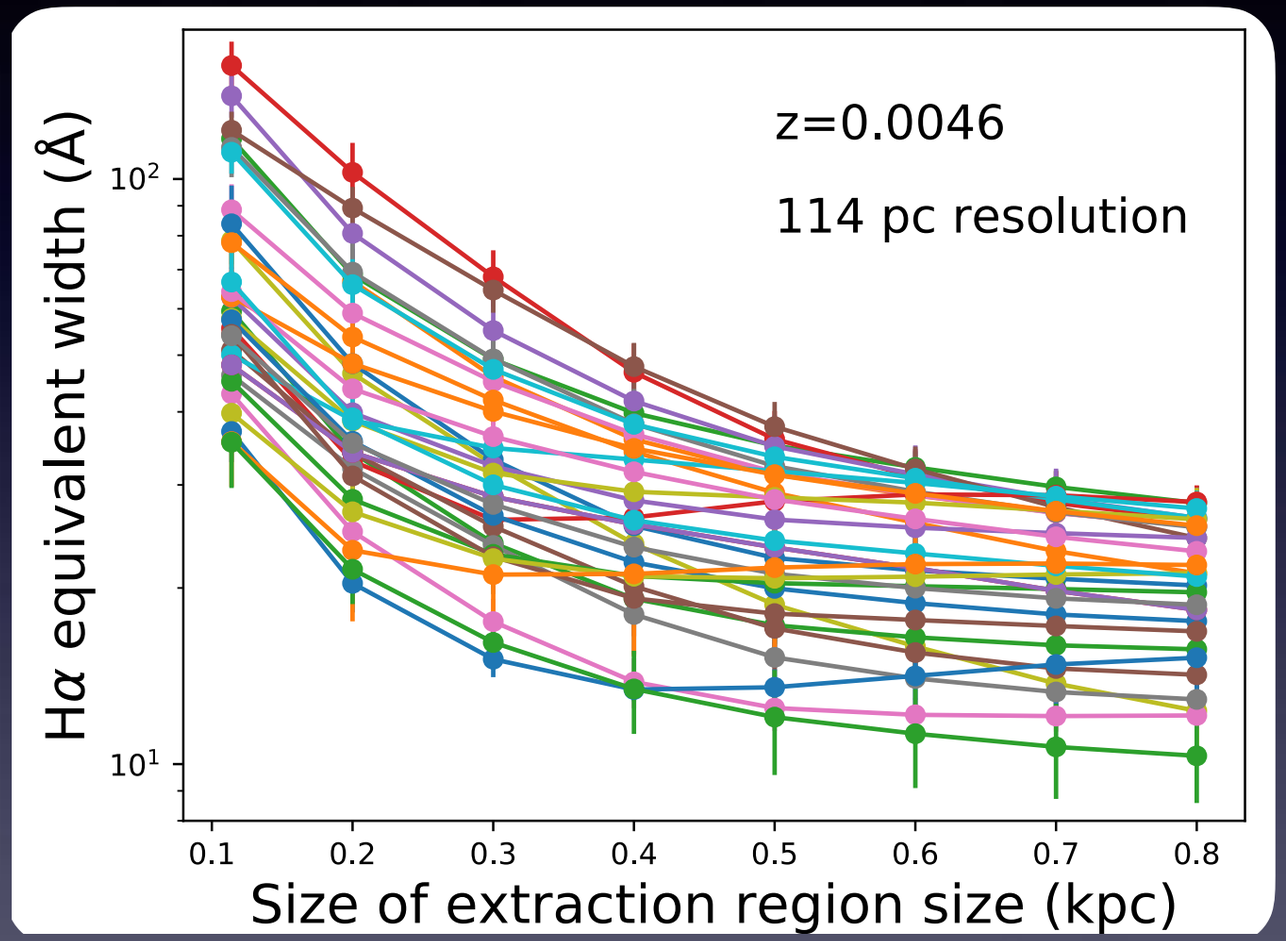
MUSE offers new opportunity to investigate dependencies of inferred galaxy properties as function of spatial resolution

Dependence of Hα EW on resolution



Dependence of Hα EW on resolution





The measured Hα decreases with increasing spatial resolution

Summary and future work

- IFU observations have the potential of providing a wealth of information on the properties of long GRB progenitors

- But care is required to understand the limitations of the data - <u>in particular spatial resolution</u>

- Future work will use much larger sample of star forming galaxies observed with MUSE to investigate how distribution of E_{B-V} varies with galaxy inclination as a function of galaxy stellar mass, SFRs, etc…

- Larger-scale analysis of *face on*, star forming galaxies planned to quantify how measured galaxy properties (Hα EW, Z_{gas}, E_{B-V},…) vary with spatial resolution