EXPLORING FEEDBACK EFFECTS ON PARSEC SCALES ACROSS PRIMORDIAL ANALOGUES

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My questions/themes:

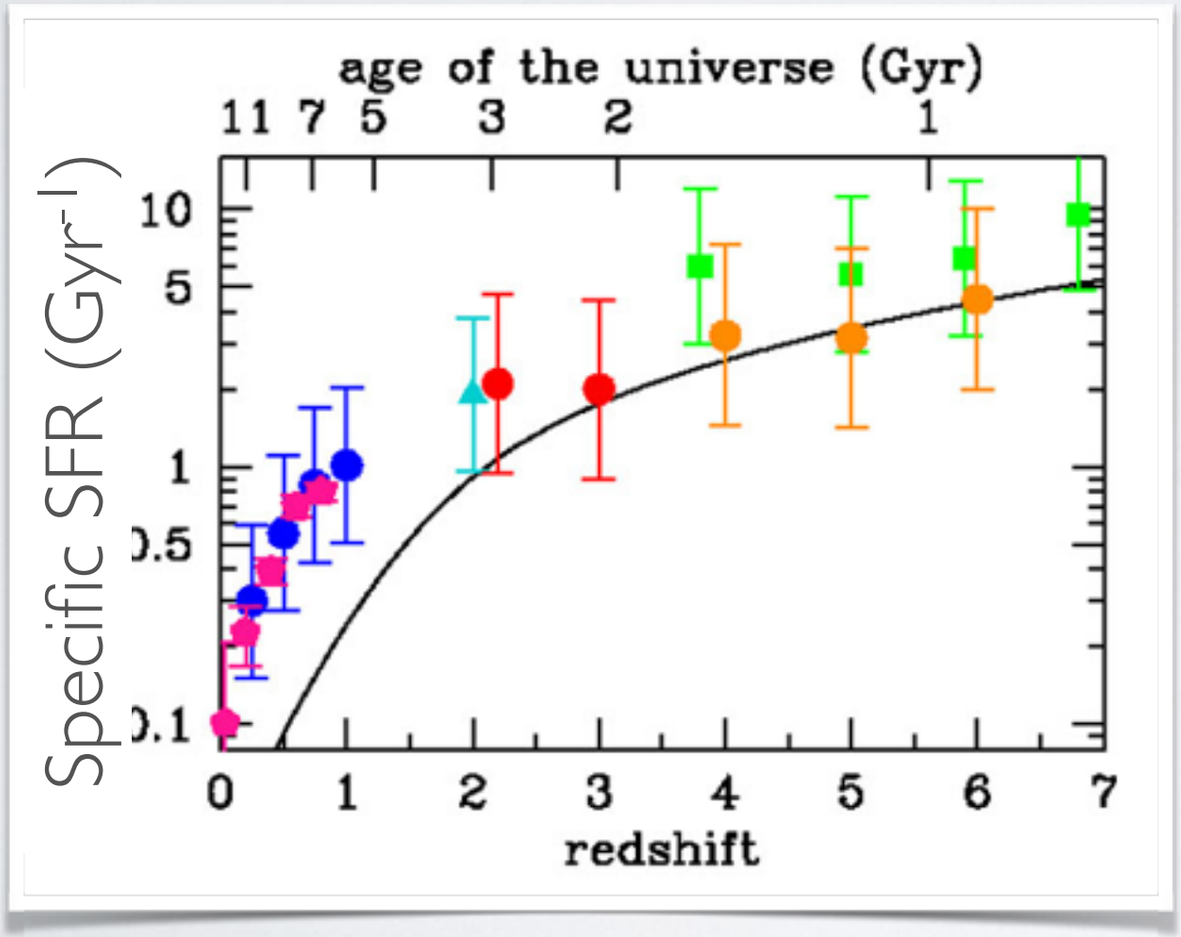
- What can we learn from metal-poor galaxies?
- Spatially resolving metal-poor galaxies at different redshifts
- What's the most efficient way of detecting and studying them?

The Cosmic Dawn Of Galaxy Formation

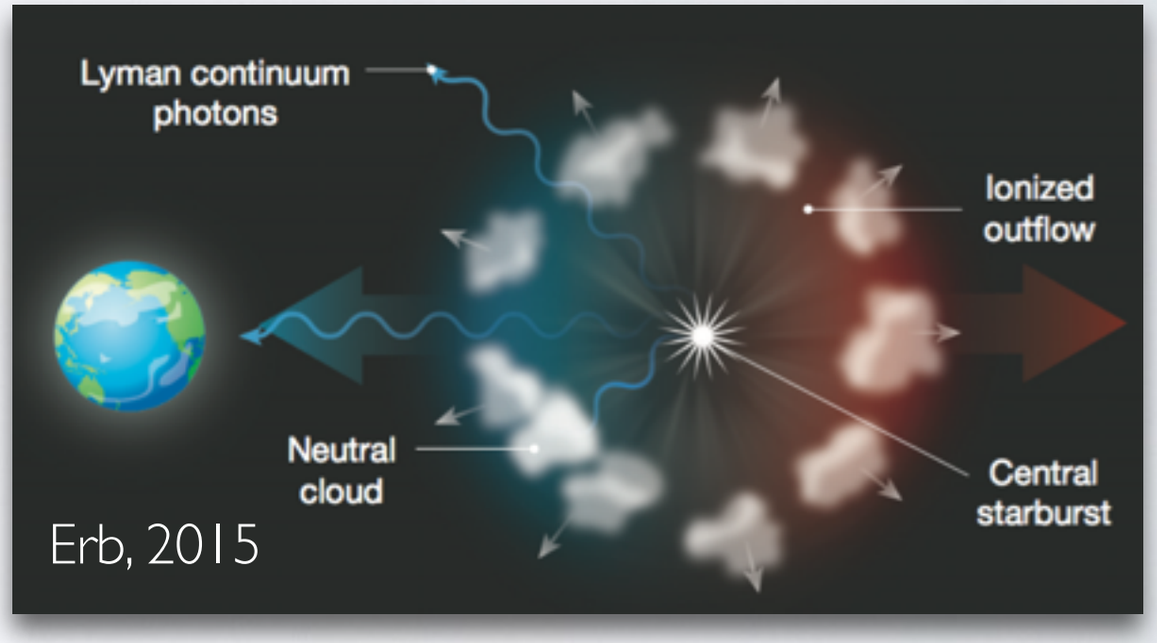
IAP, Paris, June 2016

What are the effects of stellar feedback in metal-poor environments?

Did dwarf galaxies play a role in cosmic reionization?



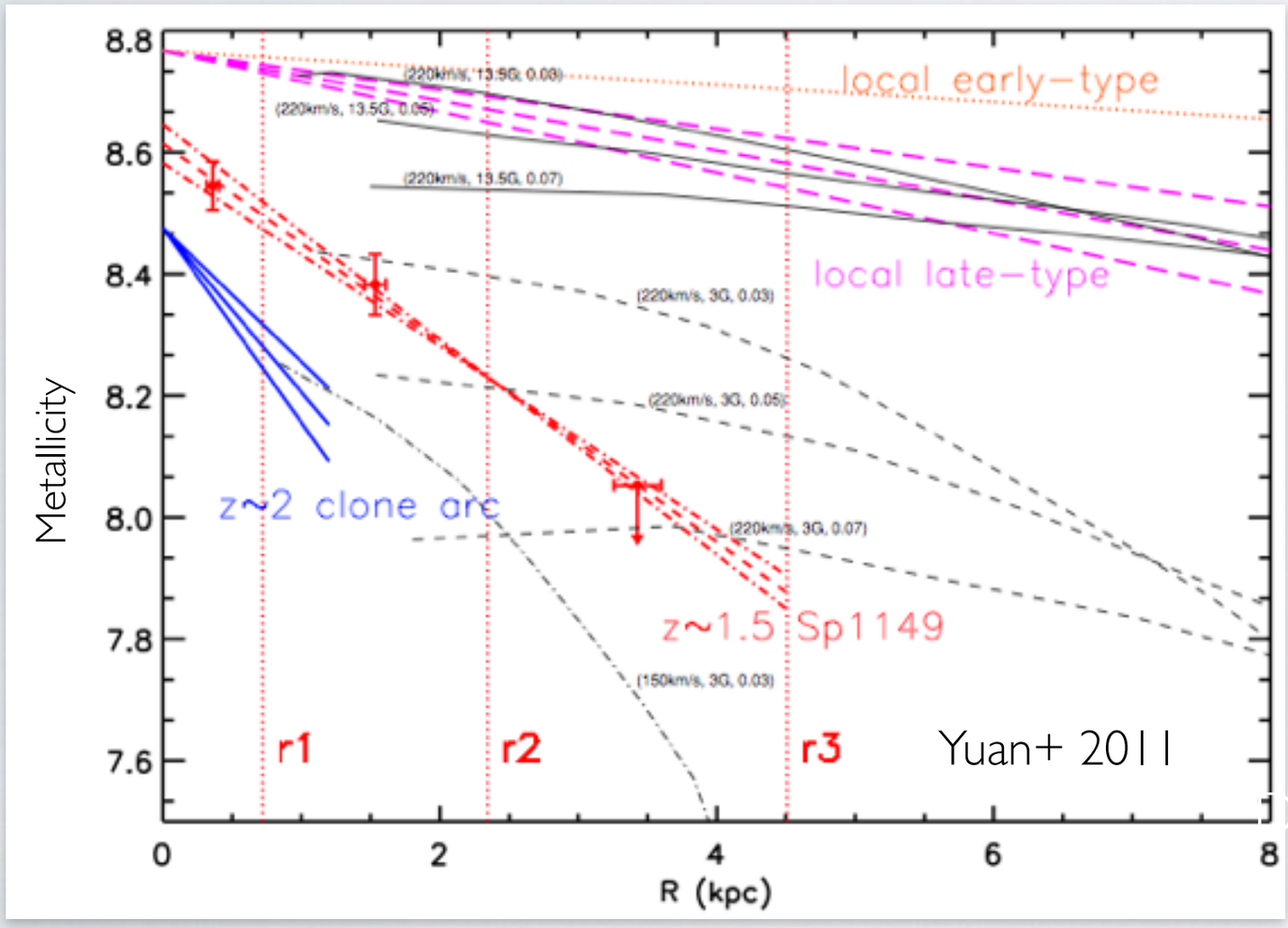
Madau & Dickinson 2014

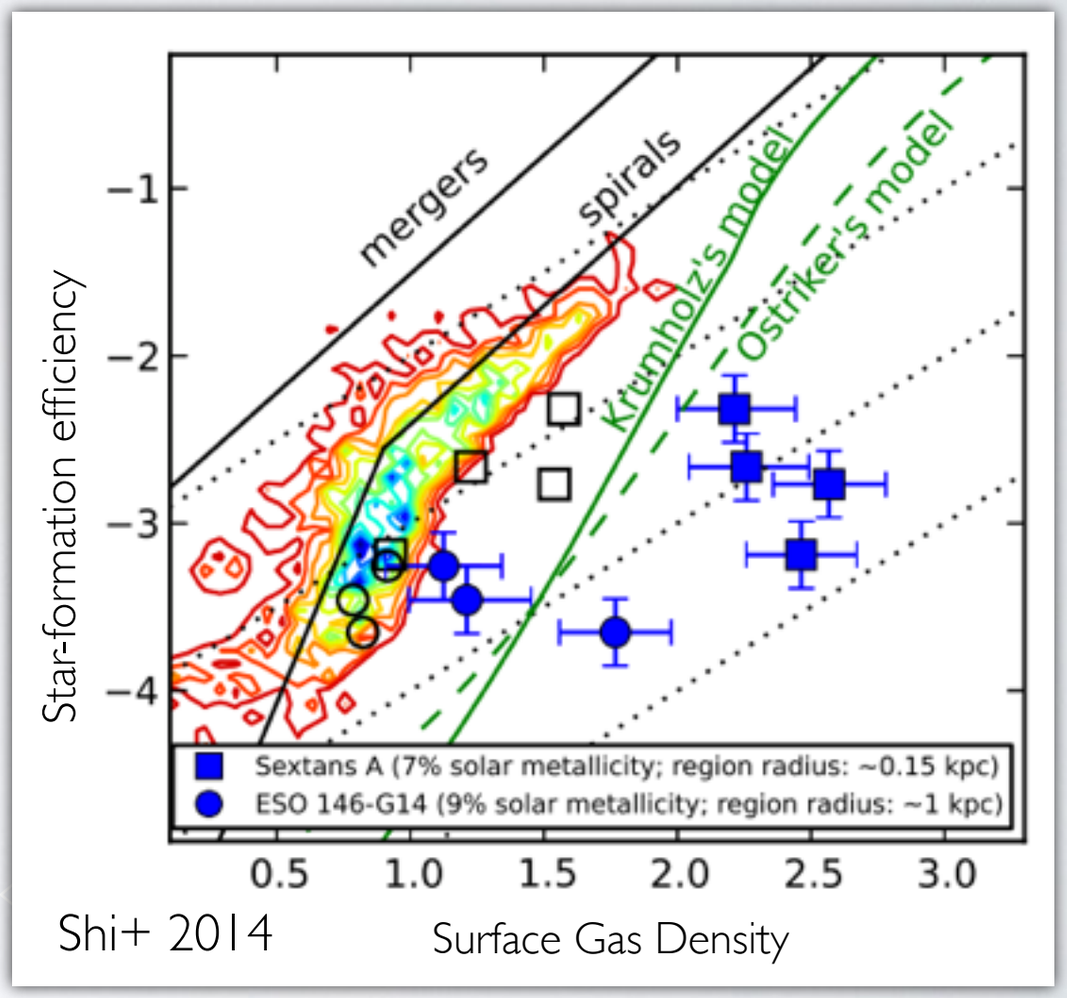


Erb, 2015

Are star-forming galaxies chemically homogeneous?

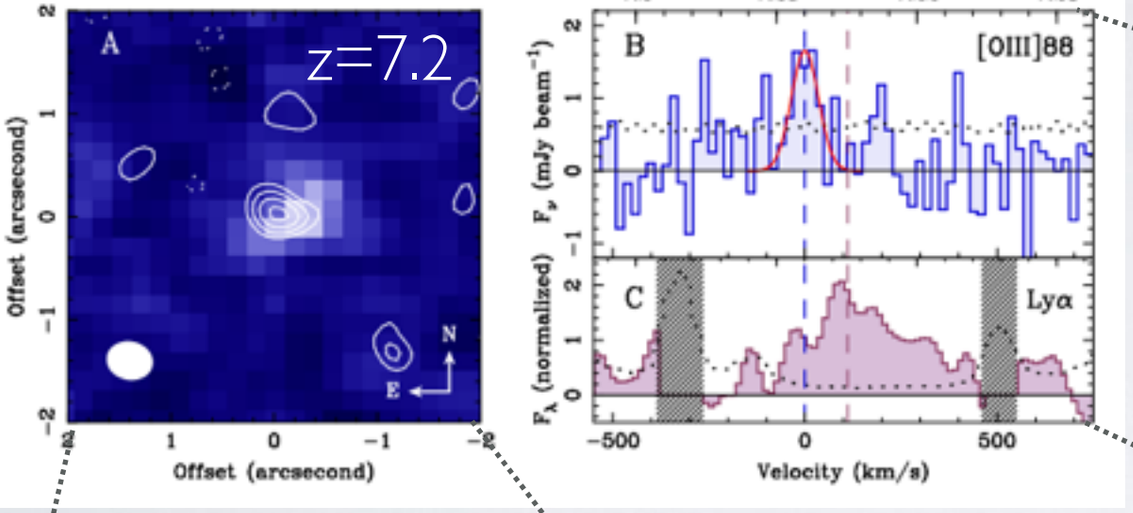
How is star-formation triggered?



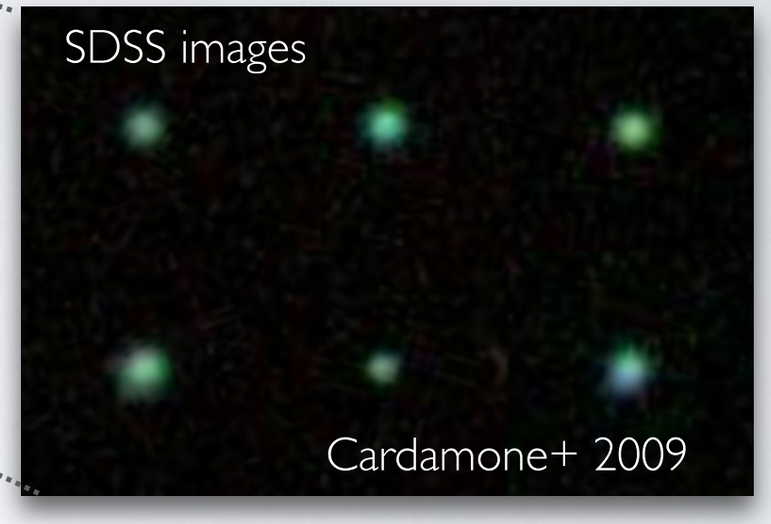


NEARBY ANALOGUES TO THE FIRST STAR-FORMING GALAXIES

Inoue+,2016



Extreme star-forming objects, e.g. green peas



✘ Metal poor
✔ Extreme SFRs
✘ z<0.35
✔ (some) LyC emission

Blue Compact Dwarf Galaxies

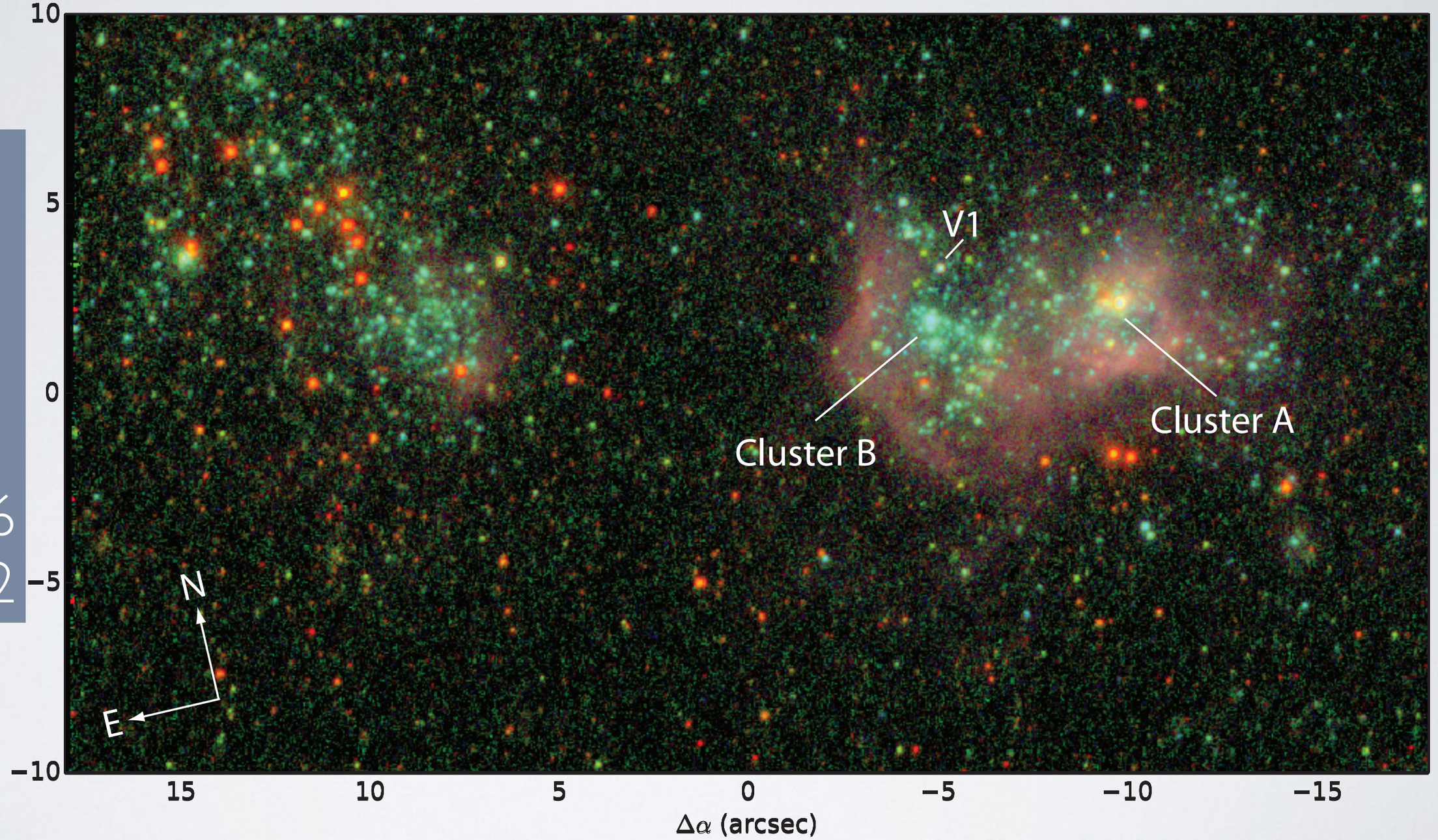
✔Extremely metal poor
✘ starbursting
✔can be *very* nearby

MAPPING STELLAR FEEDBACK IN MRK 71

11 filters: 7 emission lines: HST-WFC3
10 orbits, 2 BCDs, PI: James

James et al., 2016a, ApJ

[OII]
HeII
Hβ
[OIII]
Hα
[SII]6716
[SII]6732

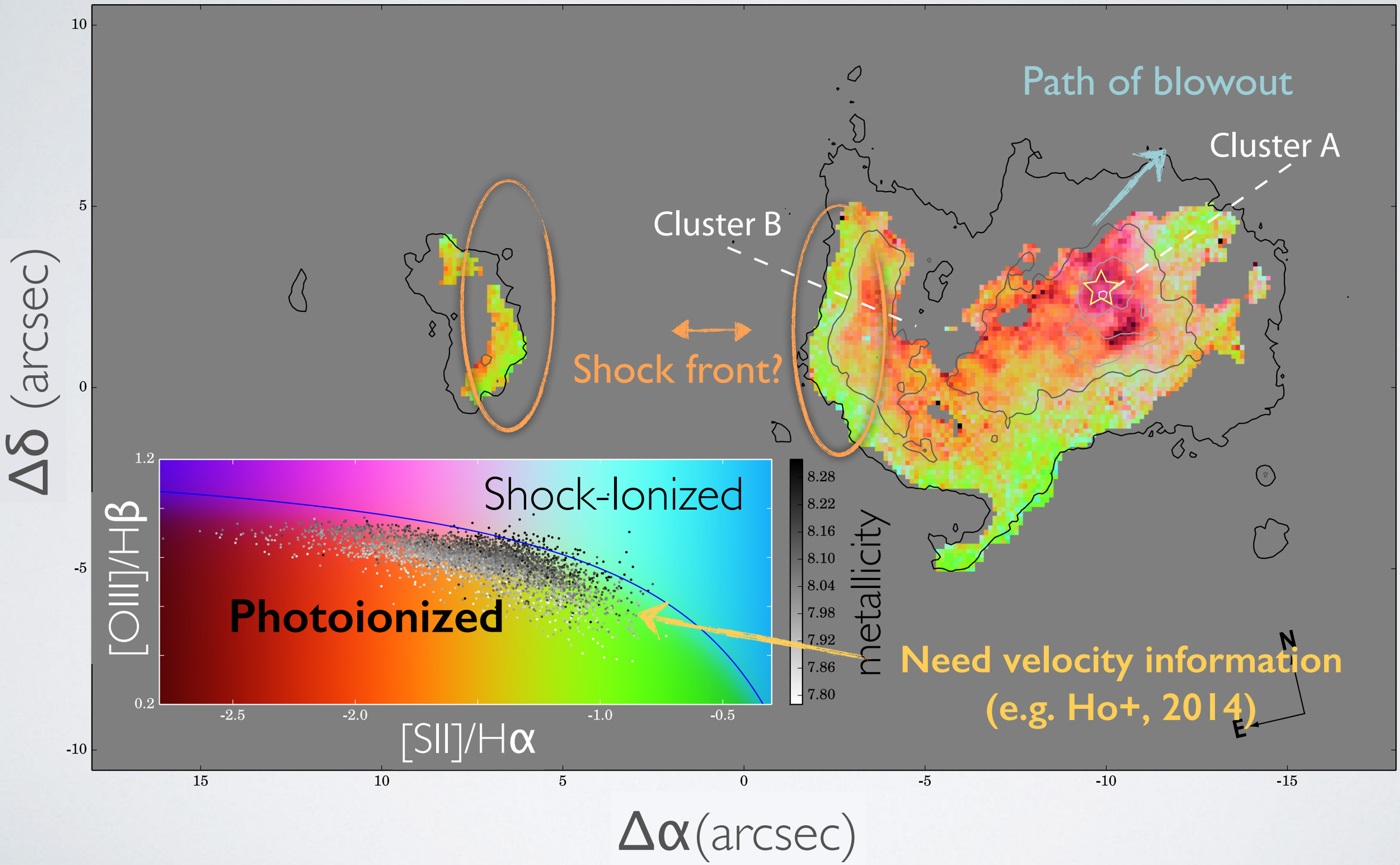


D=3.44 Mpc, **0.04"/pixel, ~0.7 pc/pixel**

Stellar: b=U, g=V, r=I
Gas: b=[OII], g=[OIII], r=Hα

EMISSION LINE DIAGNOSTIC IMAGING

James et al., 2016a, ApJ



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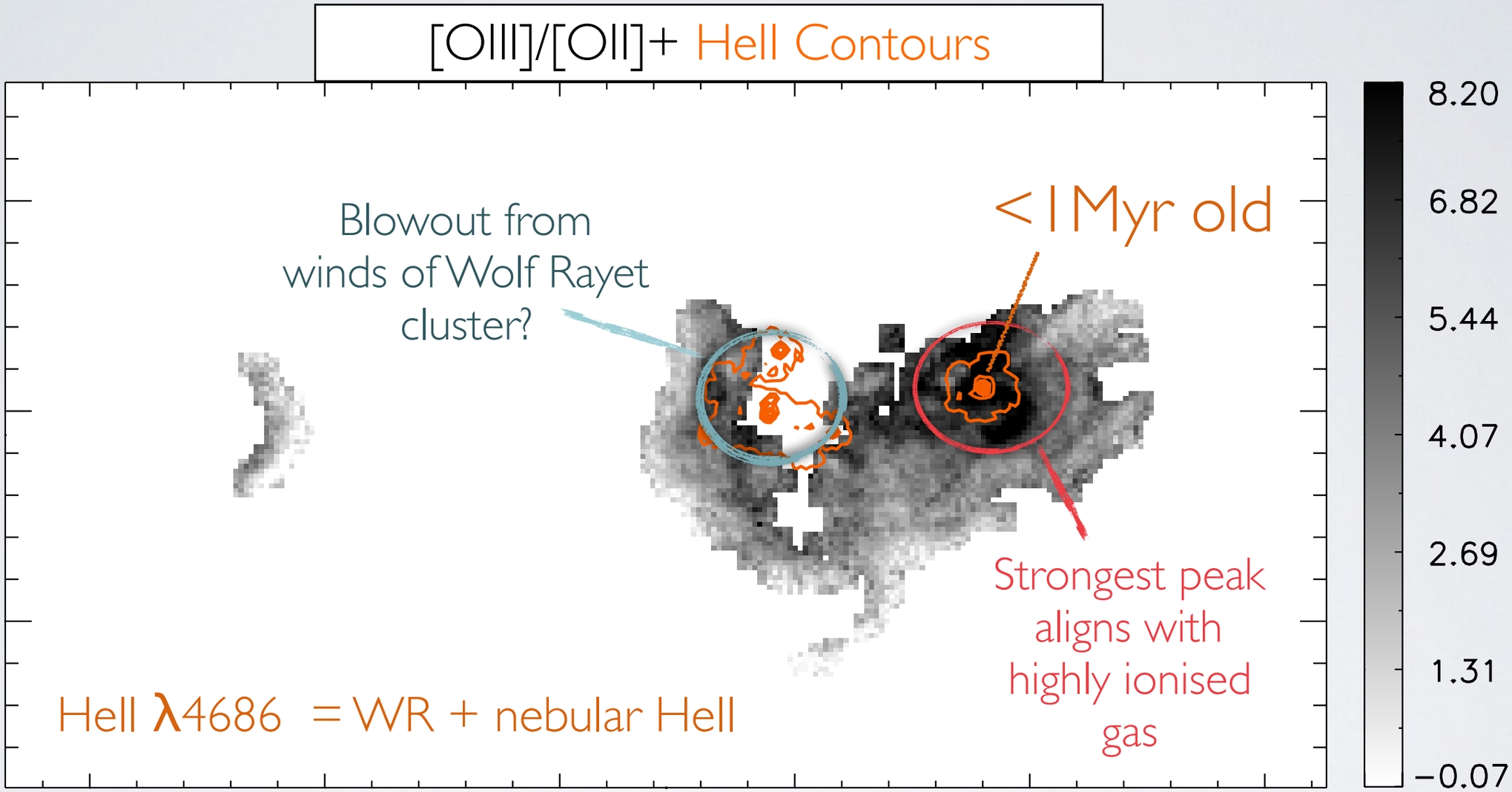
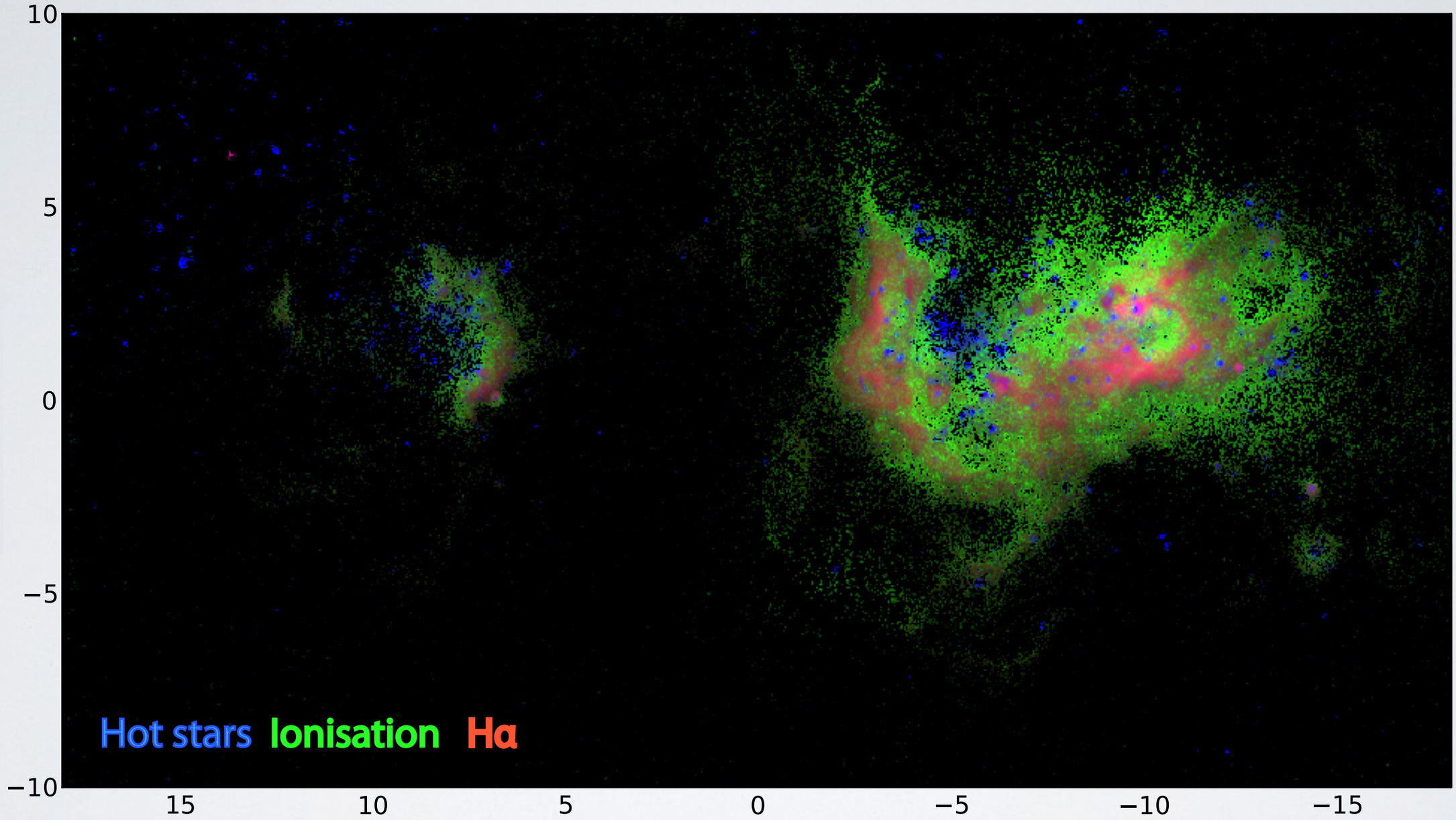
STELLAR FEEDBACK IN MRK71



(Ionisation parameter image)

"FEEDBACK IMAGING"

James et al., 2016a, ApJ



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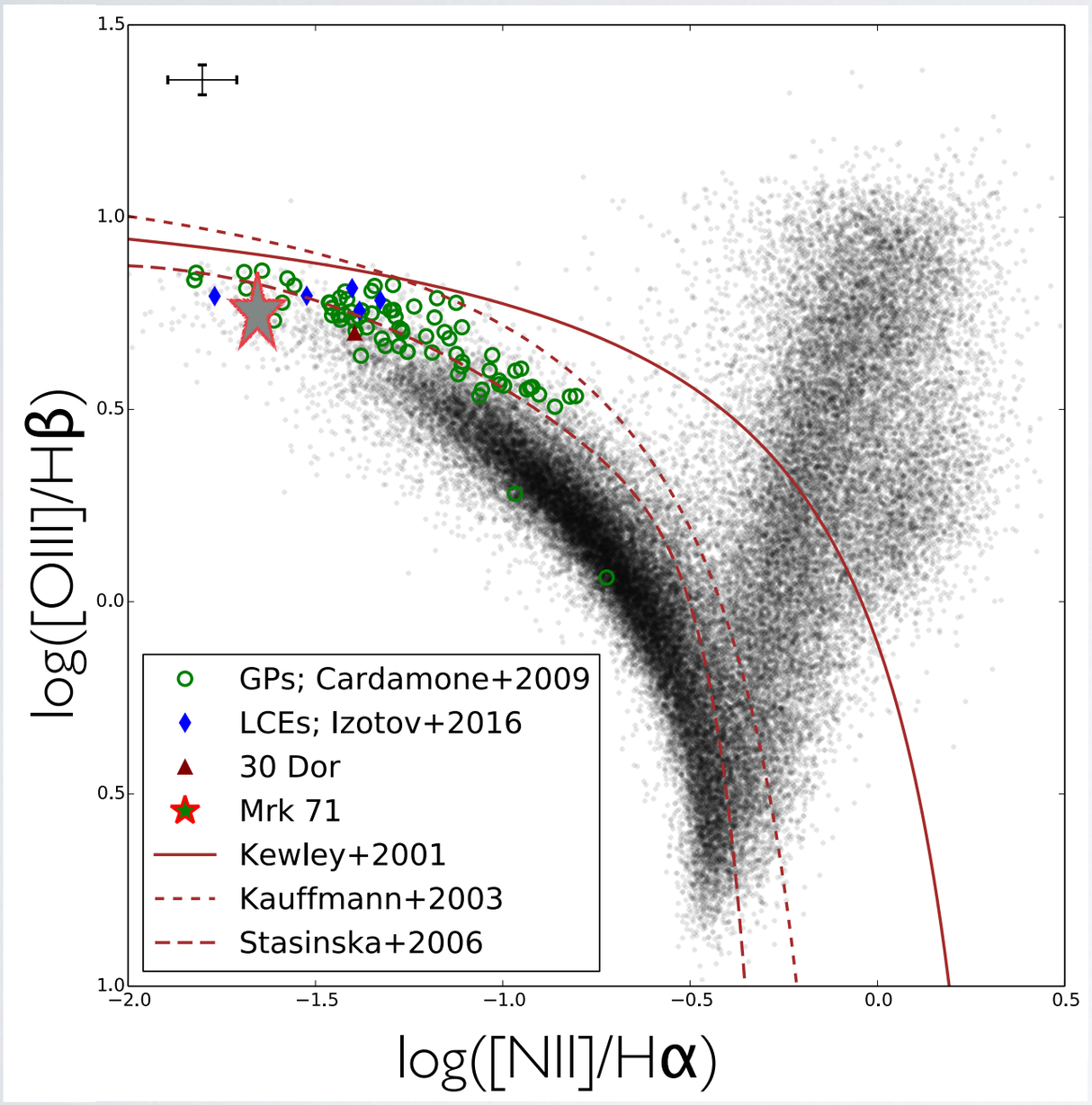
IS MRK71 THE FIRST LOCAL GREEN PEA?

Micheva, Oey, Jaskot & James
(2016, in-prep)



	Mrk 71	X-GPs
log(U)	-2.1	≥2
EW([OIII])	650	613-2175
$Z/Z_\odot$	0.2	~0.2
$M_*/10^8 M_\odot$	0.26	0.7-21
C(Hb)	0.13	0.0-0.29
sSFR/10^{-9}yr^{-1}	6.2	3-90
Broad Ha	✓	✓
CII 1334 abs?	✓	✓(LCEs)
High velocity gas?	✓	✓
LyC emission	?	✓ (some)

Jaskot & Oey 2013, Izotov+ 2016
Henry+ 2015

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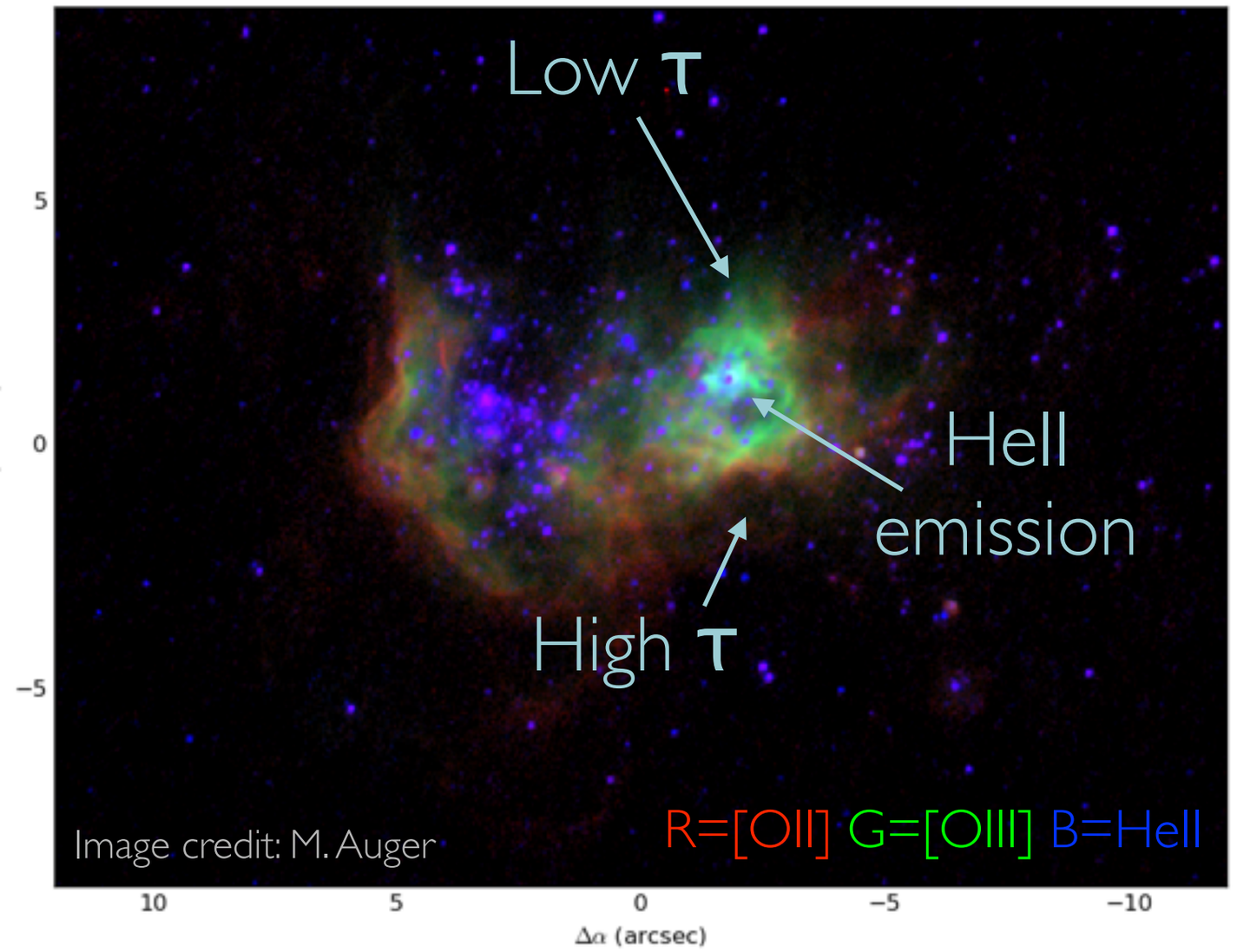
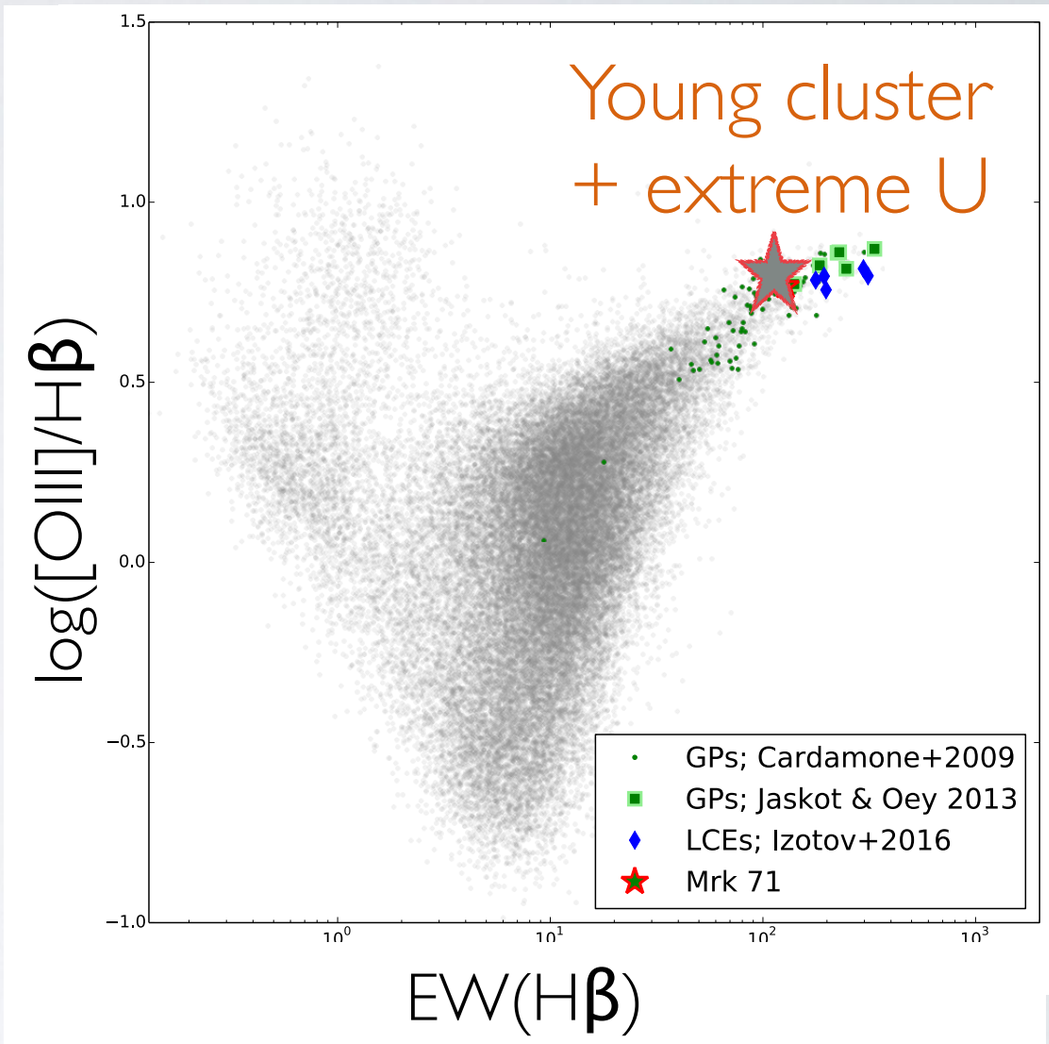
IS MRK 71 A LYMAN CONTINUUM EMITTER?

Micheva, Oey, Jaskot & James (2016, in-prep)





Need to investigate feedback & f_{esc}…
Bubble blown by radiation pressure alone?
[see attempt by Roy+ 1992]

Excellent nearby LyC candidate

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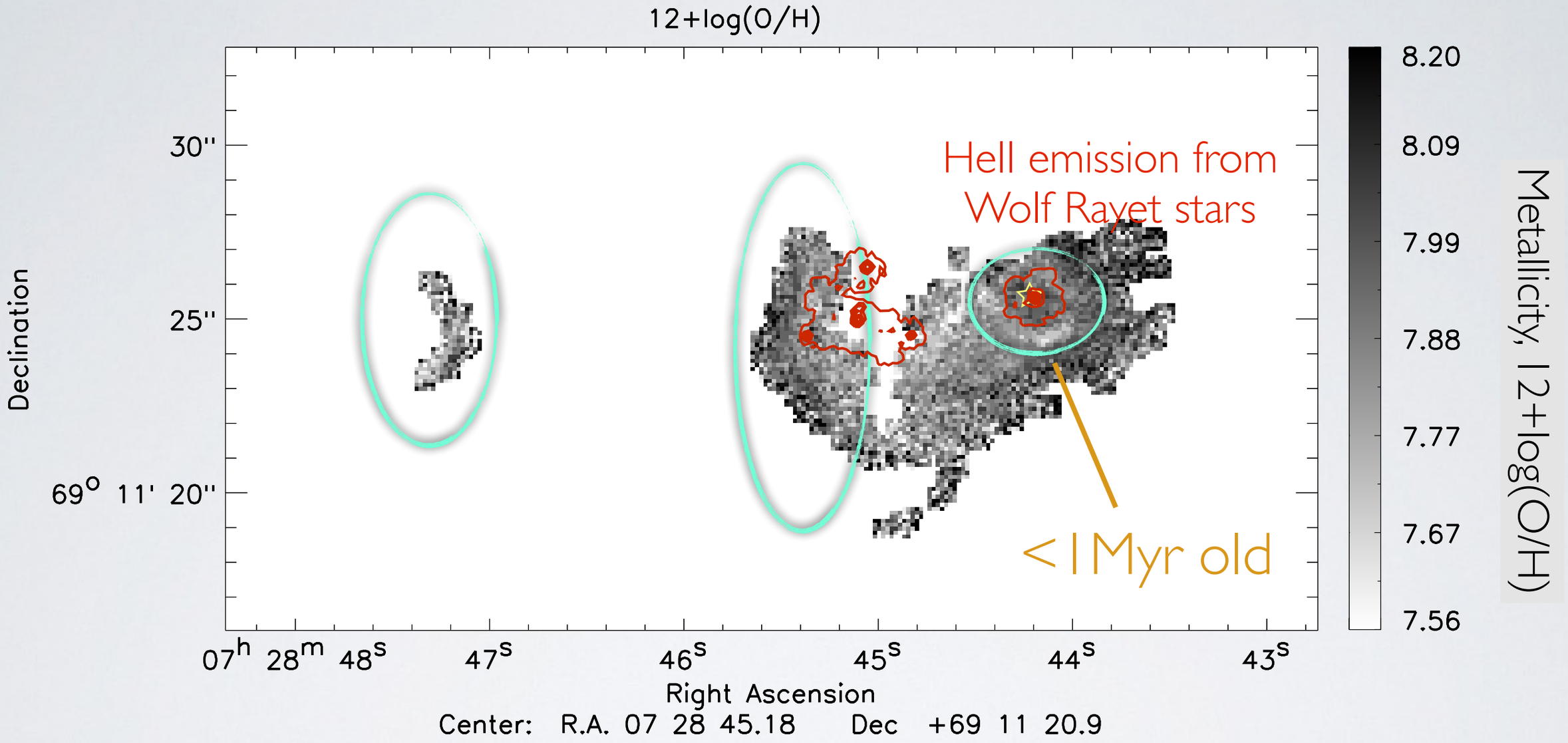
What are the effects of stellar feedback in metal-poor environments?

- ➡Shock-excitation: very difficult to detect…large consequences?
- ➡Feedback mechanisms create gas cavities:
  - ➡suppress star-formation?
  - ➡transport photons: reionization of the IGM?
- ➡Mrk71 might be the first nearby GP + excellent LyC candidate

METALLICITY "IMAGING" OF MRK 71



Decrease in O/H surrounding main super star cluster:

- Blow-out of primordial gas?
- Pollution from young clusters hasn't mixed?
- Has the R_{23} diagnostic broken down?…
- Haven't accounted for OIV?

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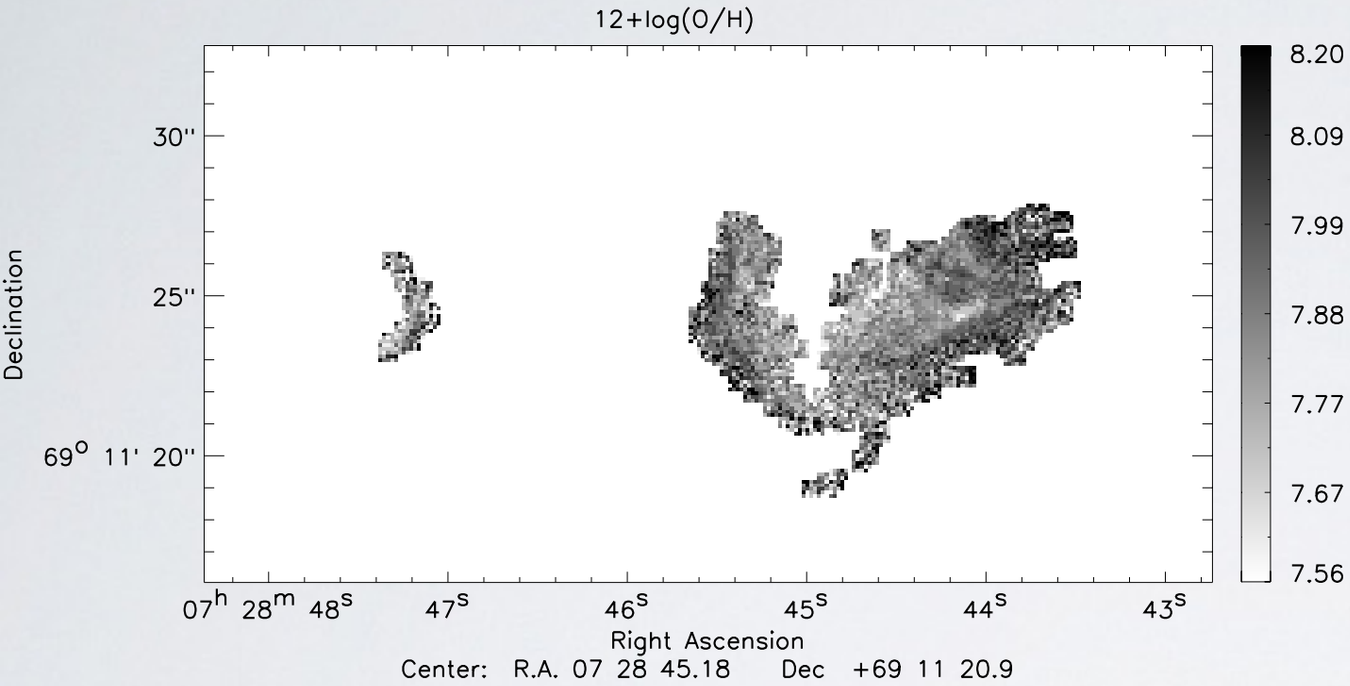
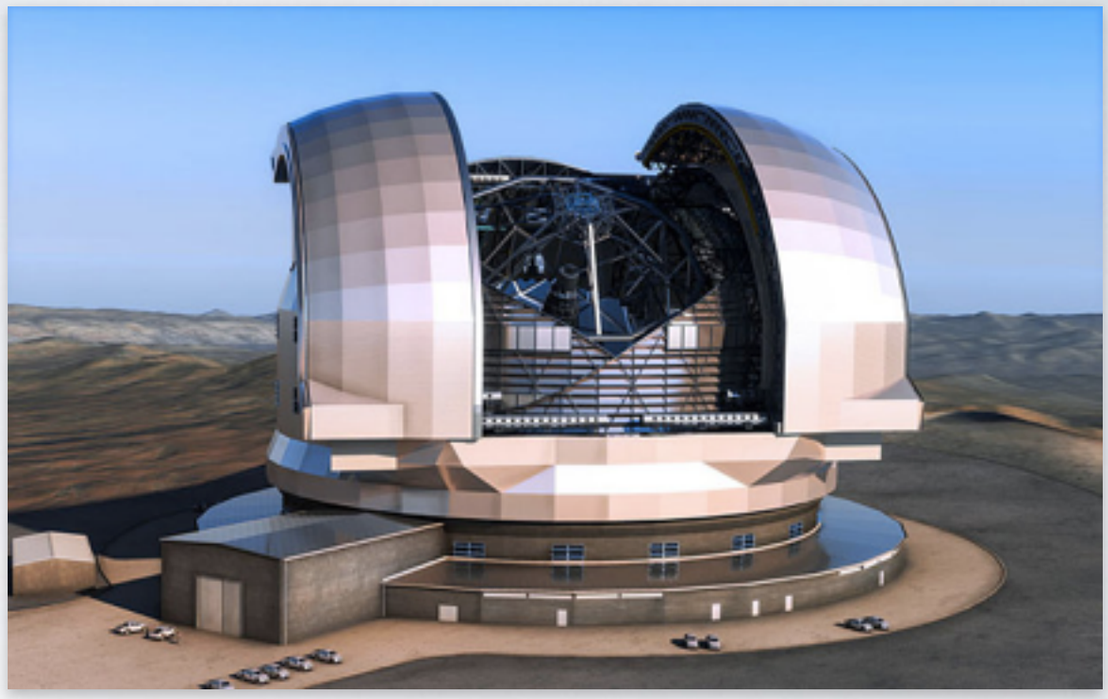
CHEMICAL MAPPING @LOW-Z: DEPENDENCE ON SCALE

The era of 30/40m telescopes is approaching…
Each one will have an IFU.



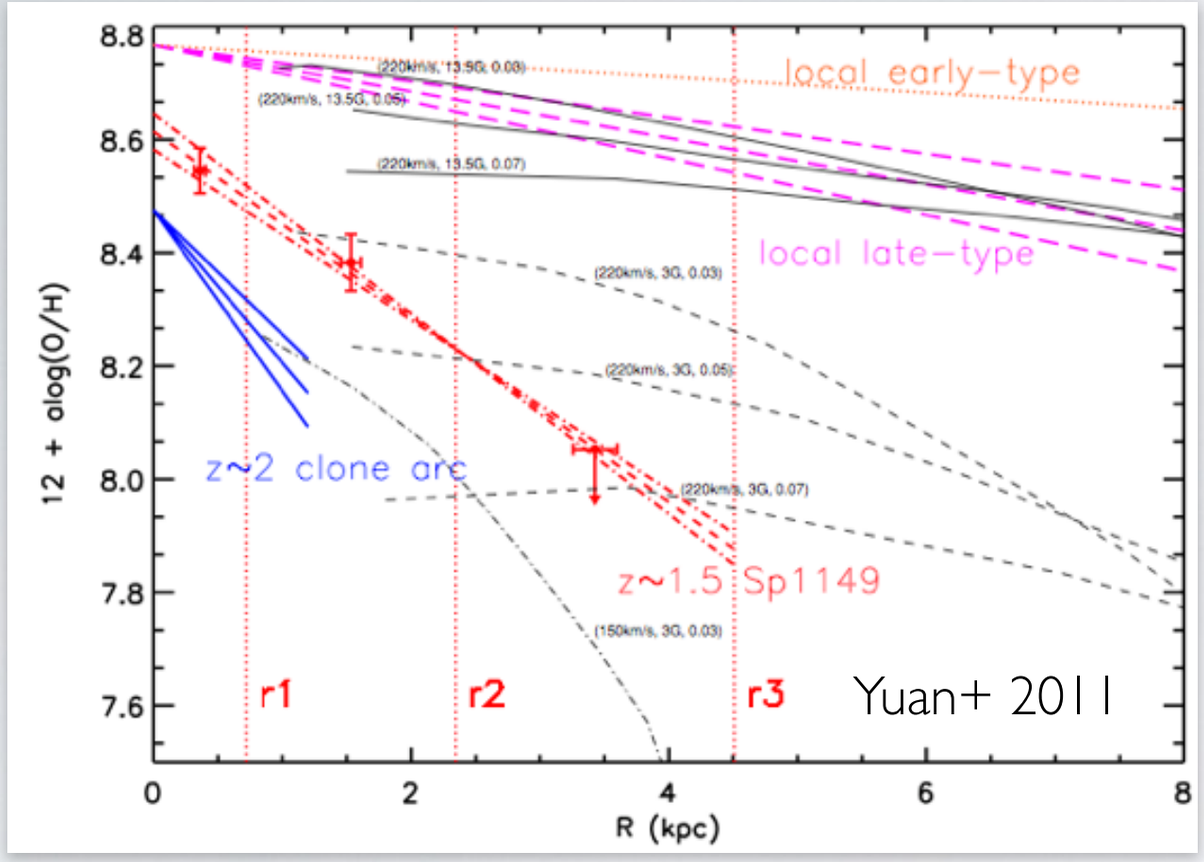
HST-WFC3 dataset: (0.04''/pixel)
Structure observed <50 pc scales

Do emission-line diagnostics have a minimum spatial scale?



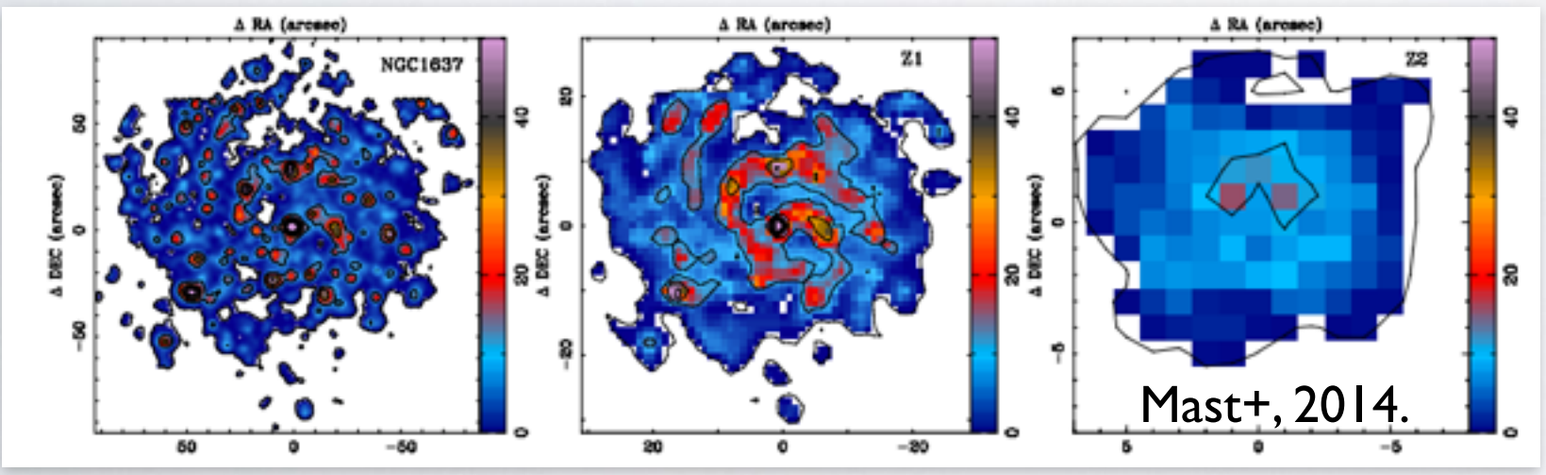
e.g. **E-ELT Harmoni**
0.04''/spaxel (5''x10'' FoV)
0.02''/spaxel (2.5''x5'' FoV)
We will probe <50pc scales at z=2

CHEMICAL MAPPING @HIGH-Z: DEPENDENCE ON SCALE

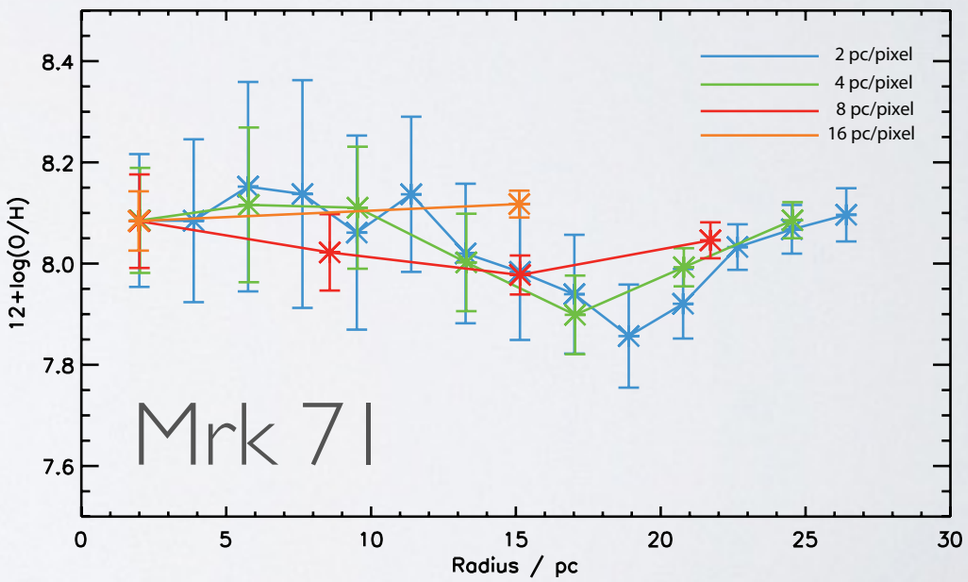


Are gradients evolving? or Discrepancy due to resolution?

Scales **<1kpc** are needed for a reliable gradient (Yuan+ 2013)



0.05 kpc/pix 0.144 kpc/pix 0.562 kpc/pix



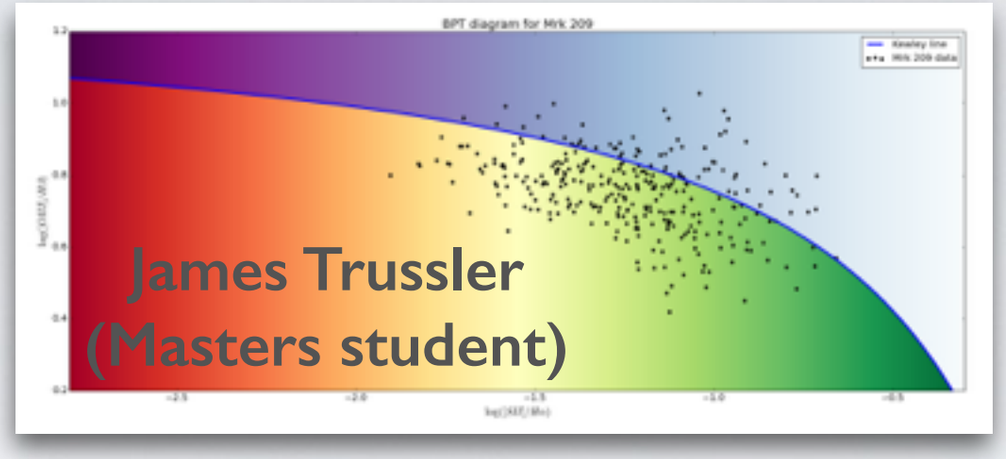
Although **ΔZ** is lost, <Z> (usually) remains

Are star-forming galaxies chemically homogeneous?

- ➡Not always!
- ➡Environments affect mixing timescales
- ➡Care must be taken with optical diagnostics
- ➡Spatial scales play a big role - at both low-z & high-z.

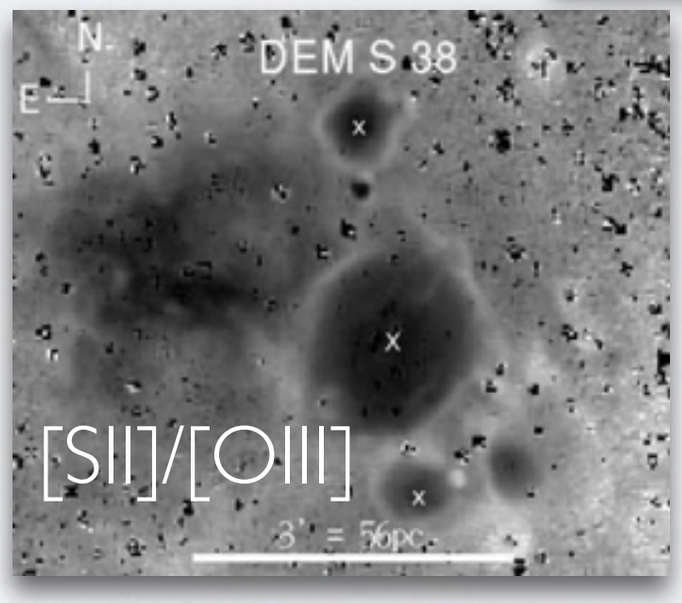
EMISSION-LINE MAPPING: FUTURE PATH

Pin-down shocks at low-z with IFUs

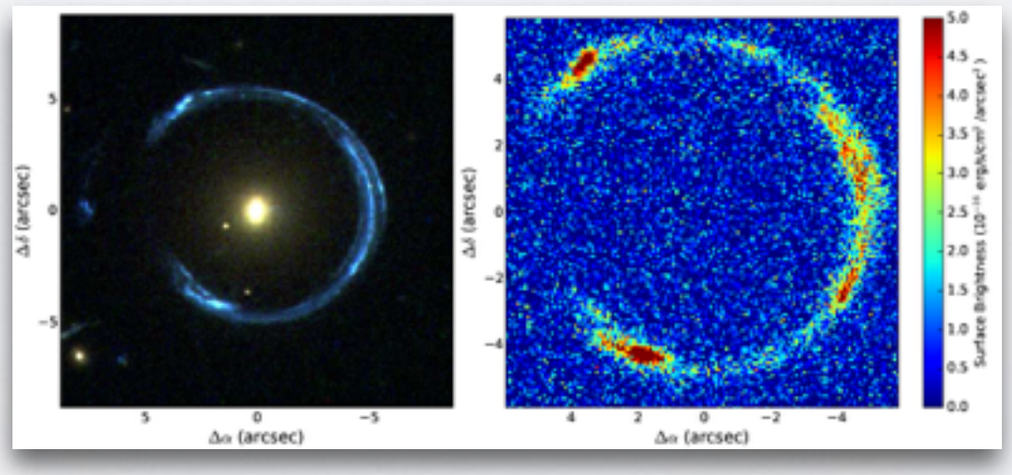


Find better high-z analogues
→Assess how LyC photons escape

Ionisation Parameter Mapping
12 HST-WFC3/ACS orbits, PI: Oey
LyC emitters: Haro 11, Tol 1247-232



Stellar Feedback at z=2.4 with HST



Simulated 3 Orbits
HST-WFC3 F167N

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ioa

Accretion

Outflows

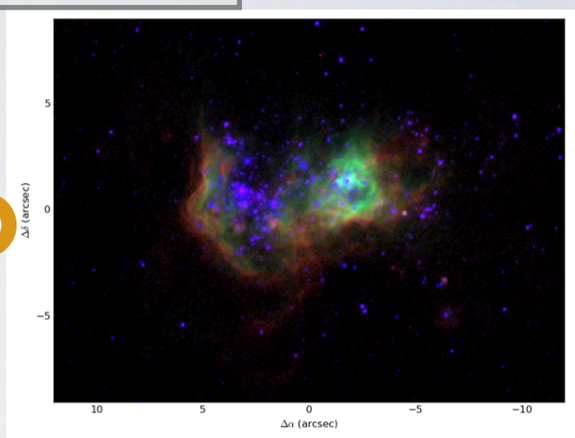
Galaxy Evolution

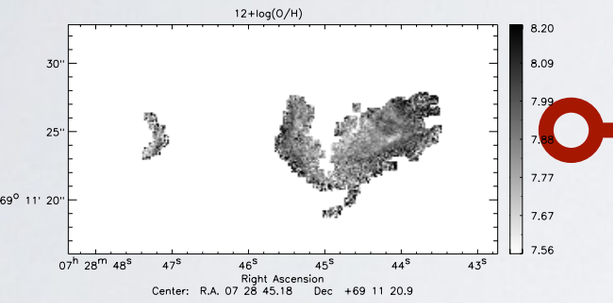
Star-Formation

Metal Distribution

Metal-poor galaxies are key in understanding galaxy evolution

Stellar feedback: suppresses star-formation & transports photons…local LyC emitters?





Star-forming galaxies are not chemically homogeneous: effects?

IFS studies of nearby systems allow extended insight into the 'realistic' ISM of star-forming galaxies at **all** redshifts → constrain high-z galaxy evolution.
A major scientific objective of all future observatories.

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