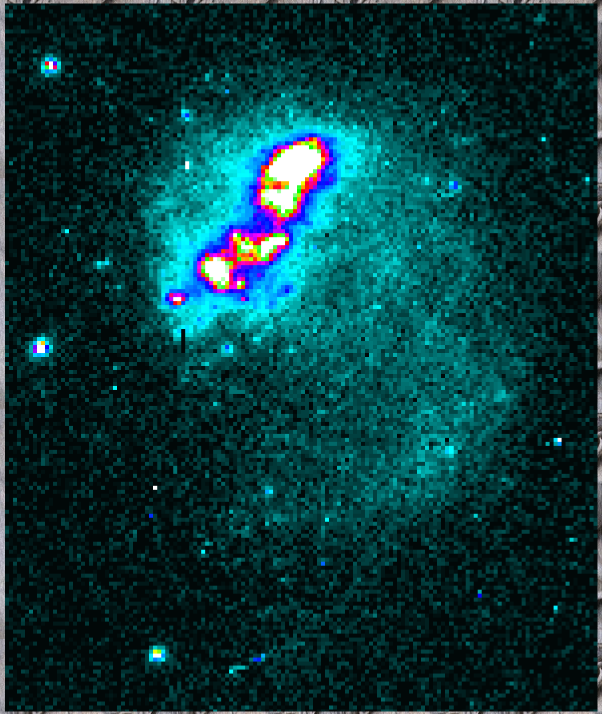
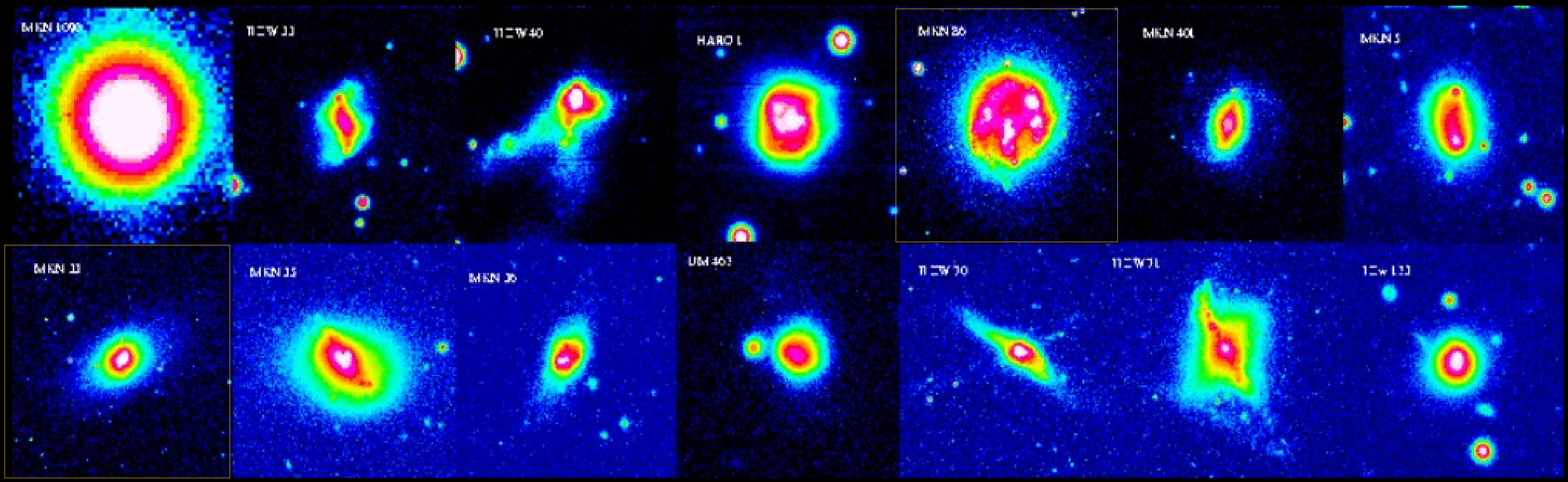


Extremely metal-poor Cometary Blue Compact Dwarf Galaxies

Polychronis Papaderos
Instituto de Astrofísica de Andalucía-CSIC

P. Papaderos
IAA
18.6.2009

Blue Compact Dwarf (BCD) galaxies: a mixed bag



Cairos et al. (2001)

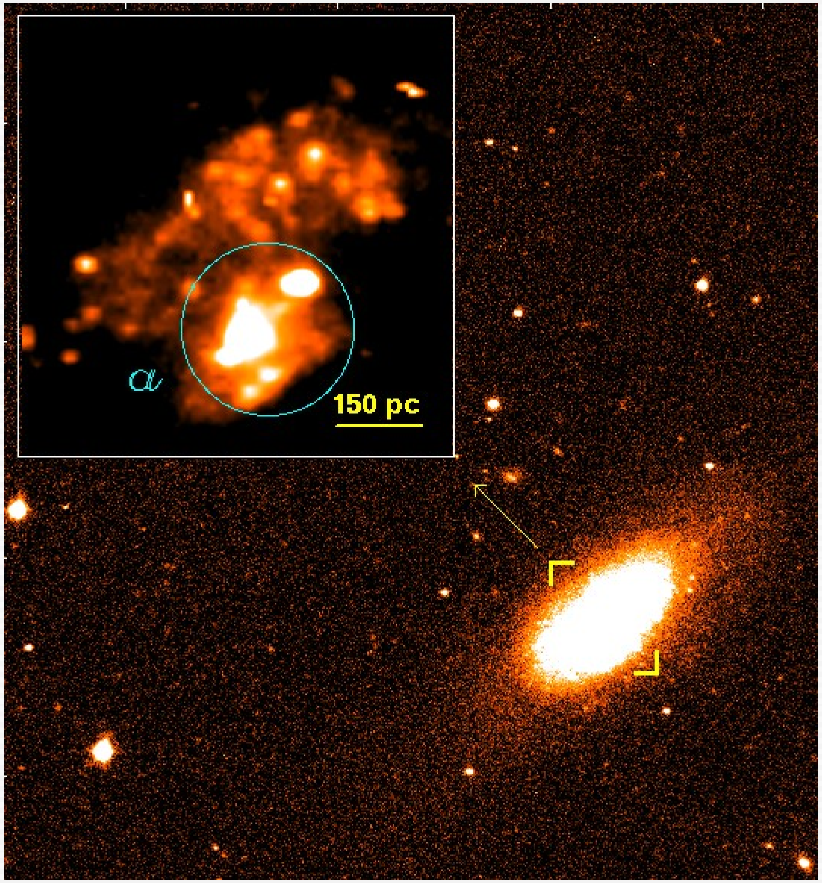
- dwarf galaxies ($10^7 \leq L/L_\odot \leq 10^9$, $M_B > -18$ mag; $M_T \sim 10^8$ ... a few $10^9\ M_\odot$)
- intense star-forming activity; spatial scale <1 kpc
- metal-poor (gas-phase metallicity $7.0 \leq 12+\log(O/H) \leq 8.4$), median $\simeq 8.0$
- evolved low-surface brightness host galaxy in most (>95%) BCDs

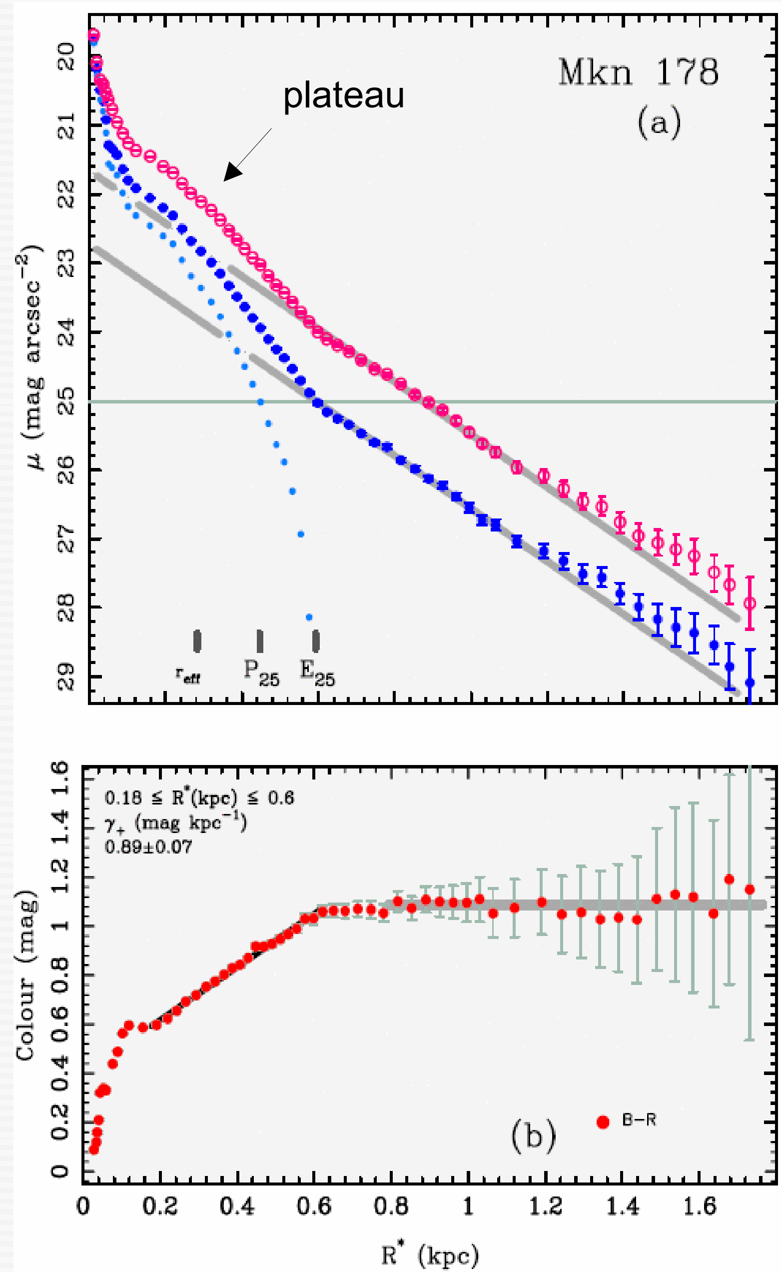
P. Papaderos
IAA
18.6.2009

Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

BCDs: photometric structure

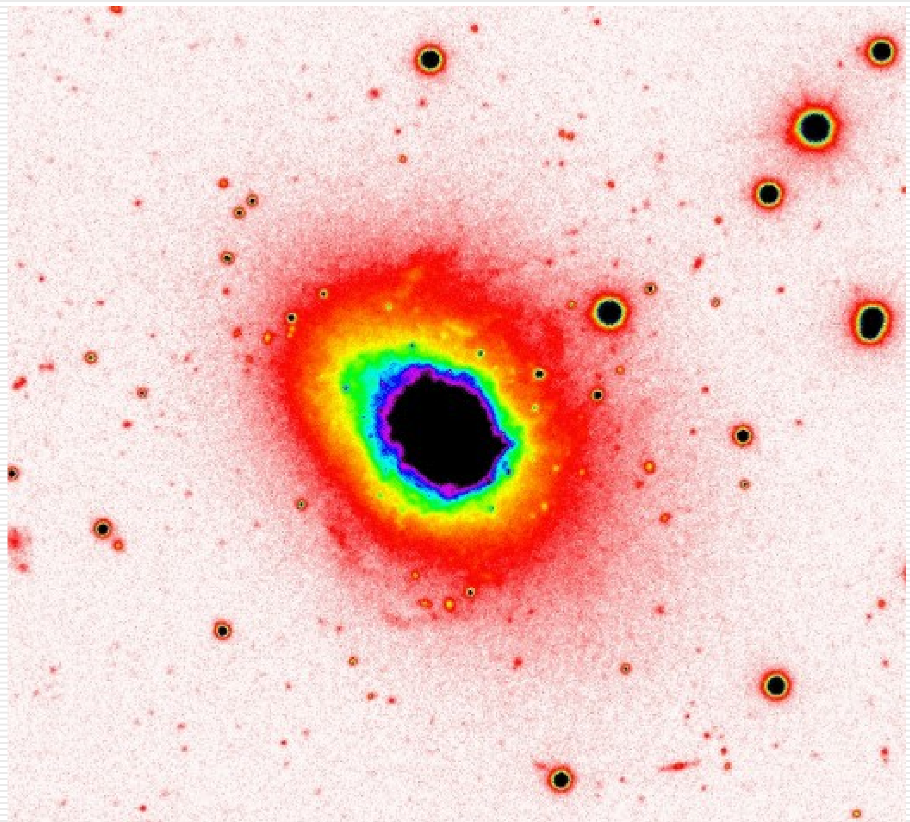
Papaderos et al. (1996, 2002)





- A single fitting law (e.g. Sersic) cannot fit the surface brightness profiles (SBPs) of BCDs
- SBP decomposition in (at least) two components: **old** host galaxy and **young** star-forming component
- Large colour gradients within the star-forming component ($R^* \leqslant P_{25}$) are typical for BCDs

In >95% of the BCD population
starburst activity takes place
within an old extended LSB host galaxy



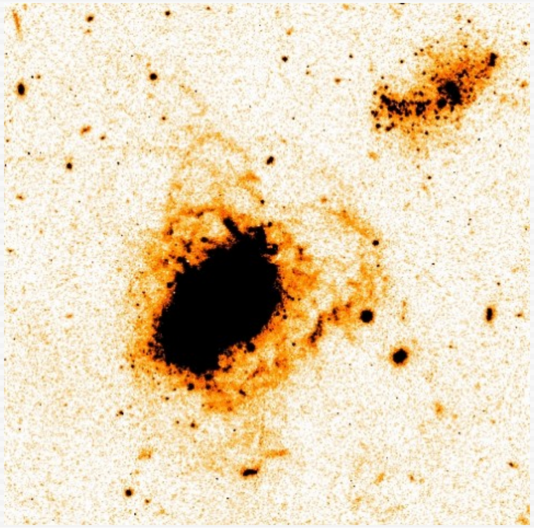
There are very few exceptions!

P. Papaderos
IAA
18.6.2009

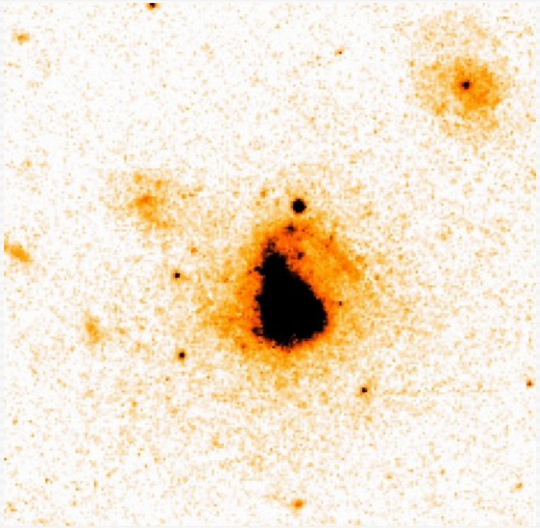
Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

Extremely metal-deficient **BCDs**: **XBCDs**

Young galaxy candidates in the local universe?

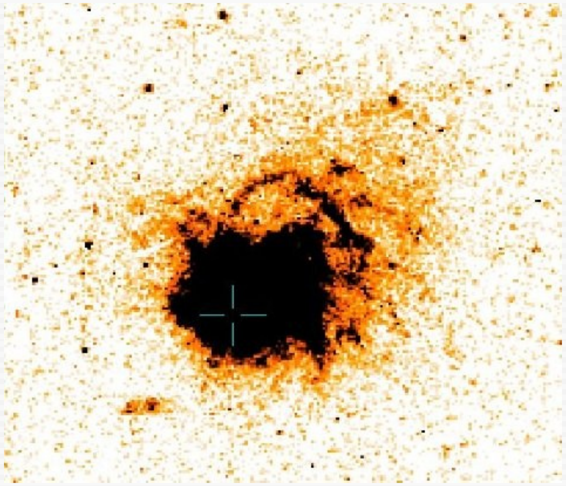


Papaderos et al. (2002)

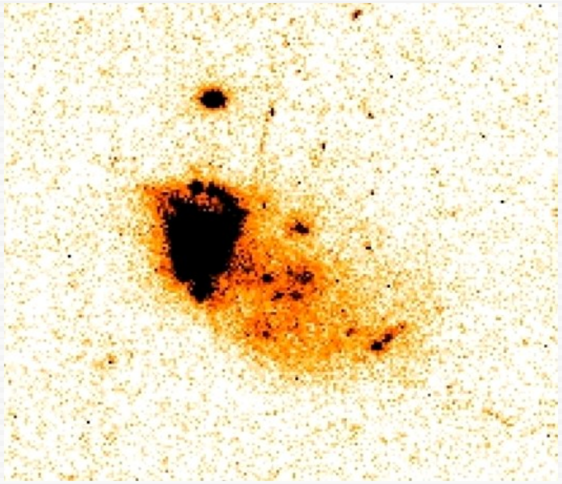


Guseva, Papaderos, Izotov et al. (2004)

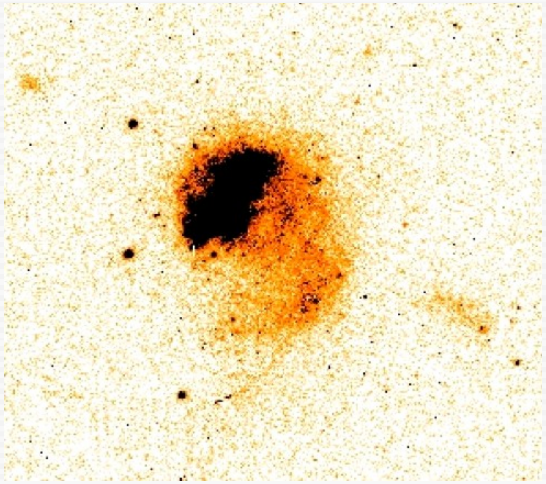
- no evidence for a dominant old stellar population
- irregular morphology, intense star-forming activity & strong ionized gas emission
- extremely metal-deficient ($7.0 \leq 12+\log(O/H) \leq 7.6$)
- extremely rare (<1% of the BCD-population; until recently only 15 such systems known)



Thuan et al. (1997),
Papaderos et al. (1998)



Fricke, Izotov & Papaderos (2001)
Papaderos et al. (2006)

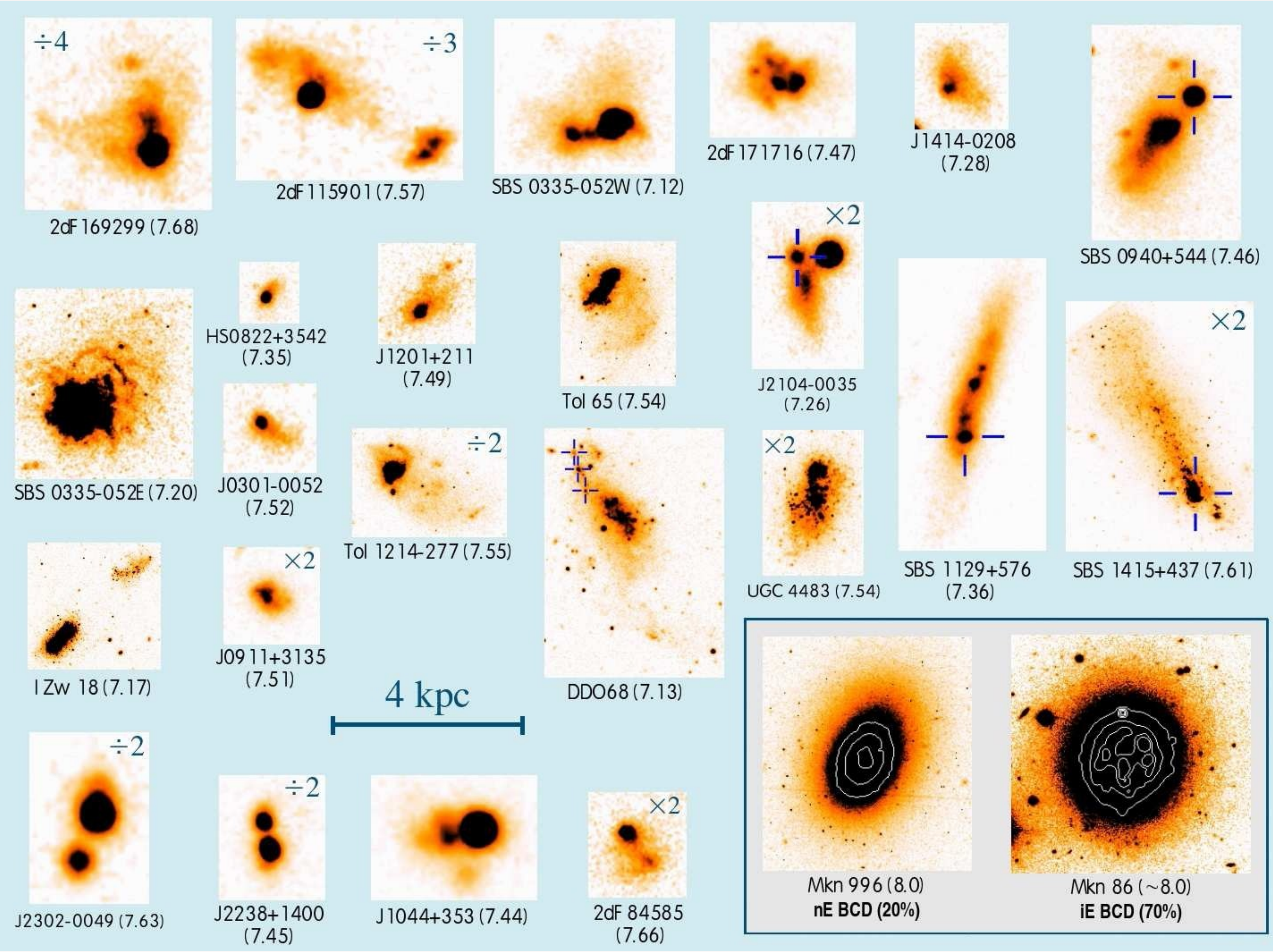


Papaderos et al. (1999,2007)

P. Papaderos
IAA
18.6.2009

Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

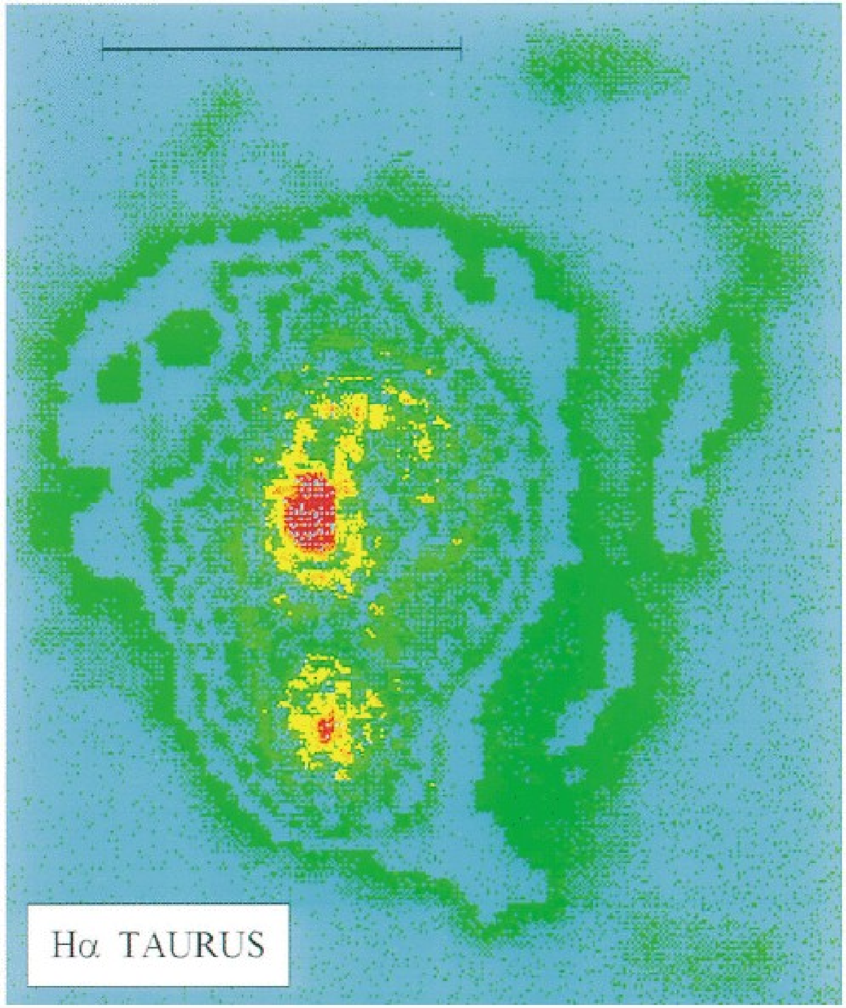
Extremely metal-poor BCDs : XBCDs

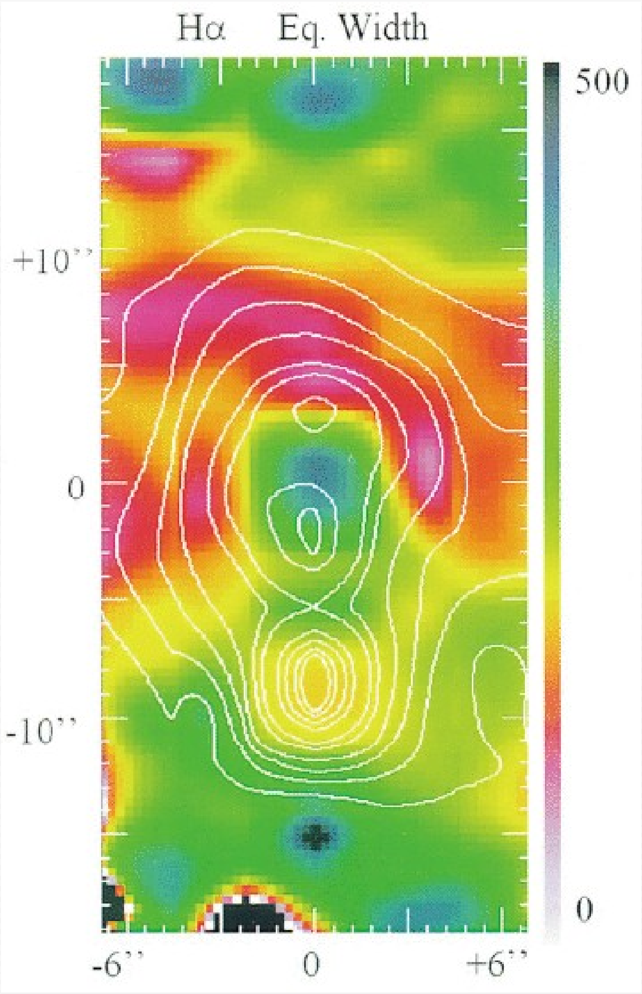


Papaderos et al. (2008)

P. Papaderos
IAA
18.6.2009

Extended ionized gas emission in XBCDs



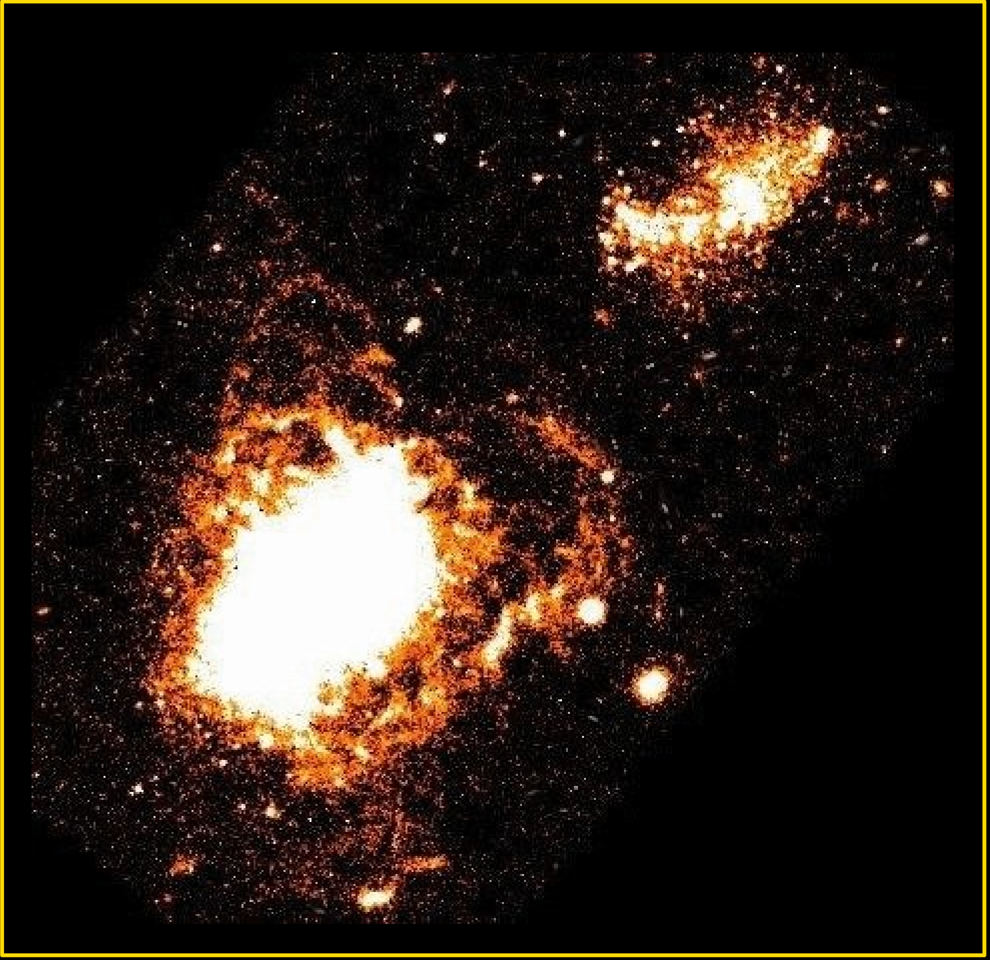


I Zw 18

Vilchez & Iglesias-Paramo (1998)

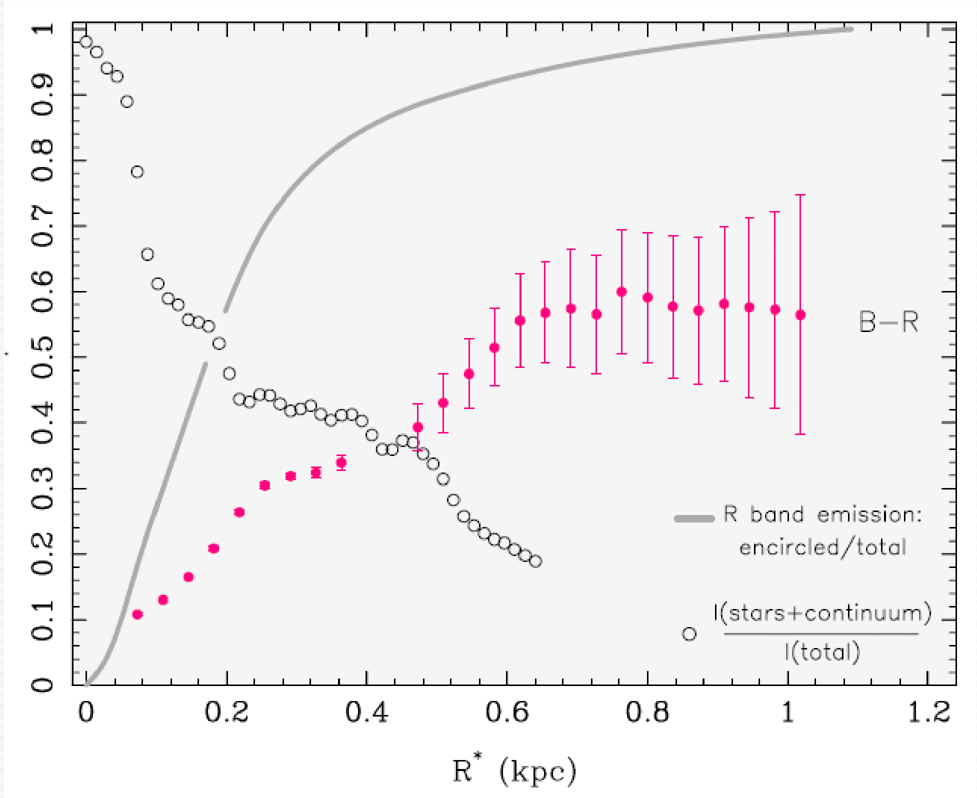
P. Papaderos
IAA

I Zw 18: a dwarf galaxy forming within an extended halo of ionized gas



Papaderos et al. (2001, 2002)

I Zw 18: radial distribution of stars and ionized gas

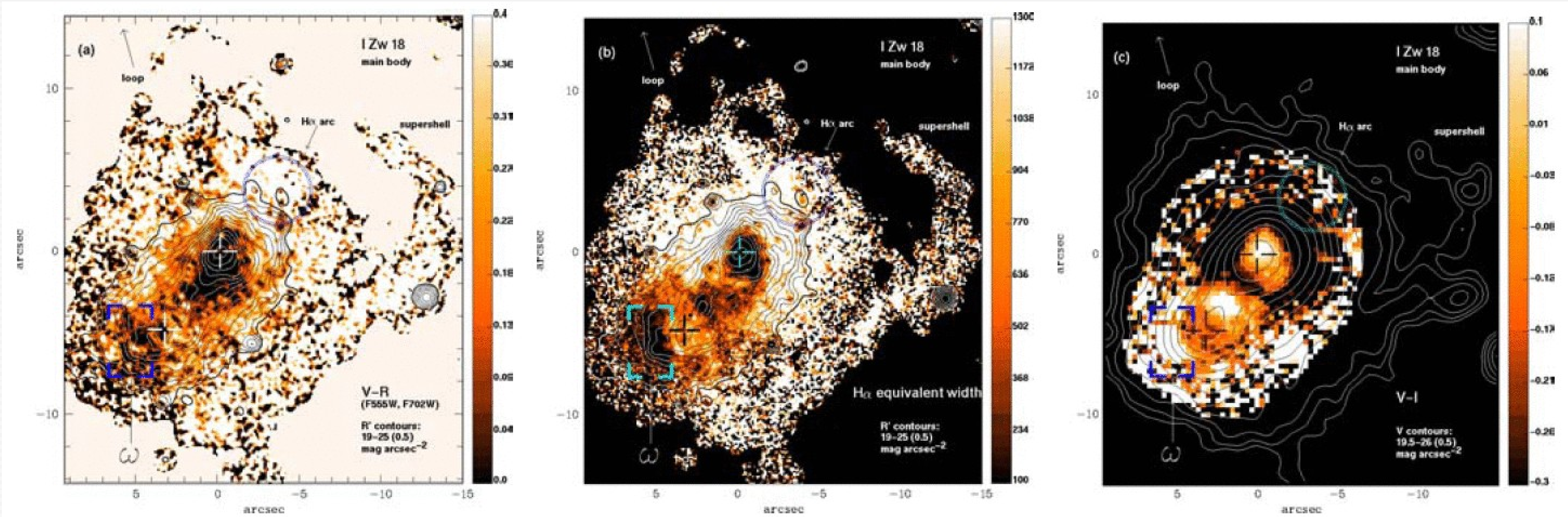


↑

the EW *may* show a strong dependence on radius

the extended (i.e. for $R \geq R_{SF}$) ion. gas emission of BCDs shows an exponential intensity decrease

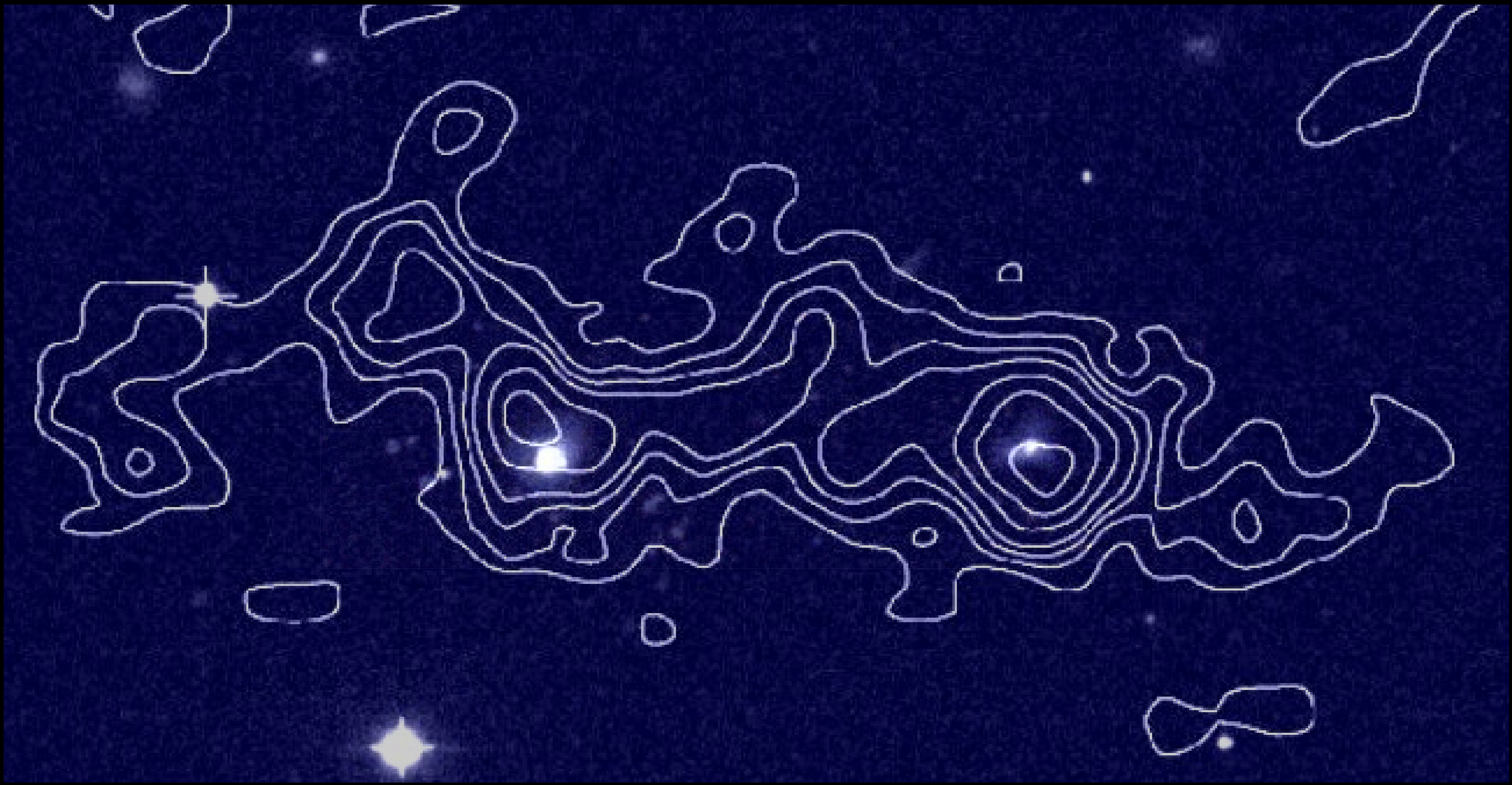
I Zw 18



V-R EW(Hα) V-I

Papaderos et al. (2002)

The pair of XBCDs SBS 0335-052 E&W



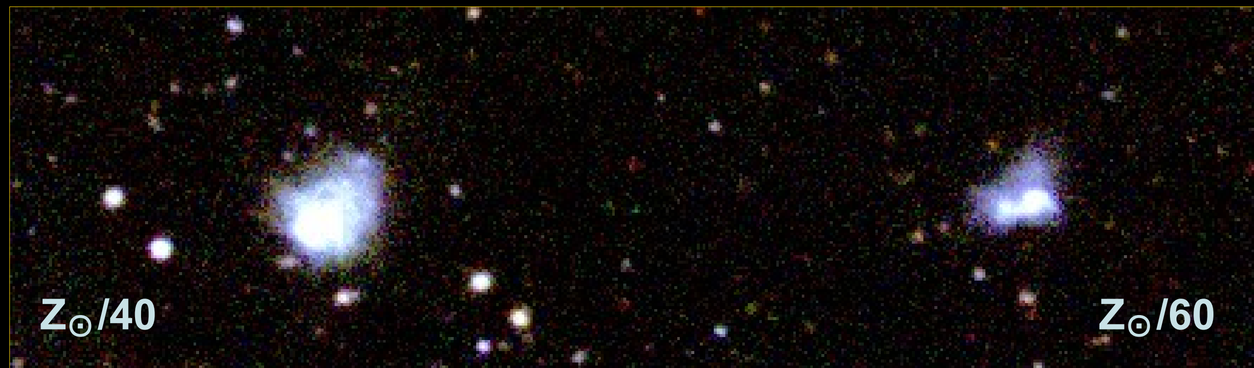
Pustlinik et al. (2001)

SBS 0335-052: HI cloud with a projected size of 70×20 kpc; mass of ~10^9 $M_\odot$

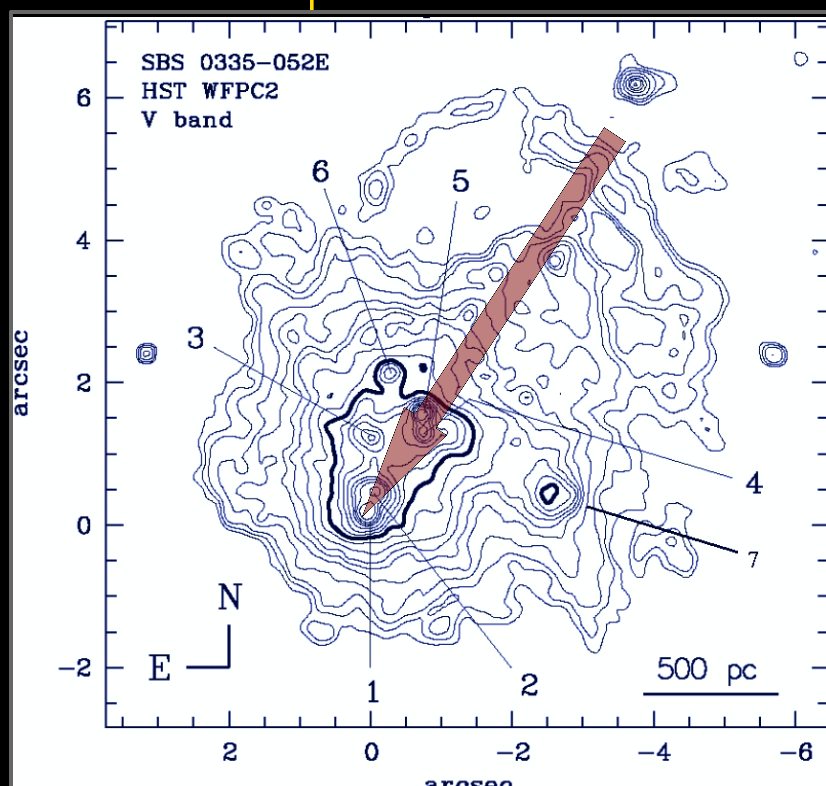
P. Papaderos
IAA
18.6.2009

Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

The pair of XBCDs SBS 0335-052 E&W



ESO 3.5m NTT
Papaderos et al. (2006b)



Papaderos et al. (1998)

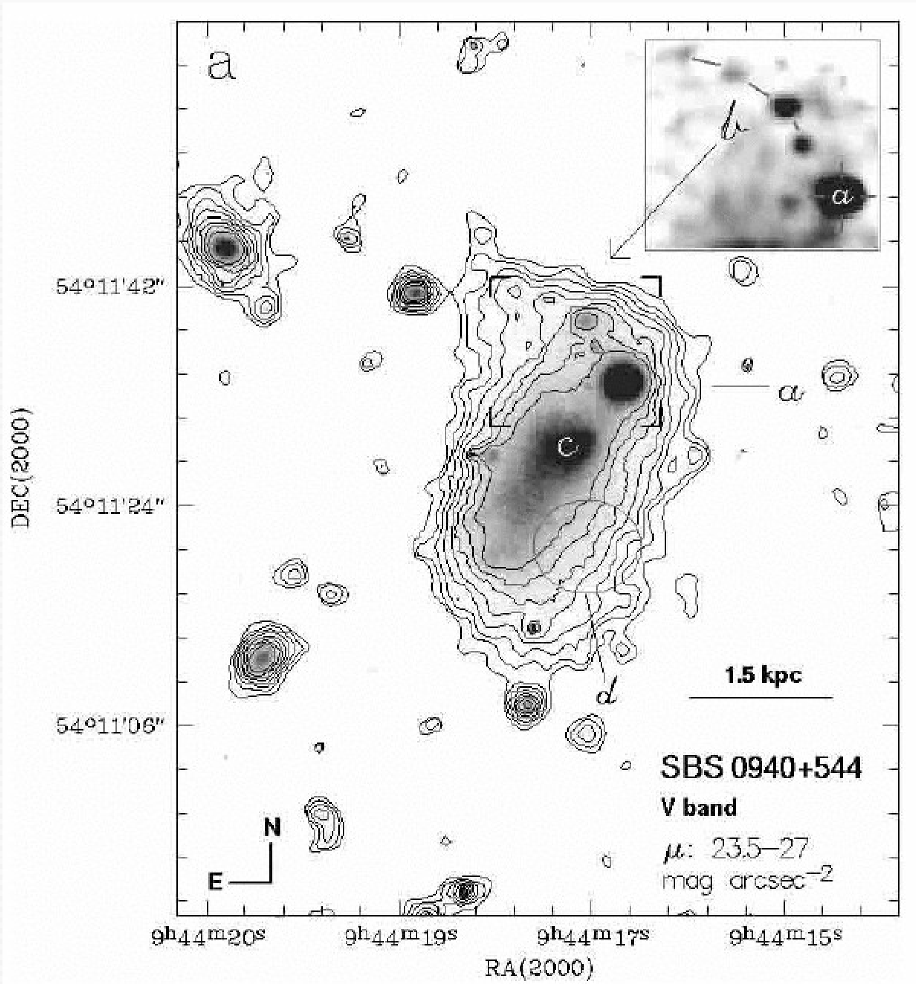
SBS 0335-052 (D=54.3 Mpc)
M_V = -17 mag/-15 mag for E&W, resp.

SBS 0335-052 E

- An old host galaxy is not detected ($M_* \sim 10^7\ M_\odot$); age < 1 Gyr
- Study of the color and spatial distribution of several stellar clusters using HST data

→ galaxy is forming in a propagating mode from northwest to southeast

Extremely metal-poor cometary BCDs



SBS 940+544

12+log(O/H)=7.46

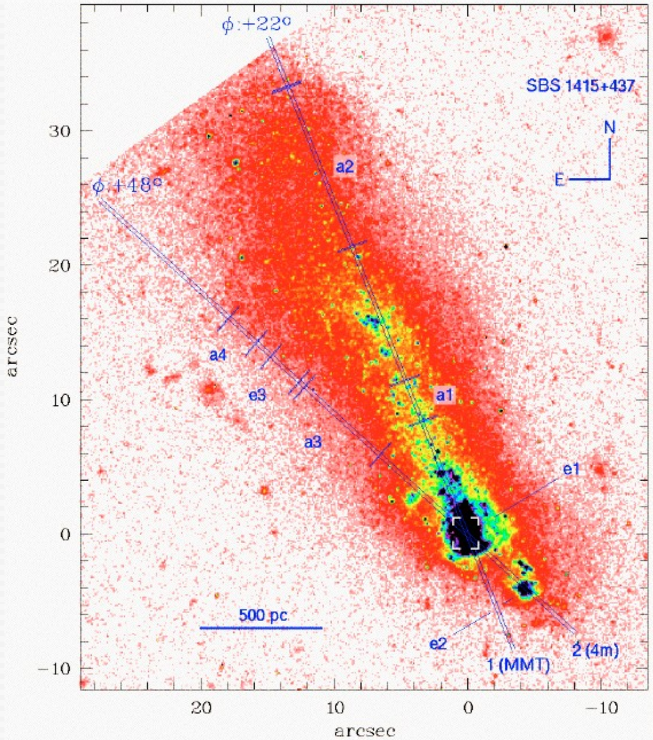
Guseva et al. (2003)

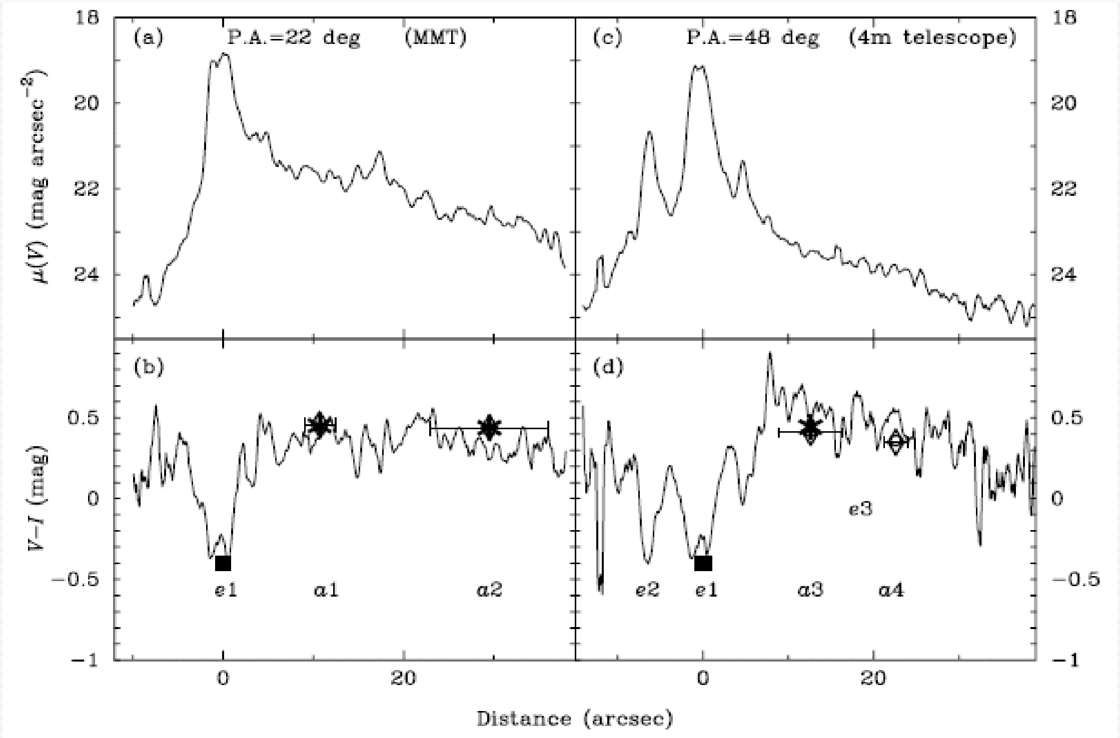
SBS 1415+437

12+log(O/H)=7.61

Thuan et al. (1999),
Guseva et al. (2003),
Aloisi et al. (2005)

Extremely metal-poor cometary BCDs: SBS 1415+437



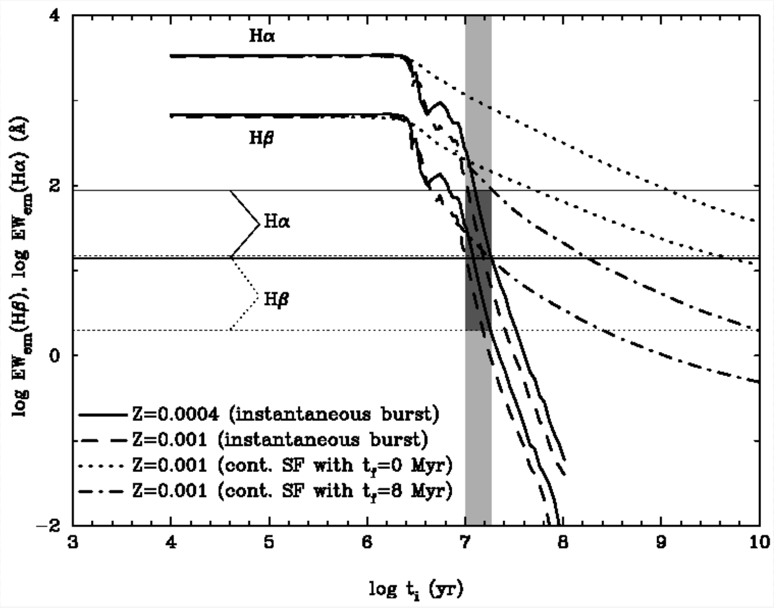


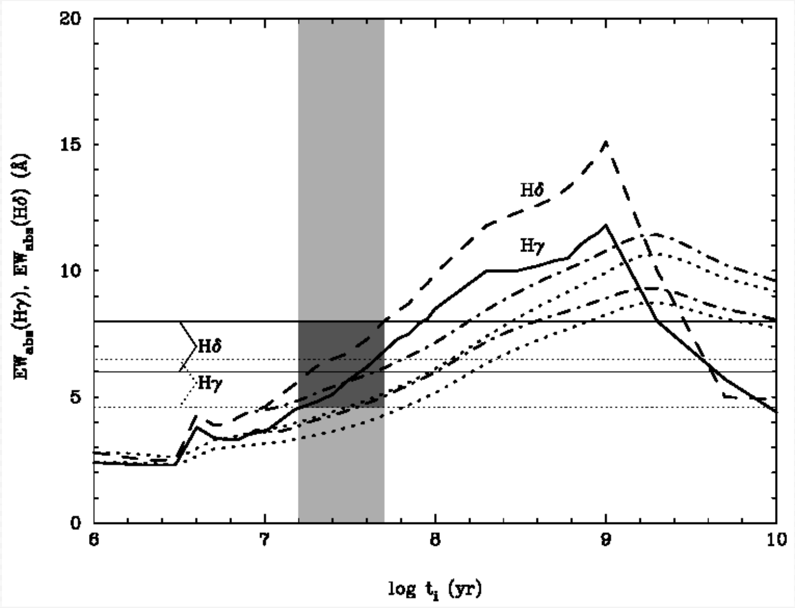
Guseva et al. (2003)

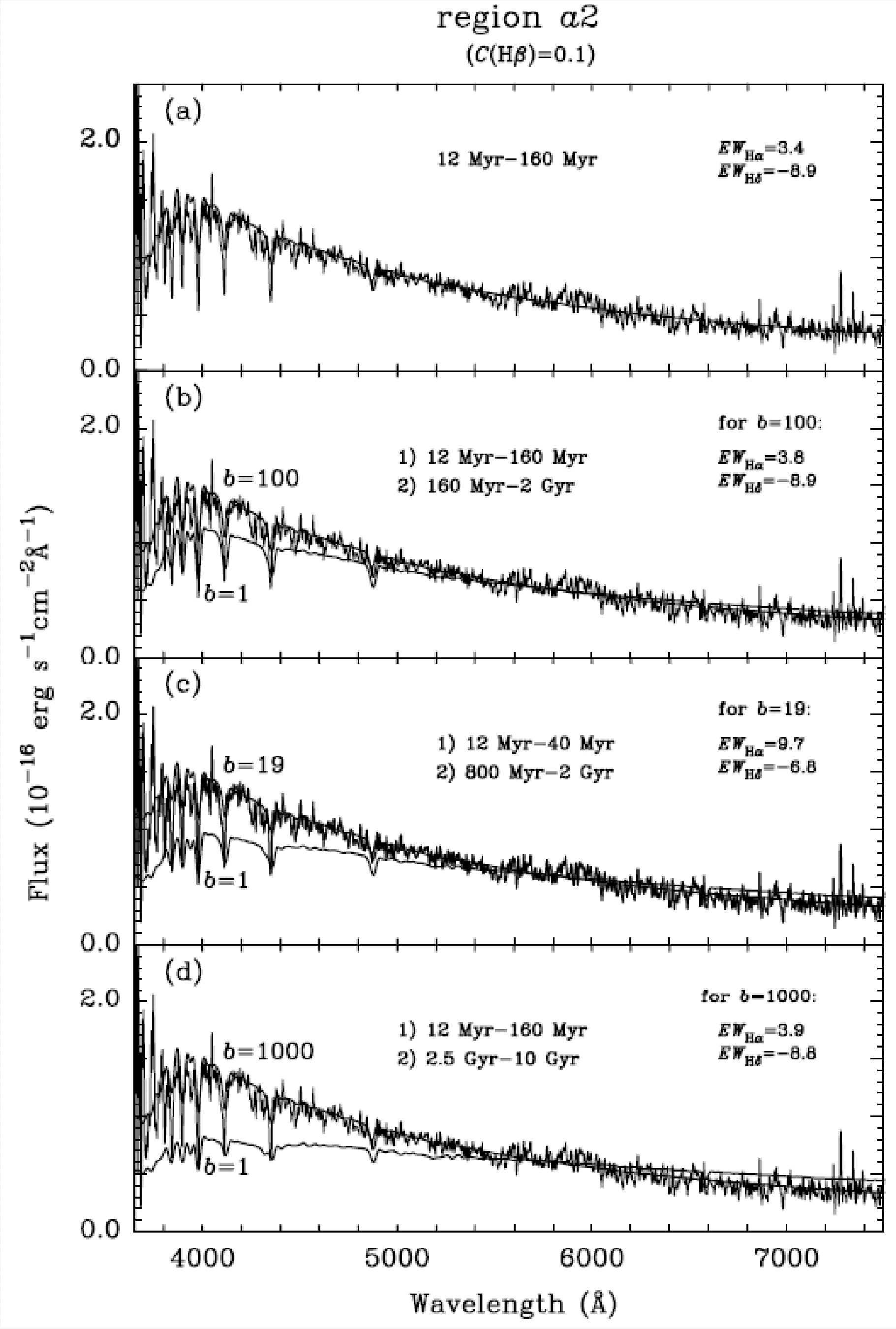
P. Papaderos
IAA
18.6.2009

Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

Extremely metal-poor cometary BCDs: SBS 1415+437







Guseva et al. (2001,2003)

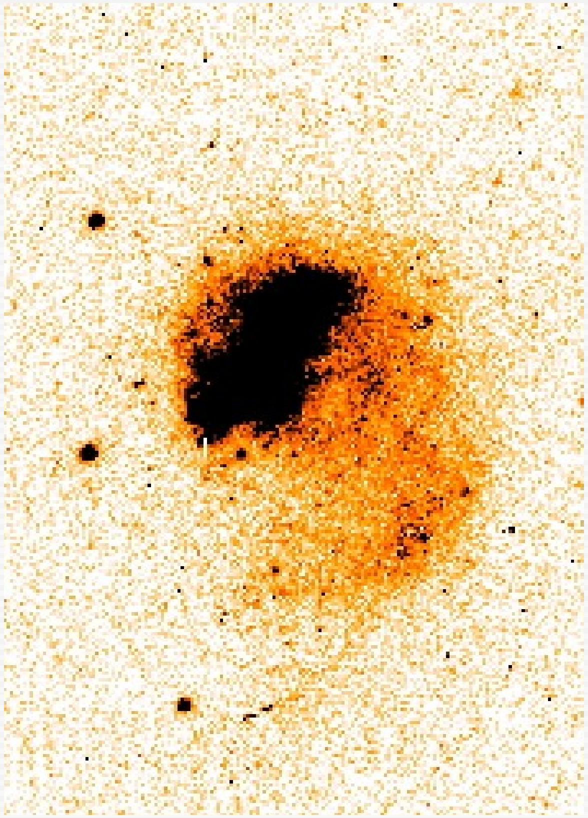
An IFU study of extremely metal-poor cometary BCDs with GIRAFFE/ARGUS

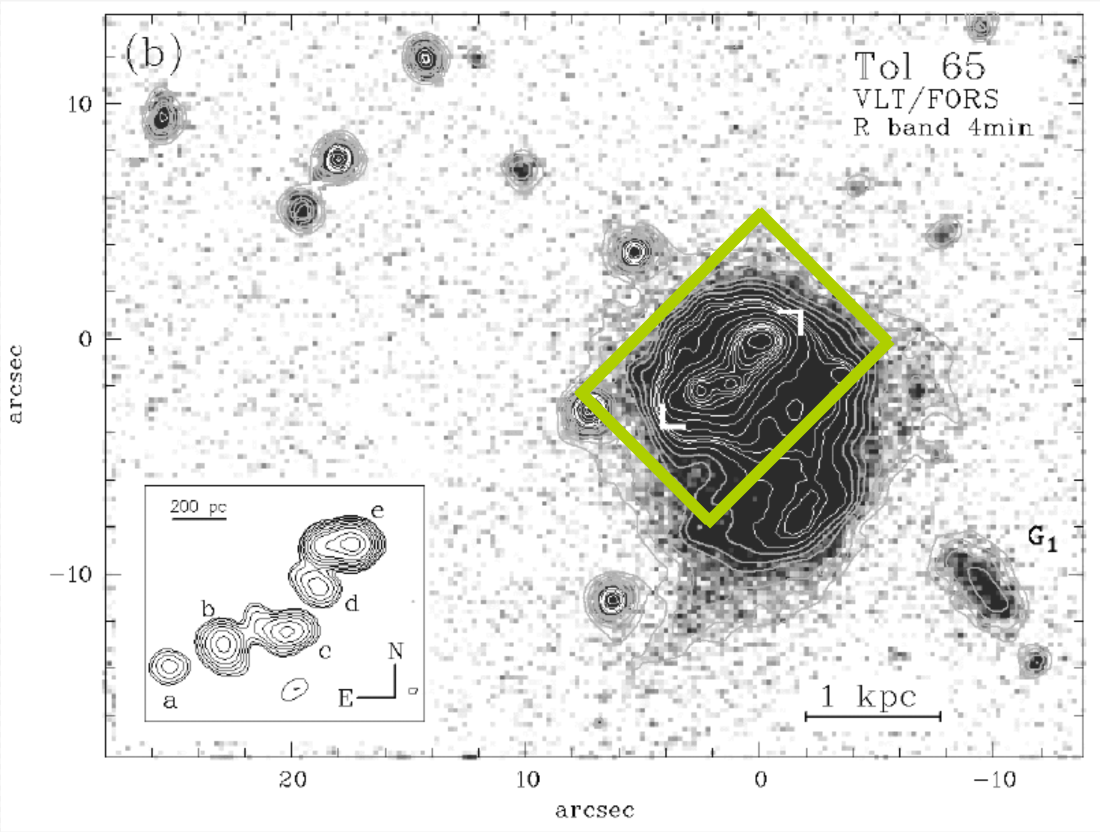
(Papaderos, Vilchez, Perez-Montero, Tsamis, Iglesias-Paramo, Amorin)

P. Papaderos
IAA
18.6.2009

Extremely metal-poor Cometary Blue Compact Dwarf Galaxies

Tol 65

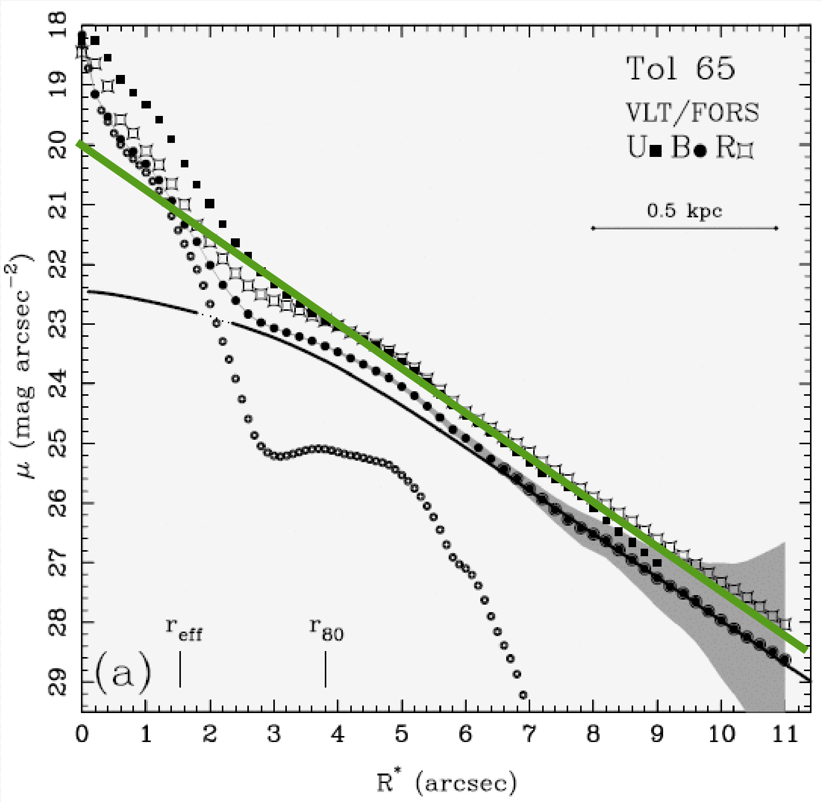




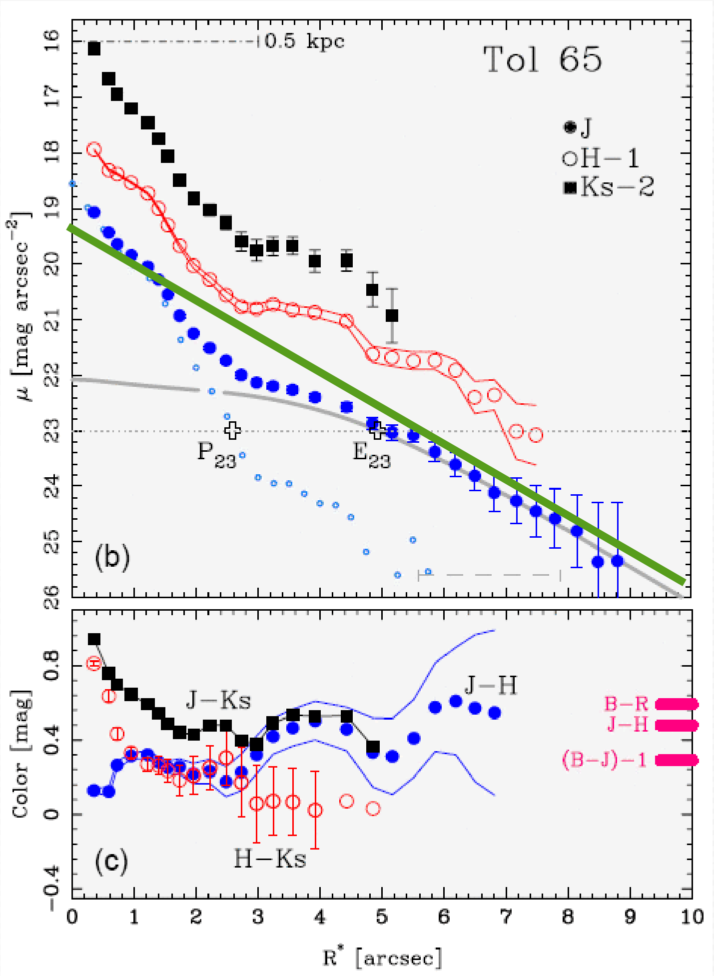
- Gas-phase metallicity 12+log(O/H)=7.54
- Intense ionized gas emission (EW(Hα) >10^3 Å) within R_{25}
- Chain of 5 Super-Star Cluster (SSC) candidates within ~1 kpc; probably very young (no WR features)
- SSCs: ages & age gradients? synchronization? mass?

P. Papaderos
IAA
18.6.2009

Tol 65



Papaderos et al. (1999)



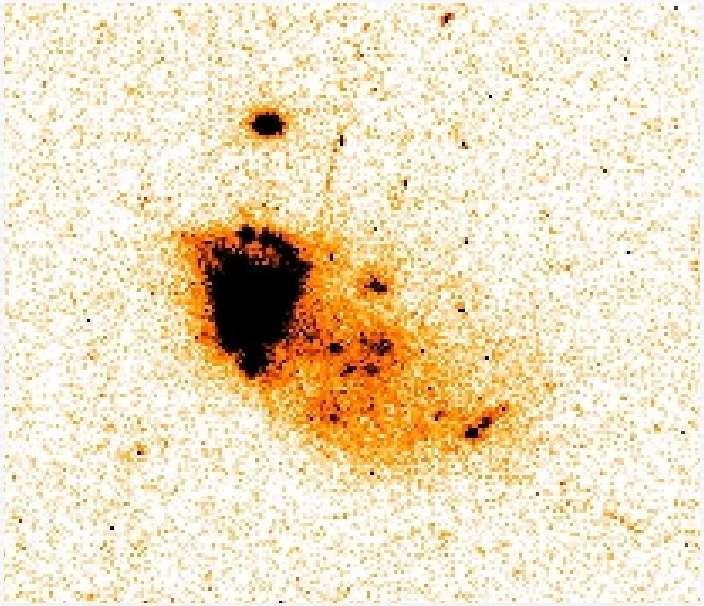
Noeske et al. (2003)

- Gas-phase metallicity 12+log(O/H)=7.54
- Intense ionized gas emission (EW(Hα) >10^3 Å) within R_{25}
- Chain of 5 Super-Star Cluster (SSC) candidates within ~1 kpc; probably very young (no WR features)
- SSCs: age gradients? synchronization? mass?
- ∃ host galaxy. Blue colors (B-R=0.6, J-H= 0.5)

P. Papaderos
IAA
18.6.2009

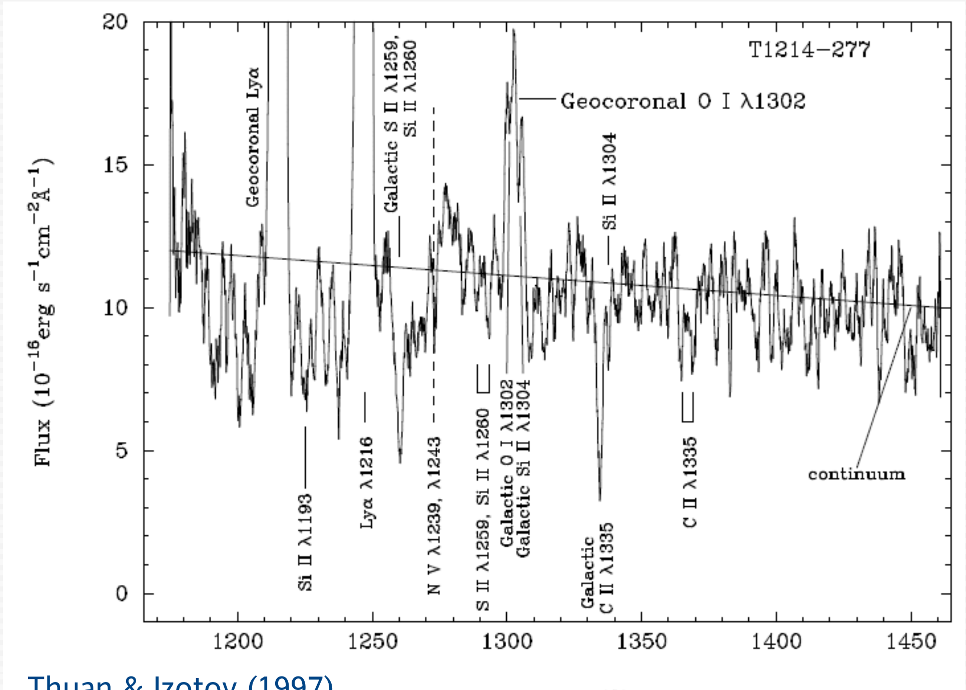
Extremely metal-poor
Cometary Blue Compact Dwarf Galaxies

Tol 1214-277

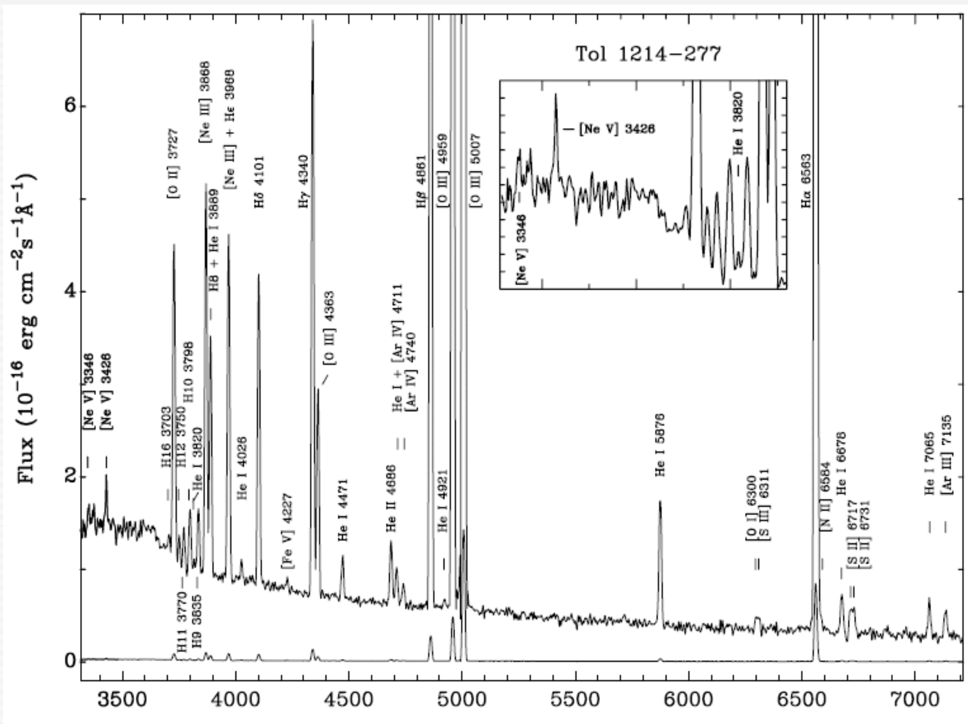


- 12+log(O/H)=7.55
- Very strong ionized gas emission (EW(Hβ) = 270 Å)
- Lyα in emission with an EW$\simeq$80 Å
- Hard radiation field ([FeV]λ4227, [NeV]λ3426, implying energies >7 Ryd)
- Strong HeIIλ4686 emission (5% of Hβ)
- Blue stellar host (U-B=-0.4, B-R=0.5)

Terlevich et al. (1991), Papaderos (1998), Fricke et al. (2001), Izotov et al. (2004ab)



Thuan & Izotov (1997)

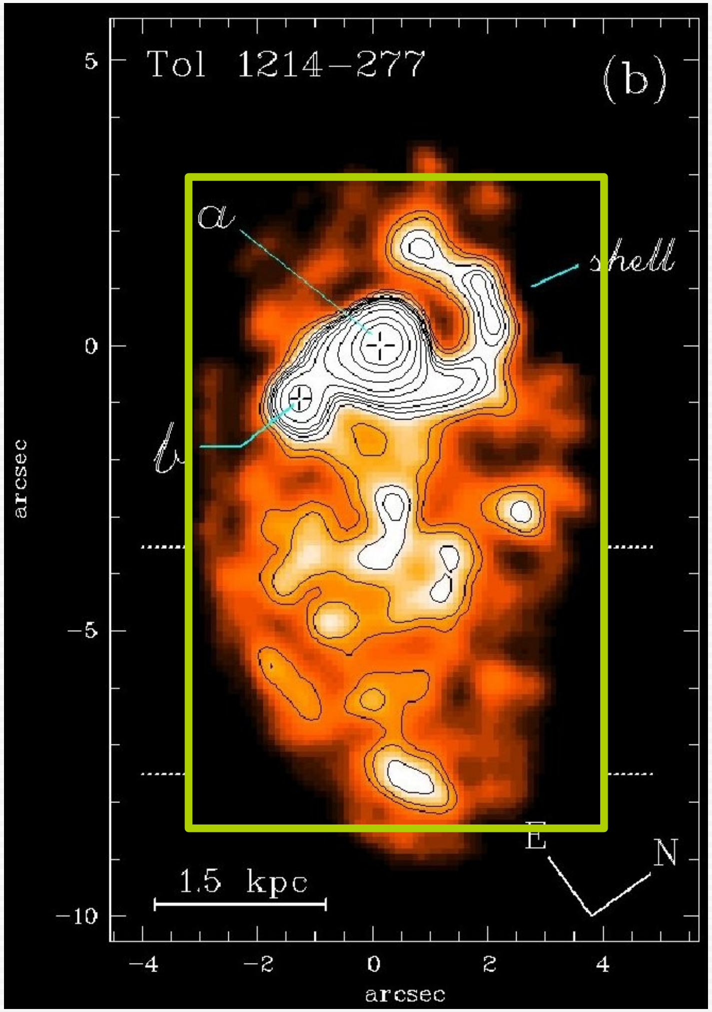


Izotov et al. (2004)

P. Papaderos
IAA
18.6.2009

Extremely metal-poor Cometary Blue Compact Dwarf Galaxies

ARGUS FOV



Questions

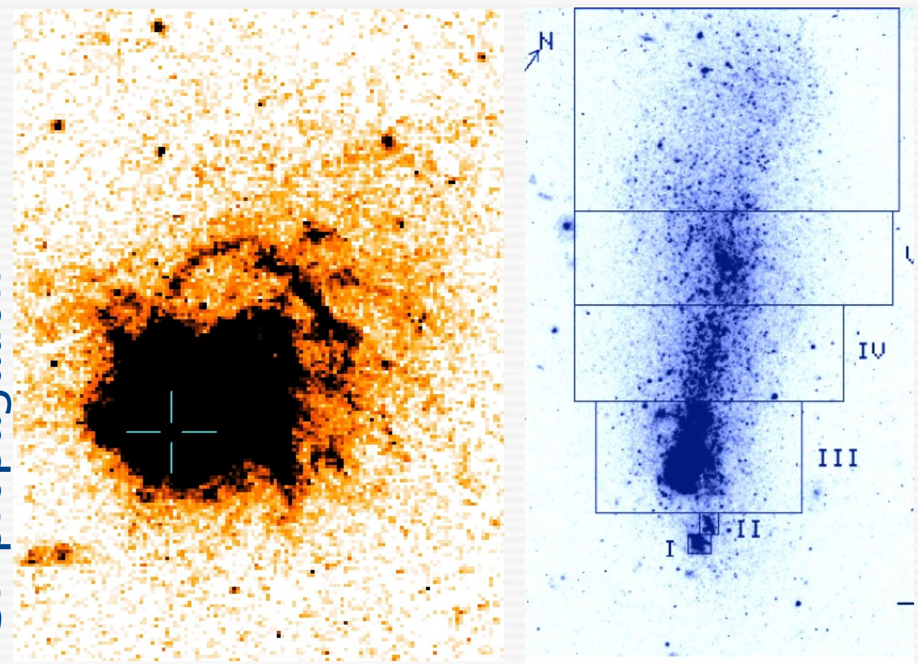
- Chemical abundance pattern (O, .., N)
- Location & origin of high-excitation lines
- Wolf-Rayet stellar populations
- Stellar age gradients, evolutionary status & formation process

P. Papaderos
IAA
18.6.2009

XBCDs: laboratories to study the formation of low-mass galaxies

Some of the (very few) extremely metal-deficient BCDs known (XBCDs with $7.0 \leq 12+\log(O/H) \leq 7.6$) are likely cosmologically young ($M_{\star,old}/M_{\star,young} \leqslant 1/2$) objects

SF propagation



XBCDs/BCDs: connection between

evolutionary status, morphology, gas-phase metallicity (?)

IFU studies are both indispensable and promising