Environmental effects in galaxy clusters: from z=0 to z=0.2

Individual effects - cluster substructure and evidence(?) of galaxy destruction

Héctor Bravo-Alfaro

Dept. de Astronomia, Guanajuato. Mexico

- **Abell 1367: E. Brinks, A. Boselli, I. Plauchu**
- **Abell 85: J. van Gorkom & Co.*, F. Durret, C. Lobo, J-M Islas**

(*) Bravo-Alfaro, Dwarakanath, Guhatakurta, Poggianti, Verheijen, Wilcots, Zabludoff

- **Abell 1689/2667: J-P Kneib, L. Cortese, G. Covone**

Overview

1. Introduction: context and goals
2. Observations: VLA-HI, NIR/Opt-imaging
3. Preliminary results on nearby clusters

A1367 **A85**
Z=0.02 **Z=0.05**

4. Evidence for galaxy destruction ?

A1689 **A2667**
Z=0.18 **Z=0.02**

1. Context

Evolution of galaxies in clusters:

Nature or Nurture?

Initial conditions **Environment mechanisms**

Gravitational ICM-ISM

- **Direct mergings**
- **Tidal interactions**
- **Galaxy harassment**

- **Ram-pressure stripping**
- **Viscous stripping**
- **HI → H2**
- **Starvation**

Targets:

(1) Nearby clusters: detailed effects of environment as a function of cluster properties and as a function of z.

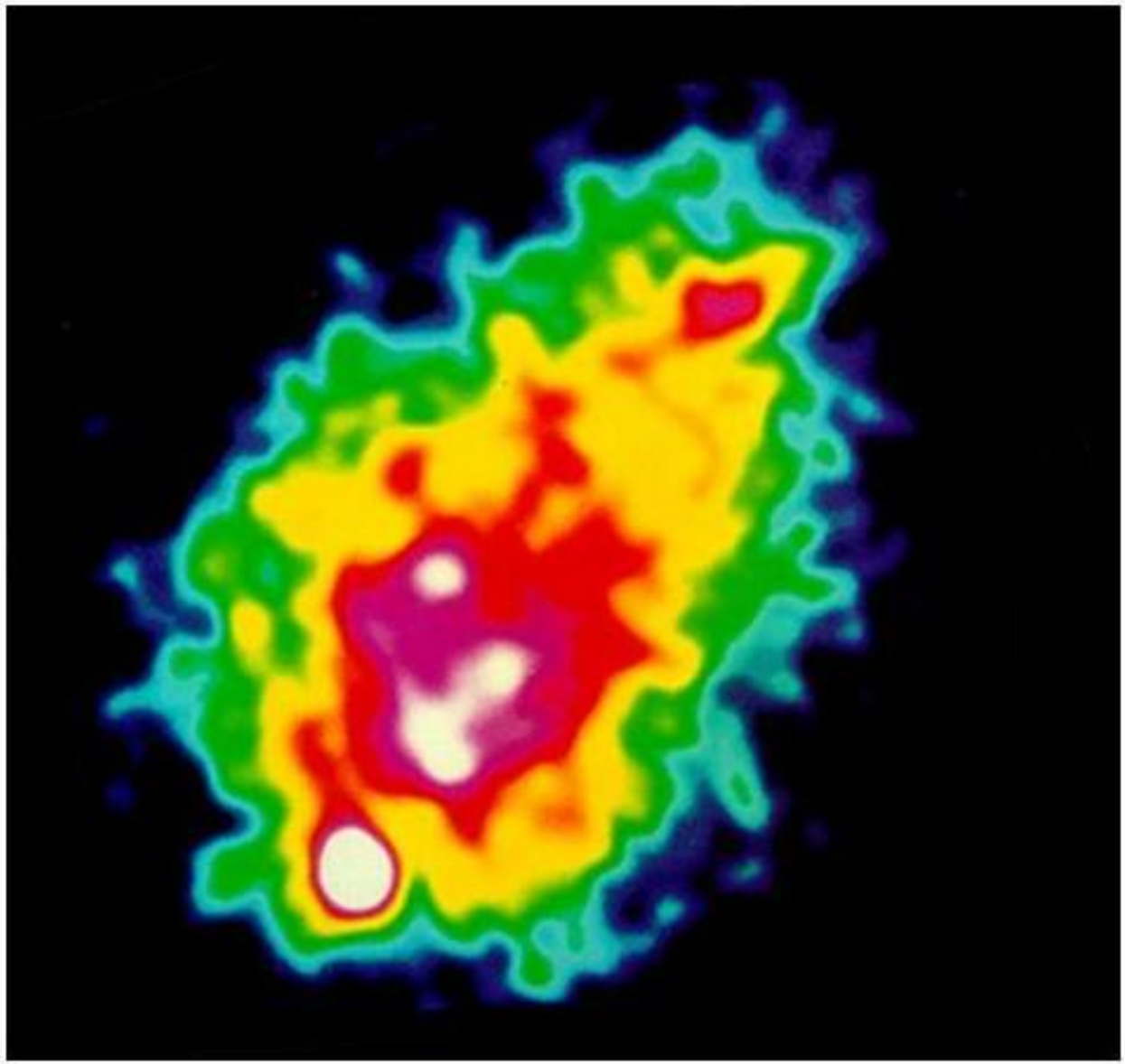
(2) Compare with numerical simulations

(3) Get an independent method to trace cluster substructure. Catch groups in the infall process

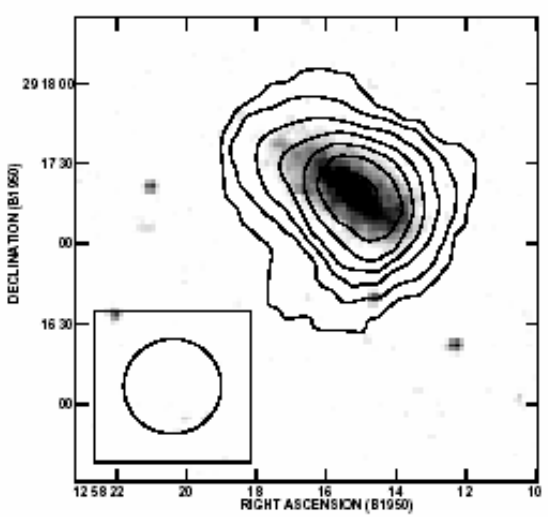
Main goal: study the evolution of D-M and the

SF history in galaxies as a function of environment

Galaxies in clusters: the Intra Cluster Medium (ICM)



Outskirts in Coma



IC 842

Fig. 17a. HI density distribution of IC 842 superposed on a DSS *B*-band gray scale image. The contours are 0.3 (2.5 σ),

CGCG 160-058

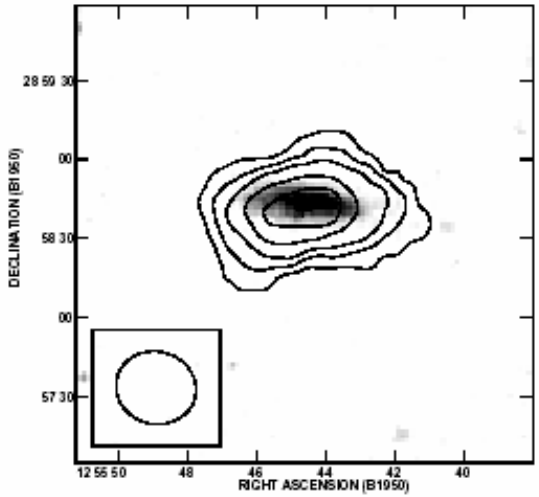
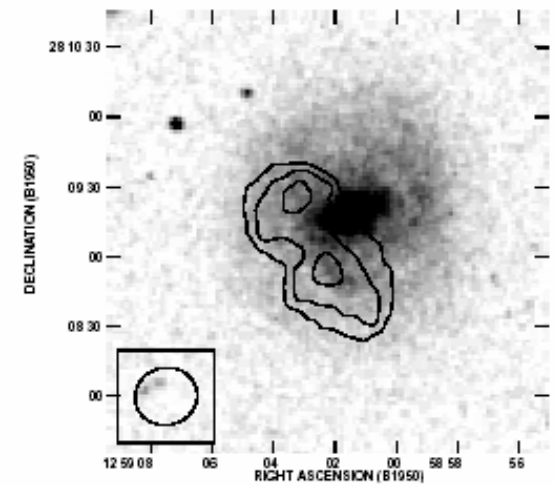


Fig. 6a. HI density distribution of CGCG 160–058, superposed on a DSS *B*-band gray scale image. The contours are 0.4

And near the Coma core….



NGC 4921

Fig. 16a. HI density distribution of NGC 4921, superposed on a DSS *B*-band gray scale image. The contours are 0.3 (2.5 σ),

NGC 4848

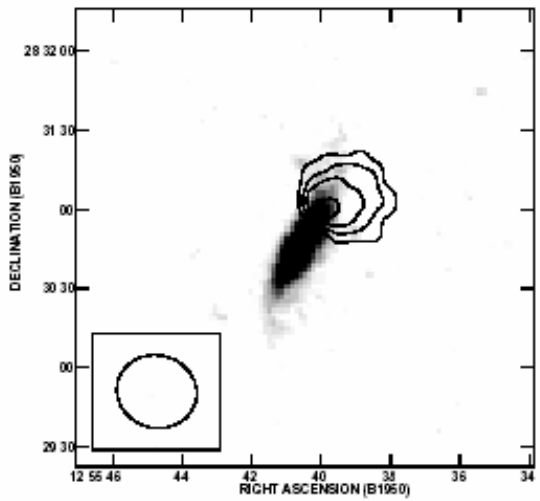
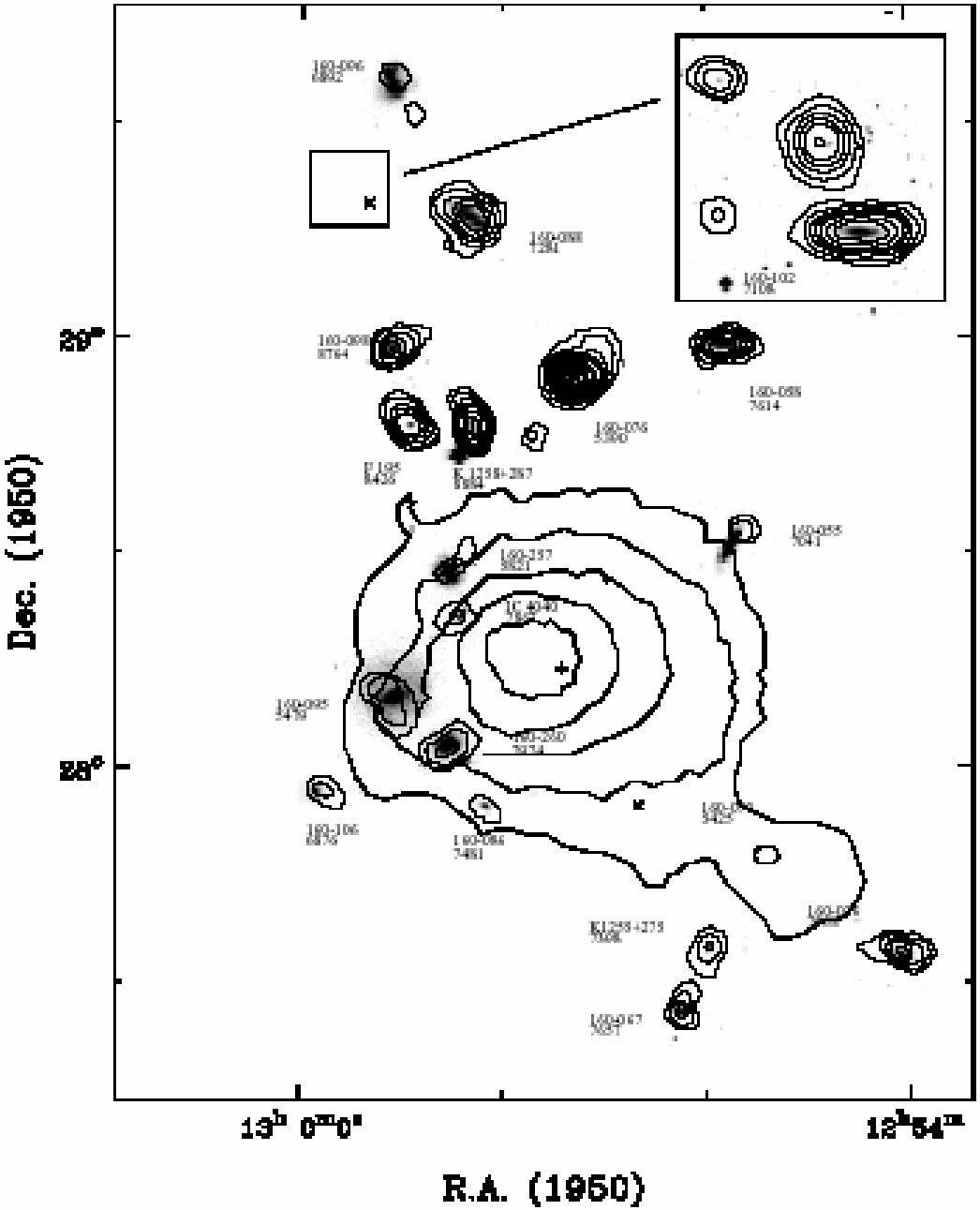


Fig. 4. HI density distribution of NGC 4848, superposed on a DSS *B*-band gray scale image. The contours are 0.3 (2.5 σ),

Bravo-Alfaro et al. 2001

HI and X-ray in Coma



(Bravo-Alfaro et al. 2000)

2. Observations: Clusters imaged in HI so far

ID	Velocity (km/s)	S:S0:E	L_X (erg/s)	Def_{HI}
Virgo	**1026**	46:39:15	43.0	0.56
Hydra	**3600**			
A 262	**4704**	47:32:21	44.0	0.48
Hercules	**11000**	51:35:14	43.9	0.21
Coma	**7000**	18:47:35	44.9	0.77
UMa	**800**			
A 1367	**6595**	43:40:17	**43.5**	**0.42**.
A 85	**16500**		**45.0**	
		Coming soon:		
A 2670	**24000**	44.4		van Gorkom & Co. in prep.
A 754	**16700**	44.6		"
A 2029	**22800**	45.2		"
A 2192	**56100**	44.6		"

Observations of Abell 1367 (z=0.02)

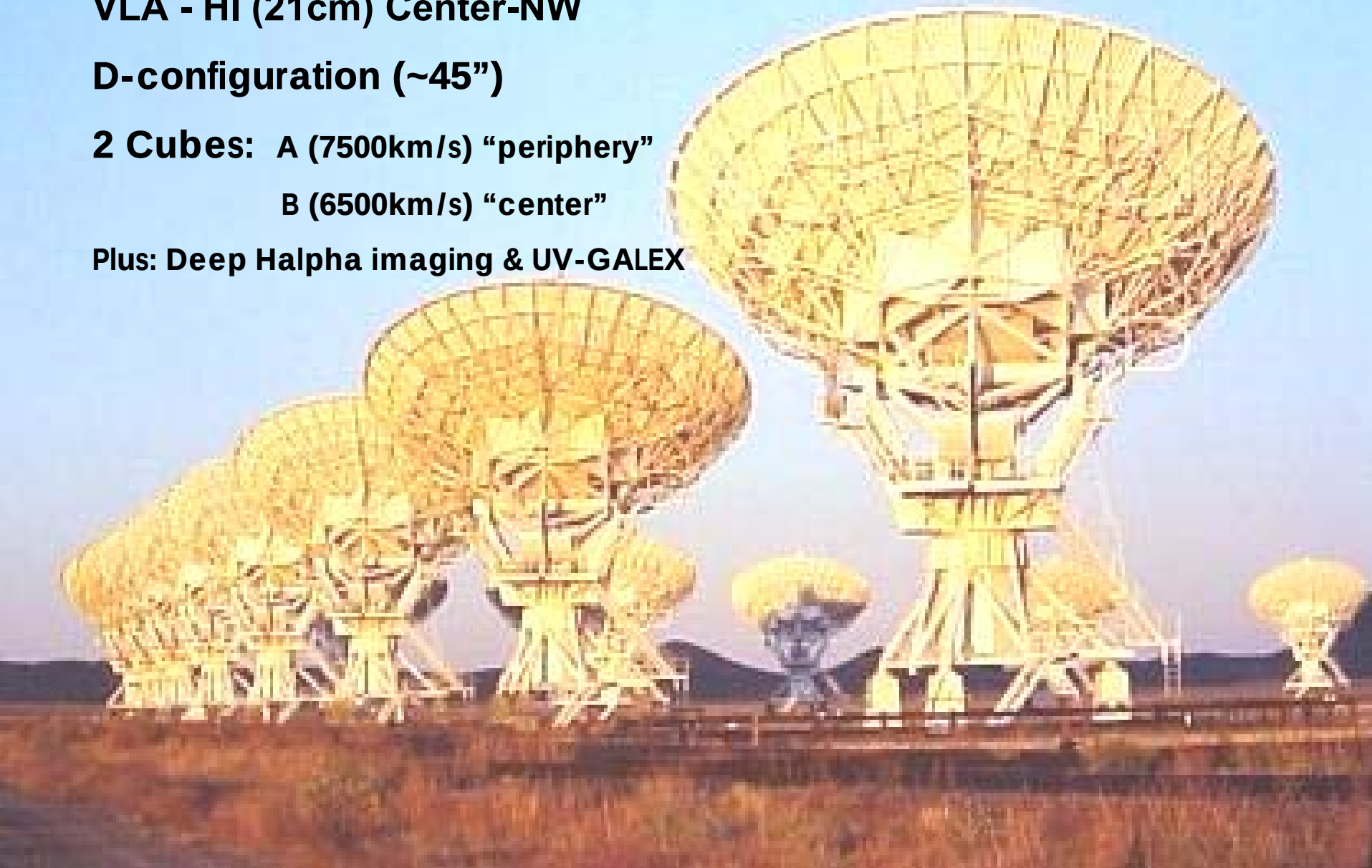
VLA - HI (21cm) Center-NW

D-configuration (~45")

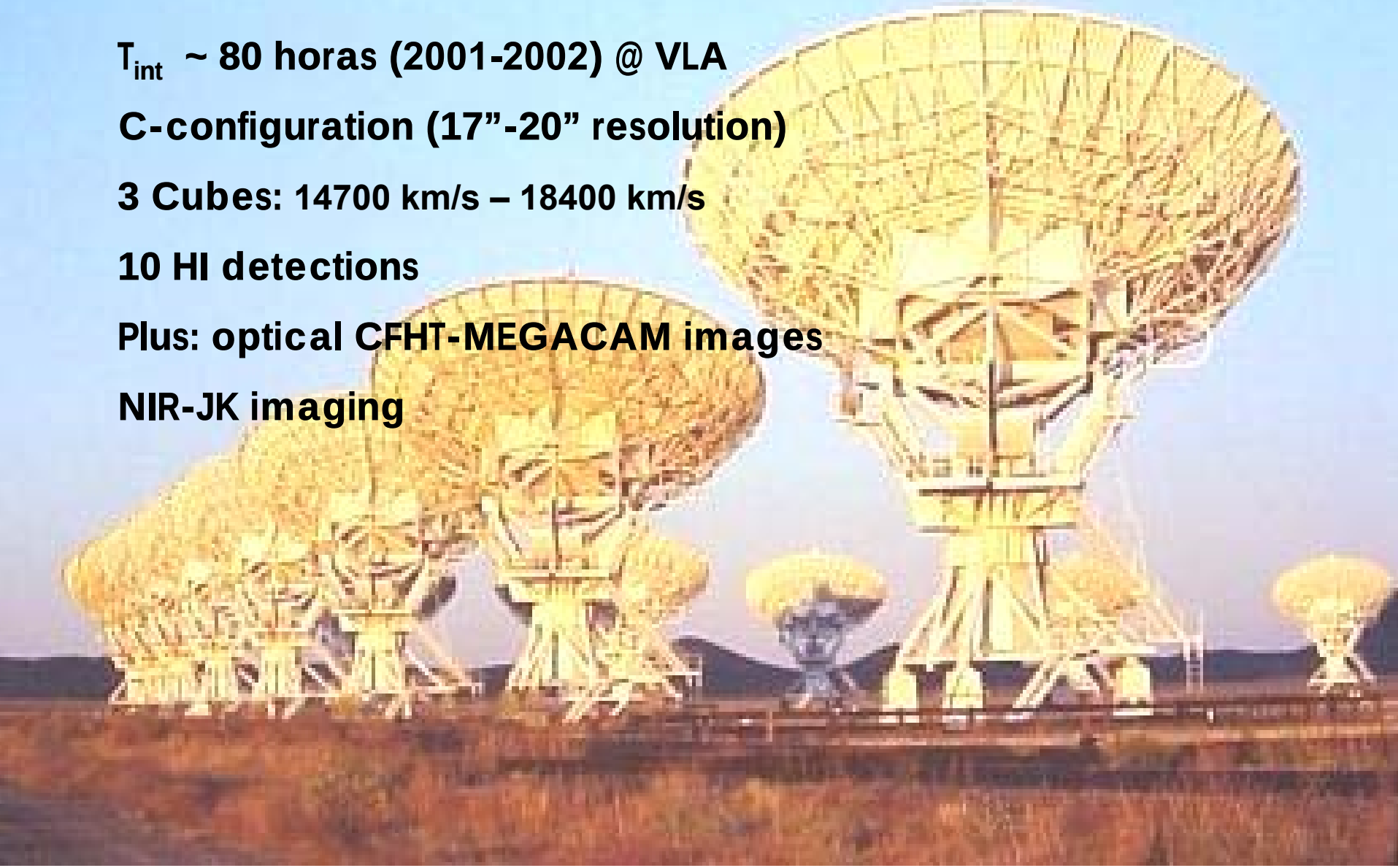
2 Cubes: **A (7500km/s) "periphery"**

B (6500km/s) "center"

Plus: Deep Halpha imaging & UV-GALEX



Observations Abell 85 (z = 0.055)



T_{int} ~ 80 horas (2001-2002) @ VLA

C-configuration (17”-20” resolution)

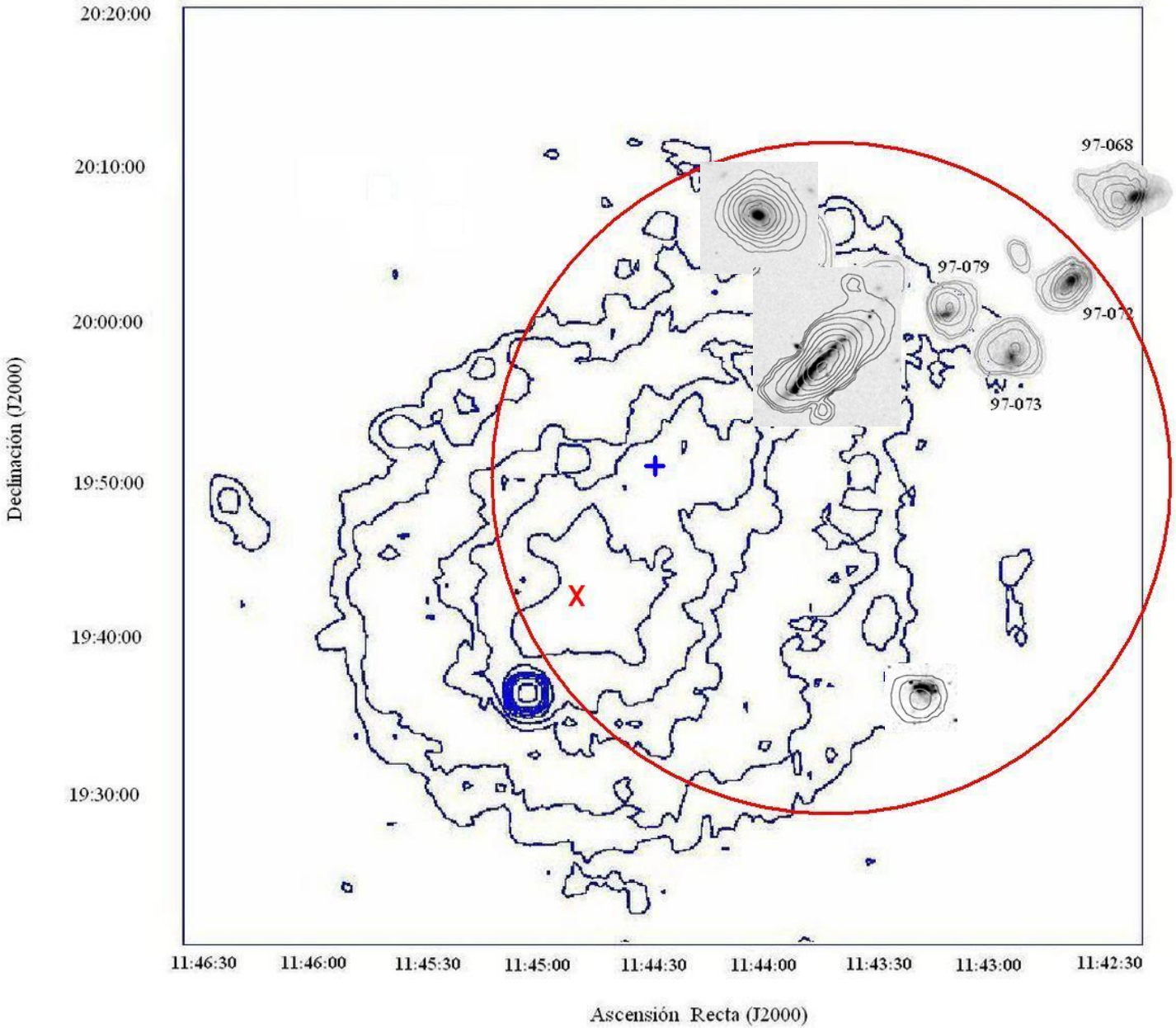
3 Cubes: 14700 km/s – 18400 km/s

10 HI detections

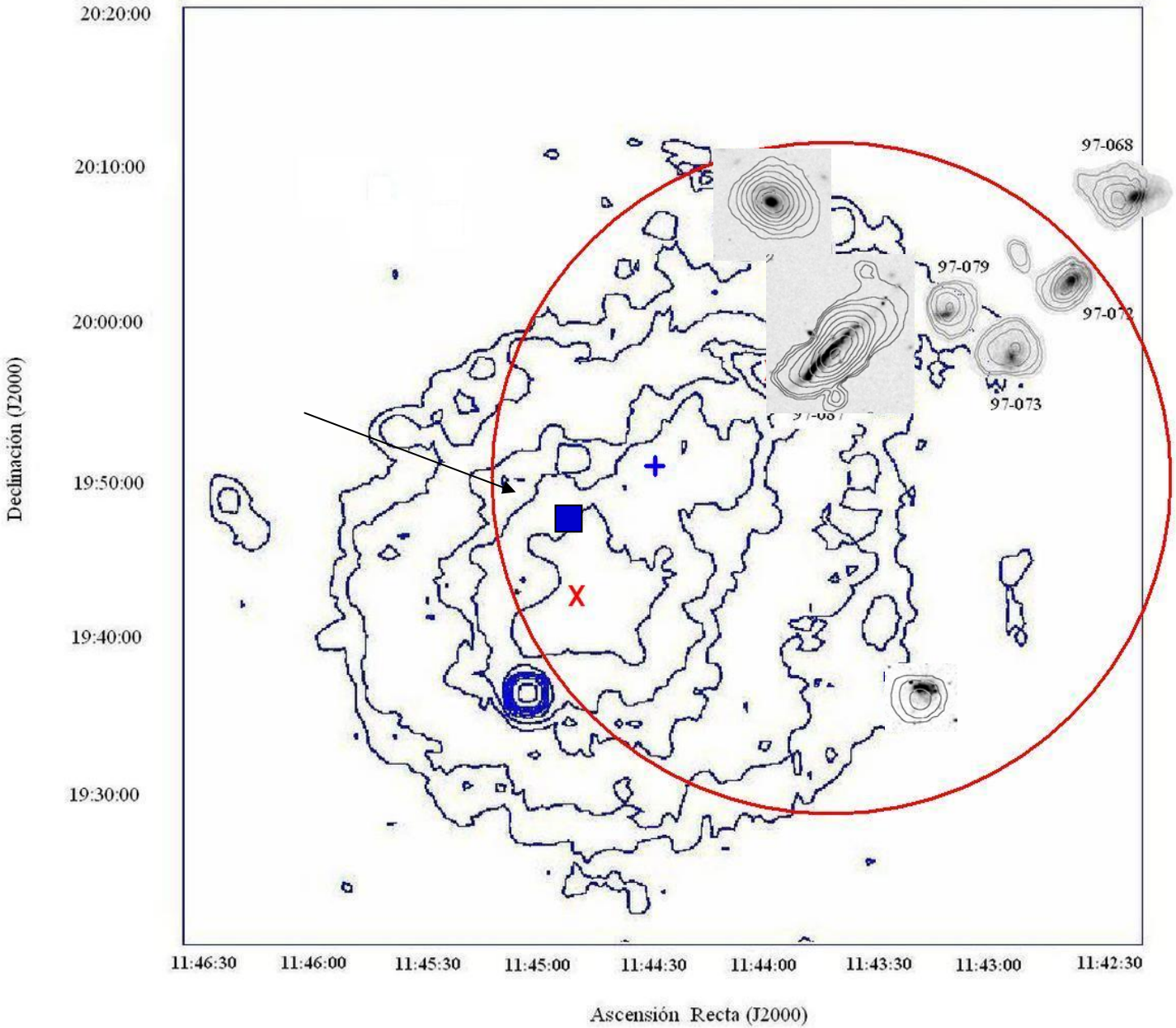
Plus: optical CFHT-MEGACAM images

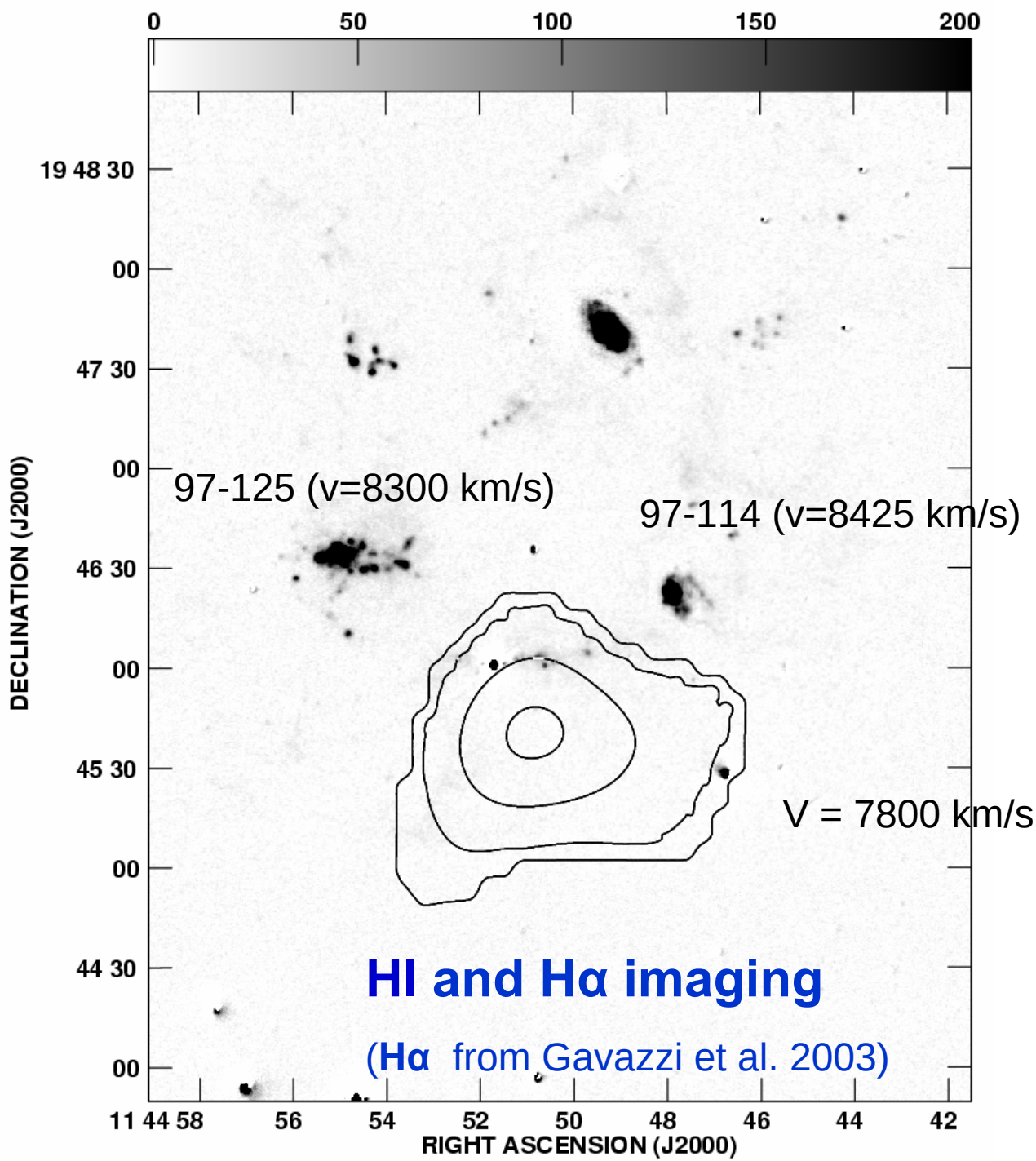
NIR-JK imaging

3. Results: Global view of A1367: HI-Xray-optical

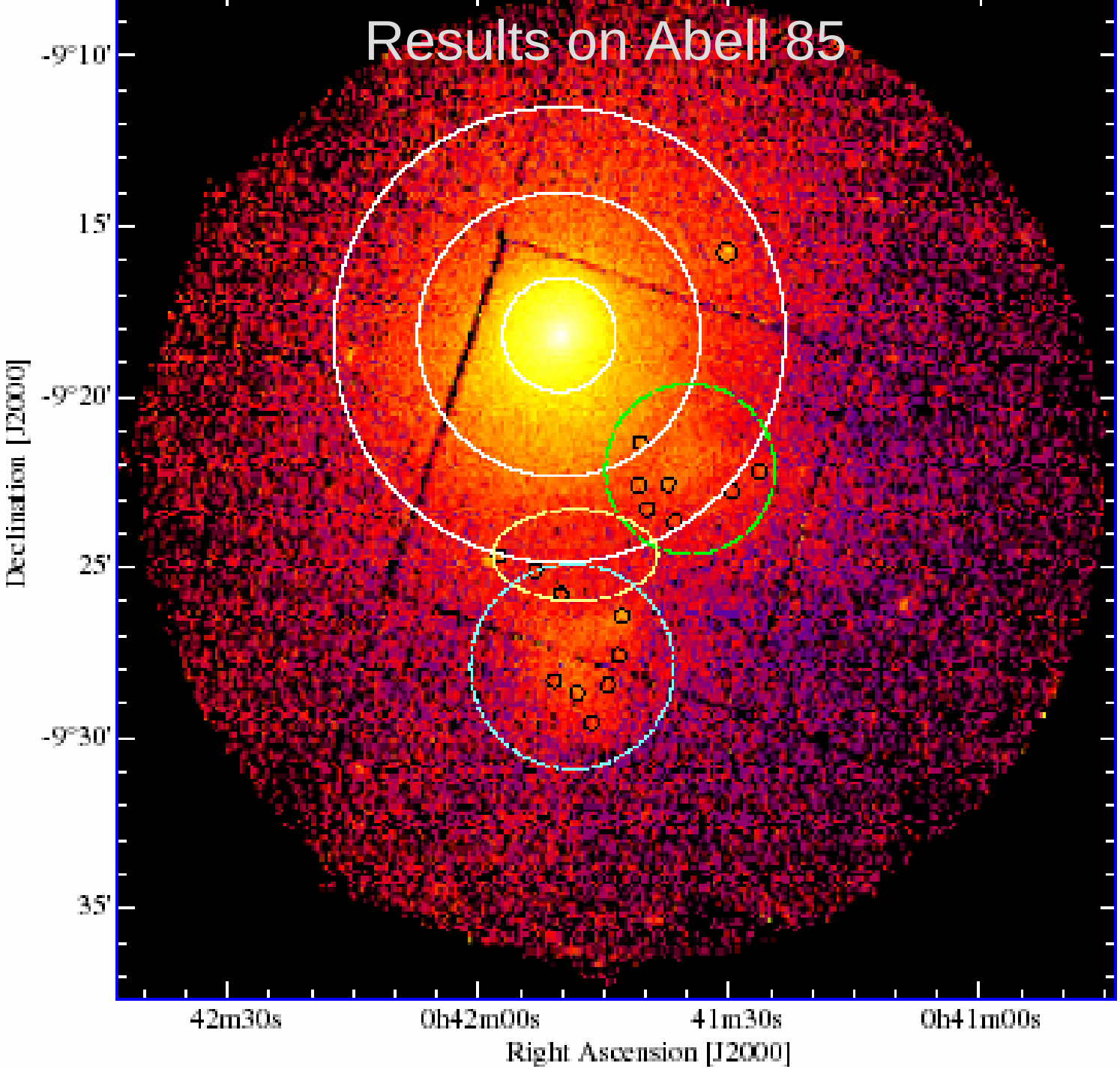


Global view of A1367: HI-Xray-optical



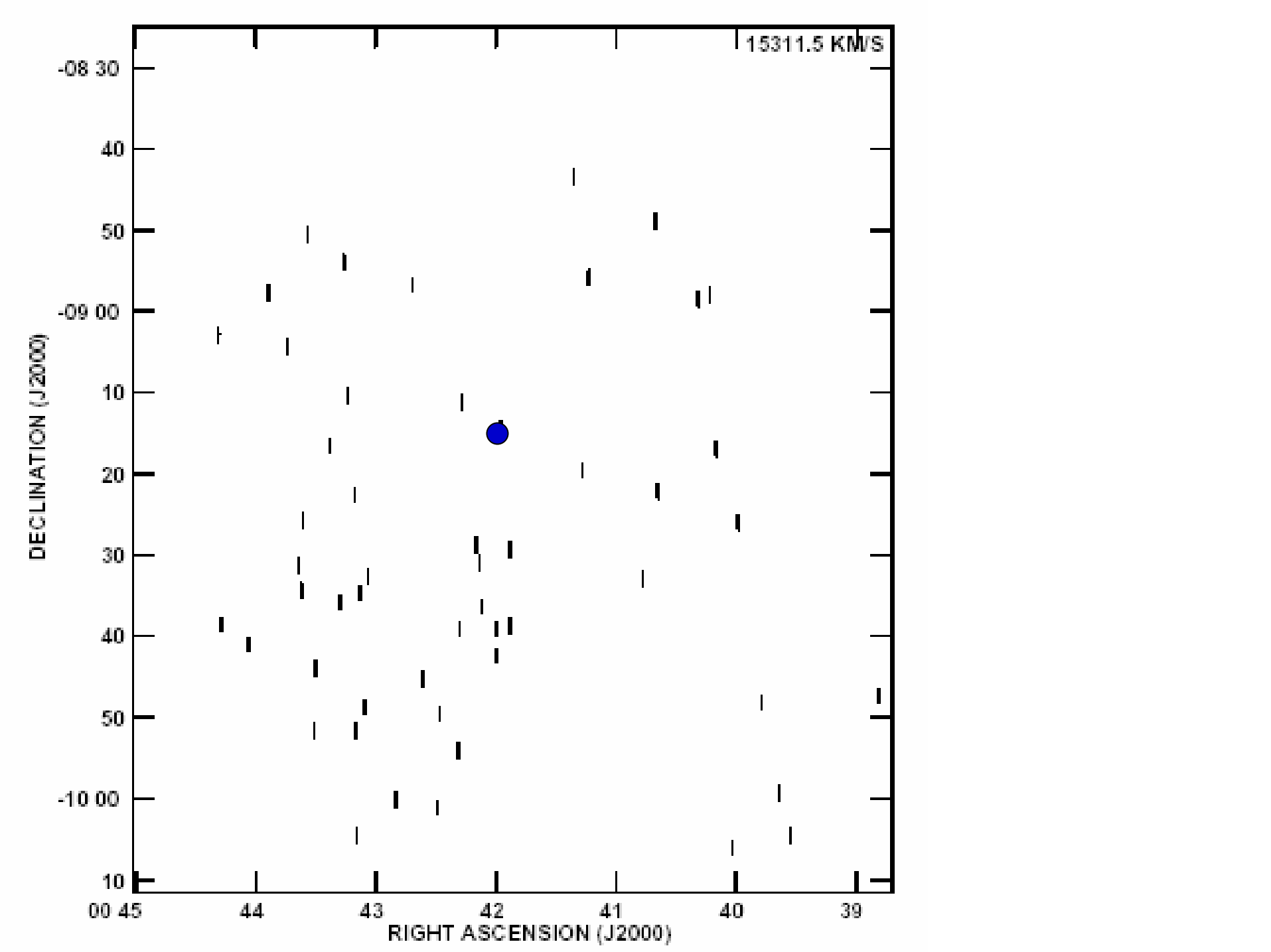

0
50
100
150
200
19 48 30
00
47 30
00
46 30
00
45 30
00
44 30
00
DECLINATION (J2000)
11 44 58
56
54
52
50
48
46
44
42
RIGHT ASCENSION (J2000)
97-125 (v=8300 km/s)
97-114 (v=8425 km/s)
V = 7800 km/s
HI and Hα imaging
(Hα from Gavazzi et al. 2003)

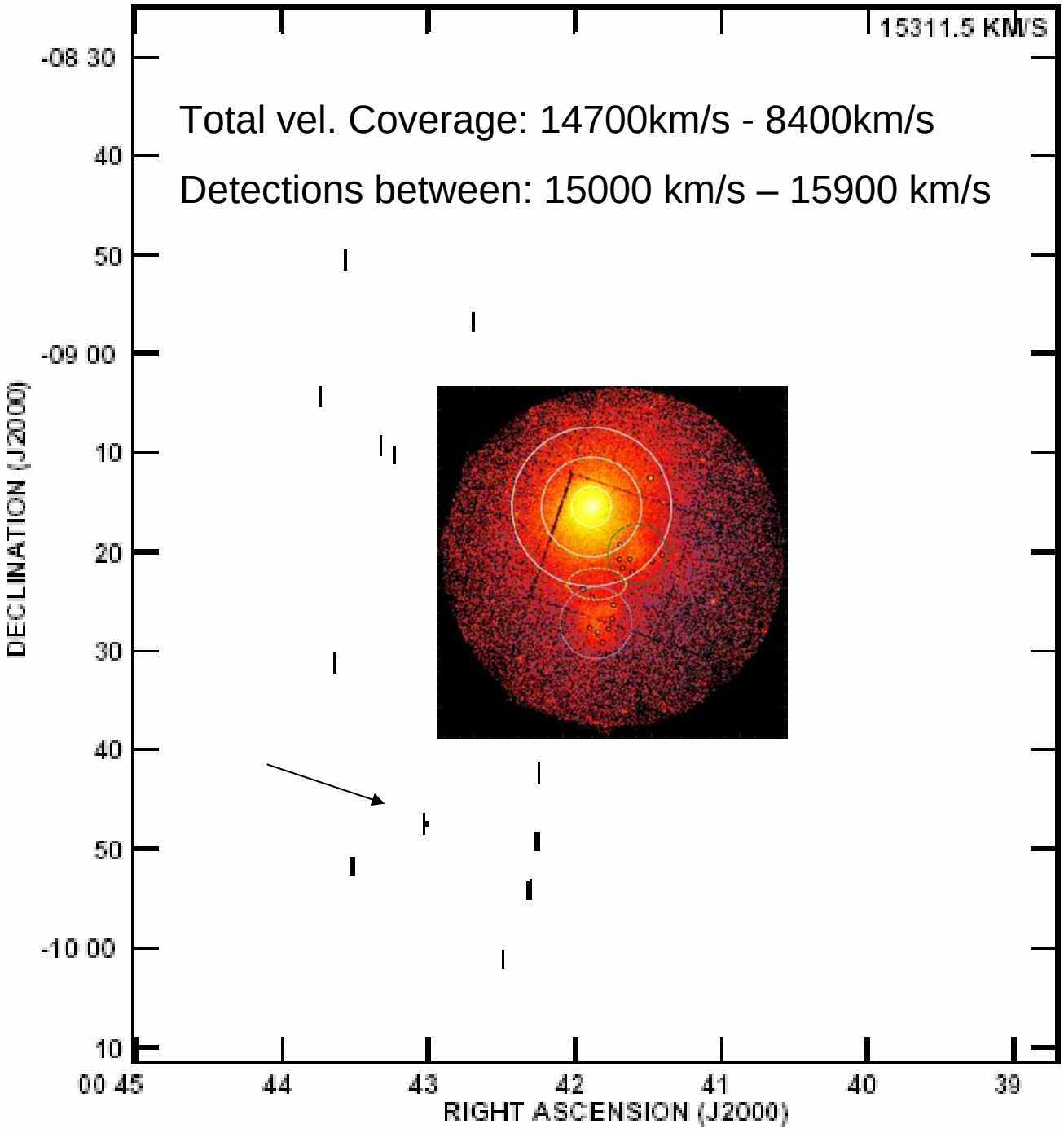
Results on Abell 85



XMM-Newton image of A85.

Durret et al. 2005

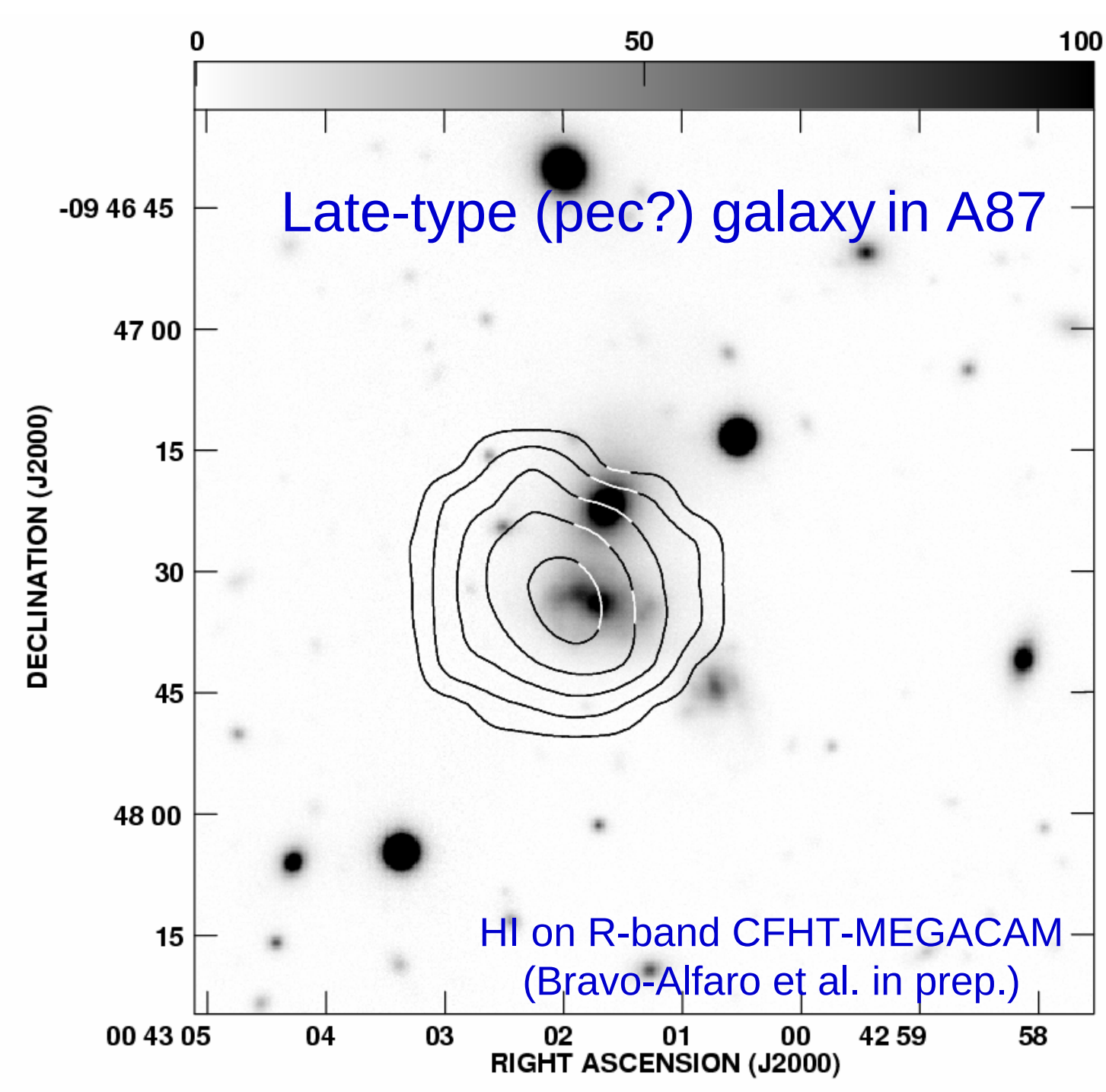

15311.5 KM/S
-08 30
40
50
-09 00
10
20
30
40
50
-10 00
10
DECLINATION (J2000)
00 45
44
43
42
41
40
39
RIGHT ASCENSION (J2000)



Abell 85

z = 0.055

Bravo-Alfaro et al. 2005
(in prep.)


0
50
100
Late-type (pec?) galaxy in A87
-09 46 45
47 00
15
30
45
48 00
15
DECLINATION (J2000)
HI on R-band CFHT-MEGACAM
(Bravo-Alfaro et al. in prep.)
00 43 05
04
03
02
01
00
42 59
58
RIGHT ASCENSION (J2000)

Summary for clusters at z = 0

Enlarging the sample of clusters imaged in HI:

Environmental effects → constrain dynamical models

Close up of cluster substructure

Distinguish different kind of groups in A1367 & A85

- HI content & 20cm radio flux → SFR vs ICM properties

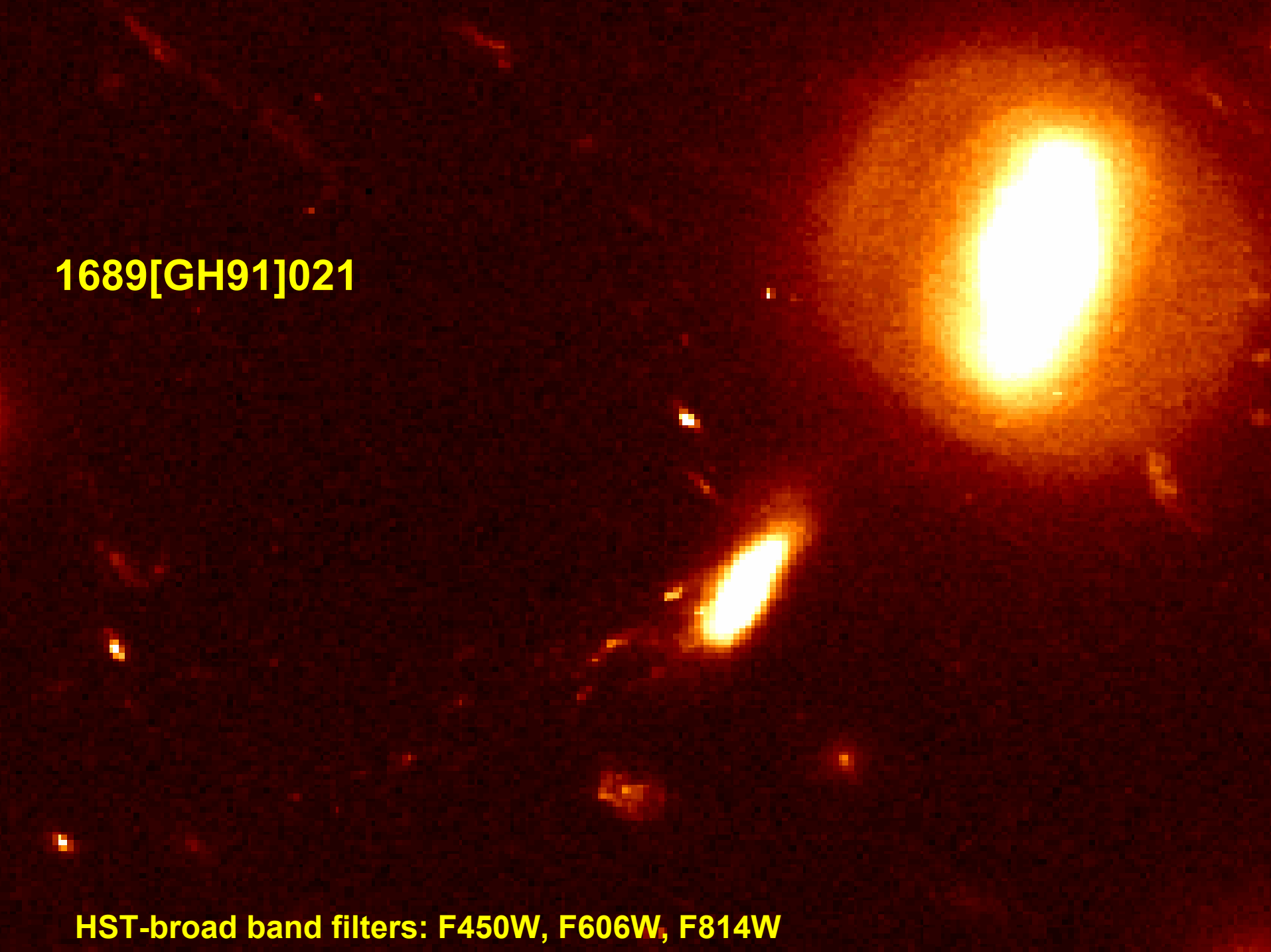
4. Bonus "track"

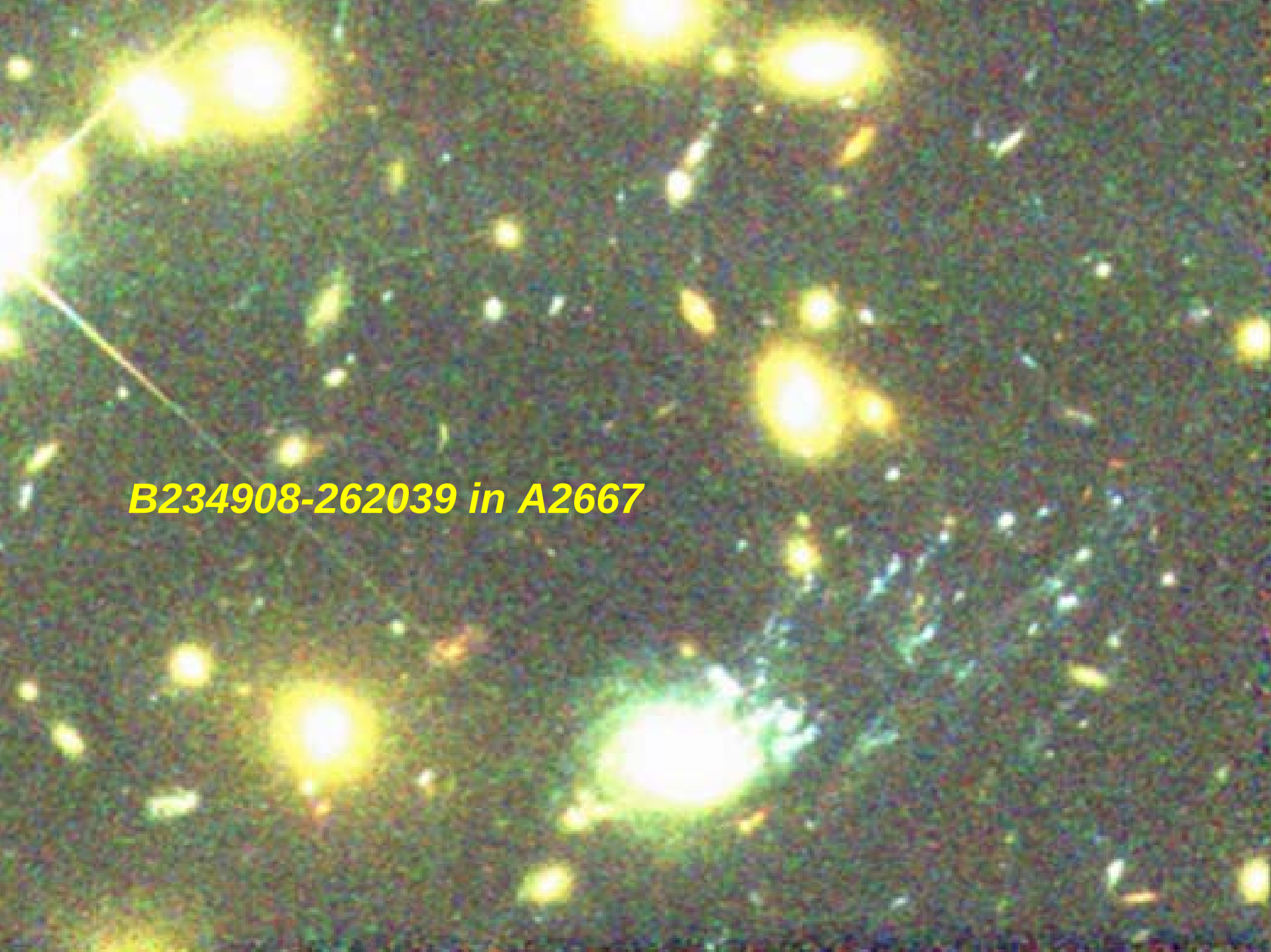
Strong environmental effects in A1689 (z=0.18) and A2667 (z=0.23).

Some important remarks:

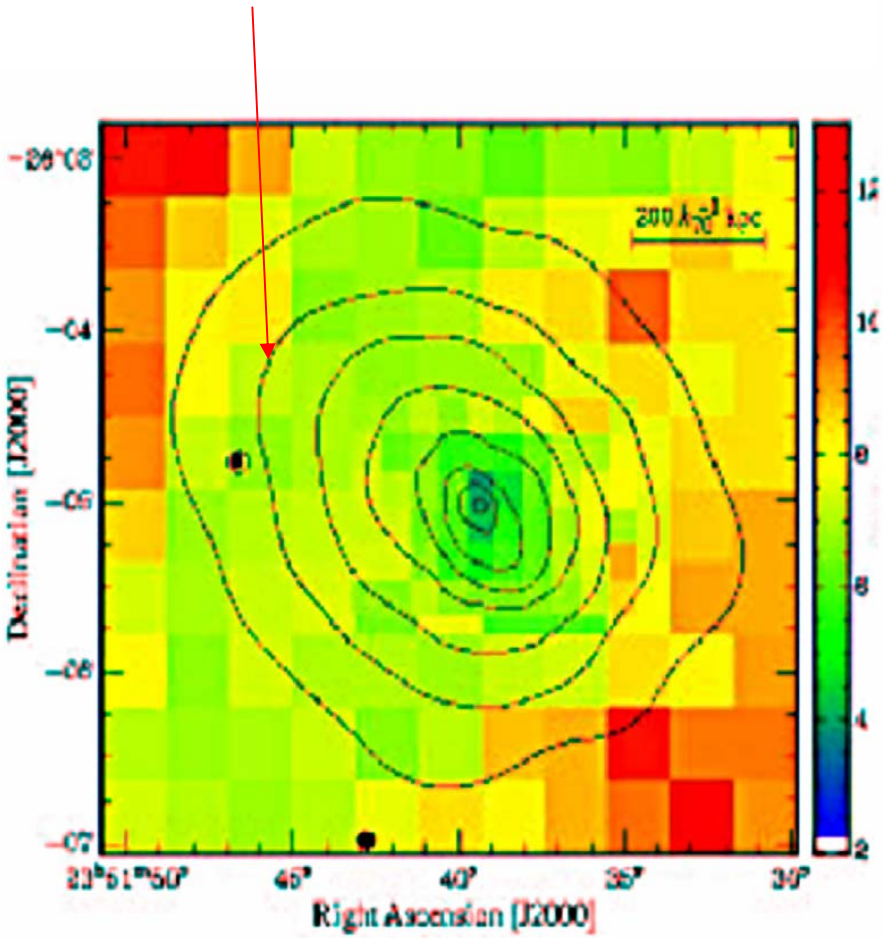
1. Numerical simulations: enhanced tidal effects in the outskirts of clusters (Mihos, Rudick et al.)
2. Deep (very deep) observations in nearby clusters: evidence for ICL (idem)
3. ESO 383-45: ram pressure or tidal stripped galaxy? (Kemp)
4. Numerical simulations: galaxy destruction and diffuse light in clusters (Calcaneo-Roldan et al.) Centaurus and Coma

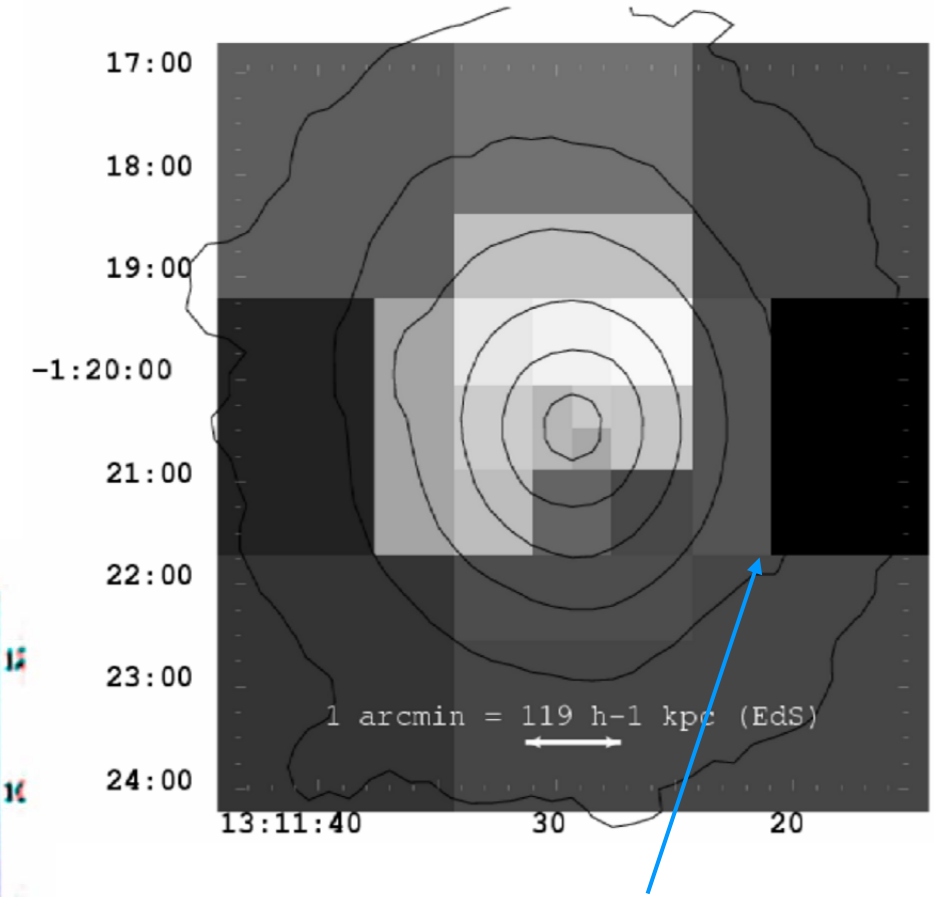
Calcaneo-Roldan et al. 2000


1689[GH91]021
HST-broad band filters: F450W, F606W, F814W

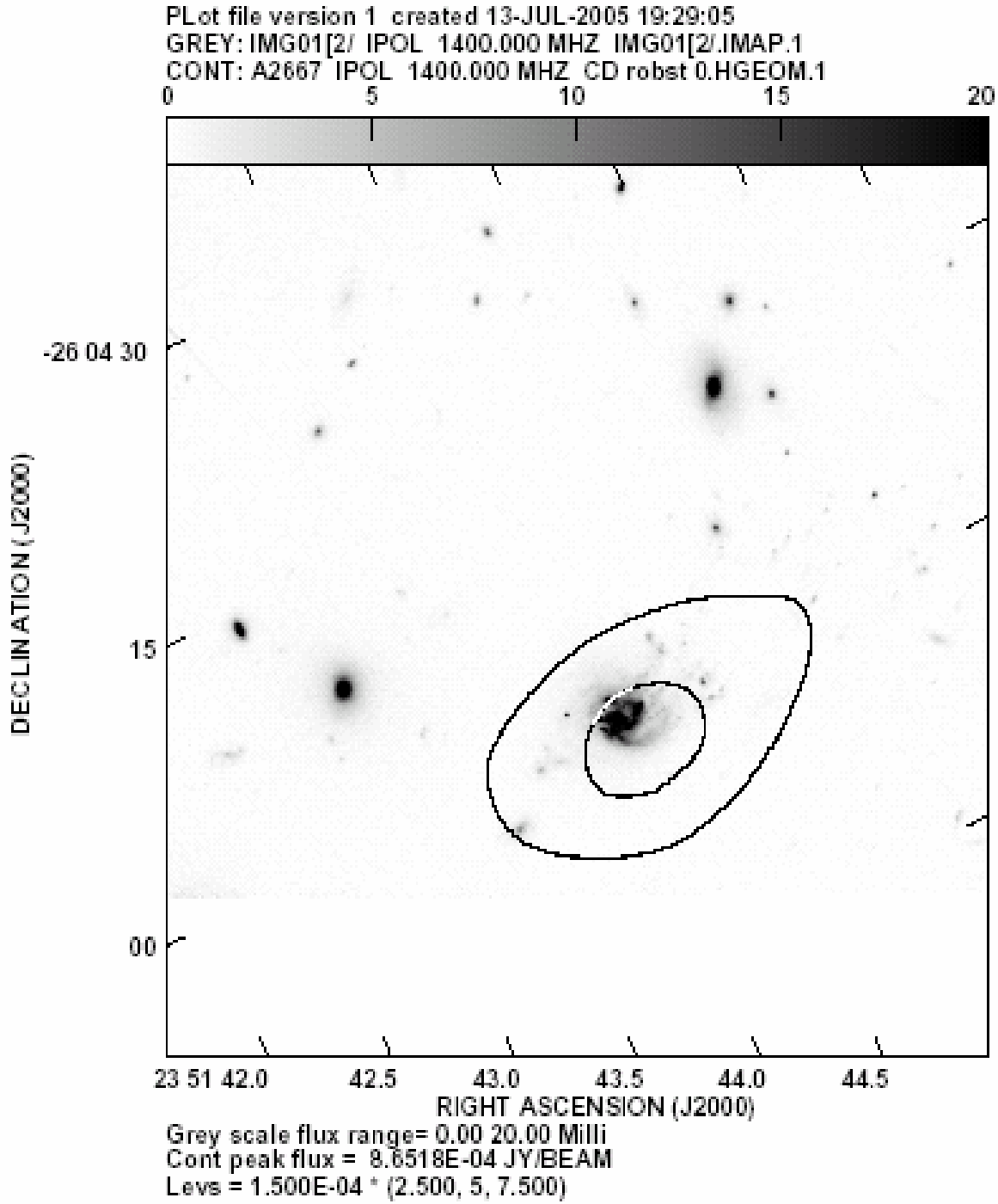

B234908-262039 in A2667

B234908-262039 **in A 2667**



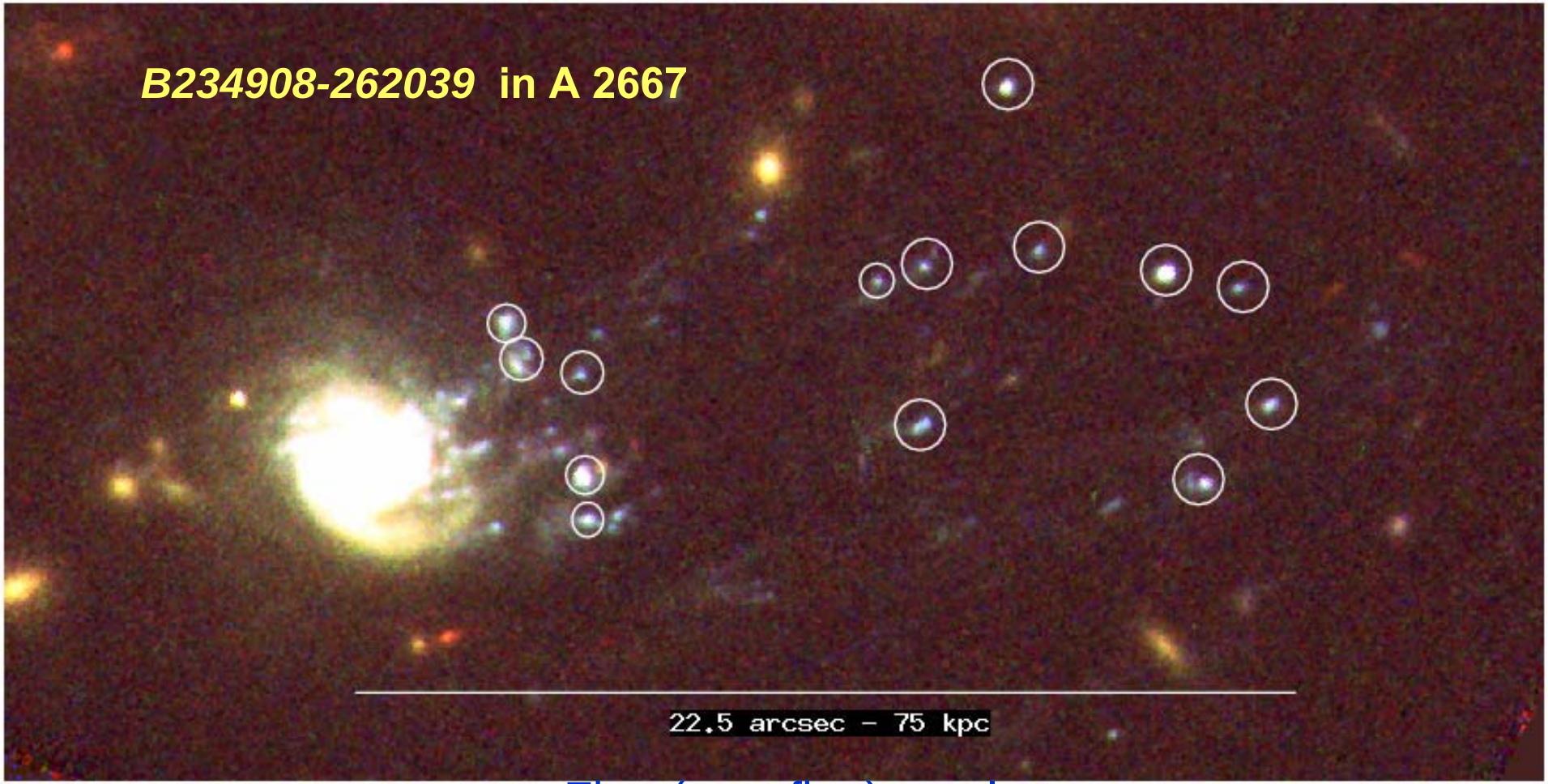


1689[GH91]021



B234908-262039 in A2667

VLA (archive)-20cm radio continuum on HST 450 filter



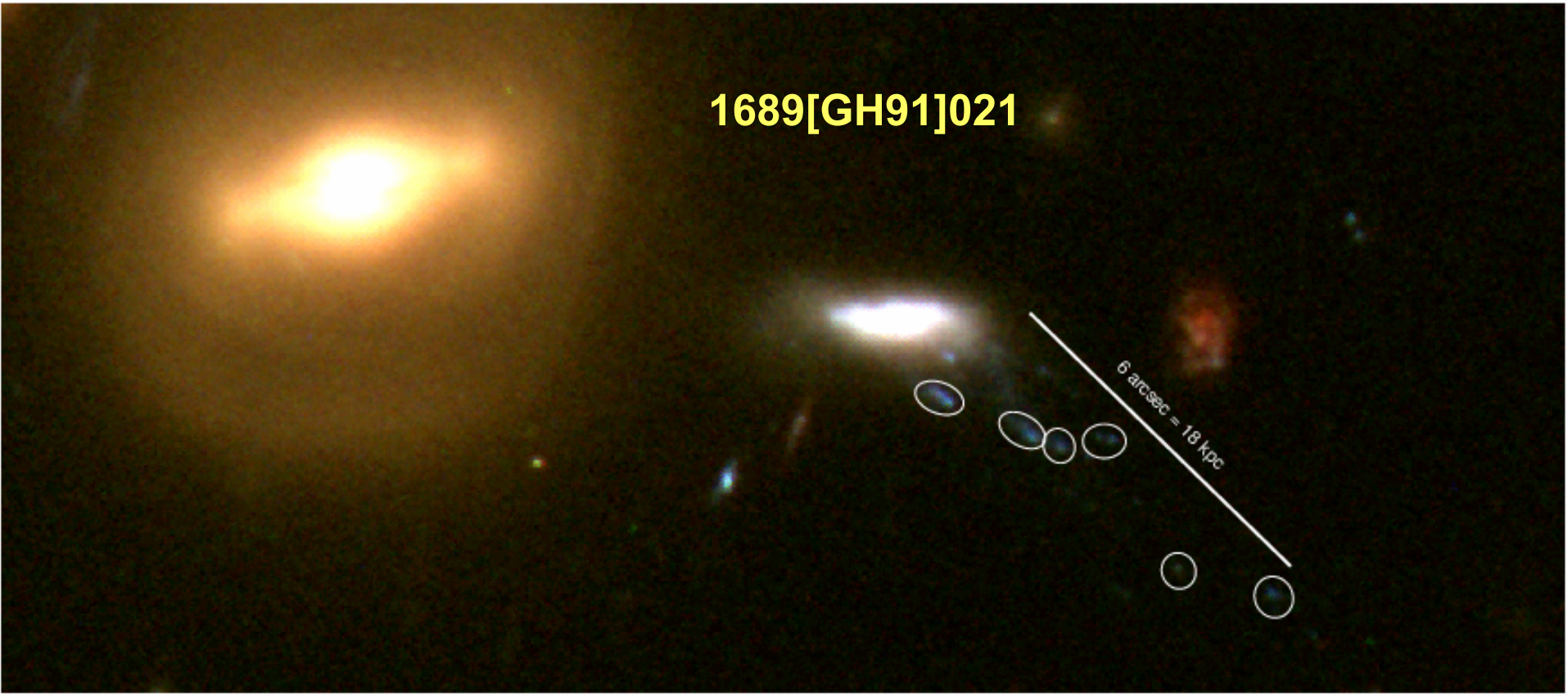
First (very first) results

-14 blue knots analyzed in A2667 and six in A1689

-Ages with very spread values: 10^{7} yrs - $5x10^{8}$ (continuous star formation model)

-Knots brighter than typical star clusters (M=-16 instead of M=-14)

-Giant OB associations or tidal dwarfs?



Comparative checking

-L (A2667's galaxy) = -22 vs. L (A1689's) = -20

-Tail extensions: 75 kpc (A2667's) vs. 20 kpc (A1689's)

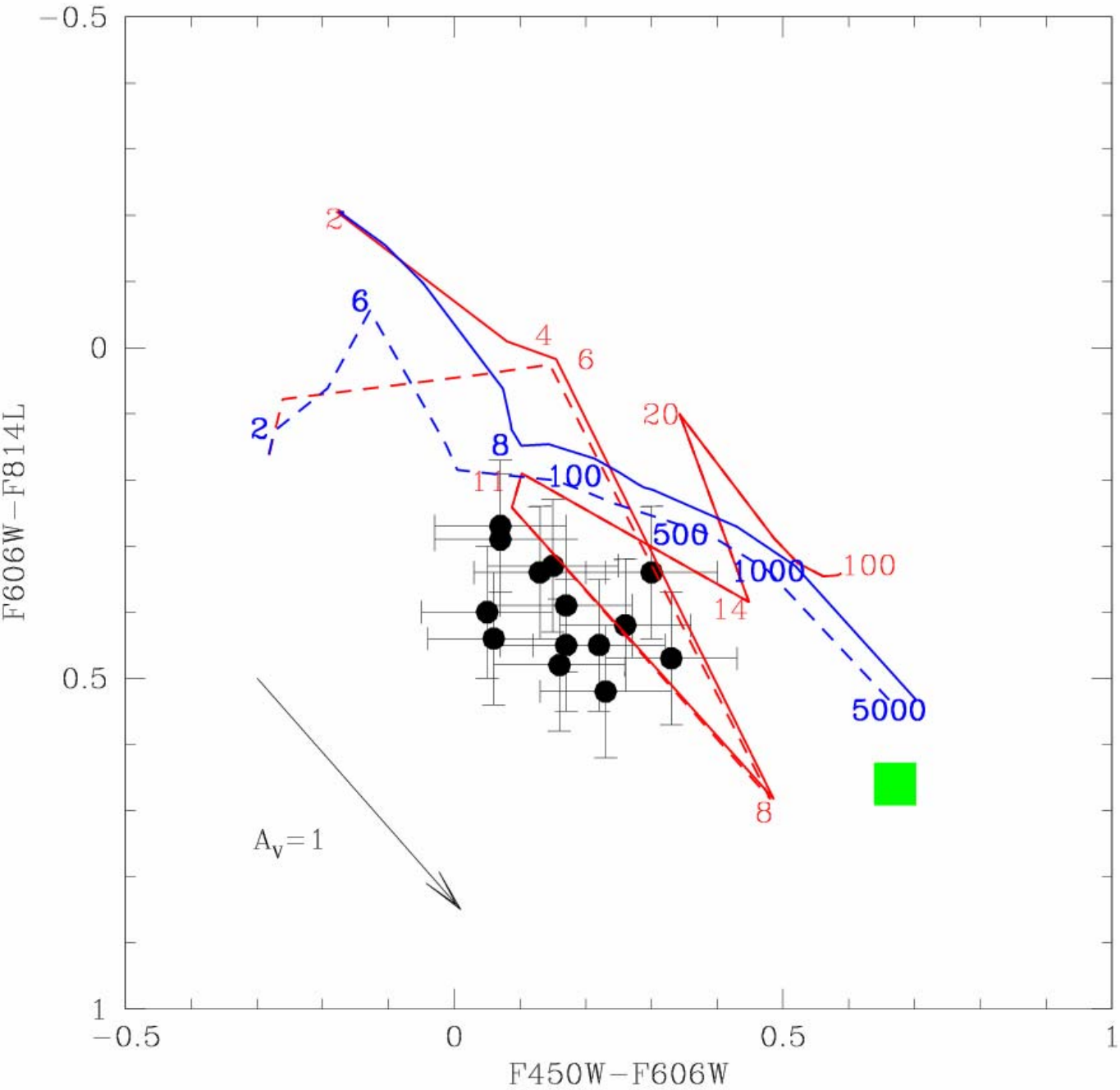
-Typical knots luminosity: M = -14 (A2667's) vs. M = -12 (A1689's)

-Radio continuum flux (20cm)

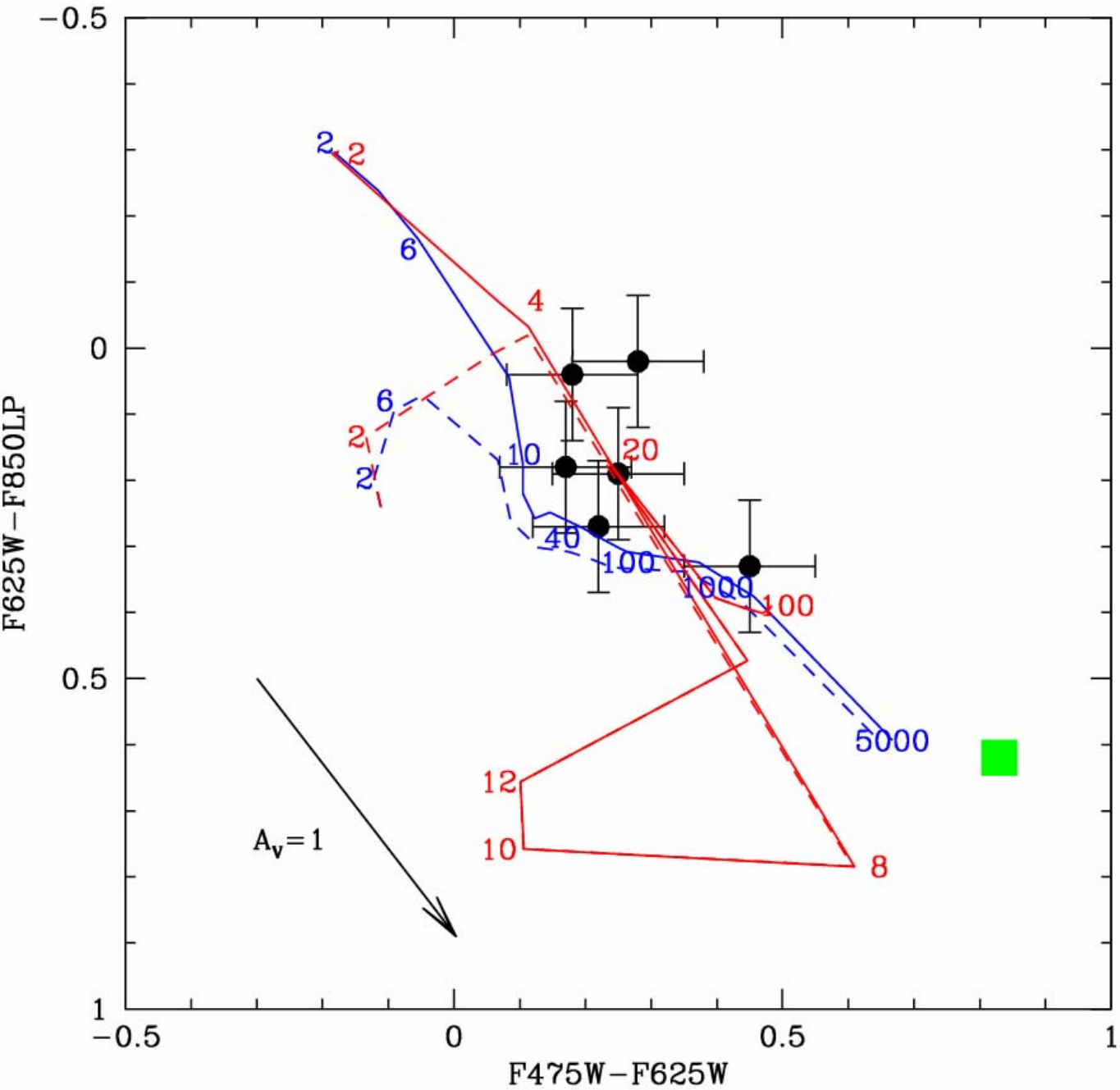
What will become the knots ?

Future work

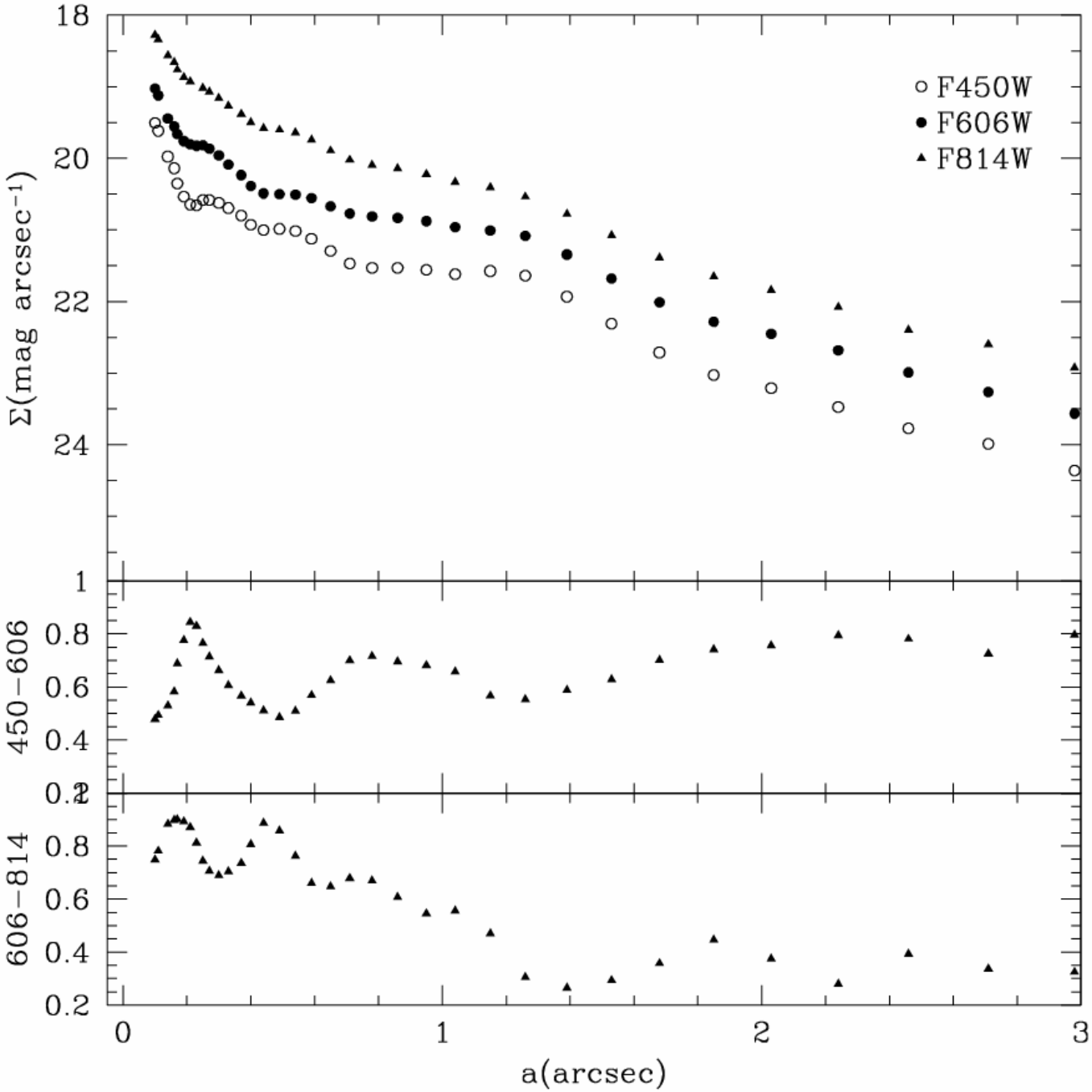
- B234908-262039 in A 2667 & 1689[GH91]021 :
  Linking galaxy destruction and ICL at z=0.2 ?
  Knots future: ultra compact dwarfs progenitors or ICL ?
- Asymmetry analysis of neighbor galaxies
- Radial profiles of main galaxies
- Check deeper VLA-20cm images
- Estimate local ICM-density to predict the knots fate



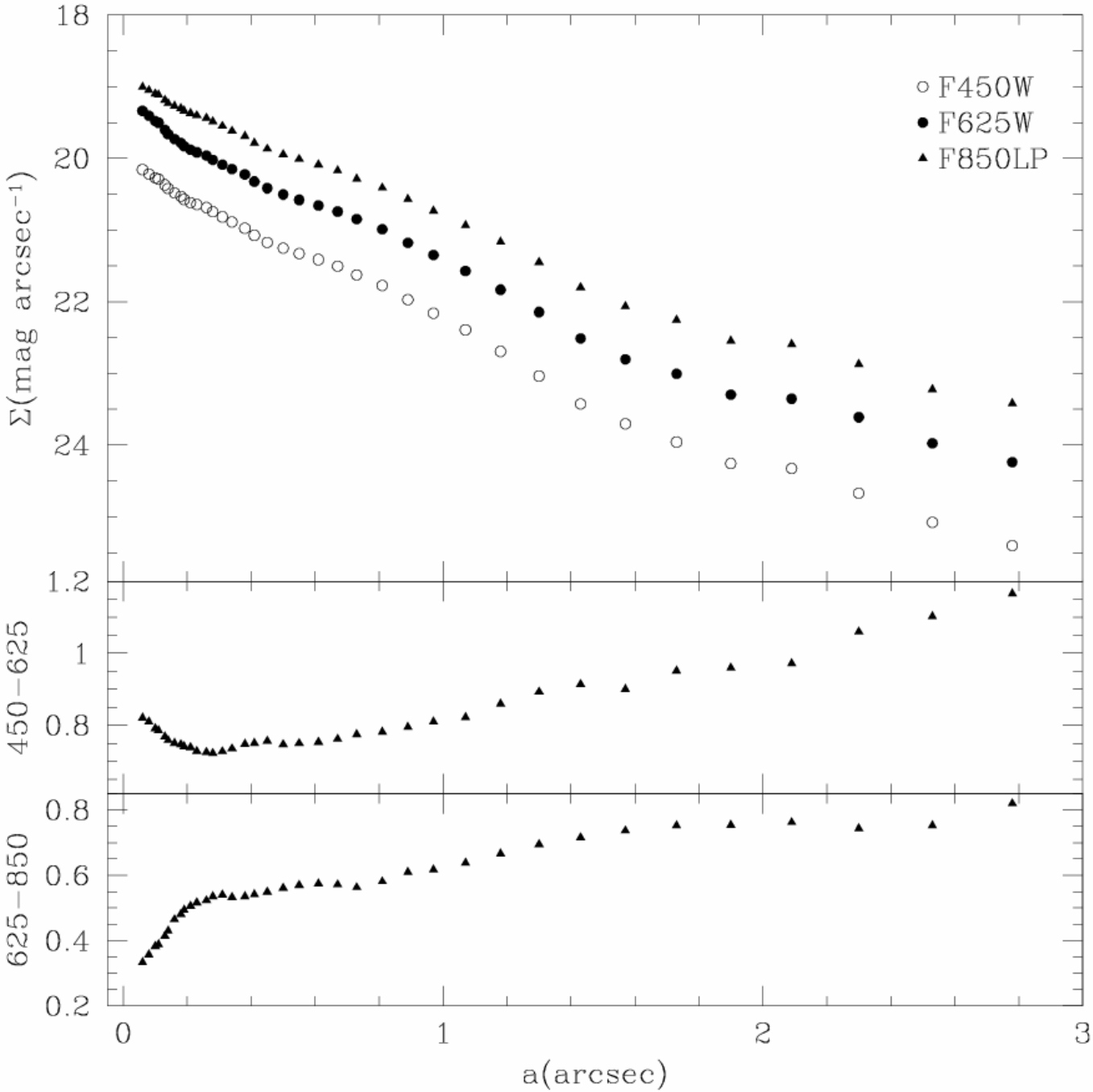
Color-color diagram for A2667's galaxy



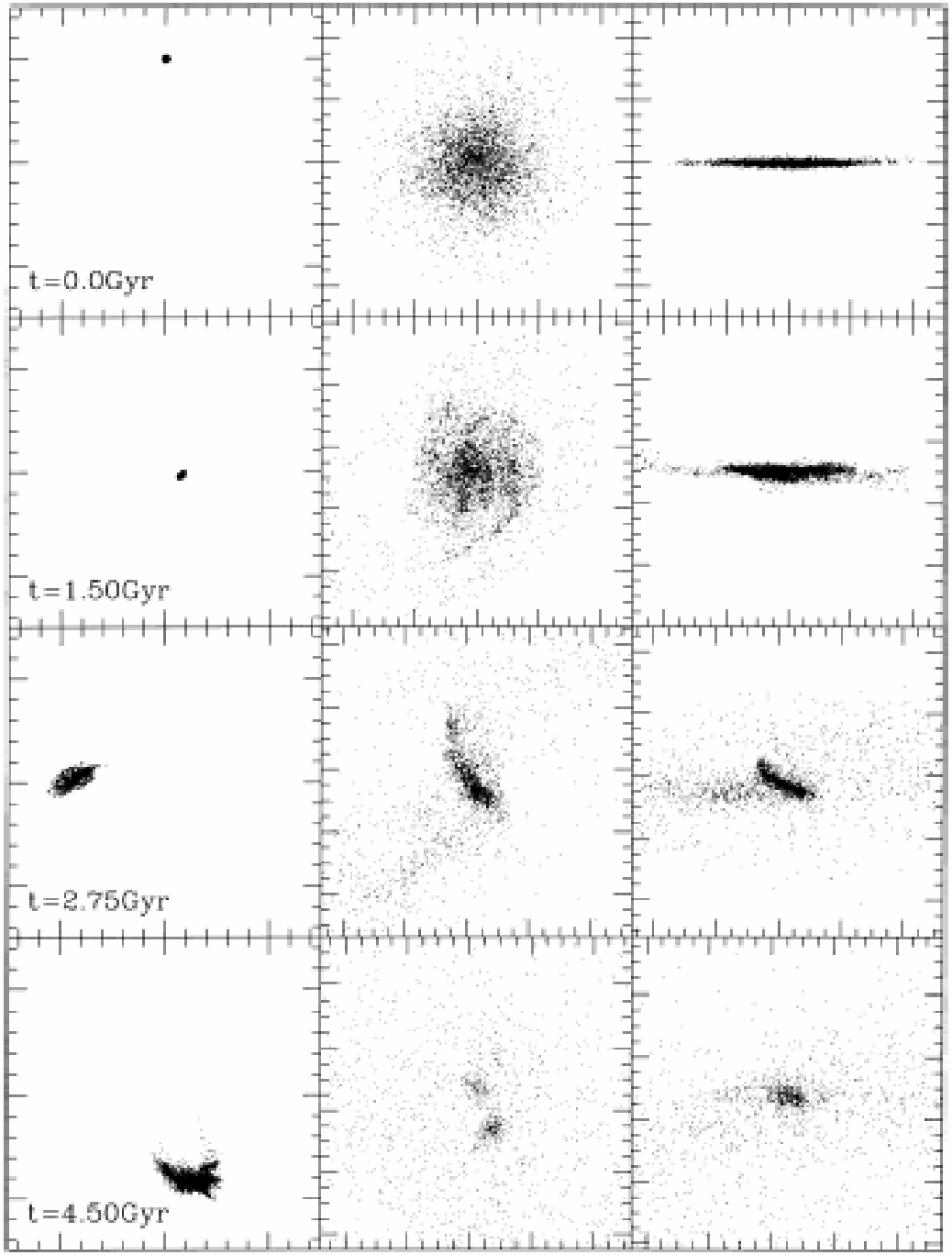
Color-color diagram for A1689's galaxy



Radial profile for the A2667's galaxy



Radial profile for the A1689's galaxy



Calcaneo_Roldan et al. 2000

Late type galaxies around A1367