NGC 741

Mergers and AGN feedback at the galaxy group scale

X-ray Universe 2017

– Rome –

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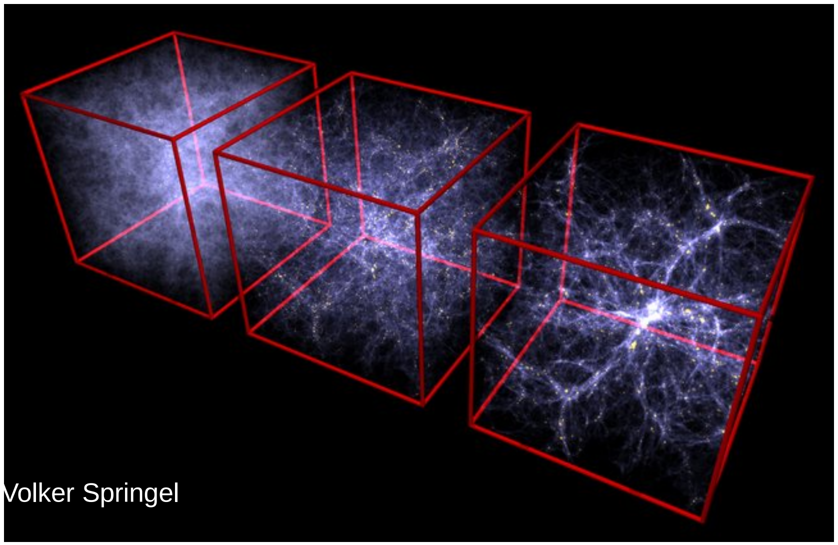
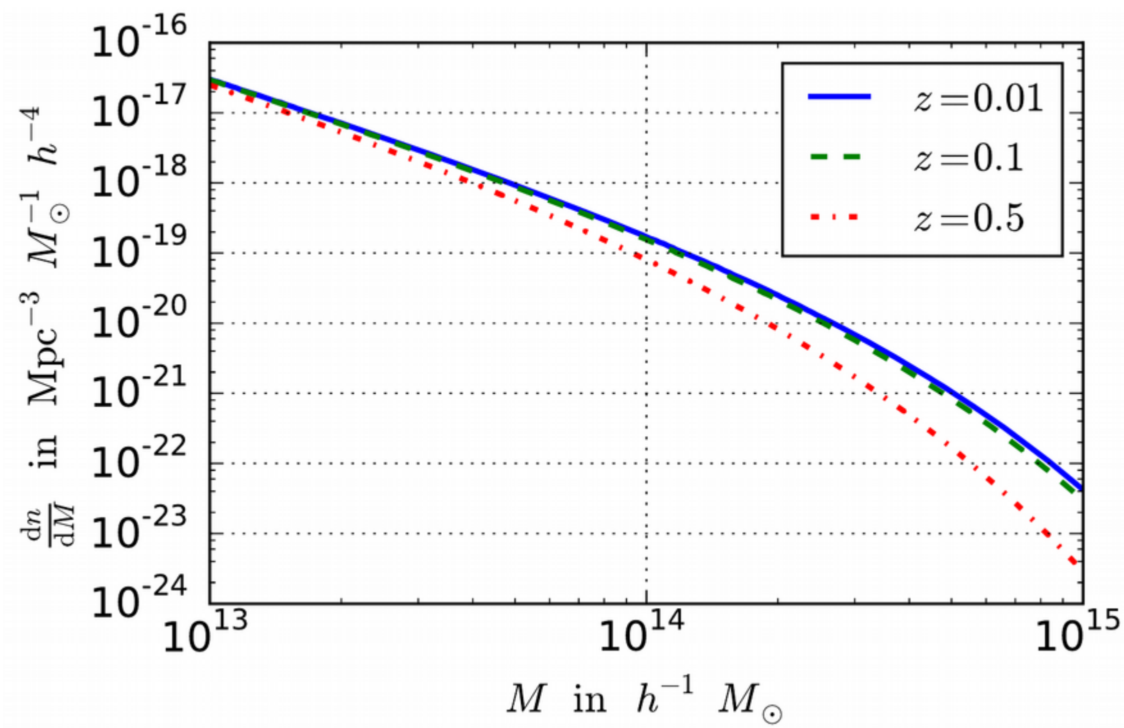
Introduction





Structure formation predicts number density of halos

Many more galaxy groups than clusters

Around 50% of galaxies are in galaxy groups (only few in clusters)

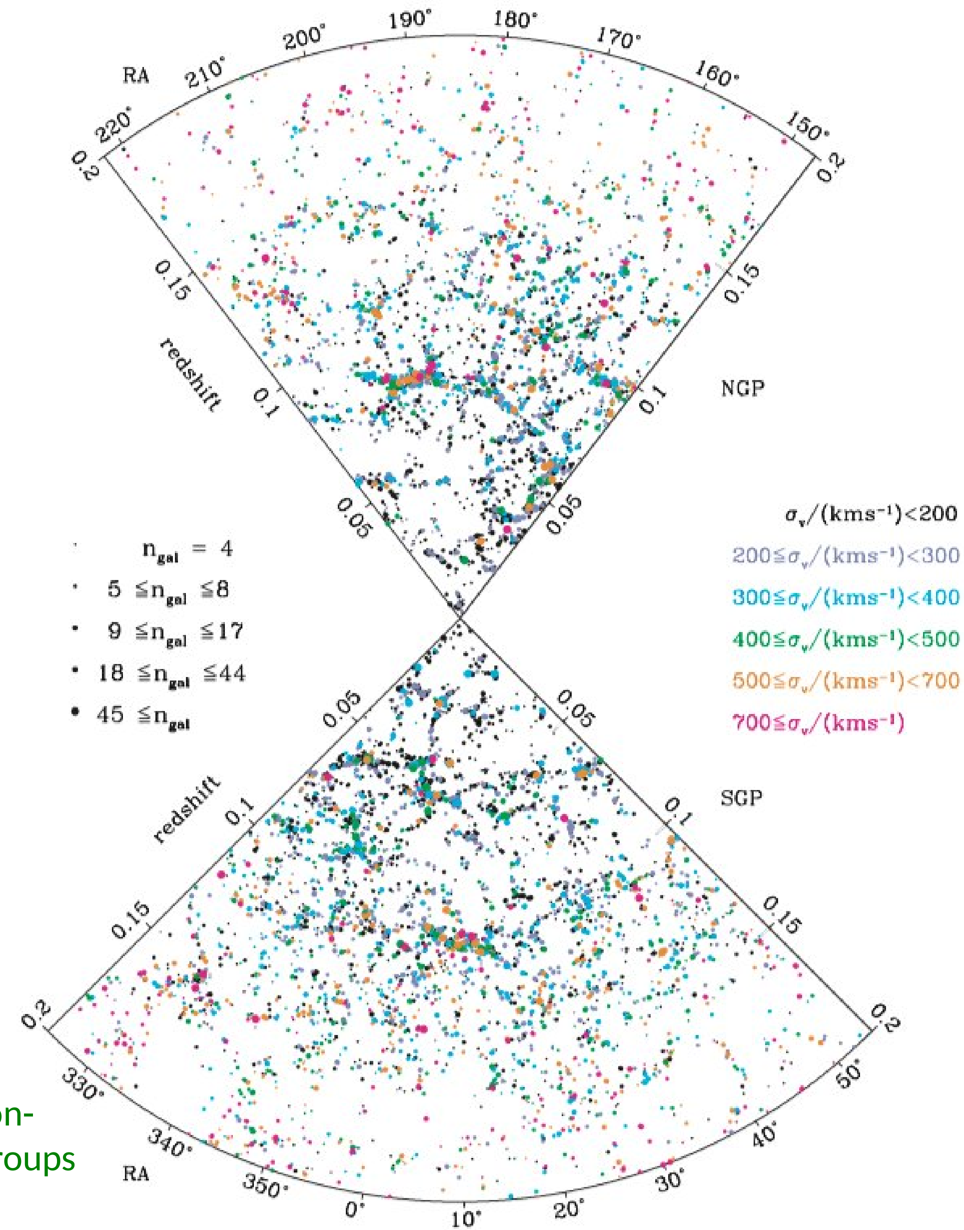
The baryonic evolution in the Universe by looking at galaxy groups

Observed properties of galaxy groups not represented well in simulations (see Poster N01 → HICOSMO)

Many interactions happen in galaxy groups

Structure formation is believed to happen hierarchically (galaxies → groups → clusters)

Introduction



2dFGRS Percolation-Inferred Galaxy Groups (2PIGGs) (Eke+04)

Open questions:

How is the group environment influenced by member galaxies?

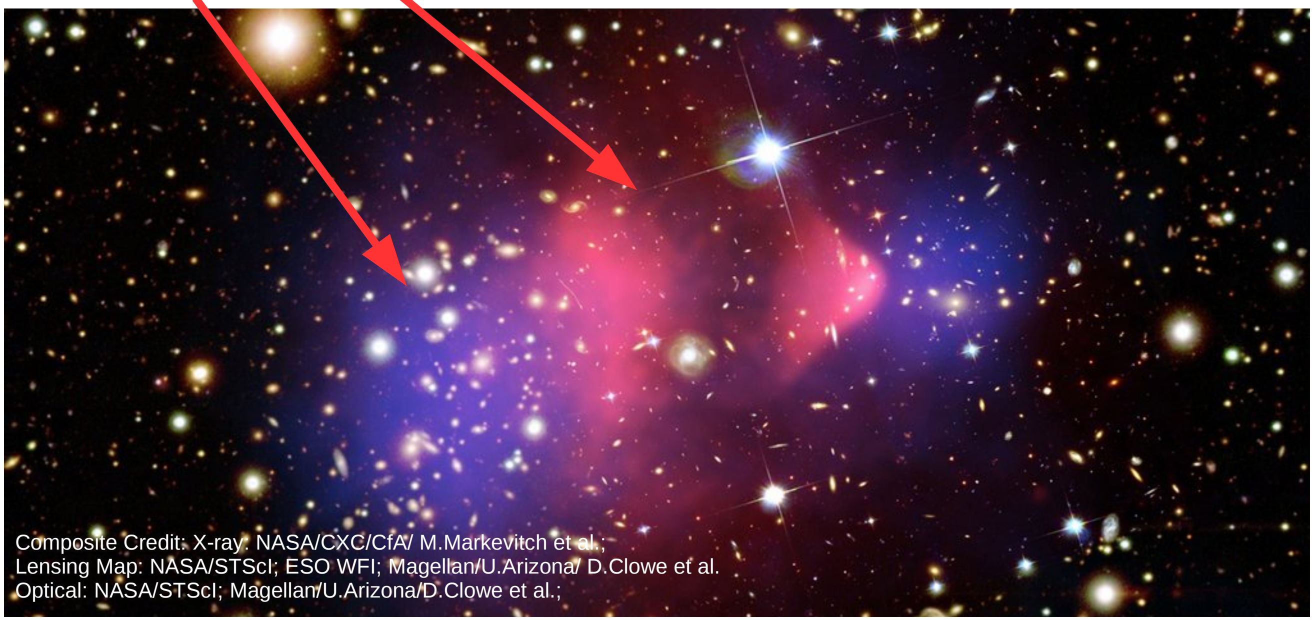
What triggers star formation?

How important is the AGN activity in member galaxies?

Is the central AGN more important than in clusters?

Introduction

~5% galaxies
~15% hot gas
~80% Dark Matter

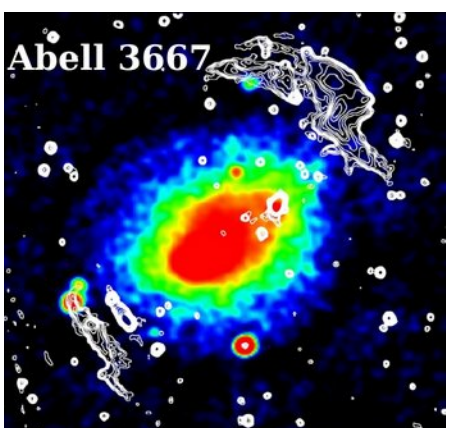

Composite Credit: X-ray: NASA/CXC/CfA/ M.Markevitch et al.;
Lensing Map: NASA/STScI; ESO WFI; Magellan/U.Arizona/ D.Clowe et al.
Optical: NASA/STScI; Magellan/U.Arizona/D.Clowe et al.;

Cluster mergers

Influence on cluster environment

Bias cosmological samples and scaling relations

Gas motion and turbulence in the ICM

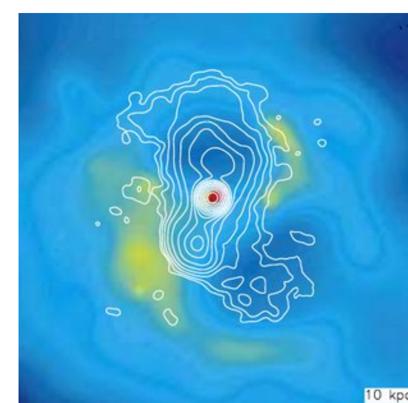


Röttgering+97

Interaction processes also lead to production of relativistic particles
→ Radio relics and halos

Strong AGN activity will produce radio lobes and create low-density bubbles in the ICM

Multiwavelength studies are of key importance



Fabian+00

NGC 741

Basic properties

Nearby galaxy group

Redshift z = 0.0185 $D_A = 77\,\mathrm{Mpc}$

$L_x = 3.2 \times 10^{42}\,\mathrm{erg\,s^{-1}\,cm^{-2}}$

High quality X-ray data

Chandra [180ks] cleaned exposure time

XMM-Newton [30ks] cleaned exposure time

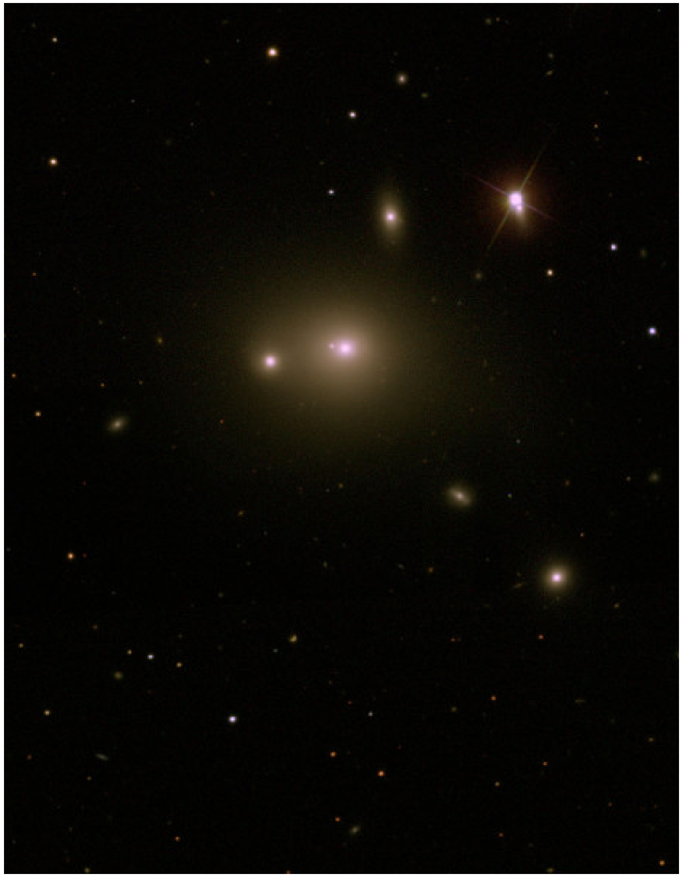
Multi wavelength coverage

High resolution radio and HST data available

Galaxies NGC741 & NGC742 are confirmed cluster members with strong radio AGNs

Past results comprise:

- Identification of ghost cavities (Jetha+08)
- Radio bright ridge (Birkinshaw & Davies 85)



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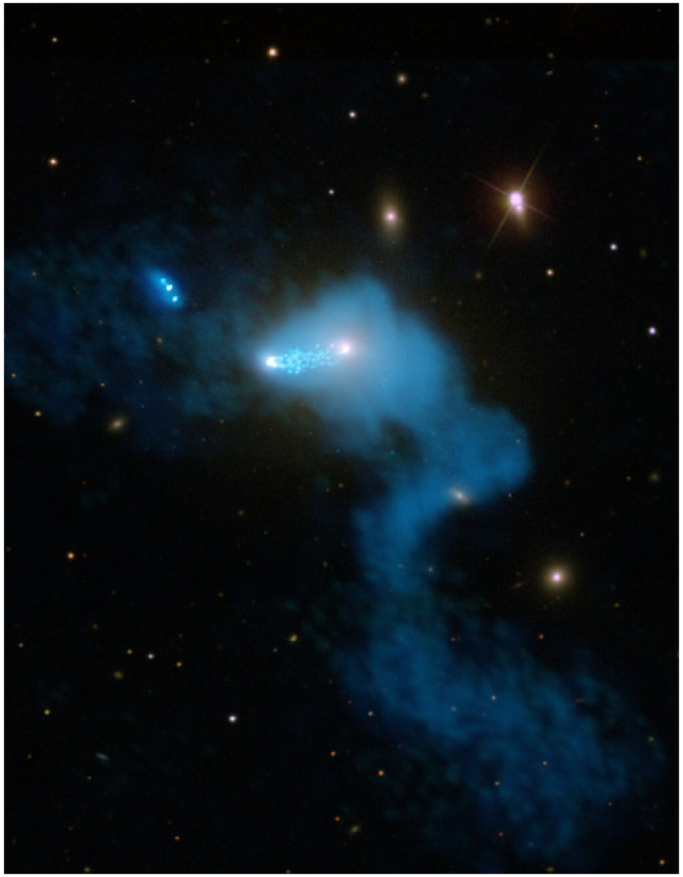

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previous work

Birkinshaw & Davis, 1985

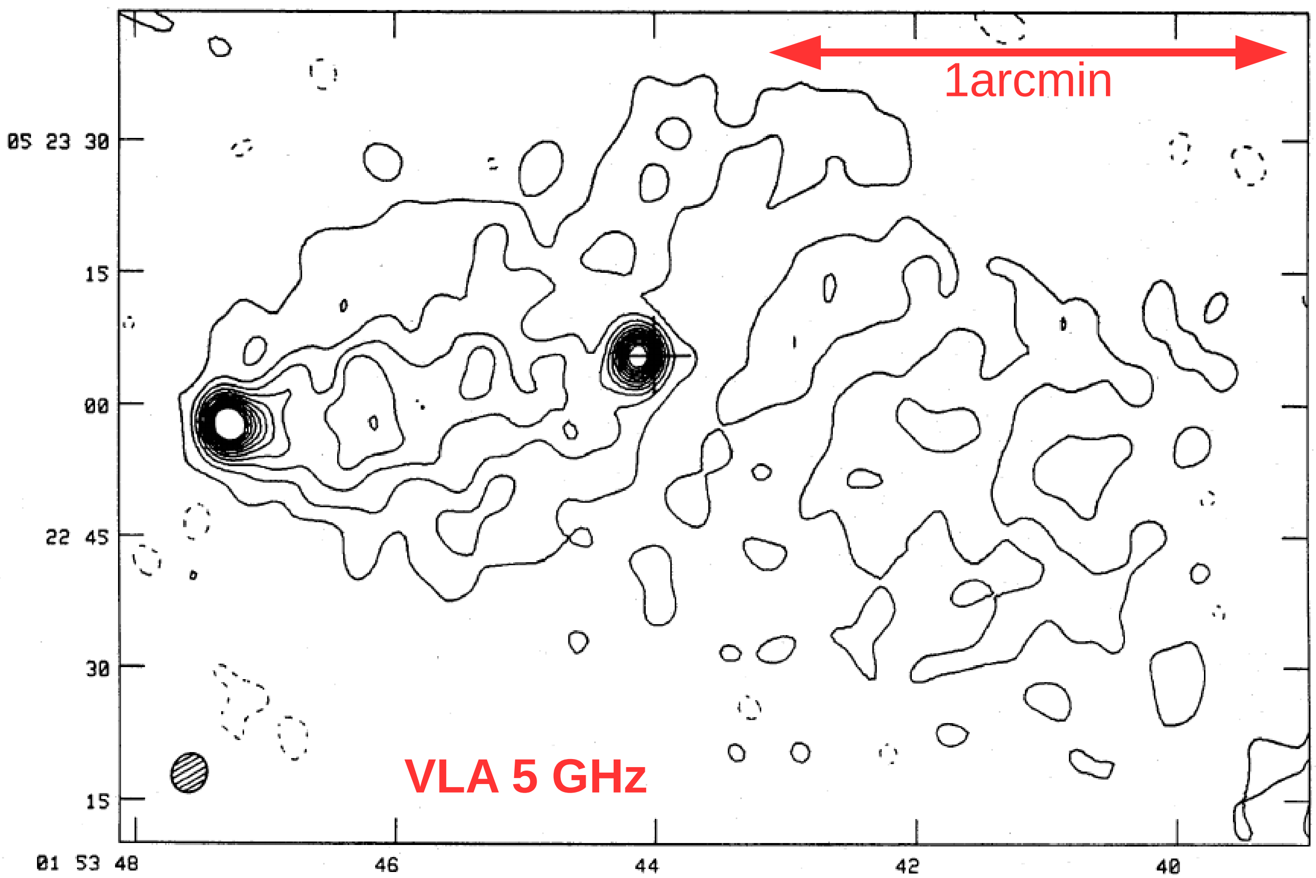
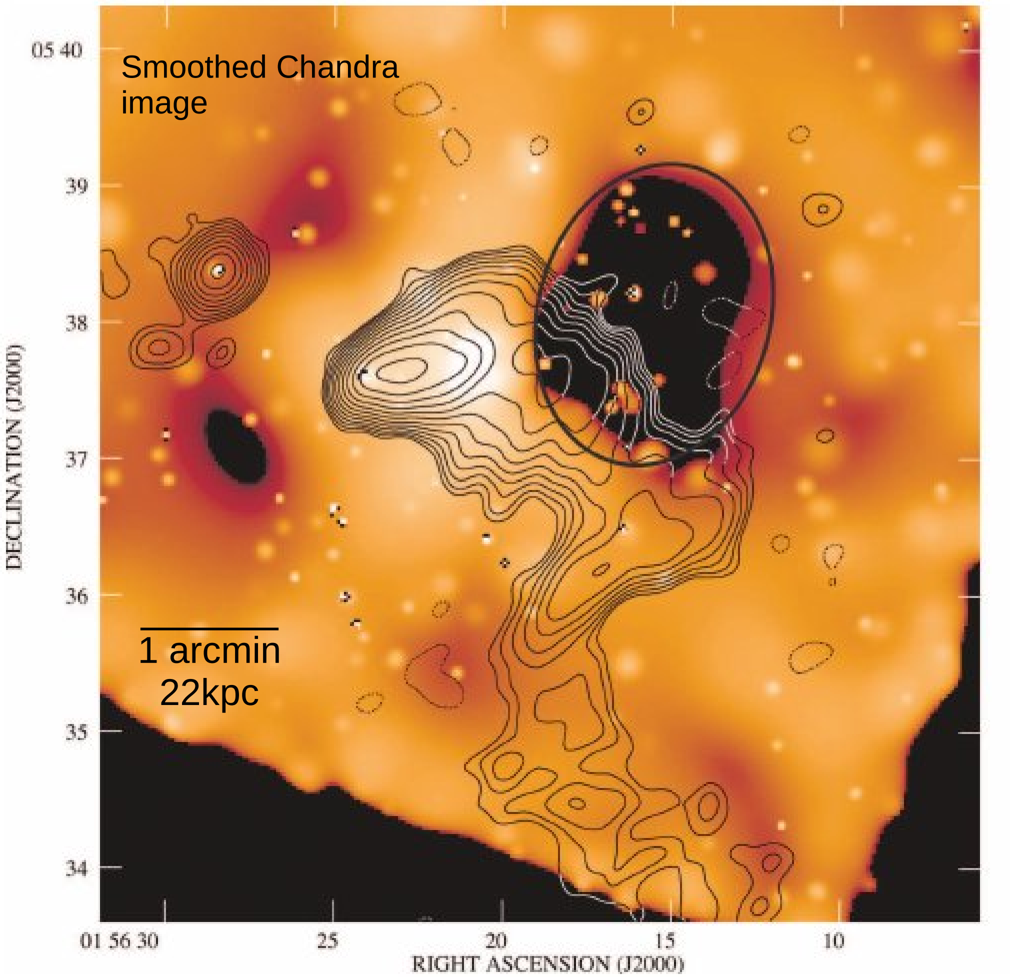


FIG. 2a

- compact nucleus
- Extended emission to the west
- Eastern component connected to the nucleus by a bright ridge

previous work



Jetha+08

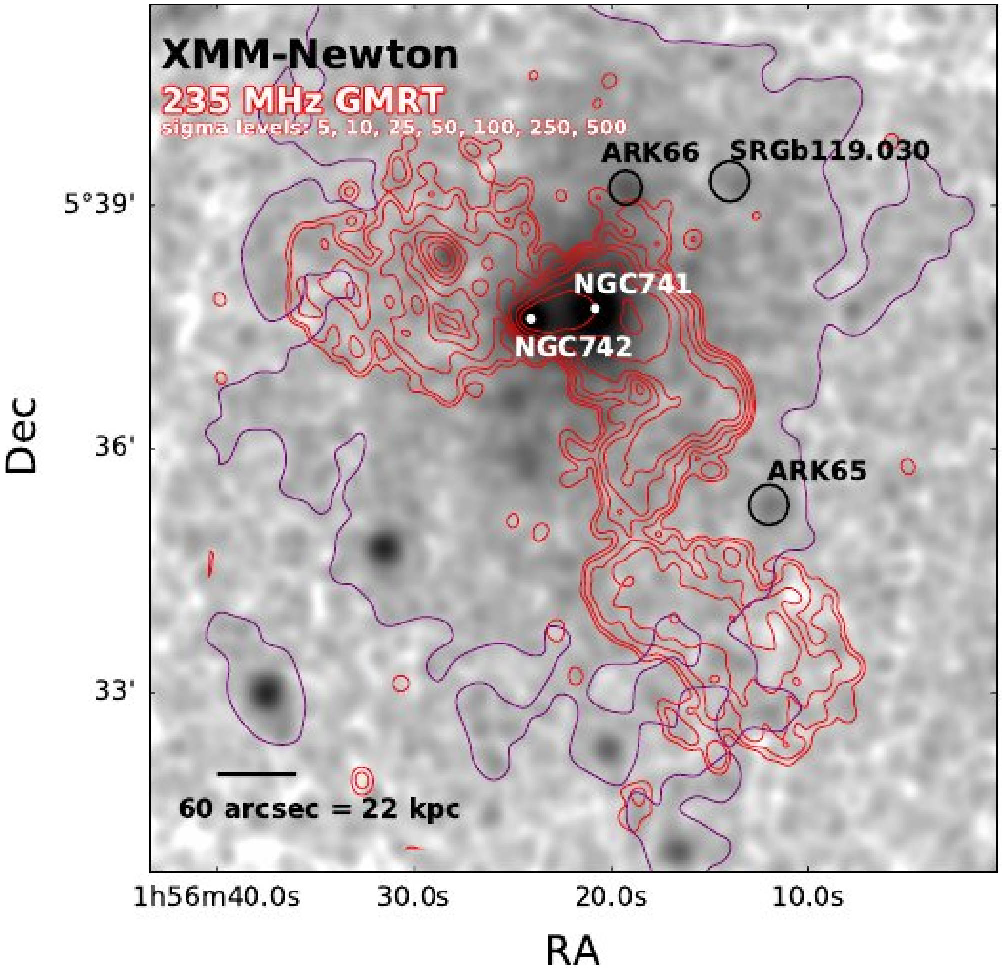
Possible ghost cavity to the west

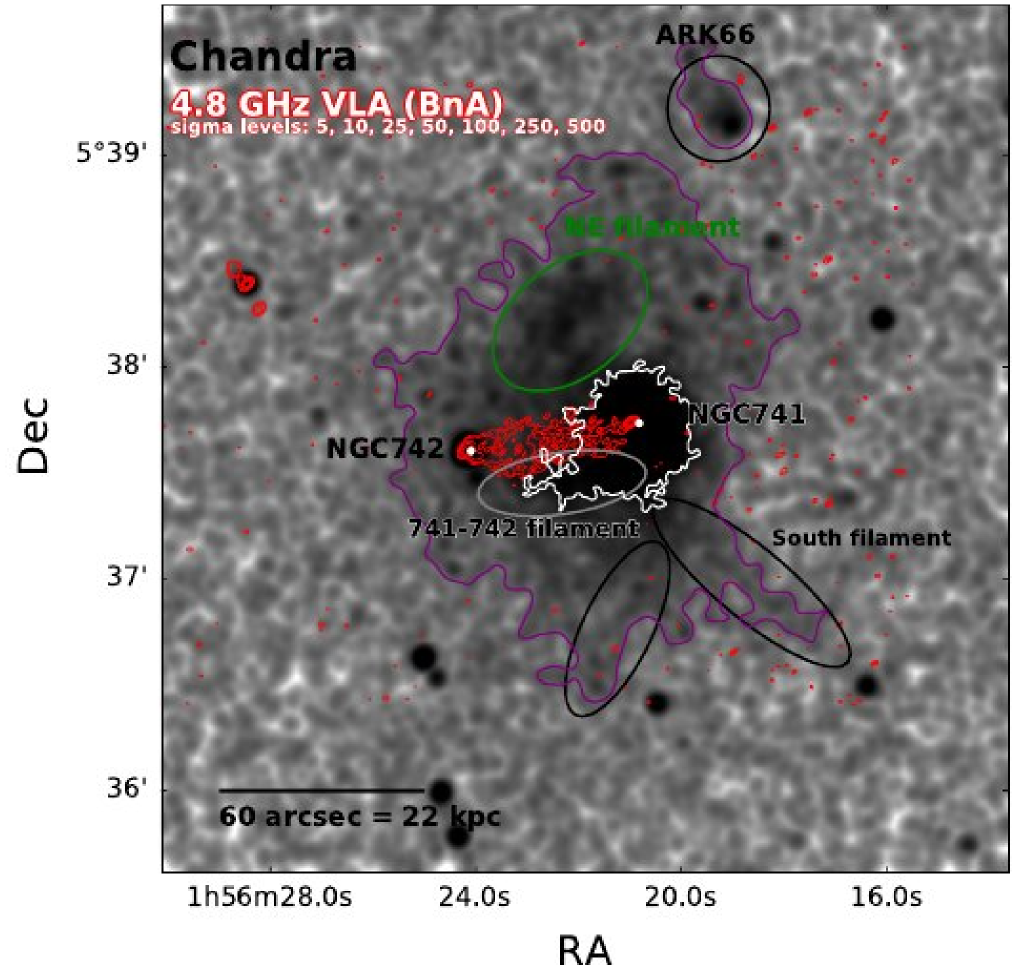
Area could be filled with hot plasma (>10keV) or relativistic plasma of non-radiating particles

Both scenarios are not compatible with high energy cut-off in radio spectrum

Origin of the bubble remains unclear

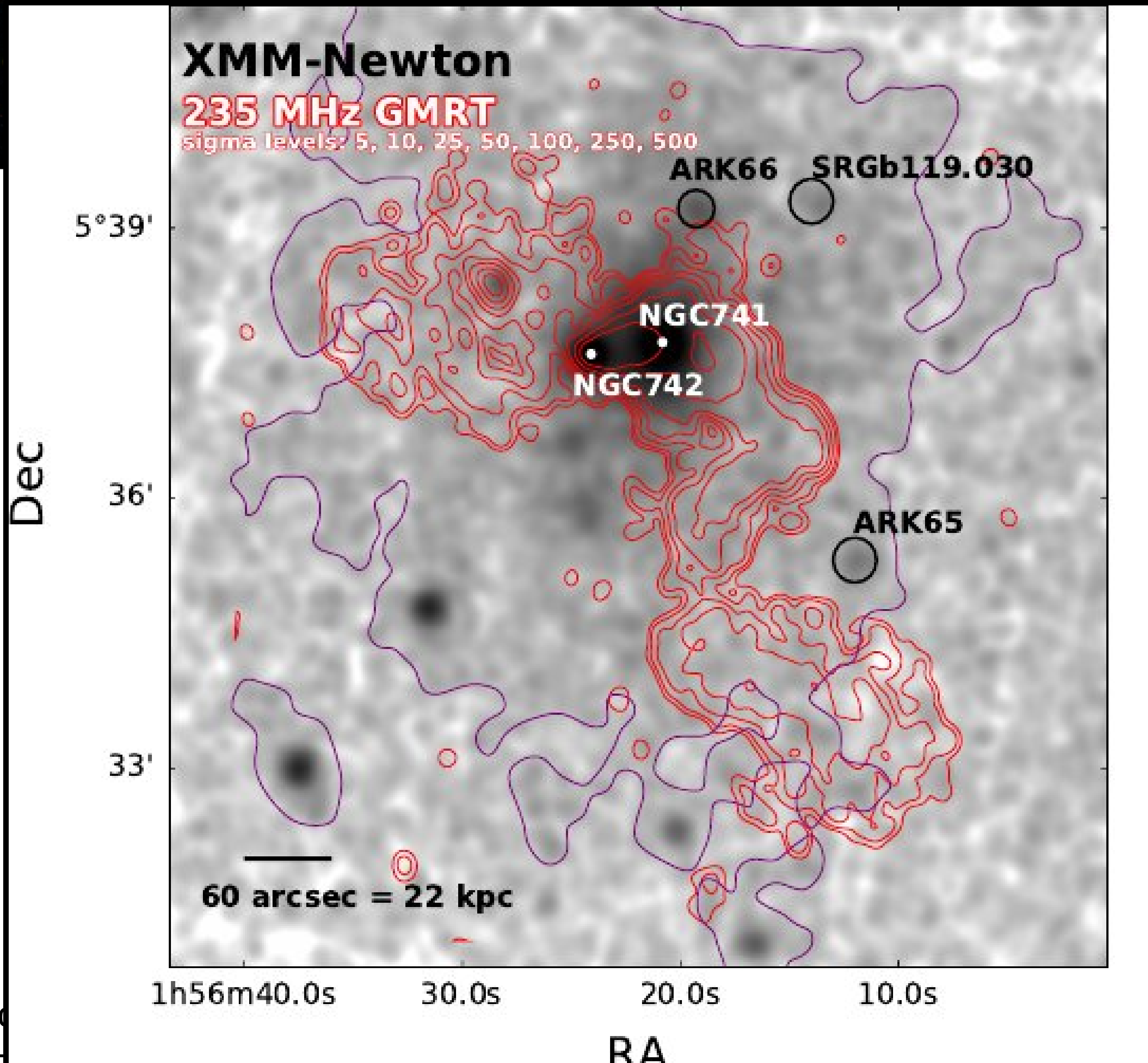
NGC 741





<u>Available data:</u>

X-ray		Radio	
Chandra	30+150ks	VLA	1.4 & 4.9 GHz
XMM-Newton	30ks	GMRT	150, 235 & 610 MHz
		(MWA)	



X-ray

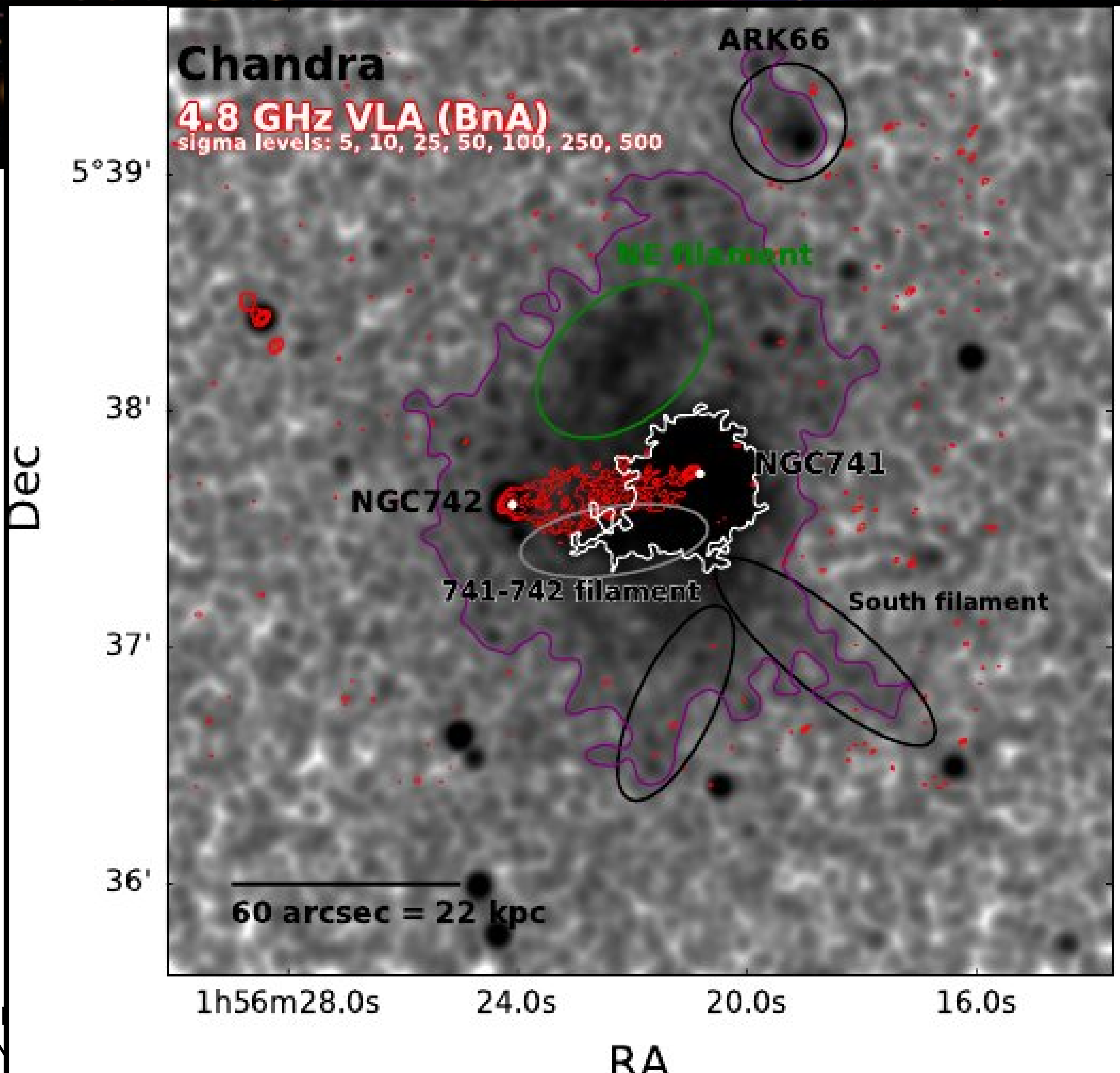
Chanc

XMM-

GHz

& 610 MHz

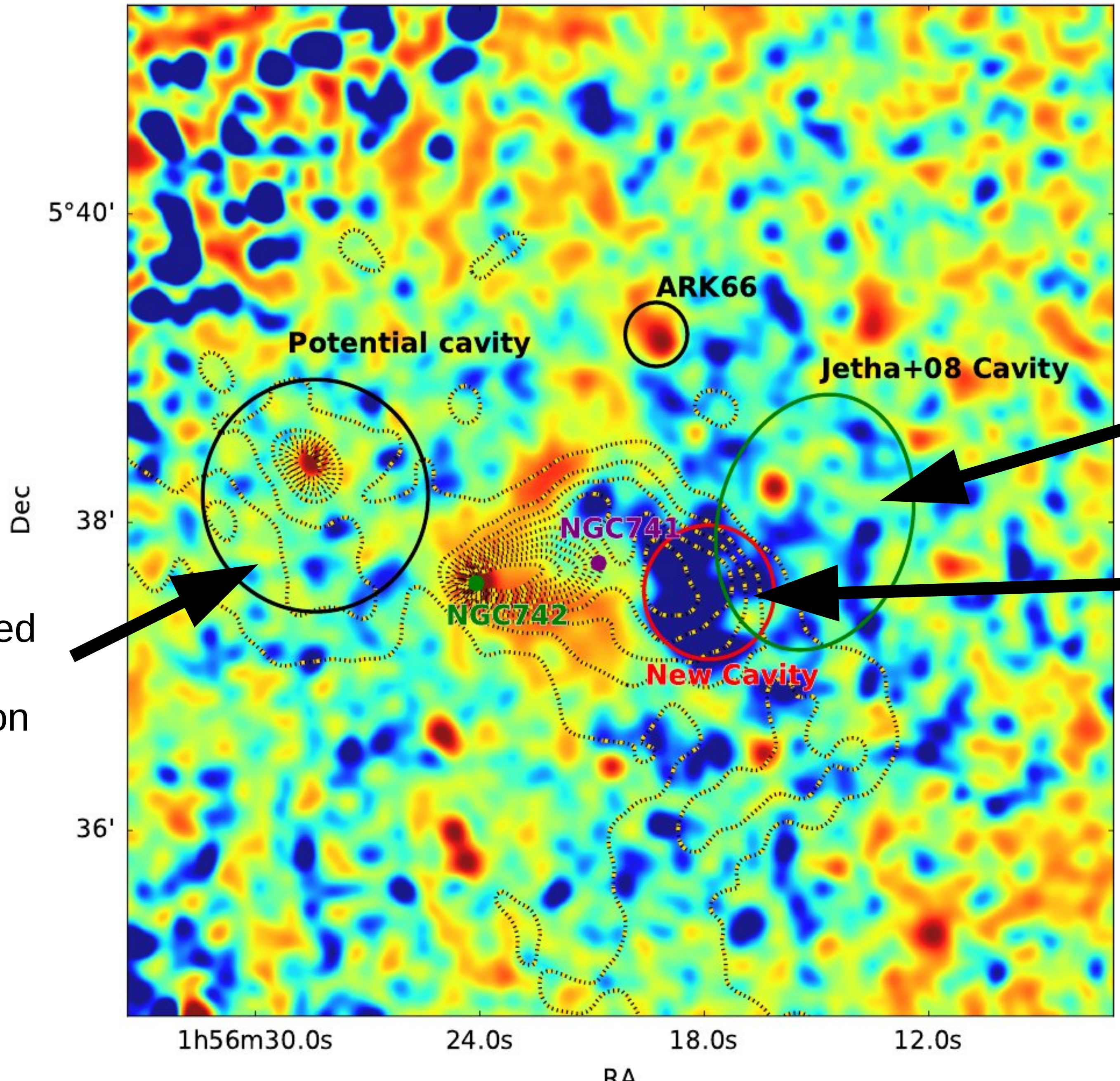
(MWA)



X-ray
Chandr
XMM-N

9 GHz
5 & 610 MHz
(MWA)

X-ray data – residuals

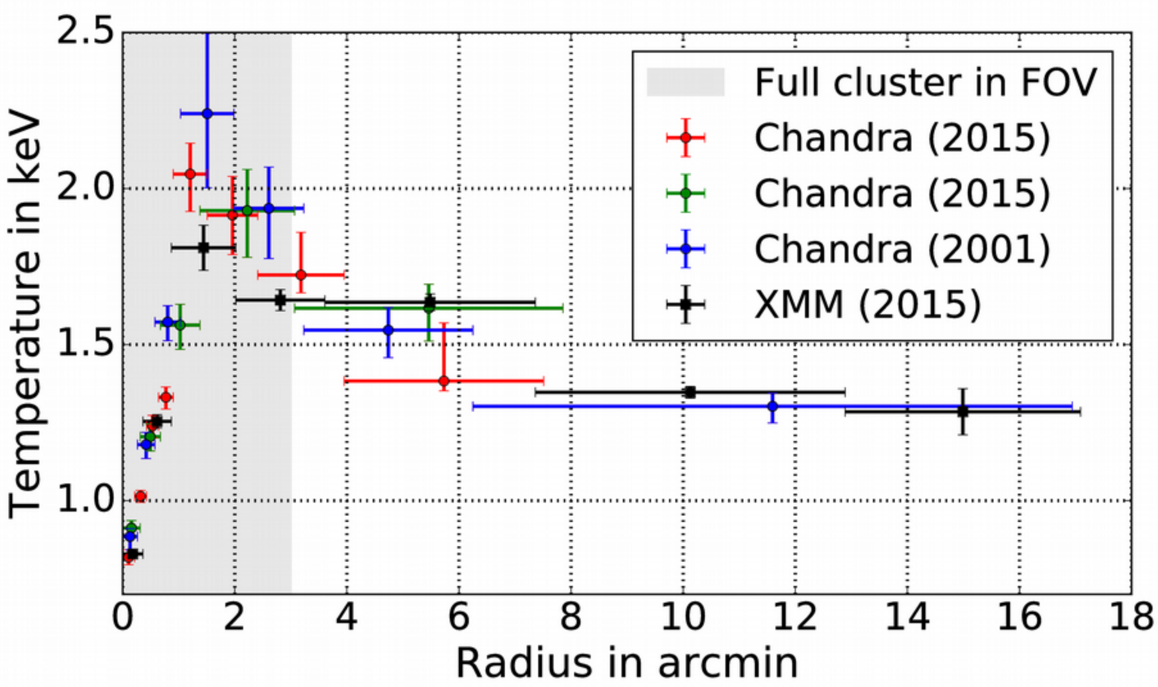


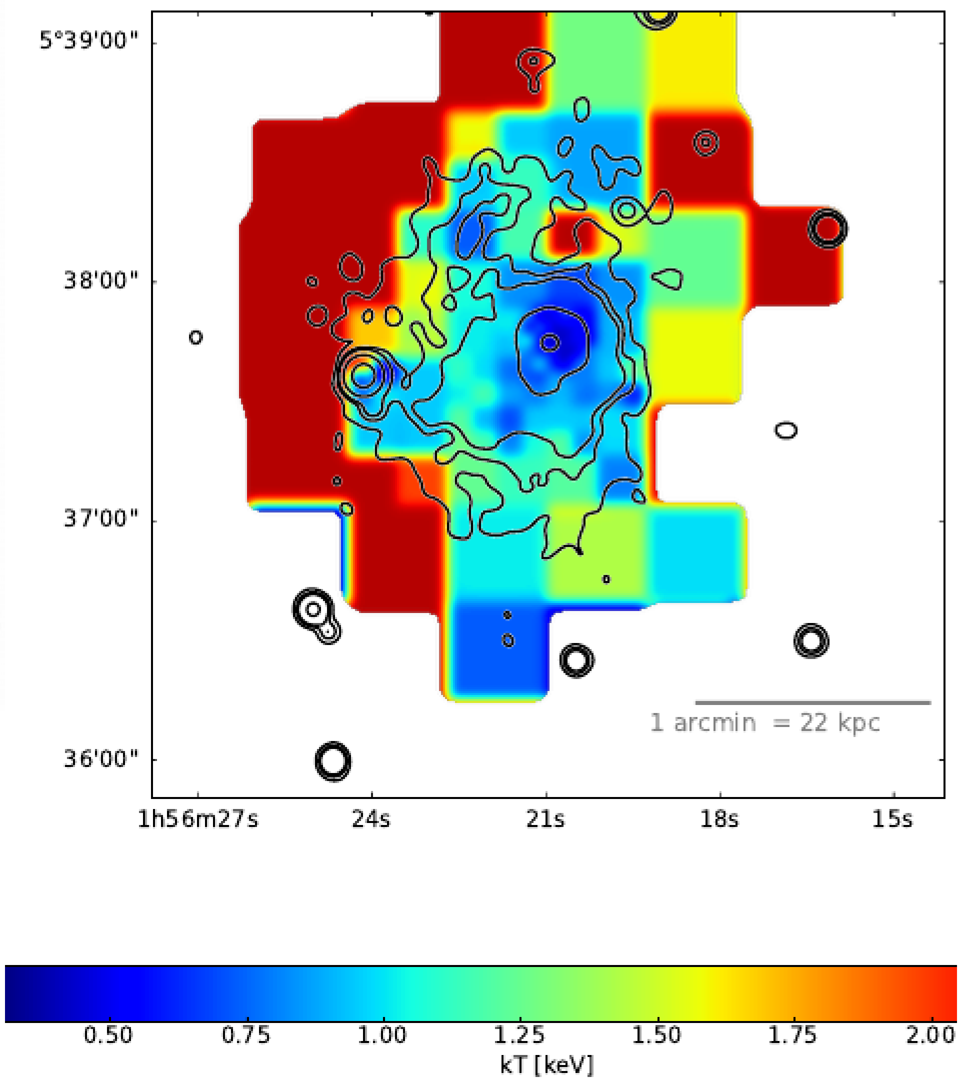
no indications

strong indications

extended radio emission

X-ray data – ICM temperature



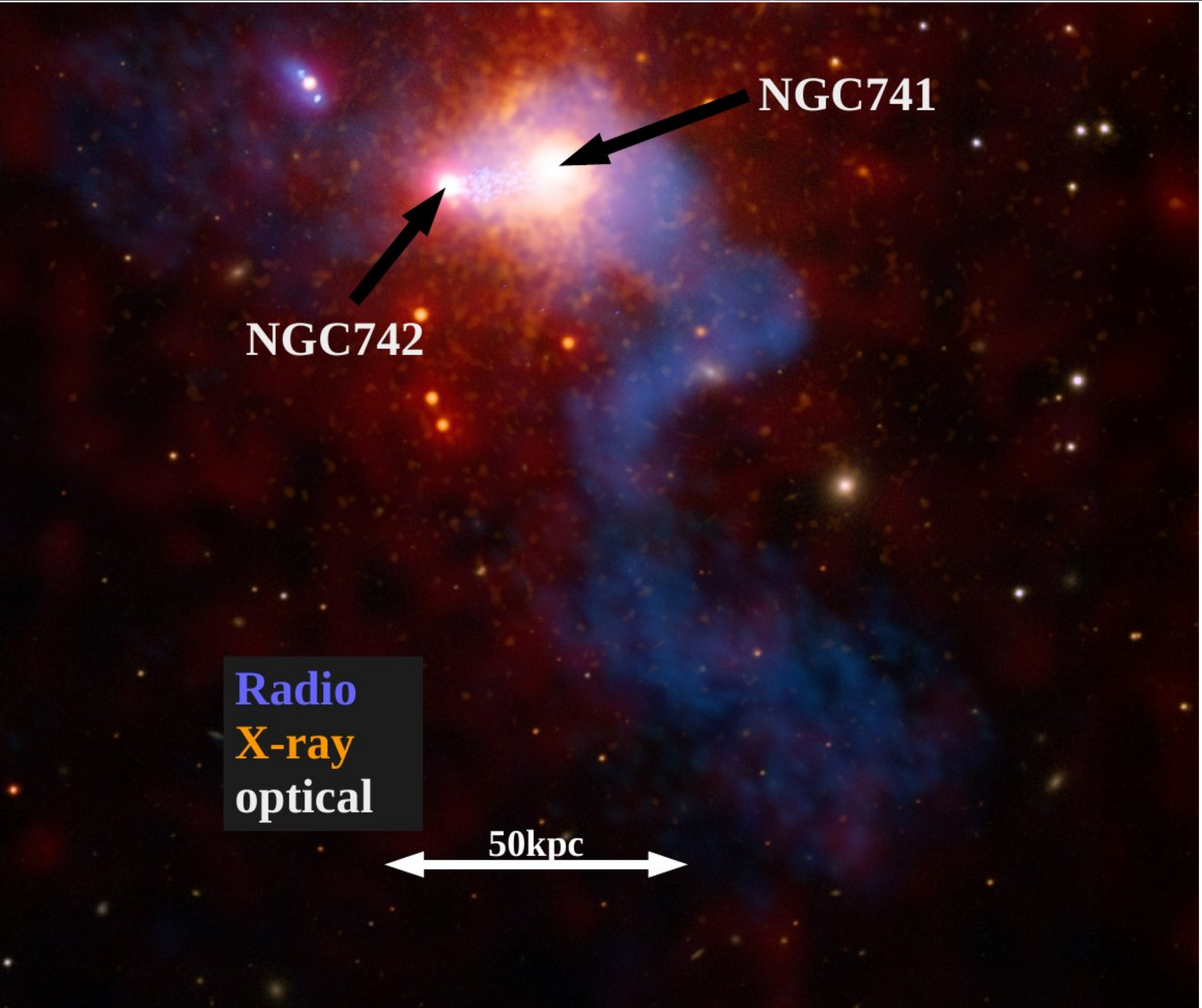


~1.4keV system

High peak temperature & cool core

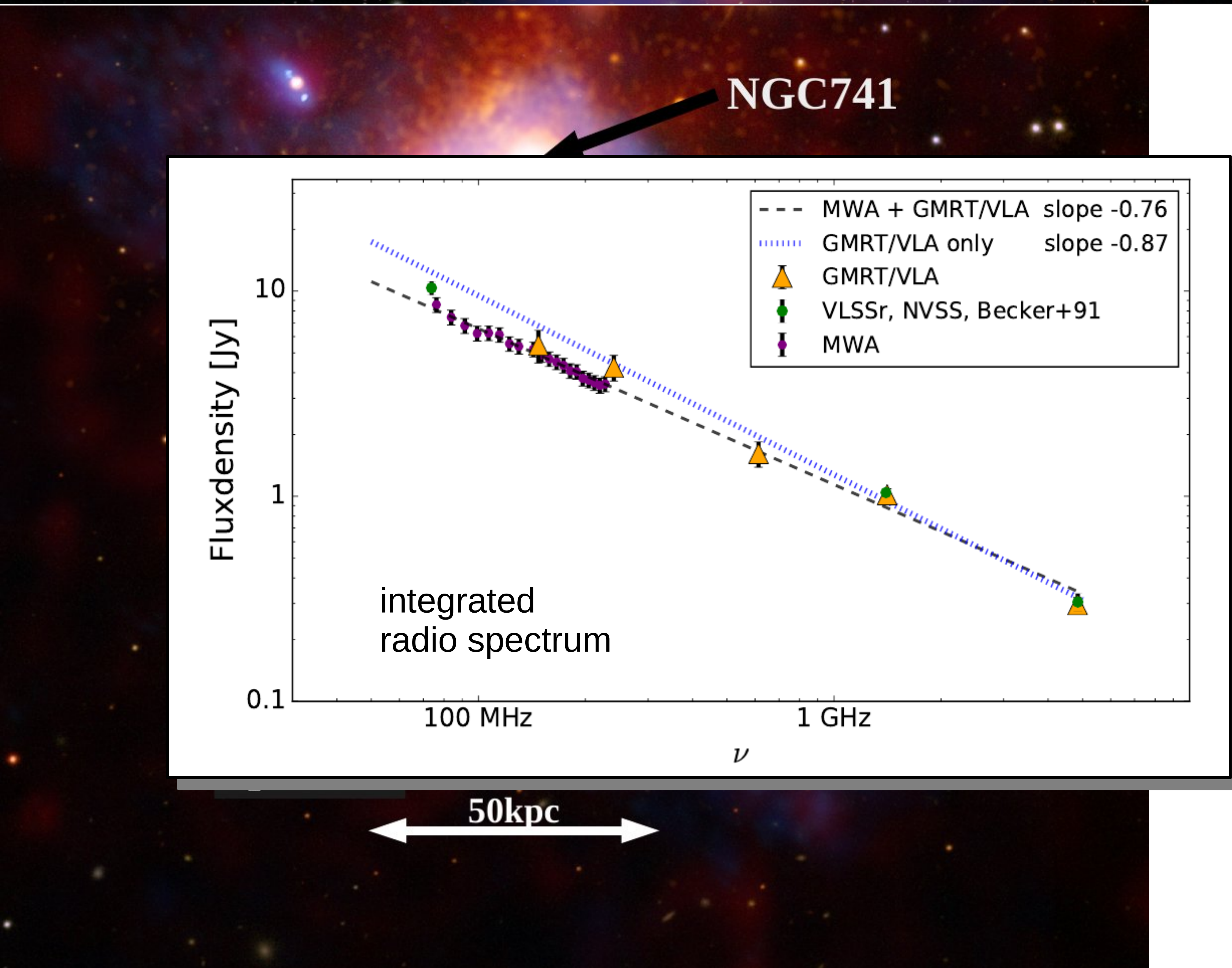
Consistency between
XMM and Chandra

The radio picture



- 5 frequency high resolution data (160MHz → 5 GHz)
- Bent lobes of NGC742
- Long and complex shaped radio tail to south west → emission mainly from NGC742

The radio picture



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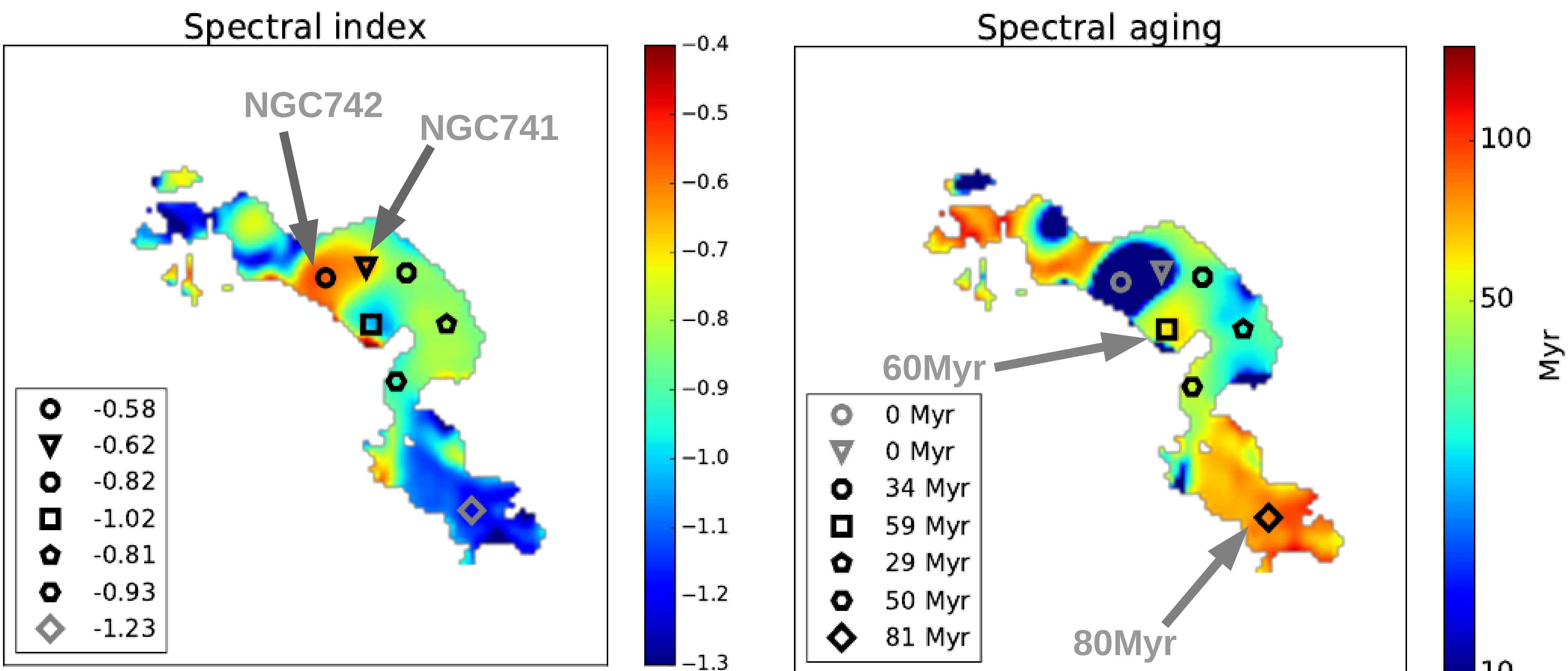
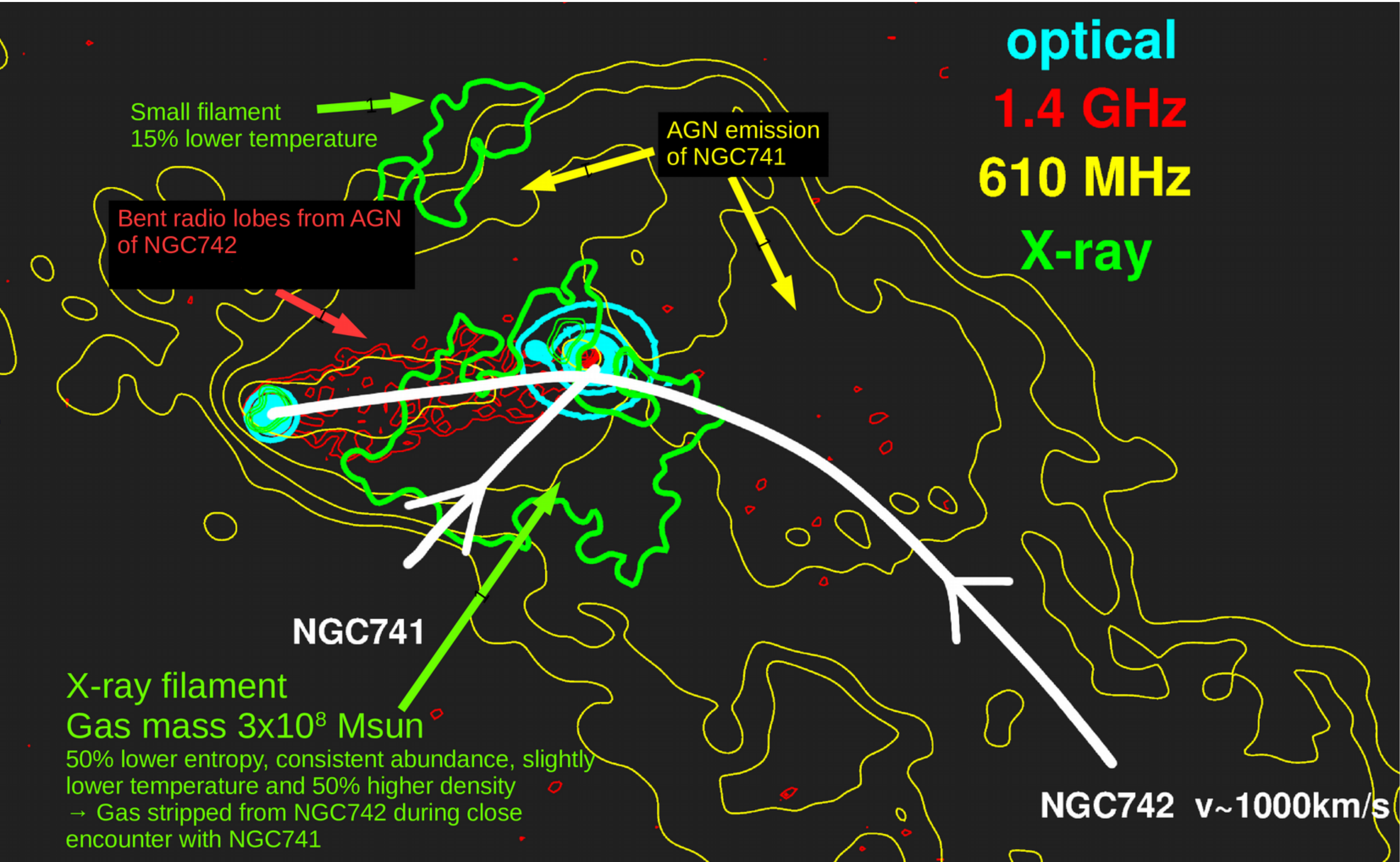
The radio picture

Measurement of the powerlaw

Steepening / exponential cut-off
(assuming spectral index of 0.76)



Scenario


optical
1.4 GHz
610 MHz
X-ray
Small filament
15% lower temperature
AGN emission
of NGC741
Bent radio lobes from AGN
of NGC742
NGC741
X-ray filament
Gas mass 3x10^8 Msun
50% lower entropy, consistent abundance, slightly
lower temperature and 50% higher density
→ Gas stripped from NGC742 during close
encounter with NGC741
NGC742 v~1000km/s