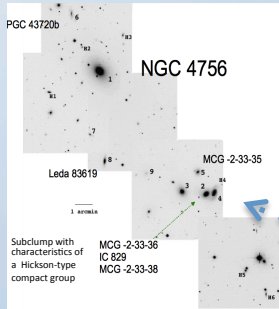


# Hot gas in groups: the intriguing case of NGC 4756

Ginevra Trinchieri (1) Roberto Rampazzo (2) Anna Wolter (1) Ruth Grützbauch (3) Werner Zeilinger (4) Paola Mazzei (2)

(1) INAF-OABrera (2) INAF-OAPD (3) University of Nottingham (4) University of Vienna



Mosaic of the ESO/CFR2 R-band images of the core region of the NGC 4756 group. Confirmed group members are labeled 1-8. H= background. Adapted from Grützbauch et al. (2005)

## The context

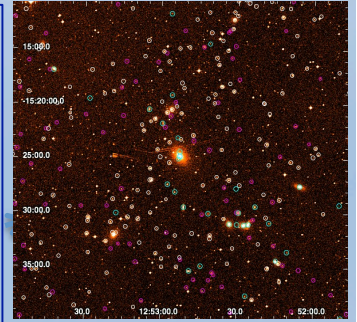
The environment appears to have a strong influence on fundamental properties of galaxies, modifying their morphology (e.g. pioneer work by Dressler 1980) and their star formation histories (e.g. Clemens et al, 2009, for early-type galaxies). Similarly, galaxies play a role in determining the properties of the hot intergalactic medium in groups, heating and enriching it through a variety of mechanisms.

### NGC 4756: an 'evolving group' ?

NGC 4756 is the brightest unperturbed elliptical galaxy in a loose group. The structure of the group is filamentary and complex, extending for about half a degree. The central part of the group contains a significant fraction of early-type galaxies. At about 7' SW of NGC 4756 a compact, Hickson type, clump of galaxies with signatures of recent interaction has been identified (Grützbauch 2005).

NGC 4756 is projected on the background cluster Abell 1631

This complicates issues in the X-ray domain!



3 separate velocity groups: ~ 4000 km/s [NGC 4756 and group] White ~ 13000 km/s [A1631] magenta Background objects

**The knowledge pre-XMM-Newton observations (Einstein, ROSAT-HRI and ASCA):** emission localized on NGC4756 and MCG -2-33-38 extended emission is also observed with harder component possibly centered N of NGC4756 (but at ASCA resolution!)

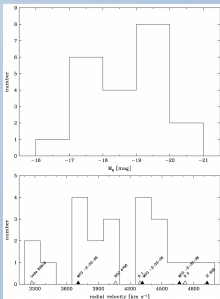
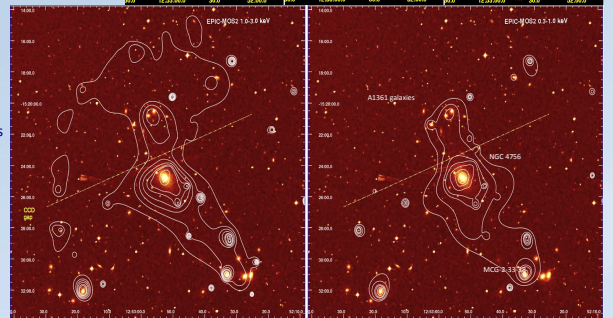
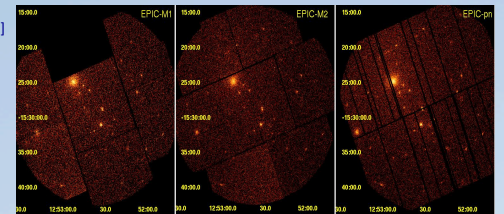
### NEW OBSERVATIONS:

We present PRELIMINARY results based on XMM-Newton observation (Dec. 2008): 48ks EPIC-MOS; 27ks EPIC-pn Results based on EPIC-M2 + EPIC-pn [EPIC-M1 not considered due to missing CCD]

FIRST ISSUE TO SOLVE: separate NGC4657 and group from background cluster A1361

Original XMM-Newton images (all instruments) and smoothed X-ray contours (M2 only) on optical image

Many individual sources  
Strong concentration on ✓NGC4756  
✓MCG-2-33-38 (Sey 1.9) in the subclump  
✓Several cluster galaxies



## NGC 4756 and its group

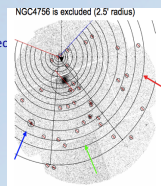
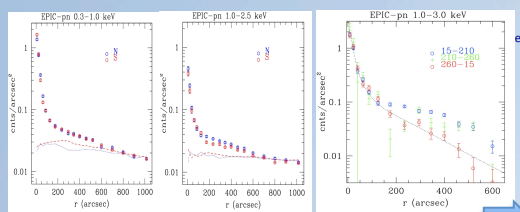
8 confirmed members + NGC4756, 22 candidates  
Mean group velocity ~4200 km/s  
Group velocity dispersion ~ 460 km/s  
Group virial mass  $10^{13} M_{\odot}$   
Group luminosity  $L_R \sim 8 \cdot 10^{10} L_{R\odot}$

The distribution of absolute B-band magnitudes reveals that all galaxies belong to intermediate- and low-luminosity galaxy classes (van den Berg 1998). The systemic velocities suggest a typical distribution for loose groups (Ramella et al. 1994)

NGC 4756: unperturbed  $E-M \sim 2 \cdot 10^{11} M_{\odot}$  (20kpc)  
Age 11 Gyr  $r < 40$  kpc ; 9.5-10 Gyr  $r < 20$  kpc  
Central velocity dispersion ~ 204 km/s  
Slow rotation  $< 30$  km/s

X-ray profiles centered on NGC 4756 show emission extending out to 600", when compared to the blank-sky profile in the same regions, energy bands and direction in the sky (within  $10^\circ$ ).

Does NGC4756 extend this far?  
Emission stronger to the N?



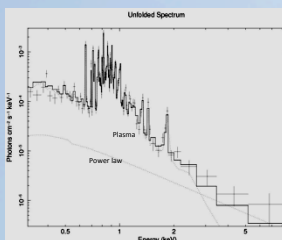
Profile center moved to the N of NGC4756 ... and towards edge of f.o.v.

### Total spectrum : 2 components

"Plasma" APEC:  $kT \sim 0.7$  keV  $L_X \sim 10^{41}$  erg/s (0.5-2.0)  
Power Law  $\Gamma = 1.6$  (fixed):  $L_X \sim 5 \cdot 10^{39}$  erg/s (0.5-2.0);  $L_X \sim 1.3 \cdot 10^{40}$  erg/s (2.0-10)

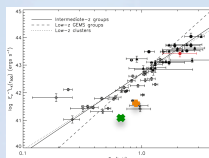
INNER/OUTER (20" // 20"-100")

"Plasma" APEC:  $kT \sim 0.6$  keV  $L_X \sim 5 \cdot 10^{40}$  erg/s (0.5-2.0) //  $kT \sim 0.7$  keV  $L_X \sim 7 \cdot 10^{40}$  erg/s (0.5-2.0)  
Power Law  $\Gamma = 1.6$  (fixed):  $L_X \sim 3 \cdot 10^{39}$  ;  $7 \cdot 10^{39}$  erg/s (0.5-2.0; 2.0-10) //  $L_X \sim 5 \cdot 10^{39}$  ;  $1.3 \cdot 10^{40}$  erg/s (0.5-2.0; 2.0-10)



Emission dominated by hot gas at ~0.7 keV and cosmic abundance. There seems to be no distinction between inner and outer regions.

Power law is consistent with the LMXB population in NGC4756 (Kim & Fabbiano 2004)



The position of the two groups NGC 4756 and NGC 5325 (see poster by Wolter et al. ) in the  $L_X-T_X$  relation for low/intermediate z groups (Jeltema et al 2008)

## References

Clemens, M. et al 2009, MNRAS, 392, L35  
Dressler, A. et al 1980 ApJ, 236, 351  
Grützbauch, R. et al 2005, AJ 129 1832  
Jeltema, T. et al 2008 ApJ 685 138  
Kim, D-W., Fabbiano, G. 2004, ApJ 611, 846  
Ramella, M. 1994, AJ 107, 1623  
van den Berg, S. 1998 Galaxy morphology classification, Cambridge Uni. Press

## Conclusions

While still preliminary, the results on the X-ray analysis indicate that there is emission associated with NGC 4756 and its group. The subclump to the SW is also detected as a separate entity.

The X-ray source associated with NGC4756 sits on top of what appears to be extended emission from the background cluster A1361, but can be relatively well distinguished from the cluster at least out to a distance of  $\sim 150''$  ( $\sim 40$  kpc) We will investigate whether the hint of an extension to the SW is a real feature.

It would suggest a trail of gas connecting NGC 4756 with the sub-clump to the SW and would have strong implications on our understanding of the evolution of this group (and other similar structures).

The X-ray luminosity and Temperature of the gas in NGC 4756 are in good agreement with what is expected from poor groups (eg. Jeltema et al 2008)