Hot gas in groups: the intriguing case of NGC 4756

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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.

NGC 4756 and its group

8 confirmed members = NGC 4756, 22 candidates
Mean group velocity ~ 4300 km/s
Group velocity dispersion ~ 600 km/s
Group virial mass ~ 10^13 M☉
Group luminosity ~ 8 10^10 L☉

The distribution of absolute B-band magnitudes reveals that all galaxies belong to intermediate- and low-luminosity galaxy classes (van den Bergh 1998).

The systemic velocities suggest a typical distribution for loose groups (Pandorino et al. 1998).

NGC 4756: unperturbed E – M ~ 2 10^10 M☉ (200km)
Age ~ 1 Gyr r~20 kpc
Central velocity dispersion ~ 204 km/s
Slow rotation ~ 30 km/s

The knowledge pre-XMM-Newton observations (Einstein, ROSAT-HRI and ASCA): emission localized on NGC 4756 and MCG -2.33-38 extended emission is also observed with harder component possibly centered N of NGC 4756 (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 + NGC 4756
+ MCG -2.33-38 (Gey 1.9) in the subclump
+ Several cluster galaxies

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°).

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

Total spectrum : 2 components

* Plasma APEC: kT~0.7 keV L~10^13 ergs/s keV, L~10^10 ergs/s keV
  * Power Law Γ=1.6 power L~5 x 10^10 ergs/s keV, L~1.3 x 10^10 ergs/s keV

INNER/DIJSTER (20'' /20°-100'')

* Plasma APEC: kT~0.6 keV L~5 x 10^10 ergs/s keV, L~7 x 10^10 ergs/s keV
  * Power Law Γ=1.6 power L~3 x 10^10, L~7 x 10^10 ergs/s keV

Profile center moved towards edge of ft. v.

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 NGC 4756 (Craig & Feldman 2006)

NGC 4756 extends at least 150''/40 kpc in radius over the emission of A1361.

A small extension towards SW in the softer band might indicate a slightly larger extent towards the subclump

CAVEATS:
How well do we know the background shape in the center from the “refilled” blank sky images?
Can we attribute rest of emission to the cluster?

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 r~150'' (~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 (e.g. Jeltema et al 2008)

References

Kim & Fabbiano 2000, MCG-2-33-38
Grützbauch 2004, Μ = 1.3 x 10^10 L☉
Kim & Fabbiano 2000, MCG-2-33-38 (fixed):
Kramers & van den Bergh 1998