Cold gas in isolated elliptical galaxies

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CONTEXT

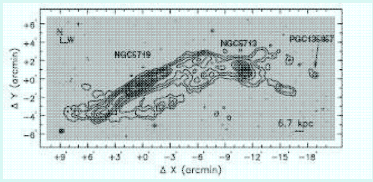
Isolated elliptical galaxies are thought to be the end product of mergers of galaxies, most of which happened a significant fraction of Hubble time ago. However, between similar end products, some ellipticals decided to be more original, by showing a diffuse and strong X-ray halo (see talk by G. Trinchieri).

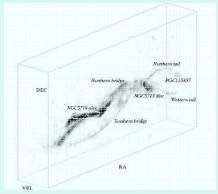
An attractive explanation of the large intrinsic scatter in the X-ray properties of early type galaxies could be linked to their merging histories. Sansom et al. (2000) first noticed a strong deficiency of hot ISM in galaxies with distinctive signs of disturbances.
The environment plays a crucial role, since it is difficult to disentangle group and galaxy properties.

Merger remnants, like NGC 3921 and NGC 7252 (Nolan et al. 2004) are under-luminous in X-rays compared with the typical mature E in which these remnants are expected to evolve. HI is also detected in on-going mergers as for instance the NGC5719/13 galaxy pair (Vergani et al. 2007)

Dynamical modeling require late-type spiral progenitors (Hibbard & Mihos 1995), which produced tidal tails rich in HI that are expected to fall back to the main body of the galaxy in about 3 Gyr.

Ellipticals which are formed through merging of spirals or groups rich in HI might possess a reservoir of cold gas which is otherwise missing in other ellipticals (e.g. Roberts & Haines 1994: ``HI is rare in elliptical systems").





NGC5719/13

VLA OBSERVATIONS

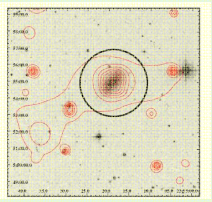
We obtained VLA+EVLA data for one of the galaxies in the sample, NGC817, to measure the distribution of the cold gas with respect to the optical body of the galaxy. Data reduction of this dataset is in progress. The intent is also to look for disturbances in the cold gas distribution that can be related to signatures of the merger event.

CORRELATIONS

We have searched for HI total measurements for the isolated elliptical galaxies for which we have X-ray data.
We plot in figure the HI mass from line measure vs. the X-ray Luminosity in the (0.5-2.) keV band.
We add to the plot the two merger remnants NGC 3921 and NGC 7252, which are both HI and X-ray detected.
Most of the galaxies for which we have a secure detection of hot X-ray emitting gas have only upper limits in the HI, while the objects for which cold gas is present are actually upper limits for the hot gas.

SAMPLE

We selected a sample of galaxies with similar average characteristics (morphology, distance, B-band luminosity) and a strict criterion for isolation. (See Memola et al 2009).
In early type galaxies, HI is rare and not correlated to the optical luminosity, as in spirals (Roberts & Haynes 1994).
The HI content might be higher for those systems which result from merging. The surface density of HI in the resulting disk might be too low for a significant optical disk to form.

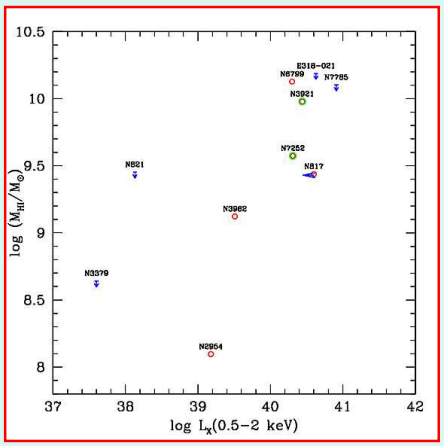


NGC7785 NGC2954

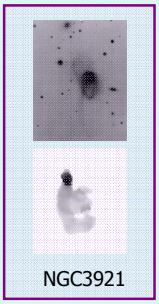
X-ray Maps

PLOT of HI vs LX

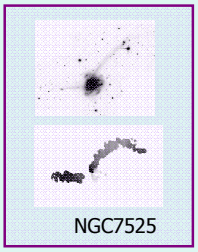
We plot the cold gas mass, measured from HI detections (red circles) or upper limits (blue arrows) vs. the X-ray luminosity for isolated ellipticals. NGC817 has only an upper limit from Einstein IPC data.
The LX for NGC2954, NGC3962, NGC6799 is a measure of the TOTAL luminosity since the statistical significance of the spectrum is such that no firm measure of the gas content alone can be made.
For the other objects, Lx is a measure of the HOT GAS luminosity.



Post-Merger



NGC3921



NGC7525

CONCLUSIONS

The possible trend visible in Figure between total HI mass and X-ray luminosity is promising in view of our predictions.
We intend to gather a larger sample of HI measurements for isolated ellipticals with and without a hot X-ray halo.
We will follow up with high resolution observations (e.g. VLA) to map the distribution of cold gas.