Istituto Nazionale di Astrofisica
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X-ray properties of isolated galaxies

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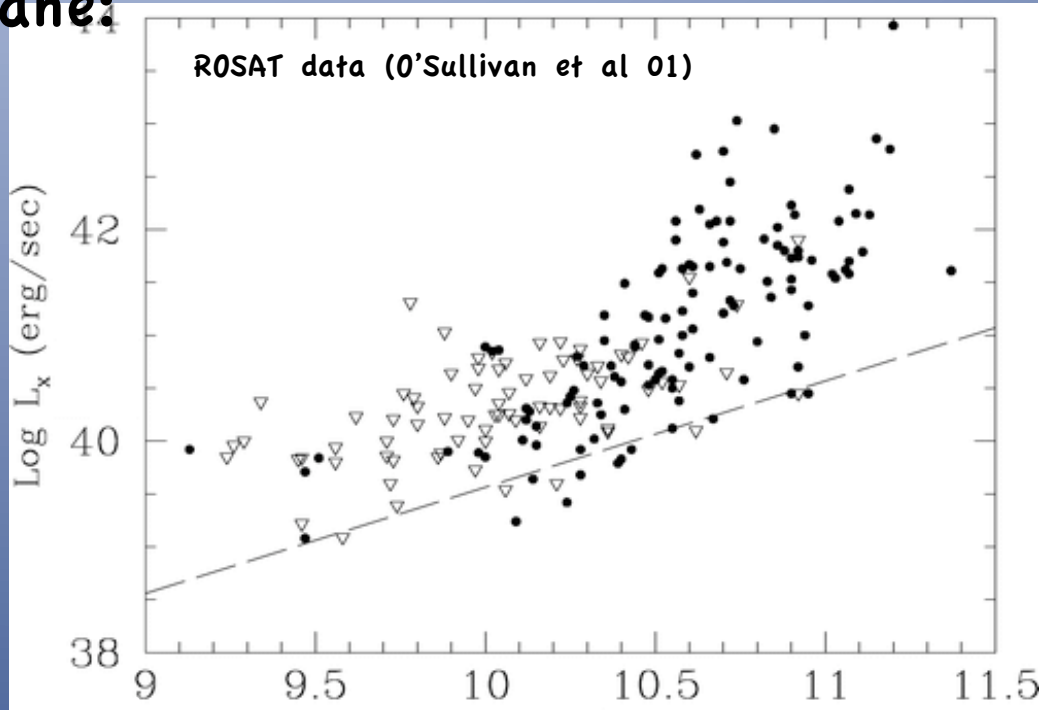
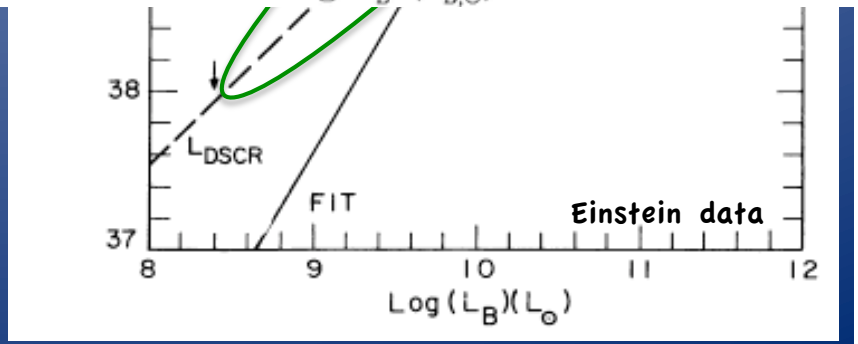
SEE poster Hot/cold gas phases in Isolated galaxies

X rays in elliptical galaxies: a puzzle since their discovery

Large spread in the Lx/LB plane:

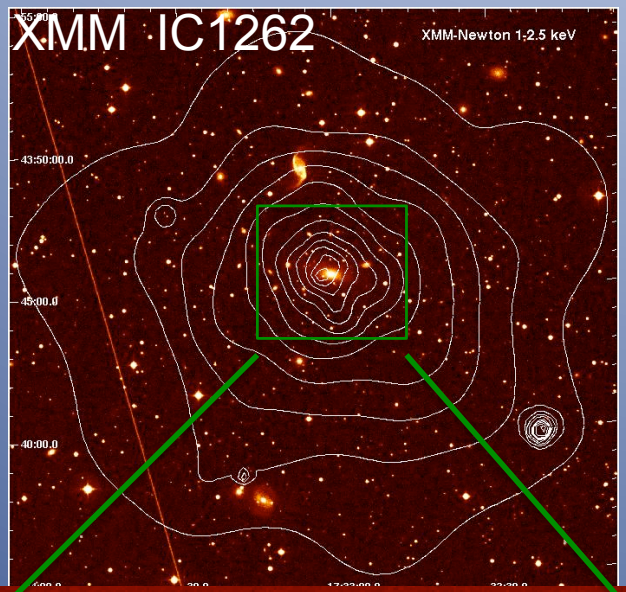
- **Discrete** sources
  - @ low Lx
  - ~ prop to mass/GCs
  - Predictable !
- **Hot** gas
  - @ high Lx
  - large scatter (>100x @ L_B~
  - correlation with galactic properties?
- [AGN]

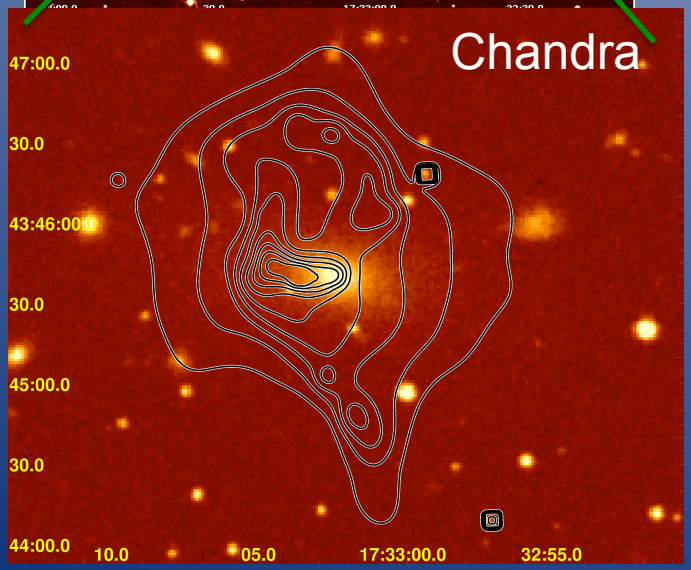




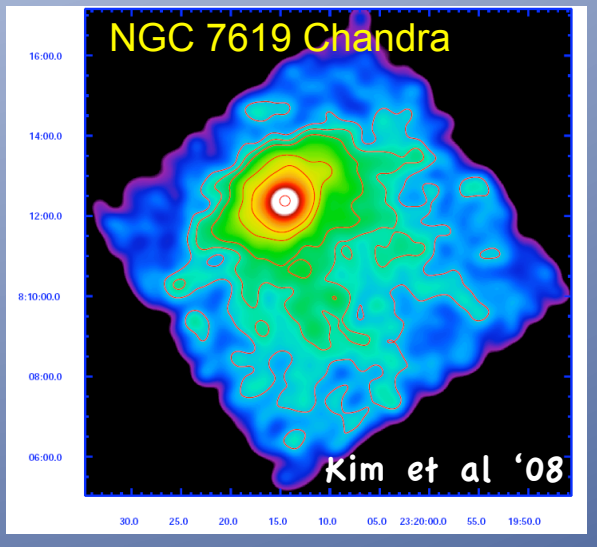
HIGH LUMINOSITY SYSTEMS
Gas dominated : extended and complex

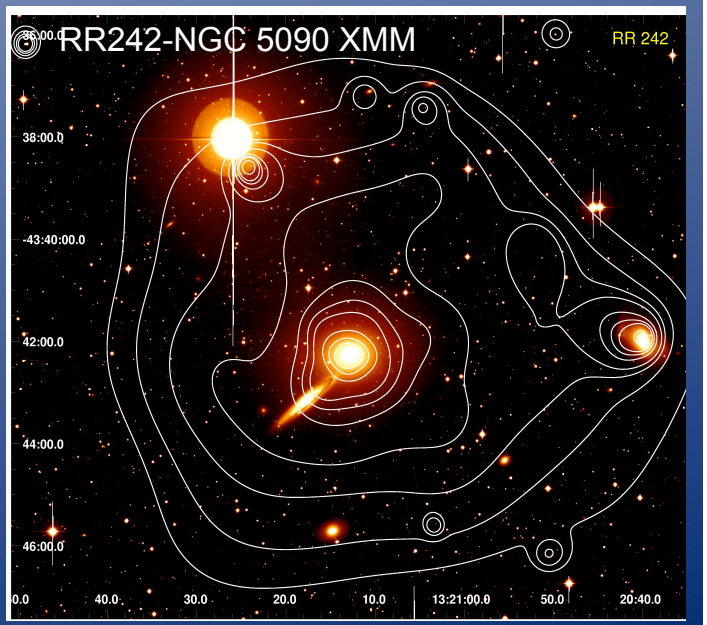
Regular at large radii
Tails
Structures at small radii





Trinchieri et al '07





Grützbauch et al '07

INTERMEDIATE LUMINOSITY SYSTEMS

Ex: NGC 1553 - L_x 1 x 10^{41} erg/s:

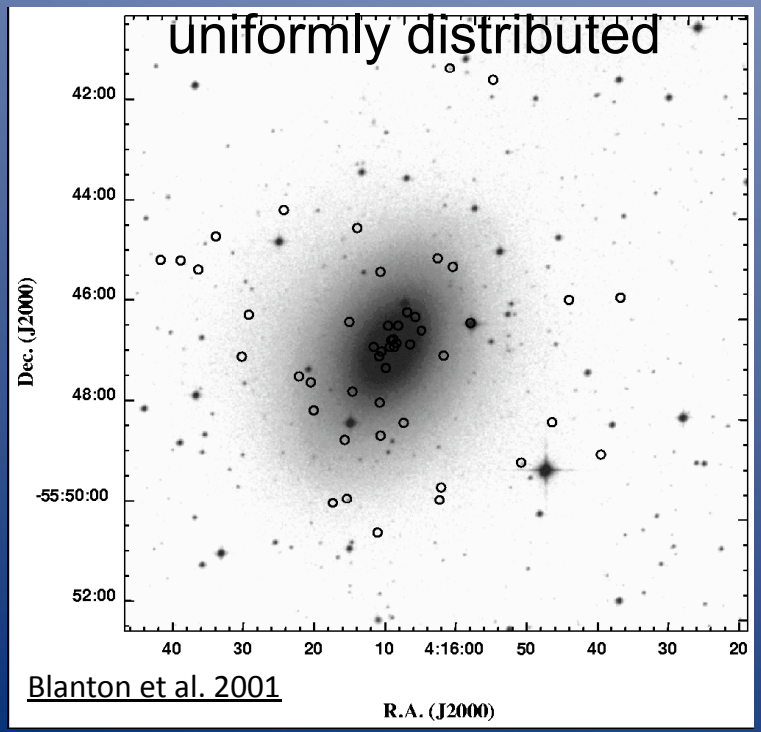
30% resolved [49sources → LMXB]

70% diffuse: 25% unresolved sources

75% hot gas

discrete sources:

uniformly distributed

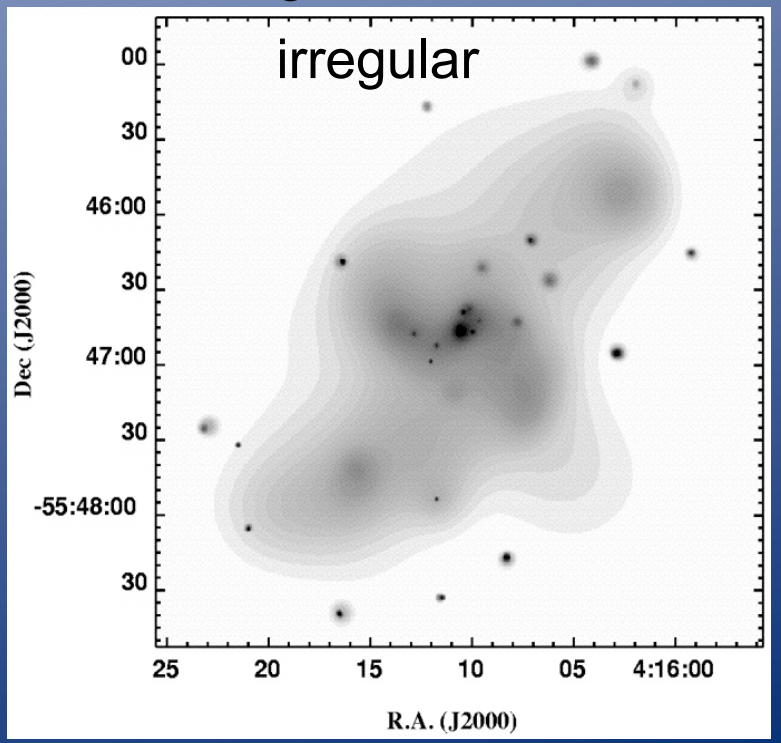


Blanton et al. 2001

Chandra data

gas:

irregular



LOW LUMINOSITY SYSTEMS

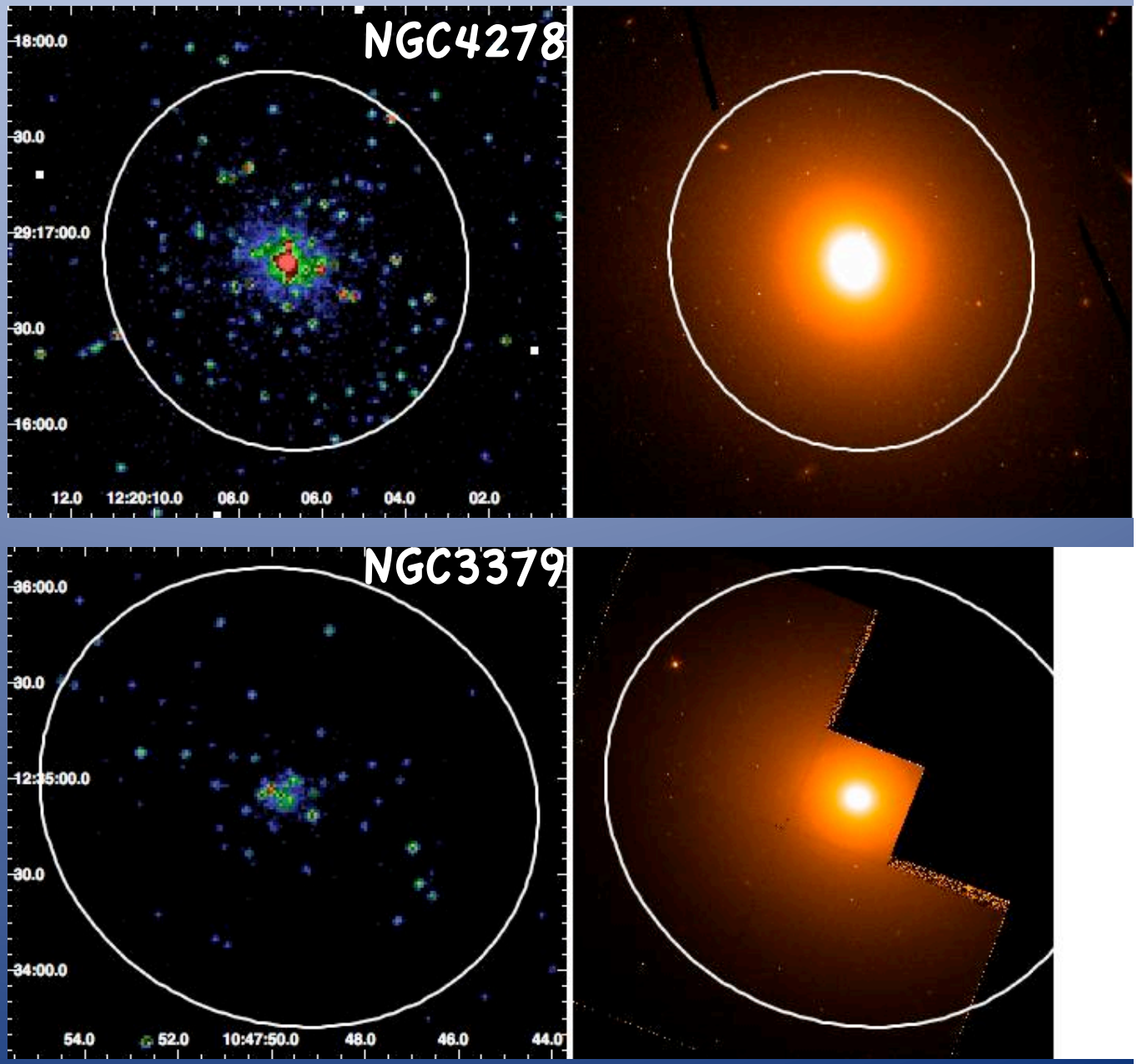
Virtually no gas:

In NGC4278: 180 sources within D_{25}

In NGC3379: 98 sources within D_{25}

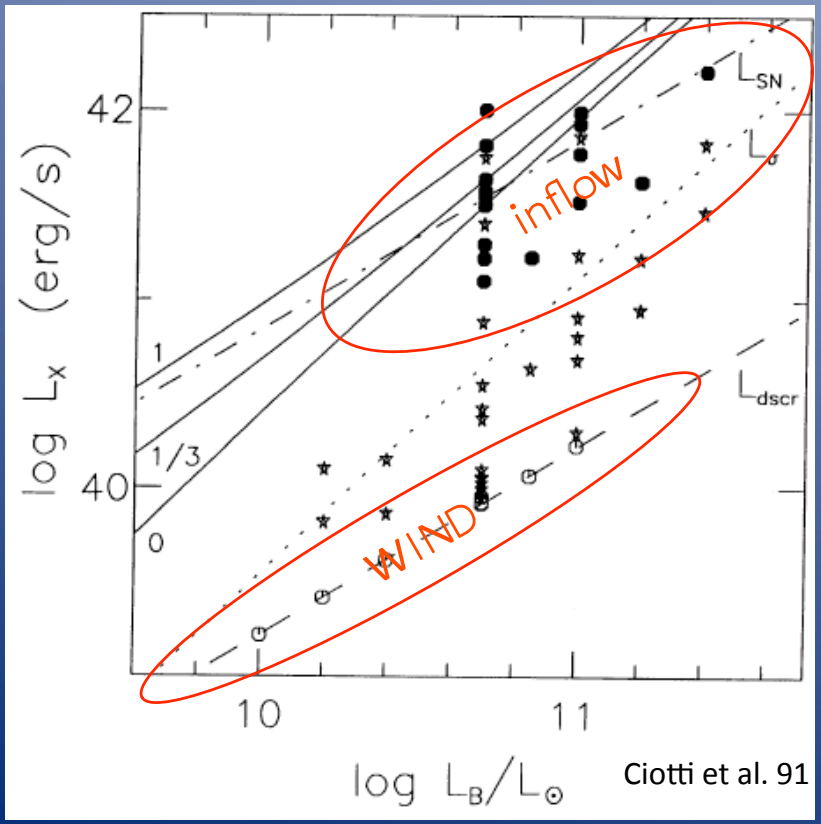
$L_x(TOT) \sim 3*10^{39}$ erg/s
$L_x(gas) \sim 4*10^{37}$ erg/s
➔ 1%!

Trinchieri et al (2008),
Brassington et al (2008, 2009)



How do we interpret the scatter?

Modeling for gas component. For ex:



Ciotti et al. 91

Inflow/outflow (winds) (Ciotti et al '91)

Inflow➔ keep gas in system
➔ high Lx

Outflow➔ clean out the gas
➔ low Lx

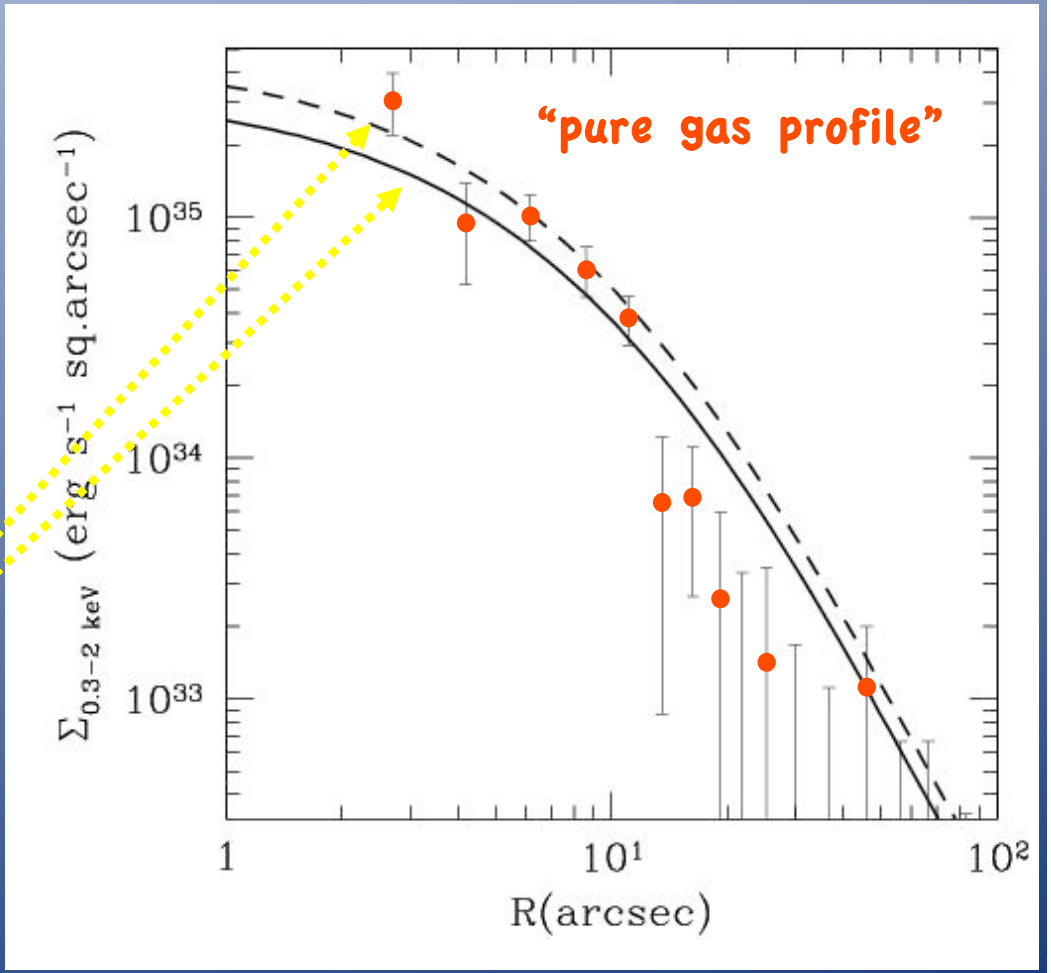
Note : winds are hard/impossible to detect!

1 case so far: NGC3379 (Trinchieri et al 08)
$L_x \sim 4 \times 10^{37}$ erg s^{-1} $M_{gas} \sim 3 \times 10^5 M_\odot$

Gas in an outflow phase?

- Hydrodynamical simulations tailored to NGC 3379
- Assume passive evolution and age=9 Gyr
- Use: observed L_B, velocity dispersion, total stellar mass
- Time evolving inputs:
  - stellar mass loss
  - SNIa heating

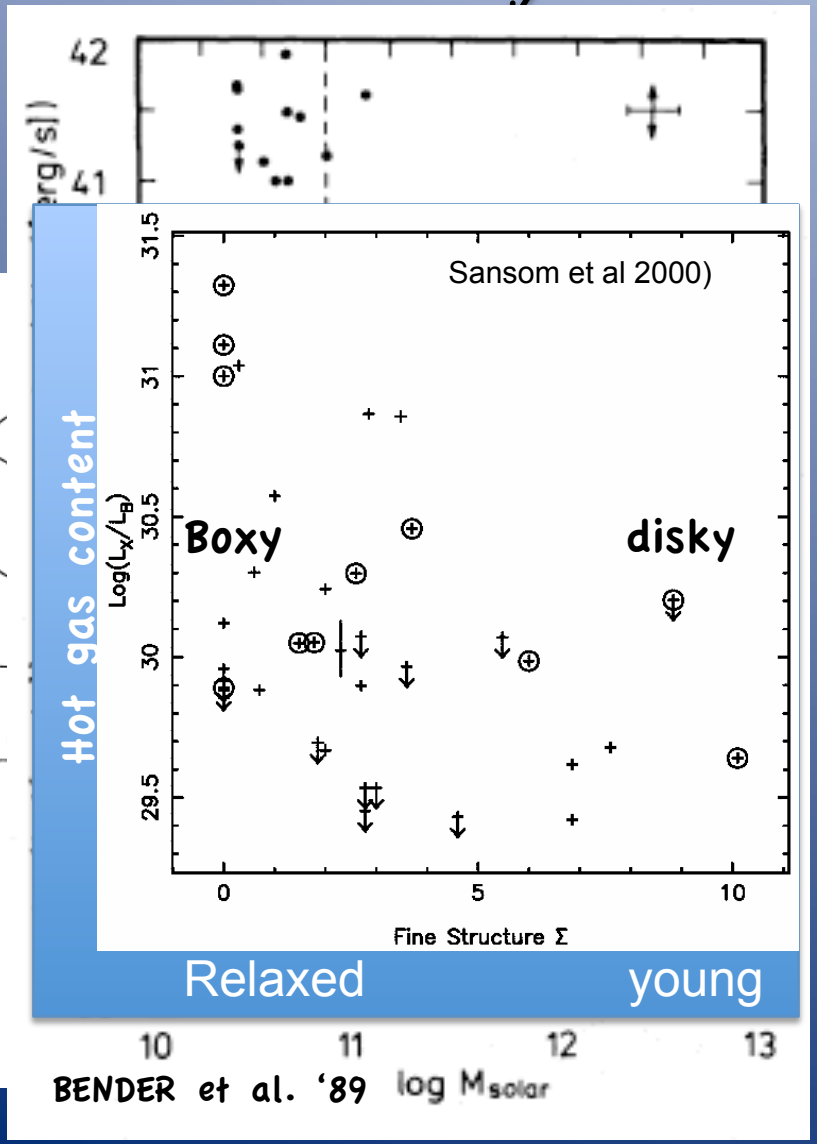
➔Predicted profiles for 2 SNIa decay rates



- Gas in **outflow** phase:

$L_X \sim 4 \times 10^{37}$ erg s^{-1} (0.5-2.0 keV) (vs 2) $M_{gas} \sim 3 \times 10^5 M_\odot$ (vs 5)

How do we interpret the scatter?



Select sample "appropriately"

Select galaxies according to :

- Morphology [E/S0] eg. Eskridge et al. '95
- Shape [Bender et al '89, Pellegrini '94, Kormeny et al '09]
- Total / luminous Mass
- Evolutionary history (Samson 2000, Nolan et al. 2004, Brassington et al 2007)
- Central velocity dispersion

. . . .

- Environment

Isolation:

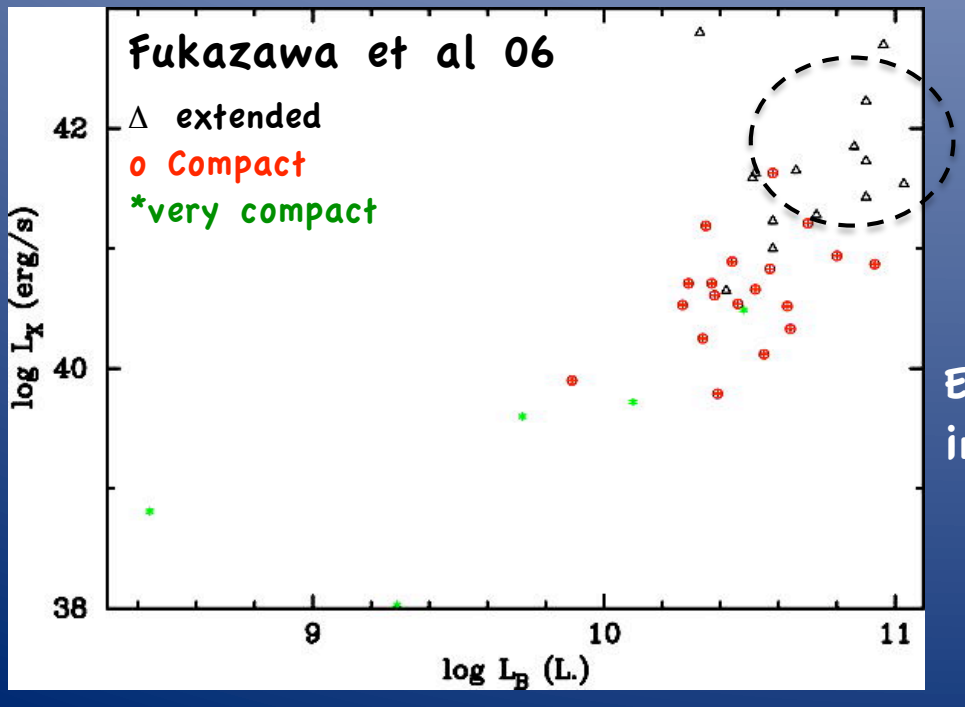
is this a guarantee of a more homogeneous behaviour?

EVIDENCE FOR ENVIRONMENTAL EFFECTS ON X-RAY HALOS: contradictory results .....

✓massive galaxies nearby ➔ systematically lower Lx/LB (White & Sarazin 91, Henriksen & Cousineau 99

✓positive correlation Lx/LB and the local galaxy density Brown & Bregman 2000

Central group galaxies are brightest – and brightest galaxies are at group centers.



✓ scatter at high L_X

× the whole scatter

Other members ?

Stripping vs confinement

EXGs are surrounded by hot intragroup medium

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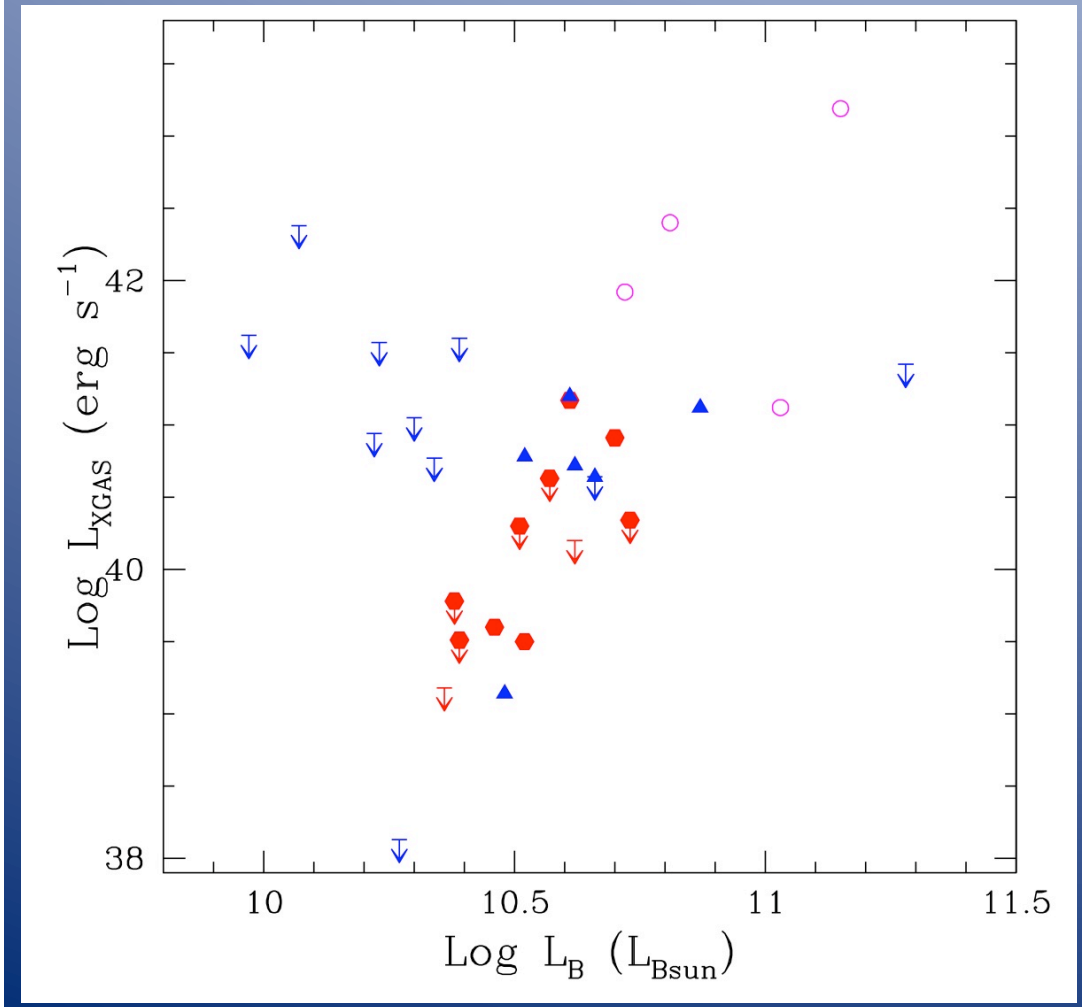
Isolation:

is this a guarantee of a more homogeneous behaviour?

Problem: overlap with X-ray datasets!

XMM proposal for a sample of isolated galaxies (Focardi & Kelm '09 – see Memola et al '09):



from Updated Zwicky Catalog (UZC, Falco et al. 1999)

a)minimum B luminosity

($L_B > 1.3*10^{10}\ L_{B\odot}$)

b)velocity range

($vr \in [2500\text{-}5000]$ km/s);

c)|bII| ≥ 15°

d)no companions in 3-D space

(R_{iso}=1.3 Mpc; Δv=1000 km/s, Δm).

8 early-type galaxies

(Smith et al, Reda et al, AMIGA …)

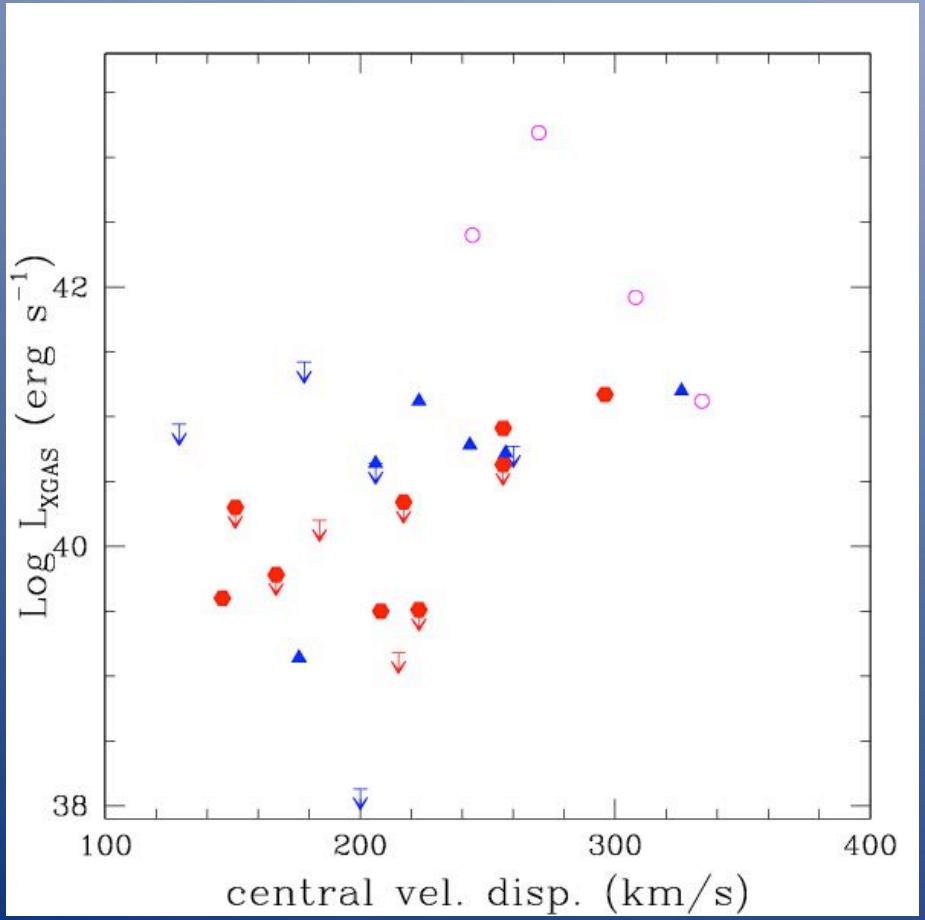
5 observed in X rays (so far)

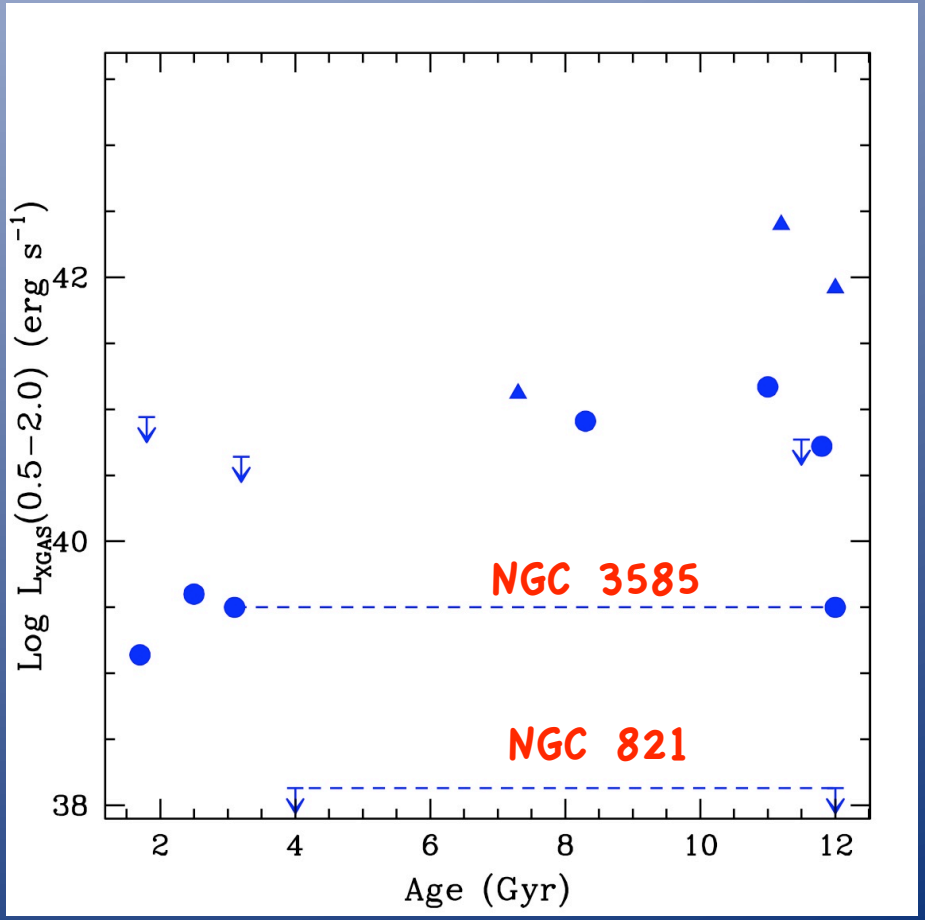
Added literature △ archival ● data

Isolation:

is this a guarantee of a more homogeneous behaviour?

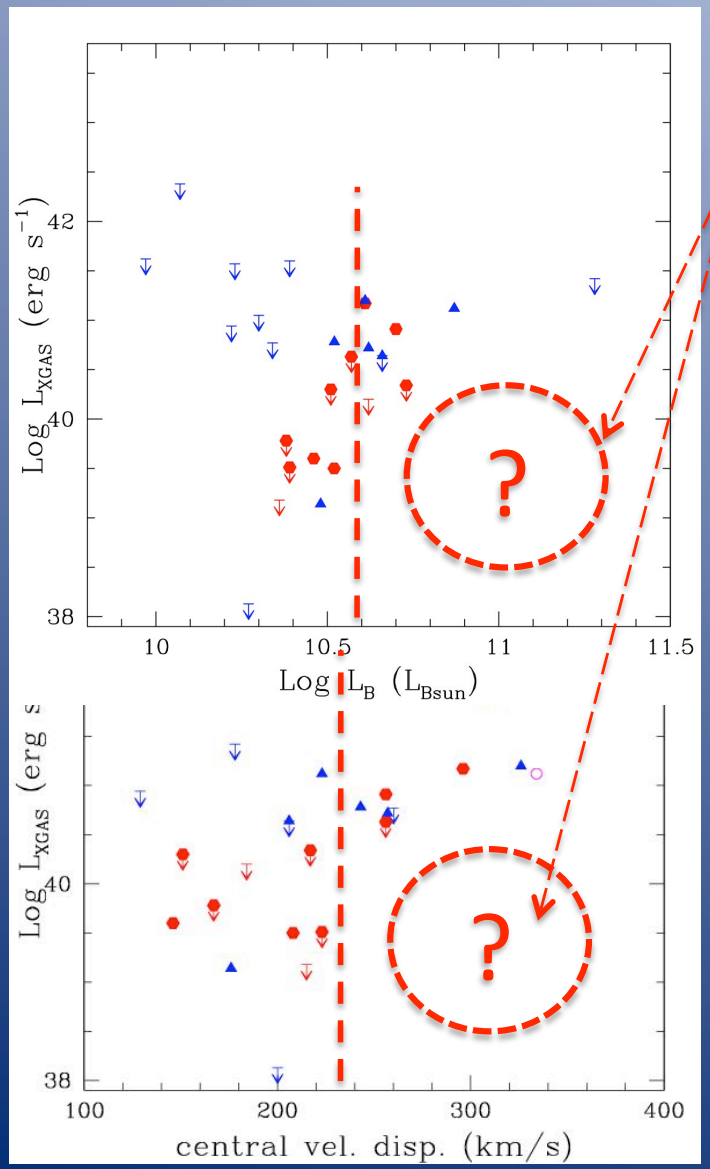
Other quantities?





Isolation:

is this a guarantee of a more homogeneous behaviour?



No "observational bias" from X rays.

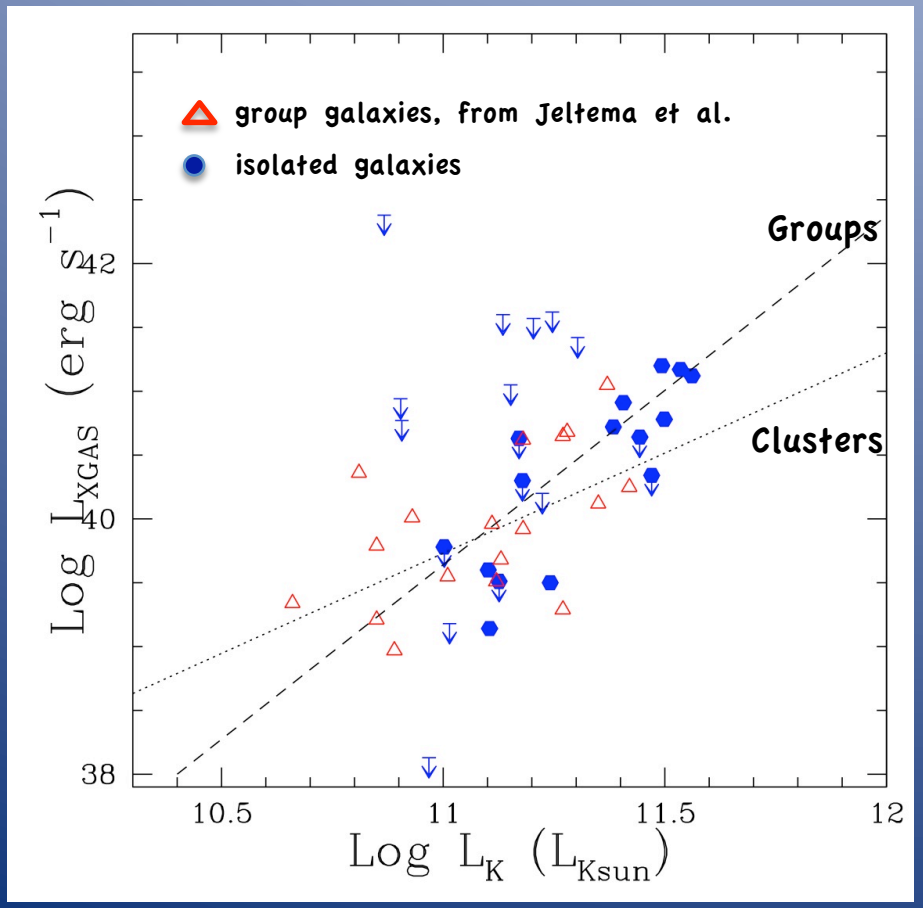
$M > M^{\star}$ or $L_B > L^{\star}$ ➔ galaxies "hold on" to the hot gas produced
Gas masses consistent with accumulation from stellar mass loss

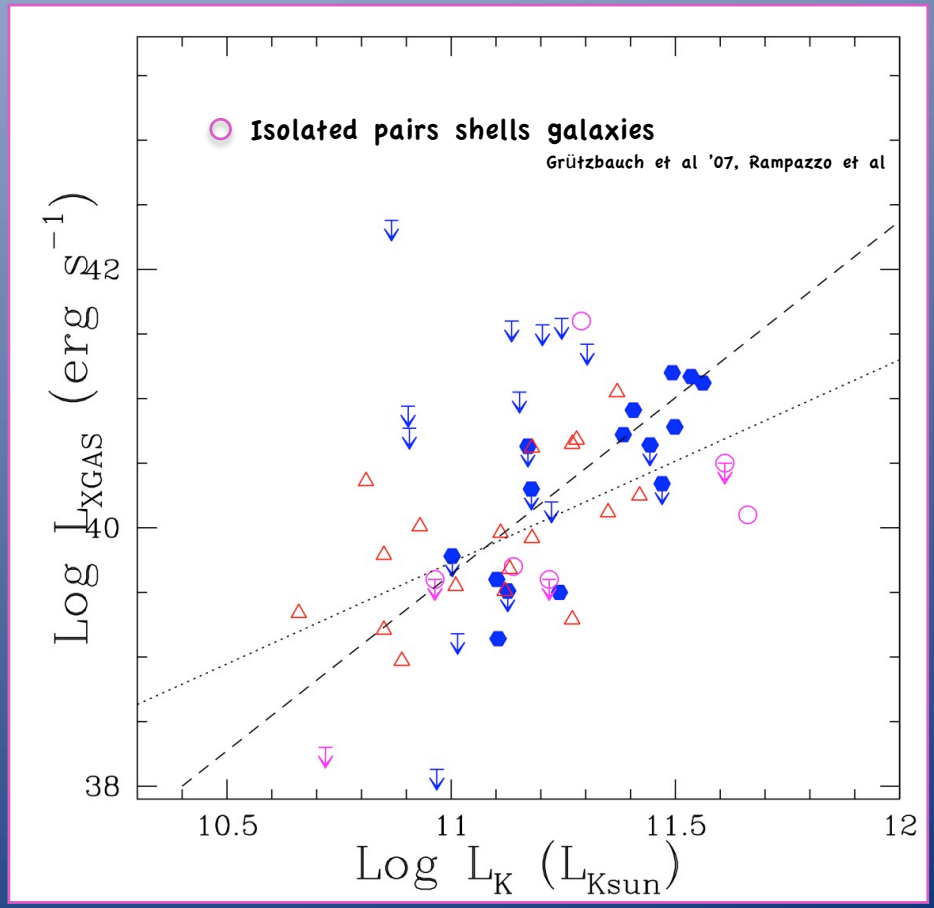
$M < M^{\star}$ or $L_B < L^{\star}$ ➔ galaxies "can" loose the hot gas produced

Isolation:

is this a guarantee of a more homogeneous behaviour?

"Less extreme" yet "poor" environments



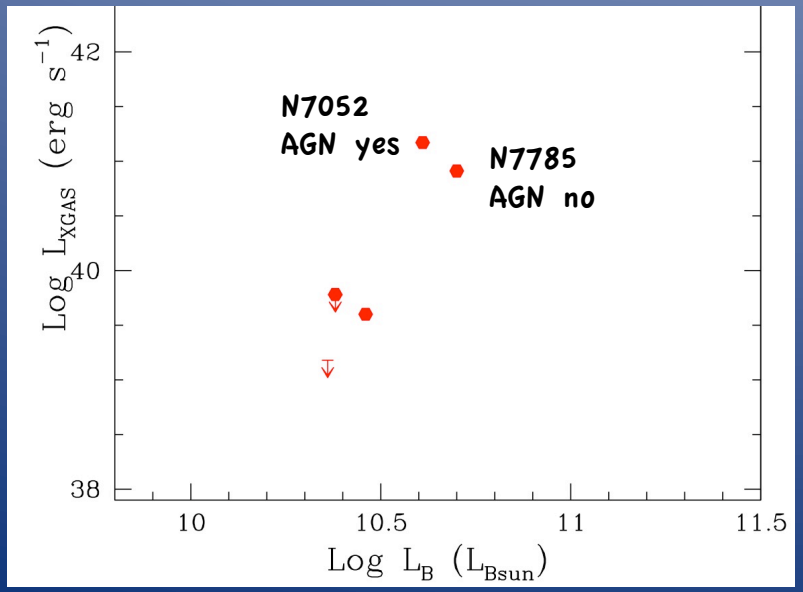


ISOLATION IS NOT THE FULL ANSWER!

Scatter in the Lx-Lb relation is not entirely due to environment - some must be intrinsic !?

ginMerging histories : a lot more work needs to be done!

AGN : what role do they play? Is feedback important at regulating "gas retention"?



More complex than simple presence of a [now active] AGN