The environmental impact of galaxy evolution

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Galaxy Groups as Probes of Cosmic Feedback

Hot gas in groups (temperature, “entropy”, metallicity) affected by cosmic feedback.

Groups are common and very susceptible to these effects.
Galaxy Groups as Probes of Cosmic Feedback

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Binned abundance profiles of 15 groups (JR + Ponman 2007):

\[ r_{500} \bar{\rho}(r \leq r_{500}) = 500 \rho_{\text{crit}} \]
Supernova Feedback

SN Ia/II ratio in core ⇒
“recent” enrichment
($z \approx 0.7$; HDF/CDF)

Ratio in outskirts:
Consistent with
predictions for $z \gtrsim 1$.
(Dahlen+ 04)

SN yields from
Iwamoto+ 99 (SN Ia),
Nomoto+ 06 (cc-SN)
Supernova Feedback and Star Formation History

Within $r_{500}$:

$\text{SN Ia}$

$M_{\text{Fe, Ia}} / L_K (M_\odot / L_\odot)$

$\langle T \rangle \text{ (keV)}$

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Supernova Feedback and Star Formation History

SN rates: Mannucci+ 05 for local early-types
Supernova Feedback and Star Formation History

- $M_{\text{HeII}}/L_K (M_{\odot}/L_K,\odot)$
- $L_{K,BGG}/L_{K,tot}$
Supernova Feedback and Star Formation History

Enrichment timescales indicate much higher SN rates per unit luminosity in the past.
Quantifying SN Feedback

If each SN within $r_{500} \rightarrow 10^{51}$ ergs:

- Enrichment levels correspond to $\sim 0.7$ keV per gas particle from SN (cf. also Davé+ 08)
- Also limits AGN feedback (virial theorem)
Quantifying AGN Feedback

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Assuming $\eta \approx 0.1$ for BH energy conversion eff.

1 order of mag. $>$ current $L_{mech}$ of AGN (cf. Birzan+ 04)
Summary

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Integrated AGN feedback limited
Results may help constrain galaxy formation models (and possibly SMBH growth).

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