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BLACK HOLE AND GALAXY COEVOLUTION

FROM CONTINUITY EQUATION AND ABUNDANCE MATCHING

AIMS AND METHODS

We investigate the coevolution of galaxies and hosted supermassive black holes throughout the history of the Universe by a statistical approach based on the **continuity** equation and the **abundance matching** techniques. Specifically, we present analytical solutions of the continuity equation without source term to reconstruct the supermassive **black hole** mass function from the AGN luminosity functions (*see Fig. 1*). Such an approach includes physically-motivated AGN light-curves tested on independent datasets, which describe the evolution of the Eddington ratio and radiative efficiency from slim- to thin-disc conditions. We exploit the same approach to reconstruct the observed **stellar mass** function at different redshift from the UV and far-IR luminosity functions associated to star formation in galaxies (*see Fig. 2*). In addition, we develop an improved abundance matching technique to link the stellar and BH content of galaxies to the gravitationally dominant **dark matter** component. The resulting relationships constitute a testbed for galaxy evolution models, highlighting the complementary role of stellar and AGN **feedback** in the star formation process.

Fig. 1: AGN luminosity → BH mass function

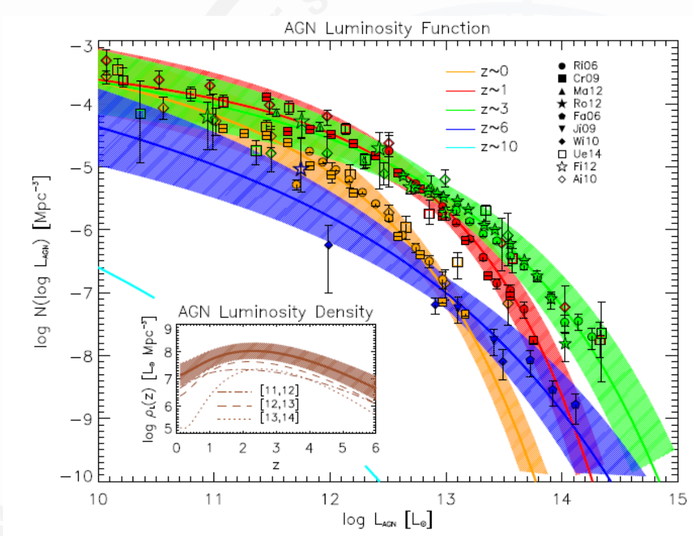
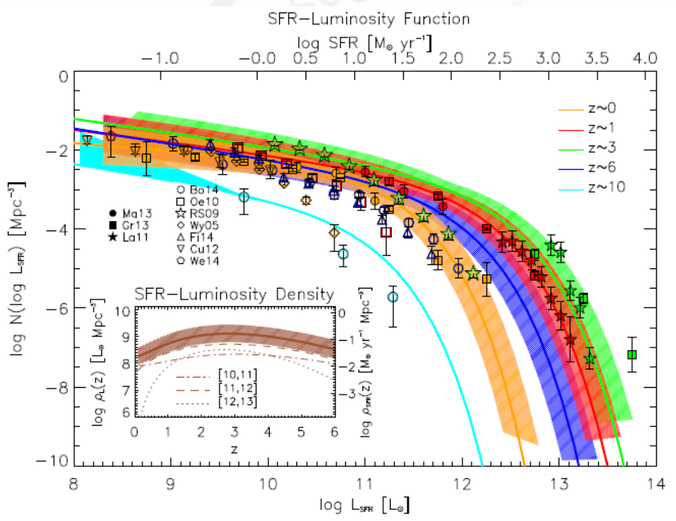


Fig. 2: Galaxy SFR → stellar mass functions



MAIN RESULTS

Our analysis highlights that:

(i) the buildup of stars and black holes in galaxies occurs via ***in-situ*** processes, with merging processes playing a marginal role at least for stellar masses $< 3 \times 10^{11}\ M_{sun}$ and BH masses $<10^9\ M_{sun}$.

(ii) The **duty cycles** of AGN and galaxy activity are close to unity at high redshift.

(iii) The **clustering** properties of BHs and galaxies are found to be in full agreement with current observations (*see Fig. 3*).

(iv) The **specific** star formation rate increases with redshift at least up to $z \sim 6$, and in the range $0 < z < 3$ the results from the continuity equation agree with the so called galaxy `main sequence' of starforming galaxies.

(iii) The BH to stellar mass ratio evolves mildly at least up to $z \sim 3$, signaling that the BH and stellar mass growth occur ***in parallel*** (*see Fig. 4*).

(v) already at $z \sim 6$ substantial **dust** amount must have formed over short timescales $\sim 10^8$ yr in starforming galaxies, making these sources well within the reach of *ALMA* surveys.

Fig. 3: Galaxy/AGN clustering

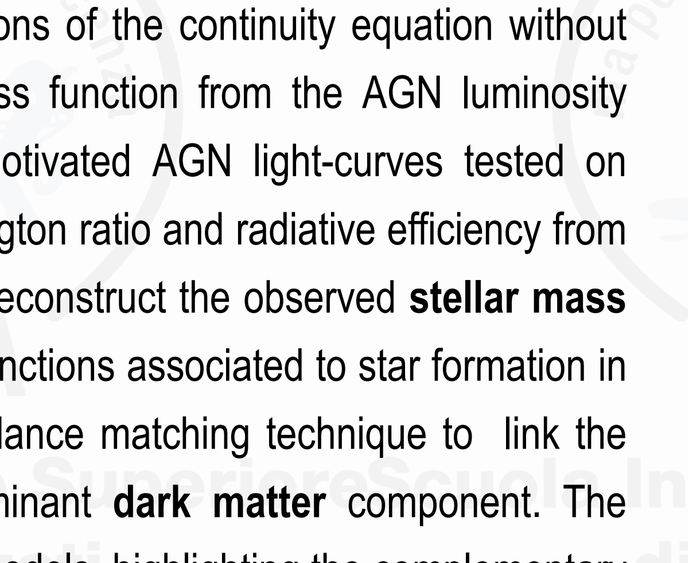
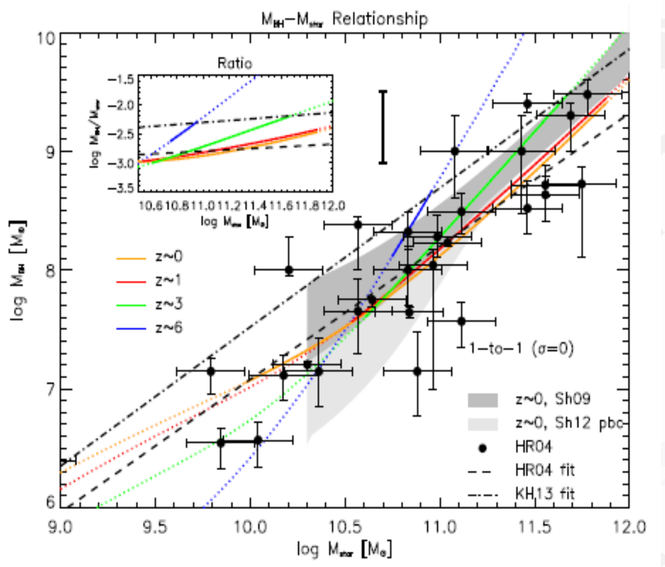


Fig. 4: BH to stellar mass ratio



Aversa, Lapi, et al. 2015, ApJ, 810, 74