SuperMassive Blackholes grow from stellar BHs of star formation history?

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Abstract. The origin of the supermassive black hole masses M_{SMBH} discovered at the highest redshifts is still actively debated. Moreover the statistically significant relation of M_{SMBH} with bulge luminosities L_V, extended on several magnitude orders, confirms a common physical process linking small ($\leqslant 1pc$) to large (kpcs) size scales. The Spectral Energy Distributions (SEDs) of two $z = 3.8$ radio galaxies 4C41.17 and TN J2007-1316, best-fitted by evolved early type galaxy and starburst scenarios also imply masses of stellar remnants. Computed with the evolutionary code Pegase.3, the cumulated stellar black hole mass M_{sBH} reach up to several $10^9 M_\odot$, similar to M_{SMBH} at same z. We propose the $SMBH$ growth is due to the migration of the stellar dense residues (sBH) towards the galaxy core by dynamical friction. Discussed in terms of time-scales, this process which is linking AGN and star formation, also fully justifies the famous relation $M_{SMBH} - L_V$.

Keywords. stars: formation, supernovae, galaxies: evolution, high-redshift galaxies, nuclei, ISM: supernova remnants

1. From the SED best-fits of z=3.8 radio galaxies

The two z=3.8 radio galaxies 4C41.17 and TN J2007-1316 are selected for their low AGN contribution from the distant radio galaxy sample HeRGE (Drouart *et al.*, 2014). Their continuous multiwavelength SEDs from the HST, Spitzer and Herschel satellites (Seymour *et al.*, 2007) are corrected for coherent apertures and calibrations. From Rocca-Volmerange *et al.* 2013, the UV-visible to far-infrared star emissions (through stellar photospheres and dust) are modeled with the help of the evolutionary code Pegase.3 (Fioc, Rocca-Volmerange *et al.*, near submission) by building a large number of synthetic libraries. The scenarios of Hubble type galaxies are robust, fitting the local SDSS color-color diagram and predicting significant photometric redshifts (Le Borgne & Rocca-Volmerange, 2002) or faint galaxy counts. Fig. 1 shows that the starburst age of 30 Myrs reproduces the far-IR emission while the old component is needed in the near-IR and the optical. At 30 Myrs, all supernovae of lifetime duration $\leqslant 30Myrs$ already exploded into dense residues (stellar black hole or neutron stars) and ejecta enriching the ISM. By subtracting the ejecta mass from each supernova mass, its dense residue mass is derived. The code Pegase.3 estimates the cumulated mass M_{sBH} of dense residues to a few $10^9 M_\odot$ comparable to M_{SMBH} measured at similar redshifts (Rocca-Volmerange *et al.*, 2015).

2. The migration process

According to Binney & Tremaine, 2008, the timescale t_{fric} for a compact object to decay towards the galactic center through dynamical friction might be long in case of a standard $10M_\odot$ stellar black hole at the scale of a few kpcs of a radio galaxy disk. Both
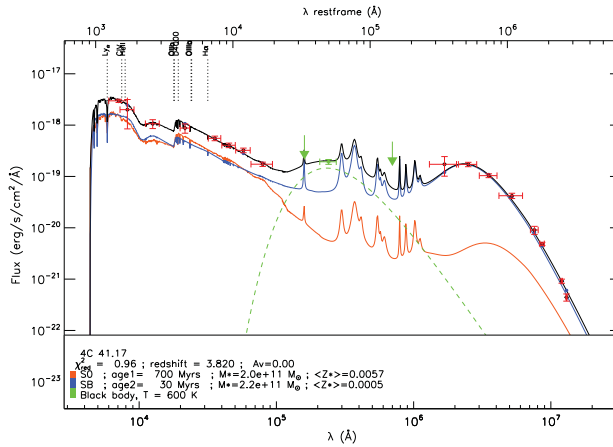
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Figure 1. Best-fit (black) of the continuous SED observations (red +) of the z=3.8 radio galaxy 4C41.17. Components are: old S0 galaxy (orange), evolved starburst (blue) and AGN thermal emission (green dashed). Green points and arrows are not fit-included.

Table 1. Ages, luminous star mass M_{star}, stellar Black Hole mass M_{sBH} and metallicity Z of the young (SB) and early (Elliptical/S0) components of the two z=3.8 radio galaxies.

Galaxy Comp.	Age [Myrs]	$\mathbf{M}_{star}$ [$10^{11} M_\odot$]	$\mathbf{M}_{SBH}$ [$10^9 M_\odot$]	Z
4C41.17SB	30	2.2	8.5	0.0005
4C41.17S0	700	2.0	4.3	0.0057
TN J2007-1316SB	35	0.8	3.4	0.0001
TN J2007-1316Ell	1200	9.4	19.0	0.0155

Spitzer-Herschel SEDs and SLOAN data correspond to apertures $\geqslant 5$ arcsecs. Higher spatial resolution images of 4C41.17 from HST (Miley *et al.* 1992) and VLA (Carilli *et al.* 1994) give star formation zones of $\leqslant 250pc$ and star masses ($10^{10} M_\odot$) inducing M_{sBH} mass of $\simeq 10^7 M_\odot$ with the final $t_{fric} \approx 0.1$Gyr respecting the cosmic time of 1.6 Gyr at z=3.8 (Rocca-Volmerange *et al.*, 2015). Probing the stellar black hole accretion for fueling central black holes is a simple explanation for SMBH growth, which corresponds to a similar star formation law for luminous stars and sBH. Moreover it would be the key of the known $M_{SMBH} - L_V$ relation. More improvements of this approach is waited for by disentangling the AGN and cold grain emissions of more active radio galaxies from the distant HeRGE sample and the z$\simeq$1 3CRR catalog, at present in progress.

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