Dust in the first quasars as a powerful probe of galaxy/BH co-evolution

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The origin of the large dust masses (>10^8 M_{sun}) revealed by mm and sub-mm observations of z>5 quasars is still hotly debated and interpreting/understanding the strong connection between the formation and growth of the first quasars and their host galaxies represent a challenge for both models and observations.
By means of a semi-analytical model we demonstrate that the physical properties of quasars and of their host galaxy, such as the mass of the nuclear BH, the dynamical, gas dust masses, are tightly constrained.
We show how dust formation and evolution may provide insight on the physical processes driving and regulating the co-evolution of quasars and their hosts in the early Universe: the dust mass produced by stars depends on the nature of the stellar populations (e.g. the stellar initial mass function) and on the shape of the star formation history, which is controlled by the evolution of the gas content through mergers and outflows driven by SNe and by the AGN; the total mass of metals is a tracer of the integrated star formation history (total stellar mass) and it is sensitive to the strength and frequencies of metal-rich outflows as well as to the efficiency of dust growth in molecular clouds.
As a further constraint, we show that the investigation of the origin of the spectral energy distribution of one of the best studied high-luminosity high-z quasars, SDSS J1148+5251 (z=6.4), points to an evolutionary scenario where about 60% of the observed FIR luminosity is due to dust heating by the central AGN; heating due to stellar radiation provides a necessary but not dominant component to the emission at 20−60 μm.