ACTIVE GALAXIES

A quasar, afar

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A luminous active galaxy at a redshift of $z = 7.54$, the most distant detected to date, has been estimated to host an actively accreting supermassive black hole with a mass of 800 million solar masses. The quasar (ULAS J134208.10+092838.61) was detected in the ALLWISE and UKIDSS large area surveys and spectroscopically confirmed with the FIRE spectrograph on the Magellan 6.5-m Baade telescope by a team of researchers led by Eduardo Bañados. It trumps the previous record-holder by $z = 0.45$, probing back into cosmic time a further 80 million years to just 690 million years after the Big Bang.

The mass of the black hole at the centre of the active galaxy was calculated using a scaling relation that links the quasar's luminosity with the size of the broad-line emitting gas region around the black hole. Combined with the width of its Mg II emission line, which reflects the orbital velocity of the swirling gas, and under the assumption that the gas is under virial equilibrium, these quantities provide a robust estimate of the black hole mass. This scaling law has been defined locally (based on quasars at $z < 5$) and the validity of the mass estimate relies on it still being applicable in the higher-redshift, higher-luminosity limit.

There are two main implications of this finding. First, that supermassive black holes of this mass can form extremely rapidly in the early Universe, presumably following the merger of seed black holes with masses in excess of 10,000 solar masses, through episodic, hyper-Eddington accretion or through the direct collapse of a massive gas cloud. Second, the quasar's Lyman-α spectrum shows absorptions due to its surrounding intergalactic medium (IGM), implying that the IGM is significantly (but not entirely) neutral. Thus this galaxy probes the epoch of reionization, the Universe's last major phase transition.

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