The hunt for high-redshift quasars

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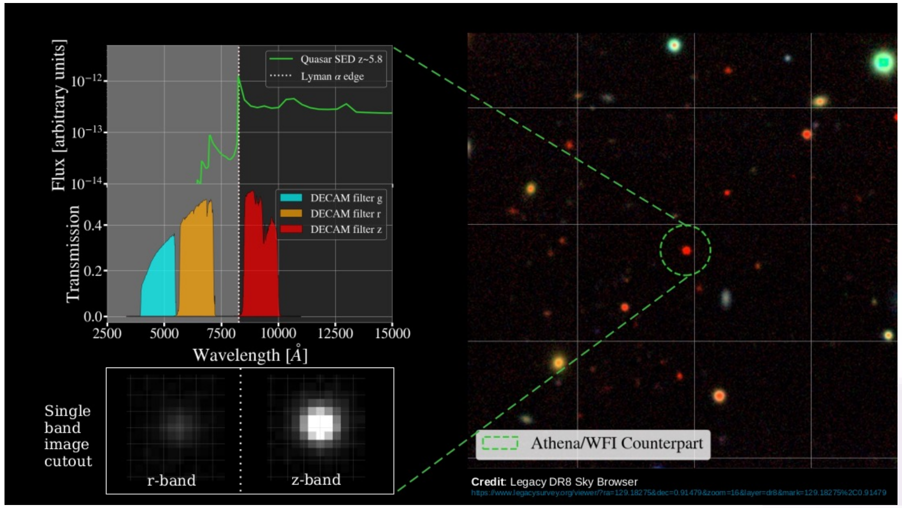

Searching for optical counterparts to Athena soft X-ray detected sources that drop out of the bluer photometric filters will enable the potential discovery of z>6 quasars (Images show a quasar found by Fan et al. 2001, seen in the Legacy DR8 survey).

Quasars constitute an ultra-luminous subspecies of active galactic nuclei (AGN). Powered by a central super-massive black hole (SMBH), they radiate from X-rays to radio wavelengths and outshine their host galaxies. From a morphological point of view, quasars appear as stellar-like point-sources on the sky but their spectra show broad optical emission lines, which are believed to be the signature of rapidly orbiting ionized gas close to the SMBH. The distance to these quasars is measured using the shift of their emission lines towards longer wavelengths, i.e. their redshift. In the past twenty years, astronomers have discovered quasars at ever-increasing distances. The farthest quasar discovered to date lies at a redshift z~7.6, which corresponds to a light travel time of roughly 13 billion years. The mere existence of SMBHs only 700 million years after the Big Bang challenges our understanding of their formation. The nature of SMBH seeds and their growth mechanisms are actively being investigated.

High-z quasars, observed when the universe was less than 1 billion years old, live in a very different environment than our local universe and are probes of the so-called epoch of reionization. At these early cosmic times, the abundance of neutral hydrogen in the intergalactic medium suppresses electromagnetic emission at wavelengths shorter than that of the Lyman alpha line, a strong and broad emission line typically observed in quasar spectra.

Astronomers use the combined effects of this spectral absorption “trough” and redshift to find quasars in wide optical and infrared surveys. A common technique is to search for point-like sources that drop out of bluer optical/UV photometric filters due to the shift of the non-absorbed part of the quasar emission towards longer wavelengths. About 345 quasars have been discovered beyond z=5.5 in this way but only 10% of these have been X-ray detected so far. Indeed, given the typical ratio of X-ray to optical emission properties of quasars, a combination of the large field of view and sufficiently high sensitivity is required to sample this population of distant and rare objects at high energies. With its expected flux limit, the Wide Field Imager (WFI) aboard *Athena* will be able to probe the emission of quasars and fainter AGN up to z=8. Searching for photometric dropouts among the optical counterparts to *Athena*/WFI detected point-like sources will enable the most complete census of X-ray selected quasars at the epoch of reionization to date. Their space density will shed new light on models of SMBH seeds and their evolution.