

## The X-ray properties of $z\sim 6$ quasars

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More than 200 quasars (QSOs) with spectroscopic redshift  $z > 6$  have been discovered so far.

Multi-wavelength observations showed that these QSOs are evolved systems with large black hole masses ( $10^{8-10} M_{\odot}$ ), and their broad-band spectral energy distributions (SEDs) and rest-frame NIR/optical/UV spectra have not significantly evolved over cosmic time.

The formation of their Super Massive Black Holes in less than 1 Gyr is still a challenge for theory, with many simulations claiming they formed at the center of primordial overdense regions.

I report the study of all the 29  $z\sim 6$  QSOs observed so far with X-rays, in which our group concluded that the X-ray spectral properties of high- $z$  QSOs do not differ significantly from those of QSOs at lower- $z$ .

We also obtained a deep 500 ks Chandra observation to study the environment around the QSO J1030+0524, which shows the best evidence of an overdense region around a  $z\sim 6$  QSO. This is the deepest X-ray observation ever achieved for a  $z\sim 6$  QSO. Comparing our results with those from previous XMM observation we found a hardening of the X-ray spectrum and a decrease of the flux by a factor 2.5. This is the first evidence of a variable QSO at such high redshift. I also report the discovery of a diffuse X-ray emission southward the QSO, that could be linked to the feedback of the AGN.

### **Affiliation**

INAF - OASBo

**Presenter:** NANNI, Riccardo (INAF - OAS Bologna)

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