Astronomers discover 16 new high-redshift quasars

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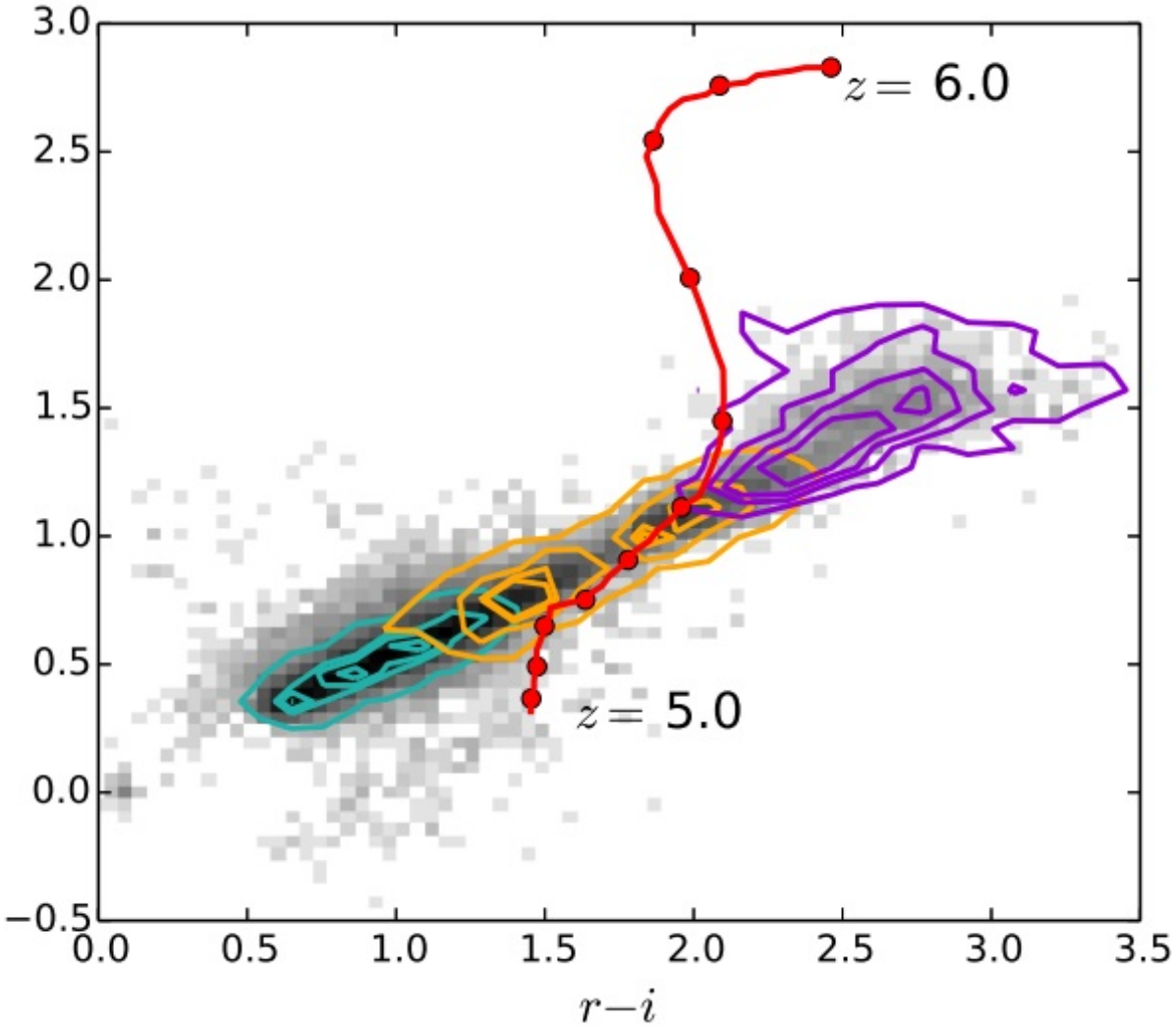

The color track of quasar at z = 5 to 6 (red dots and line) with a step of Δz = 0.1, generated by calculating the mean colors of simulated quasars at each redshift bin. The contours show the locus of M dwarfs, from early type to late type. The

cyan contours denote M1-M3 dwarfs, the orange contours denote M4-M6 dwarfs and the purple contours denote M7-M9 dwarfs. Clearly, z ~ 5.5 quasars are serious contaminated by late type M dwarfs. Credit: Yang et al., 2017.

(Phys.org)—Using a new color selection technique, astronomers have detected 16 new luminous, high-redshift quasars. The discovery could be very important for understanding of the early universe, as such high-redshift, quasi-stellar objects provide essential clues on the evolution of the intergalactic medium, quasar evolution and early super-massive black hole growth. The findings were presented in a paper published Mar. 10 on the arXiv pre-print repository.

High-redshift quasars (at redshift higher than 5.0) are very difficult to find using conventional color selections. This is due to their low spatial density and high contaminants from cool dwarfs. Among more than 300,000 quasars discovered to date, only 290 of them are at redshift higher than 5.0. The scientific community is especially interested in high-redshift quasars at redshift between 5.3 and 5.7, due to their optical colors, which are similar to those of late-type stars. Only about 30 such objects have been found so far.

With the aim of filling this gap of known quasars at redshift ranging from 5.3 to 5.7, a team of astronomers led by Jinyi Yang of the Peking University in Beijing, China, has developed a new optical/infrared color selection technique. The method is based on optical, near-infrared and mid-infrared photometric data from Sloan Digital Sky Survey (SDSS), UKIRT InfraRed Deep Sky Surveys - Large Area Survey (ULAS), VISTA Hemisphere Survey (VHS) and NASA's Wide field Infrared Survey Explorer (WISE).

The method has proved its worth as the researchers were able to find 16

new luminous, high-redshift quasars at redshift within the desired range. The observations were carried out between October 2014 and November 2015.

"In this paper, we report initial results from a new search that focuses on the selection of z ~ 5.5 quasars," the team wrote.

Among the newly discovered quasi-stellar objects, J113414.23+082853.3 is the one with the highest redshift – at 5.69. This quasar also showcases strong Lyman-alpha emission and strong intergalactic medium absorption blueward of Lyman-alpha line.

Another interesting new quasar found by the researchers is J152712.86+064121.9 (at 5.57). It is a weak line quasar with a very weak Lyman-alpha emission line and no other obvious emission features. However, the team revealed that its redshift was measured by matching the continuum to template; thus, its redshift uncertainty is a little larger than others.

The scientists underline the importance of their research, noting that it could help us better understand the evolution of quasars at redshift from 5.0 to 6.0, over the post-reionization epoch.

"The physical conditions of the post-reionization intergalactic medium, at z ~ 5-6, provides the basic boundary conditions of models of reionization, such as the evolution of intergalactic temperature, photon mean free path, metallicity and the impact of helium reionization. They place strong constraints on reionization topology as well as on the sources of reionization and chemical feedback by early galaxy population," the paper reads.

The team now plans to publish another paper in which a broader sample of high-redshift quasars will be presented. This study will also include

the data from the UKIRT Hemisphere Survey (UHS), Pan-STARRS PS1 Survey and the VLT Survey Telescope (VST) ATLAS.

More information: Discovery of 16 New z ~ 5.5 Quasars : Filling in the Redshift Gap of Quasar Color Selection, arXiv:1703.03526 [astro-ph.GA] arxiv.org/abs/1703.03526

Abstract

We present initial results from the first systematic survey of luminous z~5.5 quasars. Quasars at z~ 5.5, the post-reionization epoch, are crucial tools to explore the evolution of intergalactic medium, quasar evolution and the early super-massive black hole growth. However, it has been very challenging to select quasars at redshifts 5.3 ≤z≤ 5.7 using conventional color selections, due to their similar optical colors to late-type stars, especially M dwarfs, resulting in a glaring redshift gap in quasar redshift distributions. We develop a new selection technique for z~ 5.5 quasars based on optical, near-IR and mid-IR photometric data from Sloan Digital Sky Survey (SDSS), UKIRT InfraRed Deep Sky Surveys - Large Area Survey (ULAS), VISTA Hemisphere Survey (VHS) and Wide field Infrared Survey Explorer (WISE). From our pilot observations in SDSS-ULAS/VHS area, we have discovered 15 new quasars at 5.3 ≤z≤ 5.7 and 6 new lower redshift quasars, with SDSS z band magnitude brighter than 20.5. Including other two z~ 5.5 quasars already published in our previous work, we now construct an uniform quasar sample at 5.3 ≤z≤ 5.7 with 17 quasars in a ~ 4800 square degree survey area. For further application in a larger survey area, we apply our selection pipeline to do a test selection by using the new wide field J band photometric data from a preliminary version of the UKIRT Hemisphere Survey (UHS). We successfully discover the first UHS selected z~ 5.5 quasar.