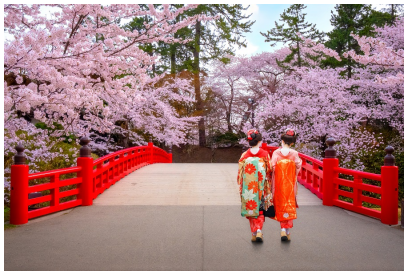

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# Black-hole mass distributions of the most distant low-luminosity quasars

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Exploration of black holes across the cosmic history not only has astrophysical values, but also represents key steps toward better understanding of putative primordial black holes, sources of gravitational waves, and other topics belonging to fundamental physics. We present the first statistical investigation of the black hole properties of low-luminosity quasars in the early cosmic epoch. Combination of optical and near-infrared surveys successfully constructed high-z (redshifts z > 6) quasar samples and are accelerating studies in many directions, such as the physics of growing supermassive black holes (SMBHs), intergalactic medium, UV photon sources that caused cosmic reionization, and the large-scale structure. These quasars have masses up to 10-billion solar masses, at the cosmic epochs as early as several 100 mega-years since the Big Bang. On the other hand, previous surveys were mostly sensitive to the brightest quasars in the rest-UV wavelengths, due to observation limits. According to the latest measurement of the quasar luminosity function, such bright quasars are very rare among the whole high-z quasars population. We are carrying out a project to look for less-luminous quasars with Hyper Suprime-Cam installed on the Subaru Telescope, based on the imaging survey data featuring an excellent combination of depths and field areas. Spectroscopic follow-up observations have been performed at Subaru and other 8-10m telescopes. However, the spectra we obtained contain only Ly-alpha emission lines, without any black hole mass estimators. That is, we haven't understood the mass distribution of these early quasars except for the brighter quasars currently known. In order to conquer this issue, we devised a method to estimate black hole masses of high-z quasars via low-z analogues found from a large spectroscopic sample in Sloan Digital Sky Survey. Through the obtained distribution of black hole masses and mass-accretion efficiencies, we obtained constraints on the nature of their seed populations. This new method would enable us to explore the population properties of the distant quasars and to trace the formation history of SMBHs throughout the cosmic history, and would also be useful for upcoming surveys.

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