研究概要
超大質量ブラックホールの初期成長過程を探る

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My research focuses on the early growth of supermassive black holes (SMBHs). SMBHs with over million solar masses are ubiquitous in our universe. What's the origin of these huge "monsters"? Theoretical works introduce two possible scenarios: they are grown up from either of (1) a massive seed black hole of 10^{3-5} solar masses, or (2) a normal seed of several tens solar masses following by a rapid growth. To clarify the two scenarios, investigating the growth status of SMBHs in the early universe can be critical.

There are already many luminous quasars, i.e., rapidly growing SMBHs, detected in the early universe (e.g., Banados et al. 2018). They are found to have massive seeds over $10^{5\text{-}6}$ solar masses. However, since they are very luminous (so that they are observable) and rare, they may only represent the SMBHs growing under specific physical conditions. To statistically probe the early growth of typical SMBHs, a sample of less-luminous and numerous quasars is required.

Thanks to the wide and deep imaging from the Subaru Hyper Suprime-Cam strategic survey program (HSC-SSP), we search for a large quasar sample at redshift 4 with a wide luminosity range of $20<i<24$ for the first time. The luminosity range is around the knee of the quasar luminosity function (Akiyama et al. 2018), indicating our quasars can represent the typical growing SMBHs at the epoch. We estimated their mass and growth rate by their spectrum derived from the follow-up observations. Compared to the luminous quasars, most of the less-luminous ones have over one order-of-magnitude lower mass and similar growth rate.

With the mass and growth rate information, we are able to trace back the mass assembly history of the less-luminous quasars by assuming different growth modes. Here we found, even under the extreme case of constantly and continuously growing, their seeds can still be as massive as $\sim 10^{4\text{-}5}$ solar masses, implying a massive seed may still be necessary to form typical SMBHs in the early universe.