Why the discovery of a bevy of quasars will boost efforts to understand galaxies' origins

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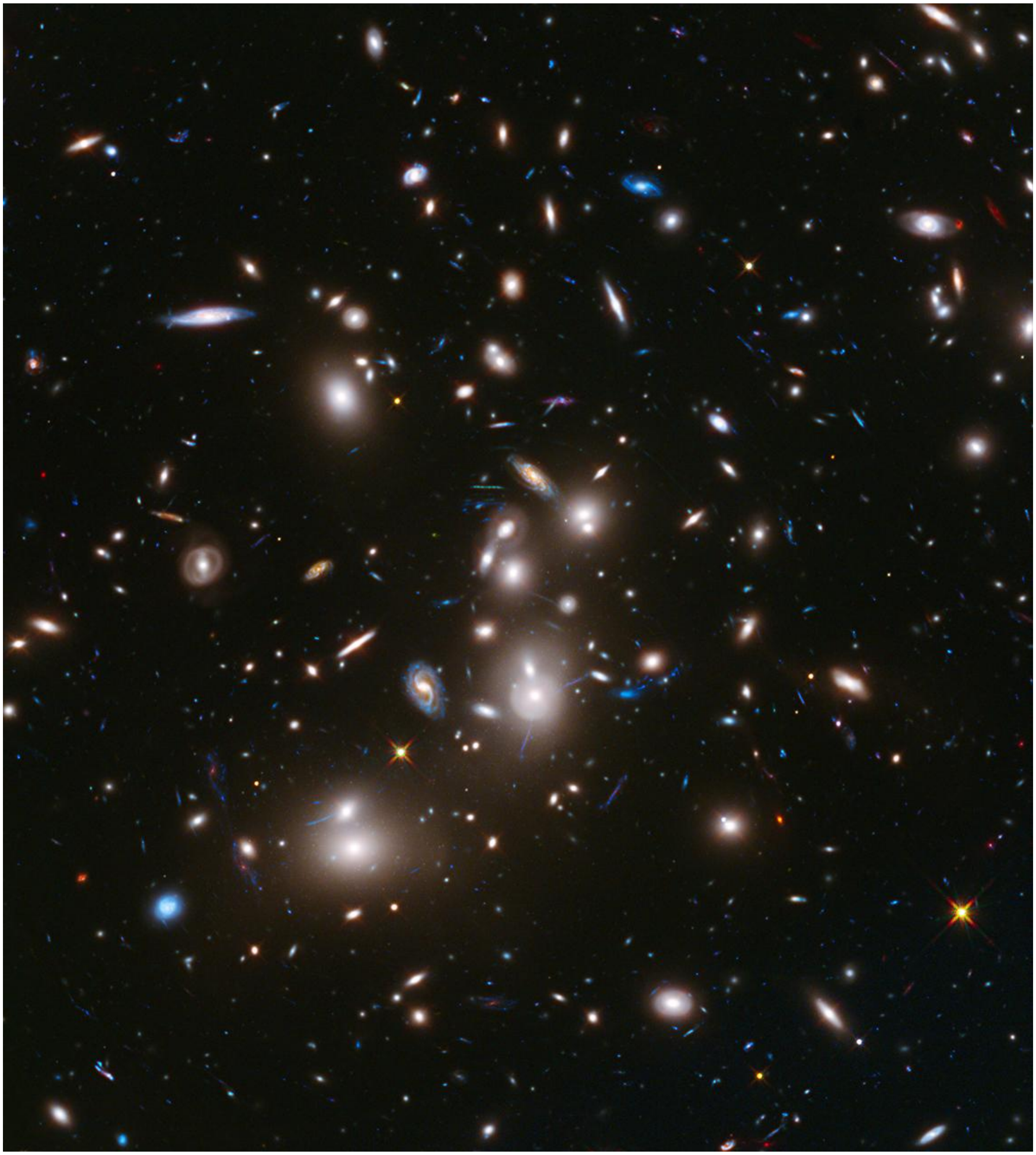

This is a long-exposure image from NASA's Hubble Space Telescope of massive galaxy cluster Abell 2744. It shows some of the faintest and youngest galaxies detected in space. Credit: NASA/ESA/STScI

Late last year, an international team including researchers from the Kavli Institute for Astronomy and Astrophysics (KIAA) at Peking University announced the discovery of more than 60 extremely distant quasars, nearly doubling the number known to science - and thus providing dozens of new opportunities to look deep into our universe's history.

Now, in a roundtable discussion hosted by The Kavli Foundation, three astrophysicists, including a member of the team that made the discovery, explain why this important finding will help unravel the secrets of our modern universe's origins, as well as the mysterious connection between galaxies and monstrous black holes.

Quasars are the stupendously bright regions in the cores of galaxies, powered by gargantuan black holes.

"You can think of quasars as lighthouses in the dark of the early universe," said Roberto Maiolino, a professor of experimental astrophysics at the Cavendish Laboratory of the University of Cambridge and director of the Kavli Institute for Cosmology, Cambridge (KICC). "Just as a lighthouse's beam might shine on nearby land forms, making them visible from far away, quasars enable us to investigate the very distant universe and understand the physics of primordial galaxies."

Ultra-distant quasars offer a unique window into how both galaxies and supermassive black holes developed and interacted. But they are rare, so finding them requires extensive observing surveys using powerful, large telescopes that take images across a large part of the sky.

"My colleagues and I used both the Sloan Digital Sky Survey and the Pan-STARRS survey to find the quasars that we recently reported. Before those surveys began, we really knew very little about distant quasars," said Linhua Jiang, the Youth Qianren Research Professor at the KIAA and an author on two studies published in November and December in *The Astrophysical Journal* about the newfound quasars.

Jiang also noted how the new haul of distant quasars will help show the regions where matter was densest in the early cosmos. Those over-dense regions are where the great clusters of galaxies we see today had their origins. "We'll learn more about the early history of galaxies and how the cosmos got its shape, so to speak," he said.

Studying these quasars will also deepen our understanding of why nearly all galaxies have supermassive black holes at their cores, begging the chicken-or-the-egg question of which came first, the galaxies themselves or the black holes, or whether the two arose interrelatedly.

"Knowing more about the black holes powering quasars will allow us to know more about how galaxies develop," said Marta Volonteri, the research director at the Observatory of Paris and the principal investigator of the BLACK project, which investigates how supermassive black holes influenced their host galaxies, especially as quasars, in the early universe. "And knowing about the evolution of galaxies allows us to trace the universe's history overall. That's why finding more quasars to study is so fundamental."

More information: Linhua Jiang et al, The Final SDSS High-Redshift Quasar Sample of 52 Quasars at> 5.7, *The Astrophysical Journal* (2016). DOI: 10.3847/1538-4357/833/2/222

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