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This article was published online on 29 August 2014.

ASTRONOMY

The age of the quasars

An infrared census of accreting supermassive black holes across a wide range of cosmic times indicates that the canonical understanding of how these luminous objects form and evolve may need to be adjusted.

DANIEL MORTLOCK

Ask an astronomer when quasars were at their peak and they will probably tell you it was about 10 billion years ago, when the Universe was about one-third of its current size[1,2]. Before then, the quasar population was still growing along with other large structures in the young Universe; there has since been a steady decrease in quasar numbers. However, in a paper published in *The Astrophysical Journal*, Vardanyan *et al.*[3] present results suggesting that this widely accepted picture may not be correct — or at least that it does not tell the whole story.

That story started in 1963 with the discovery[4,5] of a new type of astronomical object, referred to variously as quasi-stellar objects or quasars, the name that is generically used today. Their physical nature was initially unknown, but it was gradually deduced[6] that a quasar is a glowing disk of hot, dense material that can form around the supermassive black hole at the centre of a large galaxy, often the result of a collision with a second galaxy. Although such accretion disks are 'only' about the size of the Solar System, they can outshine all the stars in the host galaxy by a factor of a thousand or so. Quasars can hence be seen comparatively easily at great distances, which makes it possible to trace their evolution back to the first billion years after the Big Bang.

More than a million quasars have been catalogued in the 50 years since their discovery. Although this is more than enough for most demographic studies of astronomical objects, it is difficult to obtain a representative sample of quasars that spans a wide range of distances from Earth, and hence cosmic look-back times. It is also challenging to properly account for all the energy output of a quasar, because some of the ultraviolet light that is emitted from the accretion disk is absorbed by dust in the host galaxy and re-radiated at much longer, infrared wavelengths. Most surveys of the quasar population have been undertaken using observations made at optical or near-infrared wavelengths (between about 0.2 and 2 micrometres), and it is these types of measurement that have provided the strongest evidence that quasar numbers peaked fairly sharply 10 billion years ago.

Vardanyan and colleagues studied a comparatively small sample of 10,000 quasars that were initially identified using optical data from the Sloan Digital Sky Survey. But, crucially, the authors had access to longer wavelength measurements (at about 8 μm) of the same objects from the Wide-Field Infrared Survey Explorer (WISE) satellite. They were thus able to get a more complete census of the quasars' energy output and, after correcting for the various complicated observational selection effects that inevitably make such studies so difficult, found some striking results. They confirmed the steady decrease in the quasar population over the past 10 billion years but, rather than the expected drop at cosmic times before 3 billion years, they found a 'plateau' in the quasars' energy output back to a little over a billion years after the Big Bang (Fig. 1). The authors were unable to probe any earlier than this, and one of their conclusions was that extending these sorts of measurements to earlier times is the best way to explore this issue further.

These results are not unprecedented — there have been several similar previous claims[7,8] that the canonical understanding of the quasar population from optical data was incomplete. However, the scale and quality of the WISE data are superior to any previously available. The findings demand serious attention, both

50 Years Ago

There are many puzzles about left handedness. Left handers are often less consistent in using the left hand than right handers in using the right; the incidence of left handedness is raised in many pathological groups and yet left handers may be of high intelligence; several different solutions have been offered to the problem of which cerebral hemisphere leads in speech functions in left handers; left handers seem to be more likely to recover from aphasias than right handers. It is the purpose of this article to describe a model of the inheritance of handedness and cerebral dominance which, together with a hypothesis about the direction of shifts of dominance, might account for many puzzling facts.
From *Nature* 3 October 1964

100 Years Ago

Every important town in Great Britain has established at least one great technical college at large cost in building and apparatus, with staffs of professors and teachers (always badly paid), and it is found that for their first two years the students have to be kept at great cost to the country learning those simple principles of science which they ought to have learnt at school. It is found that they are not only ignorant, but they have none of the habits of thought and scientific method which school laboratory work induces. The clever ones, if they leave school at seventeen, recover from the effects of a school education which prepared men only for being lawyers or clergyman; but the average man finds that he has been prepared only to be a hewer of wood and a drawer of water to the real engineer.
From *Nature* 1 October 1914

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