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2009 : September 2009 - Fast Moving Fronts : Scott M. Croom

## FAST MOVING FRONTS - 2009

**September 2009**

PDF

**Scott M. Croom talks with *ScienceWatch.com* and answers a few questions about this month's Fast Moving Front in the field of Space Science. The author has also sent along an image of his work.**

**Article: The 2dF QSO Redshift Survey - XIV. Structure and evolution from the two-point correlation function**

Authors: Croom, SM;Boyle, BJ;Shanks, T;Smith, RJ;Miller, L;Outram, PJ;Loaring, NS;Hoyle, F;da Angela, A
Journal: MON NOTIC ROY ASTRON SOC, 356 (2): 415-438 JAN 11 2005
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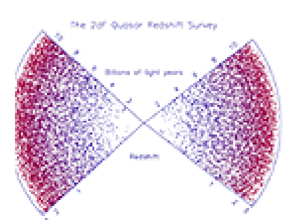
**SW: Why do you think your paper is highly cited?**

We now know that all massive galaxies contain super-massive black holes—a million to a billion times the mass of the sun. There is a growing realization that these super-massive black holes play a critical role in the formation and growth of galaxies.

When gas is funneled down towards a black hole, it forms an accretion disk. The gas in the disk is heated via turbulent processes and generates massive amounts of radiation, as well as relativistic jets. Both the radiation and jets can couple to the material in the host galaxy, strongly influencing its evolution.

In a high accretion rate mode, these black holes can be seen as quasars, the most luminous sources in the Universe. Exactly how the high accretion rates required for a quasar are achieved is not clear, but it is likely that the merging of galaxies could cause the loss of angular momentum in the gas required to fuel quasars.

[+] enlarge



The spatial distribution of 2QZ quasars in our two survey regions, which are

The formation of galaxies, and the impact that feedback from an active super-massive black hole contains, is currently one of the hottest topics in cosmology. There is a large amount of research attempting to model these processes. Our measurements of the clustering and evolution of quasars are primary inputs that guide and constrain these models.

**SW: Does it describe a new discovery, methodology, or synthesis of knowledge?**

The main result of our paper was a new discovery based on a substantial new dataset. It is the size of this dataset that enabled these new insights into the physics of quasars.

5x75 degree regions on the sky, one in each of the north and south galactic caps. Our galaxy is at the centre of the plot, and the points are color coded with more distant (higher redshift) quasars becoming redder. Because the survey volume is so large the distribution of quasars appears largely uniform, but statistical clustering analysis shows very significant clustering on small scales.

**SW: Would you summarize the significance of your paper in layman's terms?**

By measuring the clustering of quasars, our work has allowed us to estimate the typical mass of quasar hosts over a wide range of cosmic time—to a time when the Universe was only 20% of its current age.

It turns out that quasars exist in the same mass hosts at all epochs, which is the mass typical of small galaxy groups. This mass scale is the optimal one for galaxy merging, adding substantial weight to the merger hypothesis for quasar triggering.

Our clustering results are also able to directly demonstrate that quasars cannot be long-lived on cosmological timescales. There must be many successive generations of quasars triggered in different galaxies.

**SW: How did you become involved in this research and were any particular problems encountered along the way?**

I began my Ph.D. studies at the University of Durham, working on the 2dF Quasar Redshift Survey (2QZ). This involved target selection and setting the key science goals of the project, as well as preliminary observations.

The biggest challenge was the massive scale of the project, which targeted over 20,000 quasars, a factor of 20 more objects than the previous largest survey. We used approximately 300 nights of telescope time on the Anglo-Australian Telescope over a period of six years.

The robotic 2-degree Field (2dF) instrument on this telescope enabled the quantum leap in survey size, by allowing us to observe 400 objects at a time. With a sample of this size, most measurements are dominated by systematic rather than statistical errors, so many of the most difficult stages of the analysis involved quantifying these.

**SW: Where do you see your research leading in the future?**

We are currently expanding this work by extending it to an earlier cosmic time. The 2QZ reached to the epoch when quasars were most active, approximately 10-11 billion years ago.

However, at earlier epochs the number of quasars is seen to decline. This decline has only been seen in the most luminous objects, and we are targeting a much deeper survey of faint distant quasars. The aim here is to understand how the quasar population is built up from the earliest epochs.

**SW: Do you foresee any social or political implications for your research?**

Cosmology is all about finding our place in the Universe and understanding our origins. Because of this, there continues to be a high level of interest among the general public. Young and old alike have a natural urge to understand their origins on many different levels.

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KEYWORDS: ACTIVE GALACTIC NUCLEI; DIGITAL SKY SURVEY; SUPERMASSIVE BLACK-HOLES; LYMAN-BREAK GALAXIES; DARK-MATTER HALOES; COSMOLOGICAL CONSTANT; LUMINOSITY DEPENDENCE; SPACE DISTORTIONS; POWER SPECTRUM; HOST GALAXIES.

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