

## Astronomers measure the speed of early quasar

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University of California astronomers working at the Lick Observatory have determined that a faint wisp of light near one of the earliest known quasars is a hot gas apparently moving at a speed of 1.25 million miles per hour.

E. Joseph Wampler, Lloyd B. Robinson and Jack Baldwin of UC Santa Cruz and E. Margaret Burbidge of UC San Diego used sensitive equipment on the 120-inch telescope at the observatory near San Jose, California to measure the properties of the wisp of light which is moving in, out or around quasar 3C 48.

Quasar 3C 48 is one of the few quasars which has a faint wisp or "fuzz" of light near it. Previous theories have attributed the fuzz to the existence of giant galaxies of stars at very great distances.

The UC astronomers found no evidence for normal stars, but determined that the wisp of light near quasar 3C 48 comes from hot gas with a slightly greater redshift than the quasar itself.

A redshift is an increase in wave length toward the red end of the light spectrum. Quasars, faint starlike objects discovered about 12 years ago, have large redshifts in their spectra.

The light of quasar 3C 48 has a 37 per cent redshift or increase in the wave length that would be observed in a laboratory.

According to the UC team, if the difference in the redshifts of quasar 3C 48 and the wisp of light is due to a difference in speed, the velocity of the wisp of light is 570 kilometers per second or 1.25 million miles per hour.

The wisp of light is more than 100 times fainter than the quasar itself even though it lies only a few seconds of arc away from it. The difficult measurement of such a faint light source close to a much brighter one was made possible by a sophisticated computerized detector previously developed by astronomers Wampler and Robinson. The instrument scans and analyzes the light while the bright sky background from the city lights of San Jose is accurately subtracted from the signal.

The redshifts in the light of quasars and even the nature of the quasars themselves are a long-standing astronomical puzzle, Burbidge said.

"The usual explanation for the redshift phenomena and also for the motion of galaxies is that the universe is expanding. Based on that theory, quasars would be very distant objects which we are seeing far back in time," she said.

Burbidge said many observational and theoretical problems in this interpretation have led some astronomers to suggest that the redshifts of quasars may have another explanation. "They may be due to very strong gravitational fields or they may have some new explanation in terms of differing masses of fundamental particles," she explained.

"Since the outlying wisp of quasar 3C 48 has a larger redshift than the quasar, the redshift cannot be due to a strong gravitational field in a black hole in the center of the quasar. If that were the cause, the redshift should be smaller in outlying regions," Burbidge said.

"Our findings, however, do not rule out gravitational redshifts in those quasars with much larger redshifts than quasar 3C 48, nor do they prove that smaller redshifts of objects like quasar 3C 48 are due to the expansion of the universe.

Most probably there are black holes in the centers of quasars where gravitational fields are so strong that light can't get out."

The research results of the UC team are published in the June 1 issue of the Astrophysical Journal Letters.

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