

VLA OBSERVATIONS OF THE DOUBLE QUASAR 0957+561:
GRAVITATIONAL DOUBLE IMAGE OR BINARY QUASAR?

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The radio source 0957+561 was identified by Walsh *et al.* (1979, *Nature* 279, pp.381-384) with a pair of quasars, 6".1 apart on the sky, whose optical emission and absorption spectra are nearly identical. Walsh *et al.* suggested a gravitational lens interpretation in which a single object is split into two images by an intervening massive object. Using the Very Large Array of the NRAO we have made a 6-cm wavelength radio map of 0957+561. The map shows unresolved sources of 36 and 30 mJy coincident with the optical N and S quasars, and a complex extended source of ~ 130 mJy (Roberts, Greenfield, and Burke: 1979, *Science* August 31). The extended emission lies on an arc containing the N quasar, and consists of two resolved sources containing 75 and 28 mJy, located 5".8 and 3".6 NE of the N quasar, a weak source of ~ 10 mJy about 5".5 SW of the N quasar, and a suggestion of a bridge connecting the NE and SW sources and the N quasar. There is no evidence of radio emission from a massive object between the two quasars. Although the existence of the extended source does not rule out a gravitational lens model for 0957+561, the underlying source required would have an unusual morphology. In addition, if the refracting object is at the redshift of the absorption seen in both quasars, its mass would have to be at least 2×10^{14} solar masses. Further observations at the VLA could rule out the gravitational lens model for 0957+561 if a second image corresponding to the NE extended component is not found.

A more natural interpretation of 0957+561 is that there are two separate but physically related quasars, one of which is undergoing an active phase, ejecting relativistic plasma which gives rise to the extended emission. The linear size and radio luminosity of the extended component are typical of those seen in quasar-jet sources such as 3C273. In this model the most intriguing features of the source are the near identity of the optical absorption spectra of the quasars and their proximity in space. The National Radio Astronomy Observatory is operated by Associated Universities, Inc., under contract with the United States National Science Foundation.

DISCUSSION

Wolfe: One crucial test of whether the northern extended radio emission is associated with the double QSO is to make detailed VLB maps of this source. If these VLB maps reveal a jet pointing from the compact component in the direction of the extended component, then the evidence for association would be strong. Have VLB maps been made, and if so, what do they reveal?

D. Roberts: I agree that the detection of such a jet in the north component would be good evidence for association of the extended emission with the north quasar. Conversely, if VLB maps of the two components showed them both to be elongated in a direction perpendicular to their separation, it would strongly support the gravitational double image interpretation. The 6-cm flux ratio of 1.20 which we measure predicts that the images would be elongated by a factor of approximately 15 to 1.