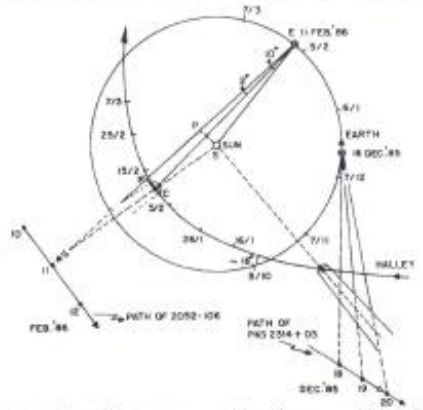

Relative positions of the Sun, the Earth and Halley's comet during the observations reported in refs 1 (December 1985) and 3 (February 1986). The paths of the quasar sources are also shown.

Quasar enhanced

SIR—During the recent appearance of Halley's comet, observations were reported[1,2] of enhanced scintillations of quasars occulted by the cometary ion-tail; however, Ananthakrishnan *et al.*[3] dispute such an origin for these scintillations.

The geometry at the time of both the 103-MHz observations[1] on 18–20 December 1985, and those at 327 MHz (ref. 3) on 10–12 February 1986, is depicted in the figure. On 18 December 1985, the source, PKS2314+03, lay at a solar elongation of about 85°, such that the solar wind contributed only to background scintillations, with an average scintillating flux of about 3 Jy (ref. 1). The observed enhancement was six times this value and 1.5 times the maximum flux normally caused by the solar wind, which, for 103 MHz, occurs at a solar elongation of about 30°.

During the 327-MHz observations[3] on 11 February 1986, the source 2052−106 was presumed to be occulted by the cometary tail. As the perihelion occurred on 9 February, the period 10–12 February is most inappropriate for observing such events: the solar elongation of 2052−106 on 11 February was about 10°, for which, at 327 MHz, strong scattering prevails. The scintillation index is near its maximum at around 14°. Consequently, most of the scattering occurs in a thin layer of the solar plasma centred around the point of closest approach to the line of sight from the Sun. The three control sources were also within 12° of the Sun. Therefore, the scintillation enhancements of all of the sources were due solely to the solar plasma. The source also gets broadened by strong scattering close to the Sun and enhanced outflow of cometary plasma, which results in reduced scintillation. These conditions are therefore unsuited to observing enhancement of scintillations by Halley's comet.

Thus, enhanced scintillations of compact radio sources resulting from occultation by strong cometary ion-tails can be identified only for favourable alignments of the comet, Sun and observer. Such conditions existed during the observations reported in ref. 1 and it is possible, therefore, that the scintillations were of cometary origin. Unambiguous confirmation could be obtained by using more control sources close to the line of sight[4].

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ANANTHAKRISHNAN *ET AL.* REPLY—The importance of our letter[3] lies in its demonstration that control sources are essential in investigations of scintillation through the cometary plasma tail. Alurkar *et al.* also agree that control observations are essential. Without such observations it is difficult to determine whether or not the observed[1] enhancement in scintillation is caused by the plasma tail.

We disagree with the suggestion that because our observations of 2052−106 on 11 February 1986 were made at a solar elongation of about 10° (actually 11.2°), the circumstances were unsuitable for studying the enhancement of turbulence. On the contrary, the outflow of plasma from the comet would be an order of magnitude higher for our observations than for those of Alurkar *et al.*[1], made at a solar elongation of 85° and before perihelion. Furthermore, angular broadening effects are unimportant unless the source is very much closer to the Sun. Therefore, the 60% enhancement seen by us (Fig. 2 of ref. 1) could have arisen either from the comet or from the solar wind. However, a similar increase in the control source implies that a solar-wind origin is most probable. In addition, observations far from the Sun, of the sources 1817−391 and 1921−293 along with control sources, also show no enhancement resulting from the plasma tail[3].

We agree that geometry of occultation is important. Unfortunately, cometary occultations of the required geometry are extremely rare, and consequently there is a need to take every available future opportunity for making occultation observations of radio sources by cometary tails (along with suitable control sources) in order to resolve the present conflict of results.

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