THE FINAL SESSION

Chairman: J. Davis

INTRODUCTION

The final session of the Colloquium opened with three short invited summary talks by R. Hanbury Brown (Two Aperture Optical Interferometry), C.H. Townes (Infrared Interferometry) and J.C. Dainty (Speckle Interferometry). The speakers were invited to highlight the questions and areas of uncertainty that had been raised by the meeting rather than simply summarize the proceedings. The summary talks were followed by an open discussion and the whole of the final session has been transcribed from tape and edited for inclusion in these proceedings.

Earlier in the Colloquium an impromptu discussion was held under the chairmanship of C.H. Townes, at the suggestion of R.Q. Twiss, on the importance of the effects of atmospheric turbulence for long baseline optical interferometry. This discussion took place in the fourth scientific session after paper No.13, but the Editors have incorporated it into the final discussion as it seems more appropriate there.

THE INVITED SUMMARIES

R. Hanbury Brown: Well, I freely admit to being asleep a good deal of the time, but I have heard a lot of the papers, and while I was awake I heard somebody say that if you took away all the angular measurements from astronomy, it wouldn't make much difference. The gentleman has gone. It has rather removed the point of some of the more acid remarks I would have made. (Laughter).

For anybody who might be of the same school of thought, I would remind you that they were being compared with the importance of making measurements of parallax, and obviously somebody didn't know much about the history of astronomy - and I am not going back to Aristarchus, but a bit later than that - I would remind you that Galileo was very much concerned with the problem of the distance to the nearest stars, and he measured the angular diameter of

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Vega in order to establish, on the assumption that Vega was like the Sun, how far away the stars are. And later on Newton calculated the distance to the stars on the assumption that the stars were like the Sun. And this is the point of our angular diameter measurements; the whole history of astronomy shows that angular size measurements have been used to find out what sort of objects we are dealing with. This is very true of radio astronomy; in about 1948-1949 we didn't know what we were dealing with in the way of radio sources, whether they were point sources or not, whether they were galaxies, nebulae or stars. It wasn't until we measured some angular sizes that we began to know what we were talking about. I started a program of measuring angular diameters at Jodrell Bank in about 1949-1950, and it has carried on ever since, and by plodding on and on and on, increasing precision and so on, it has paid off extremely well. I make this point because optical astronomy hasn't conquered this difficult problem of applying very high resolution to optical observations, and I include infra-red astronomy. High angular resolution has paid off in radio astronomy, and it will pay off in optical astronomy. I just want to remove any suspicion that this is not a new observational field of astronomy, because it is, and it is potentially an important one. Therefore it is a great pleasure to attend this meeting.

Now I will confine myself to just one-third of the discussion, which is the question of Michelson-like interferometers at visual wavelengths. By "Michelson-like" I mean an instrument with two apertures in which the flux collectors are comparable in size with r_o. They may be in the range 0.1 to 2 r_o, that sort of thing. Other people will speak about infrared and other people about speckle.

Now in listening to the discussion - and being asleep half the time - my conclusion is that there are two principal questions about a Michelson-like interferometer: the accuracy of the results and the limiting magnitude. As yet there is no evidence on which an answer to either of those questions can be firmly based, although we are beginning to see what the problems are.

In thinking about two aperture Michelson type interferometers, there is one other important problem, the tracking of fringes. We are uncertain as to what we've got to do, because we don't know what the atmosphere does at two

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spaced points; we don't know what the random relative rate of time arrival of light rays is so we don't even know what the fringe tracking thing has got to do, and it looks rather difficult to measure it without first building the instrument itself. The second thing of course is that we don't know how to do it technically. We don't know whether we have to track the actual fringes or whether we can track the envelope of the fringes. We don't know how large the mirror can be in order to gather the light, relative to r_o, for fringe tracking. In fact we don't know much about it yet, and that is a very important thing which has to be solved. I personally believe that if we think about two things in interferometry, accuracy and limiting magnitude, it will turn out that the precision of 1 - 2% which was talked about at this meeting will eventually be achieved, perhaps, by Michelson interferometry; but the limiting magnitude which takes you down to objects like Seyfert galaxies and things like that will be, perhaps, achieved by speckle interferometry. I think maybe that is what will happen, and therefore both fields must be pursued actively because both are important astronomically.

Now another problem in the Michelson interferometer is the problem of tilt correction. Tilt correction is a vital problem in connection with achieving the accuracy we want. We don't really know too much about it; there is a lot of mathematics. We don't really know how fast it is necessary to tilt correct yet, we don't know how accurately we can measure $|\Gamma|^2$, given tilt correction. We don't yet know whether the results that we shall get, which are going to be lower than they should be due to all these various effects, can be accurately corrected back to the value they should have. That is the important thing we have to resolve.

I think this meeting has value in bringing together people who are connected with theory and with practice, and people who are connected with speckle and with Michelson type interferometry. I hope they have exchanged ideas. I certainly have benefited by it.

C.H. Townes: The discussions about astrometry have reminded me of the period about two decades ago when the measurements of time and of length were in a rather similar state. They had been measured for years, and were well-measured with good accuracy, and there had been very little improvement over

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