

VLBI: PAST, PRESENT, AND FUTURE

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ABSTRACT

A brief review of the fundamental principles of very-long-baseline interferometry (VLBI), with emphasis on the role of the frequency standard, will be given first, followed by a discussion of the accomplishments to date in the fields of astrometry, geodesy, and geophysics. The instrumental improvements now under development and their consequences for these sciences will then be described.

QUESTION AND ANSWER PERIOD

DR. VESSOT:

I think these astronomical papers often leave us in a little bit of a mind-boggled condition. I wonder, do you have a gee-whiz number which tells us what a milliarc second is? Is it the size of a Volkswagen on the moon?

PROF. SHAPIRO:

A milliarc second is 5 times 10 to the minus ninth radians so 1,000 kilometers is 10^8 centimeters, so it is a half a centimeter at a thousand kilometers.

DR. VESSOT:

This field, to me, is extremely exciting in that it is a very immediate indication that time is related to a lot of other things, and in future these conferences may well be called the PTTI in length or PTTI in angle measuring, because distance is going to be in -- is, right now -- philosophically not separable from time interval, and I know well that the work at the Bureau of Standards which Helwig is headed toward, is to integrate the question of time interval and distance.

Now, Irwin Shapiro has measured the distance across the solar system in terms of time, so your yardstick isn't scratches on a kilometer bar someplace, but --

PROF. SHAPIRO:

Light seconds.

DR. VESSOT:

Light seconds, or scratches on some other bar, but a different kind of bar.

PROF. SHAPIRO:

In fact, none of the work, either the VLBI work on the earth or the radar work in the solar system is at all related to the -- well, that is not quite so, but it is effectively that kilometers are relevant for our work.

The light second is the key to success.

MR. KRUTENAT:

Would you care to expand on the expansion of those two centers? I heard two numbers, twice the speed of light and three times the speed of light.

PROF. SHAPIRO:

I just did that to see if I would get a rise out of anyone, to see if anyone was awake. That did not imply any violation of general relativity. It is simply that you can take two sources and have them expand, one from the other, in their frame at, say, .95 times the speed of light, and look at them. Look at the light that arrives from one of them where you are, and look at the light that arrives from the other one where you are, but those two are arriving at the same time, and with trivial elementary algebra that you would learn in high school, you can then calculate what the apparent speed of separation is, looked at, on the plane normal to your line of sight, and you can get arbitrarily high apparent velocity.

That is why there was that sub-apparent, and there is no implied violation of general relativity, but it is certainly an implication that things are happening rapidly, and that is why I stressed that.