## DISCUSSION

## EFFECT OF RF NOISE ON BEAM

A. M. Sessler: You have estimated the effect of external noise on the beam, and we know that in the ISR they use the intrinsic noise of the beam to detect the nature of the beam and make plots of intensity versus aperture. So, I wonder about the beam-generated noise and its effect. Have you thought about that at all?

E. D. Courant: Very roughly. I think that this shot noise would be a small component of the beam-induced forces. Now the beam-induced forces are usually just barely large enough to cause some trouble, and this shot noise should be a fairly small component of that.

Sessler: Yes, but there are different time scales involved. The self-forces are barely enough to cause catastrophic trouble but, if you are talking about several hours, then it is not so clear that the noise part is negligible.

Courant: That is entirely possible and I have not looked at this in detail, but I think that question is very much worth exploring.

Amman: We have at least a limit from the ISR. The point is that the self-forces are small and noise can be a fraction only of that force; a measure of the self-forces is the Q shift. Now, you know the limit from the beam-beam limit so you know the noise is acceptable up to a certain limit. I think that at the ISR the Q shift is of the order of $5 \times 10^{-4}$. Ernie has said that the noise effect is only a fraction of the self-forces. You know that the self-forces give a Q shift of the order of say, 0.1. You can say that you can accept, given the ISR experience, a fraction of the order of 3% of this 0.1. So, if the noise gives a force of the order of 3% of the collective forces of the beam it is acceptable. This gives you an order of magnitude.

Courant: I think that the mechanism of the beam-beam limit which Amman will present is something one could call noise or the extraction of noise from the system with several degrees of freedom. The question is quite quantitative: How much noise is extracted out of the shot quality of the beam, and how much noise is extracted from the other degrees of freedom? In both cases that is only a small fraction of the total signal, so the two effects might be comparable but this is highly speculative, because I for one don't really understand the mechanism of converting multidimensional motion into the equivalent of noise.