## PANEL DISCUSSIONS ON LIMITATIONS ON BEAM QUALITY AND INTENSITY IN LINACS, SYNCHROTRONS AND STORAGE RINGS PART II

Panel Moderator: K. H. Reich

(A. A. Kolomensky was asked, and had accepted, to be moderator for these panel discussions. We regret that, unfortunately, at the last moment he was unable to come to the Conference.)

### A. Beam-Beam Interactions and Single-Beam Coherent Effects (Theory)

Panel Members: N. S. Dikansky, J. Le Duff, G. Gendreau, H. G. Hereward, M. M. Karliner, A. Piwinski, J. Rees, A. Sessler

Rapporteur: C. Pellegrini

Most of the discussion was concerned with beam-beam interaction, which proves to be the fundamental limit on the luminosity in electron-positron storage rings. It was emphasized that no theory is yet able to explain the recent experimental observations at the ADONE and ACO storage rings, and that more experiments are needed. Of particular interest were the suggestions to study in more detail,

i) the difference between the weak-strong and the strong-strong beam interactions;

ii) the rôle played by radiation damping in limiting beam current, and

iii) the possibility that coherent interaction between the beams and the surrounding environment also might be of importance since Landau damping may be less efficient when two beams interact strongly.

The discussion on coherent effects indicates that at least a qualitative understanding of these phenomena is now emerging. Particular emphasis was laid on the importance of the shape of the particle distribution function for determining thresholds.

Papers giving more details of the work discussed in this panel are included in the following pages of this session.

### B. Other Mechanisms Leading to Beam Blow-up and Loss (Theory)

Panel Members: E. D. Courant, H. G. Hereward, E. Keil, D. G. Koshkarev, V. N. Melekhin, E. A. Myae, T. Nishikawa, L. Smith

Rapporteur: A. N. Skrinsky

Three topics were discussed during this panel. The first involved the effect of nonlinear space-charge forces in low-energy transport systems. The numerical results obtained in different laboratories are in general agreement and indicate that the distortions of the phase volume can be minimised by rapid acceleration to higher energies and by smoother focusing (+-+- rather than ++--) which decreases the wiggle factor. On the theoretical side, a hydrodynamic approach seems promising. This employs the first few moments of the Boltzmann equation and hopefully will lead to an "equation of state" that describes emittance growth.

The second topic was a coherent instability due to neutralizing electrons. It occurs for unbunched beams at 5 GeV in the Bevatron, and is similar to the instability observed in the DCX-1 plasma at Oak Ridge in 1964. A related phenomenon occurs in the ISR, namely, weak spectral lines are observed at frequencies corresponding to electron oscillations in the potential well of the proton beam.

Finally, a lively discussion centred on Arnold diffusion, which was put forward as a possible explanation for the observed losses in the ISR. Together with radiation damping, this mechanism might also help to explain the observed energy dependence of the beam-beam limit in electron-positron rings. However, clear-cut experiments are needed, preferably in the ISR.

Papers giving more details of the work discussed in this panel are included in the following pages of this session.