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Memo

DATE: *April 11, 2003*

TO: RHIC E-Coolers

FROM: *Ady Hershcovitch*

SUBJECT: **Minutes of the April 11, 2003 Meeting**

Present: Xiangyun Chang, Michael Harrison, Ady Hershcovitch, Jorg Kewisch, Derek Lowenstein, Christoph Montag, Thomas Roser, Jie Wei.

Topics discussed: Simulation & Calculations, Magnets.

Simulation & Calculations: Ady opened the meeting by presenting calculations suggested by Ilan regarding the affect of a 10 nC, 3 cm long electron bunch on parallel ion energy spread during the cooling process. Inside the cooling solenoid, ion and electron bunches travel at the same velocity. With a short intense electron bunch, some of the bunch ions can be subjected to an intense electric due to the electron bunch. As a consequence, an electric force attracts ions into the electron bunch. Since the cooling solenoid is 30 meter long, that force duration is about 100 nsec. To evaluate this effect, ion velocity change is computed from an impulse, which is the product of the 100 nsec interaction time and the force due to the bunch electric field. Once the electric field is known, the rest of the calculation is straightforward. To compute the electric field, the electron bunch was assumed to be an ellipsoid with a hard-edge homogeneous space charge distribution. Under those conditions, an analytical solution to the electric field exists, though the final arithmetic evaluation is rather complex. At that point Alessandro Ruggiero (who used Mathematica for a final integral calculation) and Mike Blaskiewicz (who independently performed the computation with his own program) assisted Ady (both were in agreement). Results of the calculations indicate that changes in velocities of the most affected ions (those at the electron bunch boundary) are miniscule. A stronger effect can result from ions moving, due to their relative velocity in the bunch rest frame, from peak to valley within the potential well generated by electron bunch. Maximum energy is less than 0.5 MeV, i.e., well below $\Delta E/E$. A peaked electron distribution would result in higher electric fields, but the energy spread enhancement will still be insignificant compared to the difference between 0.5 MeV, and $\Delta E/E$. Thomas claimed that this effect is unlikely, since ions are “frozen” within the bunch. And, accumulating effect of multiple impulses may be more significant. Mike pointed out that the effect of an impulse is so small that even multiple impulses is insignificant.

Jorg reported that he is still working on a dispersion that is encountered at dipole where the high and low energy electron beams merge.

Magnets: in answer to Thomas' question, Mike reported that attended the engineering magnet design meeting. The magnet group seriously working with Jorg's latest embodiment that includes two cryogenically cooled regions separated by a meter long warm section. Presently, Jorg has a cooling solenoid solution that has a 3-meter long matching section composed of 6 quadrupoles. It works with reversed field directions in the two solenoids.