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<u>Afternoon Session (14-17:00)</u>

1. **White paper**. The usefulness of a white paper that will clearly and briefly state the advantages of a polarized rf gun and also outline the needed R&D was discussed. A White Paper Committee was formed (Cary, Clendenin, Fliller, Tsentalovich) charged with having a finished paper ready before then next meeting.
    a. The paper should be directed towards all potential applications (ILC, eRHIC, etc.)
    b. Some advantages of rf gun over current DC guns:
        i. Better beam quality (lower transverse and longitudinal emittance), which will reduce beam losses, especially important in the damping ring;
        ii. Simplify injection system by eliminating bunchers;
        iii. Reduction in losses also reduces charge required to be produced by gun.
2. **Known problems**.
    a. Ion bombardment expected to be dominated by light ions. The lower the pressure the fewer the ions.;
    b. Electron back bombardment must be eliminated because of the high SEC.

3. **SRF RF guns**.
    a. Support high average current
    b. Large apertures will mitigate some FE electrons hitting the cathode
    c. Will Cs affect Nb cell?
    d. Kapitza conductivity limit a problem?

4. **Comparison with high-field DC gun**.
    a. A high field (20 mV/m) DC gun would be very competitive with L-band RF gun
    b. For RF gun, beam energy higher, longitudinal emittance lower
    c. RF gun simpler?
    d. No electron back bombardment for DC gun, but serious ion bombardment

5. **ILC BCD**.
    a. RF gun neither a backup nor an alternative design to DC gun
    b. RF gun should be considered “next generation”, although situation might change if ILC emittance were demonstrated

6. **Thermal emittance of GaAs**.
    a. Thermal emittance usually made by measuring emittance in normal way (quad scan, pepper pot, other) for a series of r (radius) values or charge values and then extrapolating to zero radius or charge. Results expressed in mean transverse energy (MTE) vary from 1 to 100 meV. [For a

uniformly illuminated photocathode with hard radius of rc, $\varepsilon_{n,rms} = \frac{\gamma r_c}{2}\sqrt{\frac{kT}{m_e r^2}}$. If we equate MTE and kT, then the normalized rms thermal emittance corresponding to 25 meV is ~0.1 m^{-6} per mm radius. If the cathode is operated at 100 K, the corresponding thermal emittance would be ~0.06 m^{-6} per mm radius.]

   b. At Heidelberg, the effect of space charge was eliminated by making use of MTE/B—where B is an axial magnetic field in which the whole experiment is immersed—as an adiabatic invariant. As the extracted beam drifts, B is slowly reduced, resulting in MTE being exchanged for mean longitudinal energy (MLE). The change in the latter was measured. The result was that electrons with MLE at extraction > the conduction band minimum (CBM) were found to have an MTE at extraction of 25 meV. Below the CBM the MTE increased to over 100 meV for a maximally NEA sample.[1]
   c. Thus it may be desirable to operate the cathode with a PEA surface, which anyway may increase the vacuum robustness and also may slightly increase the polarization.
   d. Generally, if the cathode is activated with Cs only (no oxide), the surface is slightly PEA. There is not much operational experience with cathodes activated in this manner.
   e. The QE for a PEA surface is at least an order of magnitude lower than for NEA. Thus for a high polarization SL, expect an initial QE of <0.1%.
   f. Surface charge limit for PEA cathodes not studied, but expected to be more severe.

7. **Modeling issues**.
   a. PARMELA type codes have limited flexibility
   b. Modern 3-D codes naturally handle electron/ion bombardment issues, but require parallel processing
   c. The physics of the photon absorption and electron emission process in the cathode could be added to the 3-D codes, but a least first this should be developed separately and the usefulness evaluated
   d. What is needed to study cathode damage?

8. **Misc**.
   a. Limited literature on electron and ion bombardment. More research encouraged.
   b. Opportunities for collaboration with FEL groups?
   c. Sub-groups within the polarized rf gun effort might be useful, e.g., for modeling effort.

9. **Next meeting**.
   a. At BNL (Ben-Zvi organize?)

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[1] S. Pastuszka et al., J. Appl. Phys. 88, 6788 (2000), and references therein.

b. In 6-months or about January 2007
c. Encourage European/Asian participation? Rossendorf? Russians?
d. Longer term, tack these meetings to end of larger conference such as PAC? Pro: more justification for extensive travel; Con: the limit at PAC on number of participants from a given lab may exclude a significant number of otherwise willing polarized rf gun scientists.