A BRIEF SUMMARY OF TLD RADIATION MEASUREMENTS IN THE 10 O'CLOCK IR

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I. Radiation dose measurements from 2000 Run.

We believe that PHOBOS may have been the only RHIC experiment to measure the integrated radiation dose on and near the beam pipe in the vicinity of the interaction point during the 2000 run. The radiation pattern is relatively simple and may be useful in estimating the radiation dose to radiation sensitive detectors in other experiments.

After reporting on the measurements for the 2000 Run, we derive a scaling factor for the 2001-2002 Run.

Experience at KEK(Belle) and Fermilab(CDF) indicates that radiation damage to the VA amplifiers on silicon detectors sets in at about 30 kRads, and the amplifiers become in-operative at about 200 kRads.

At 10 o'clock the beam is bent outward from the blue and yellow rings into the IR beryllium beam pipe. The beta* of the intersection was 8 meters and the integrated luminosity was 3 inverse micro barns. The TLD's were read under the assumption that the radiation field was that of a Cs137 gamma source.

Lithium fluoride TLD's from Landauer were taped on the inside and outside of the beam pipe at four locations(-4.84,-1.35,+2.55,and +4.84 meters). Also there were TLD's in the ring plane at +/- 27 cm from the beam center line at z=+/-2.4 meters. These locations and the readings are shown in Fig 1.

The TLD's on the outside of the beam pipe showed a only a factor of 2 variation in dose at the four locations from -4.84 meters(250 rads) to +4.84 meters(120 rads). The TLD's on the inside of the beam pipe showed variations of between 21 and 45 Rads. TLD's on the top and bottom of \the beam pipe at the z=-1.35 meter and z=+2.55 meter locations showed readings equal or less than the TLD's on the inside of the beam pipe as indicated in Fig 2.

At the +/-27 cm distances from the beam center line, the doses dropped to 3 Rads. Judging by the readings at z=+/-720 cm and 14 cm radial distance, the fall off from beam pipe to +/-27 cm is approximately exponential. TLD's at 75 cm radial distances from the beam center line were at the 1 Rad level and may represent the diffuse background level.

The hypotheses for the large outside/inside ratio are that ions are striking the interiors of the quadrupole triplets on either side of the IR. There neutrons are generated and are collimated to the outside of the ring by the D0 and DX dipoles, or ions lose magnetic rigidity and are displaced toward the outside of the ring by the D0 and DX dipoles.

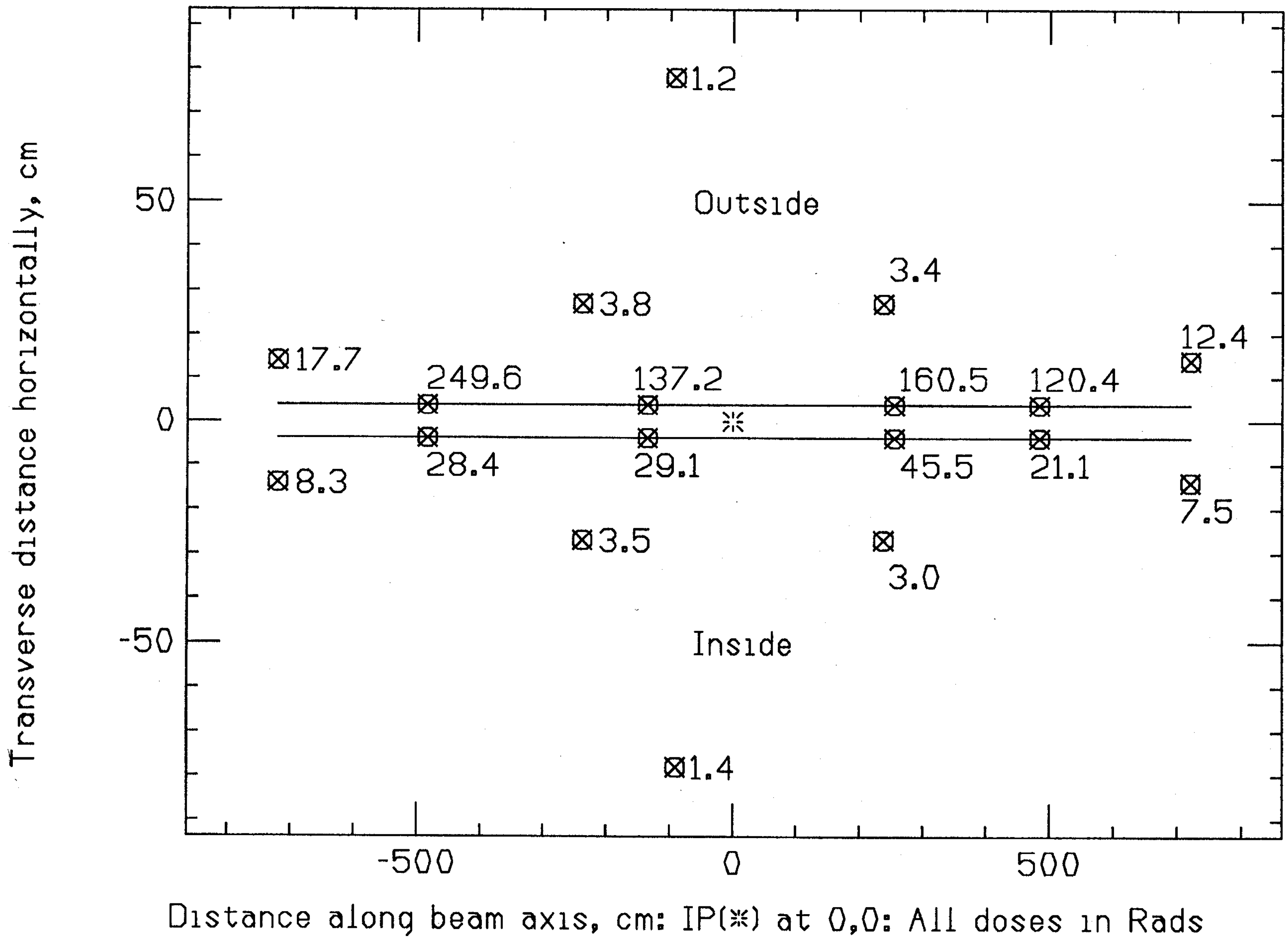

Fig. 1 Location and reading of TLD's in median plane of beam (X-Z)

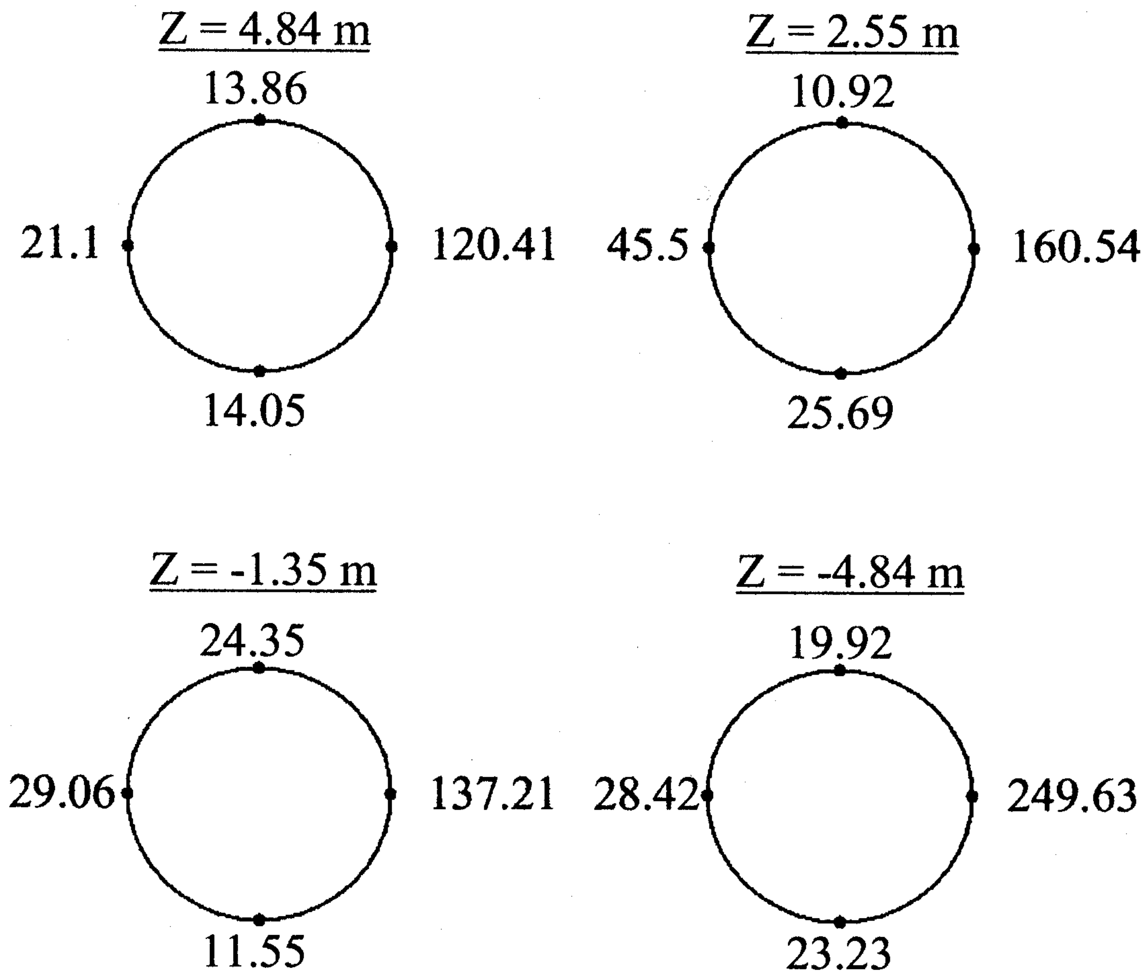

Fig. 2 Locations and readings of TLDs at four beam pipe positions: Longitudinal distances in meters. Diameter of beam pipe is 7.5cm

II. Estimated Increase in Radiation Dose from RHIC 2001 -2002 Run.

If the RHIC run goes from the beginning of June 2001 to the end of March 2002 that will be 10 months of running. The radiation from the polarized protons will be similar to that from Au-Au collisions. The number of protons per bunch is 10^{11} and the number of nucleons per bunch of Au is 197 * 10^9 per bunch, so they are comparable. The lifetime of the proton fills is also longer indicating smaller losses.

The radiation dose is approximately proportional to the beam intensities. The radiation dose due to Au-Au collisions is expected to be at the 1 kRad level from strong interactions for the year. e^+e^- from collisions may possibly increase this value.

Last year, the integrated luminosity for BRAHMS & PHENIX was 4 μb^{-1} in 6 days or 5 μb^{-1} per week. According to Thomas Roser's projections, the luminosity will go to approximately 60 μb^{-1} per week. Luminosity is proportional to the square of the beam current, so the increase in current will be sqrt(12)=3.5. The length of of the 2000 run in terms of luminosity was about 1.5 weeks.

So increase in the integrated beam current for the 2001-2002 run will be:

(10 months x 4.3 weeks/month x 3.5)/1.5 weeks
=~(50 to 200) times 2000 run.

The large uncertainties in RHIC operations lead to the wide range for this estimated increase. It could easily go down due to improved machine performance, a shorter run or significant down time. The estimated increase could go up due to higher losses at the quadrupole triplets or quenches.

For PHOBOS the integrated dose on the outside of the ring averaged 170 rads which would increase to 8 to 34 kRads. The dose expected for the first layers of silicon of the PHOBOS spectrometer, 10 cm from the beam center line for the positive arm would be 1.5 to 6 kRads.

On the inside of the beam pipe the integrated dose averaged to 31 Rads which would go to 1.6 to 6.4 kRads.