Items to Add to Test Beam Run Plan

1. We expect the 1st contribution to saturation to be the inability of the ion chamber to achieve a steady state removal of the ions being deposited at a rate of J= Coulombs/m^2 /sec.
   (J is what Donna calls "instantaneous intensity")
   $\alpha = (d^2/V)\sqrt{J/\varepsilon_0\mu}$ = 1.25 for 1% saturation

2. Saturation does not occur immediately at the beginning of a spill even for a case where J is too large to allow a steady state charge removal. There might be a small time window of one to several hundred nanoseconds in which saturation does not occur. The length of this window should also depend on J, V and chamber geometry. Since MINOS beam spills are 8 microseconds, we probably should not investigate J dependence for short spills or we might get erroneous results. We should use spills as close to 8 microseconds as we can get.

3. The 2nd contribution to saturation will be the transverse explosion of the ion space charge due to the self repulsion. We will not see this effect if the ion chamber pad is much larger than the beam spot. To isolate this effect we should use a 1 cm^2 pad with a 1 cm^2 beam spot. We then compare charge collected on the pad to that collected on the guard ring as a function of intensity.

4. As conditions approach saturation, the electric fields due to the ion chamber plates become smaller, and the ion velocities become very slow. ($v = \mu E$) A false saturation may appear if the integration gate is too short to allow charge collection as the fields recover more slowly. Electron drift velocities are not too sensitive to the fields, but they do vanish at zero fields. At or near saturation we should experiment with widths of integration gates to make certain the apparent saturation is not due to a collection time that is too short.