

Radiation Tests for EMU Electronics

- ***On-chamber electronics to be tested by 6/30/2000.***
- ***Off-chamber electronics will be tested in 2001-02.***
- ***All on-chamber ASIC's and COTS are ~same for all chambers, so they should survive the worst-case radiation environment (ME11)***
 - **Neutron Fluence (>100 keV): $6.2 \times 10^{11} \text{ cm}^{-2}$**
 - **Total Ionizing Dose: 1.8 kRad**
- ***Off-chamber ASIC's and COTS need to survive***
 - **Neutron Fluence (>100 keV): $4.1 \times 10^{10} \text{ cm}^{-2}$**
 - **Total Ionizing Dose: 0.13 kRad**
- ***Need to include a safety factor of 3 - 5 in the above numbers***

Goals for On-chamber Electronics

- Measure **SEE (SEU and SEL) cross sections** for COTS and ASIC's. Use the measurements to predict SEE rates for neutron fluence of **$2 \times 10^{12} \text{ cm}^{-2}$**
- Measure analog performance degradation of ASIC's and COTS due to **TID effects** up to a dose of **5 kRad**
- Measure analog performance degradation due to **displacement damage** of bipolar or biCMOS devices for an *equivalent* neutron fluence of **$2 \times 10^{12} \text{ cm}^{-2}$**

Proposed Test Plan

Following 12/17/99 revised CERN proposal

	63 MeV Protons <i>fluence $3 \times 10^{10} \text{ cm}^{-2}$</i> <i>(TID=4.7 krad)</i>	1 MeV Neutrons <i>fluence $2 \times 10^{12} \text{ cm}^{-2}$</i>
<i>On-chamber CMOS</i>	SEU, SEL, TID	
<i>On-chamber Bipolars</i>	SEU, SEL, TID	Displacement
<i>Off-chamber CMOS</i>	SEU, SEL, TID	
<i>Off-chamber Bipolars</i>	SEU, SEL, TID, Displacement	

Test Procedures

- **Use 63 MeV proton facility at UC Davis to measure SEE Xsections and TID effects**
 - Use latest (final) prototype boards. Power and operate boards as in real situation
 - Use x-y scan table to irradiate one ASIC or COTS at a time, each with proton fluence of $3 \times 10^{10} \text{ cm}^{-2}$
 - Irradiate a number of chips to get meaningful statistics.
 - Monitor analog performance (*gain, noise, timing, offsets etc*) of ASICs during irradiation
- **Use 1 MeV neutron facility at OSU/U Mass to measure displacement effects for bipolar devices**