

Irradiation of 3D devices and bump-bonding

Introduction:

Neutron irradiation (bare sensors + assemblies) shall be performed at Prague. Proton irradiation shall be performed at Los Alamos. Sensors should put under radiation up to 1×10^{16} p/cm².

Protons irradiation is trickier than neutron irradiation because the electronics is highly sensitive to proton radiation. FE-I3 chips have been designed to hold up to 1×10^{15} . It is therefore a problem if one wants to irradiate the assembly (3D + FE-I3) to higher levels. Another ingredient is that sensors should be irradiated under bias and cooled (between -10 and -40 C).

Several solutions have been discussed:

1. irradiate bare sensors and bump-bond afterwards. The problem is to deal with activated sensors (and surrounding equipment) and to do the bump-bonding while keeping the sensor cool
2. the second solution would be to irradiate assemblies and shield the FE-I3 chip from the proton beam. Cinzia and Steve have proposed a shielding idea. There are several issues to be worked out: how to build a fast removal setup of the sensor assembly from the shielding that could be significantly activated, how to increase the bias during the irradiation, how to measure the dose, how to align the beam wrt to the assemblies and shielding. It was suggested that SLAC would design and build the shielding. Simulation is required. This solution was not pursued...!
3. Cold bump bonding: irradiate the sensor and cold bump bond the sensor to the FE-I3 chip afterwards. See point 1.
4. Use a staggered bonding
5. Use a PCB between sensor and FE-I3.

Irradiation periods:

we have been allocated beamtime at LANSCE during the intervals:

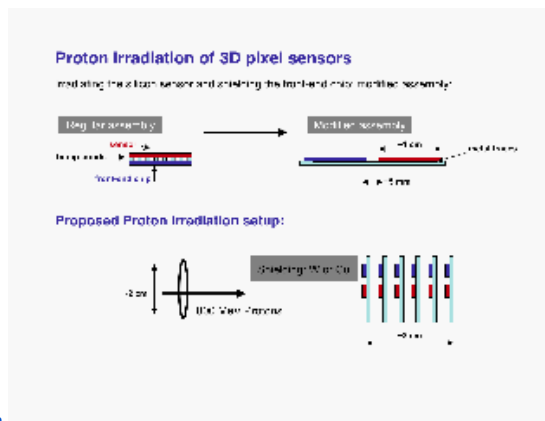
Aug 4 (8am) - Aug 6 (7am)

Dec 1 (8am) - Dec 3 (7am)

We will irradiate sensors in August, in order to test the irradiated sensors during the October TestBeam.

Use of a PCB between sensor and chip:

here the idea is not put a PCB between the sensor and the chip, which would allow to shield the chip. It requires two bump bondings: sensor+PCB and PCB+chip. See Chris's presentation here: [Radiation test with PCB](#)



A drawing of the irradiation set-up can be found here: [Proton_Irradiation](#)

Simulation of the proposed LANL setup (by Heinz Vincke):

Los Alamos irradiation facility

Proton irradiation can be performed at the Los Alamos National Laboratory:

<http://www.lansce.lanl.gov/>

The deadline for submitting proposal for beam time is end of February. Information on how to submit proposals can be found here:

<https://wnr-proposals.lanl.gov/index.shtml>

A summary of the Irradiation can be found here: [Irradiation_Update.pdf](#)