

LANL Irradiation

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Goals

- 1) Study oxide damage in presence of electric fields
- 2) Prepare for CERN beam test of irradiated sensors
- 3) Study radiation tolerance of planar active edge and trench sensors

Conditions

800 MeV protons

Pulse charge measured with Faraday cup

Irradiated five planes, each with multiple devices

Monitored sensor current during irradiation

Monitored sensor temperature during irradiation

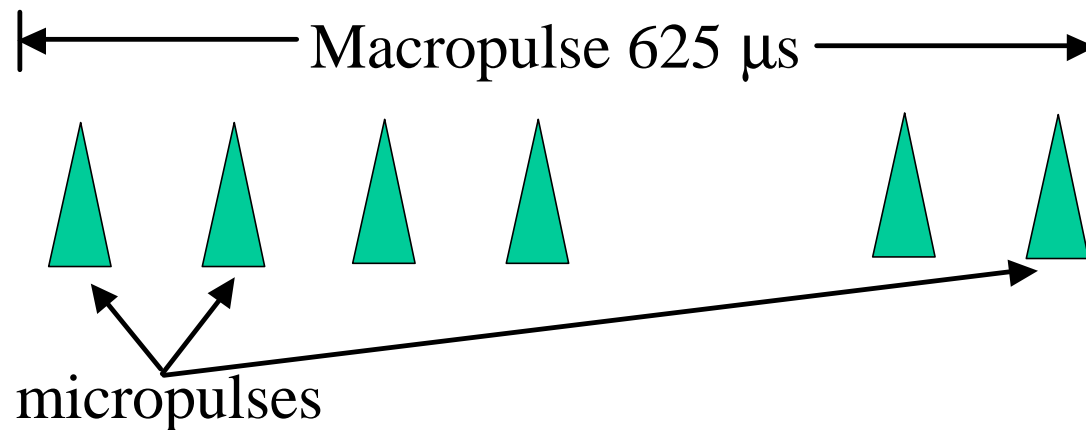
Beam

Narrow “micropulses” 20 ps wide

Micropulse period is 900 ns

697 micropulses form a macropulse

Macropulse is about 625 μs long



Weapons Neutron Research facility

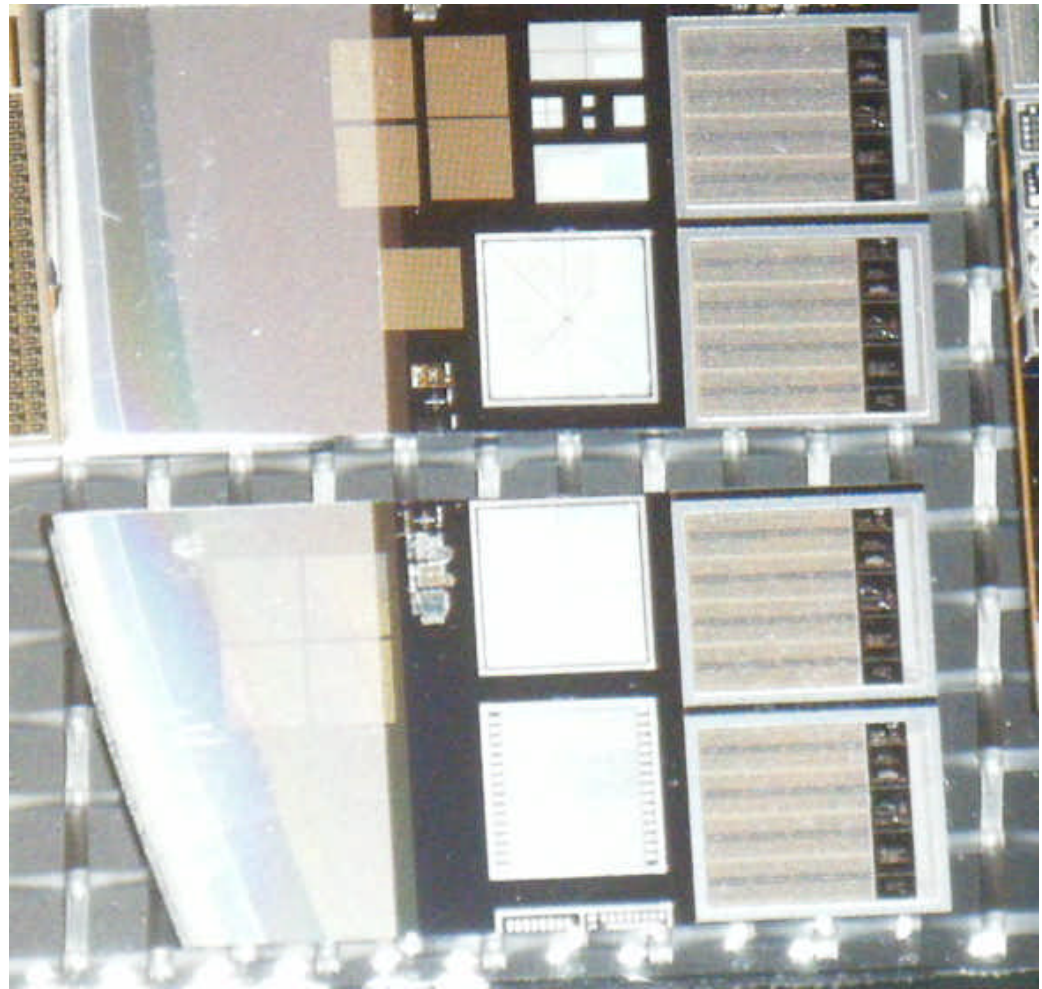


Planes 1 & 2

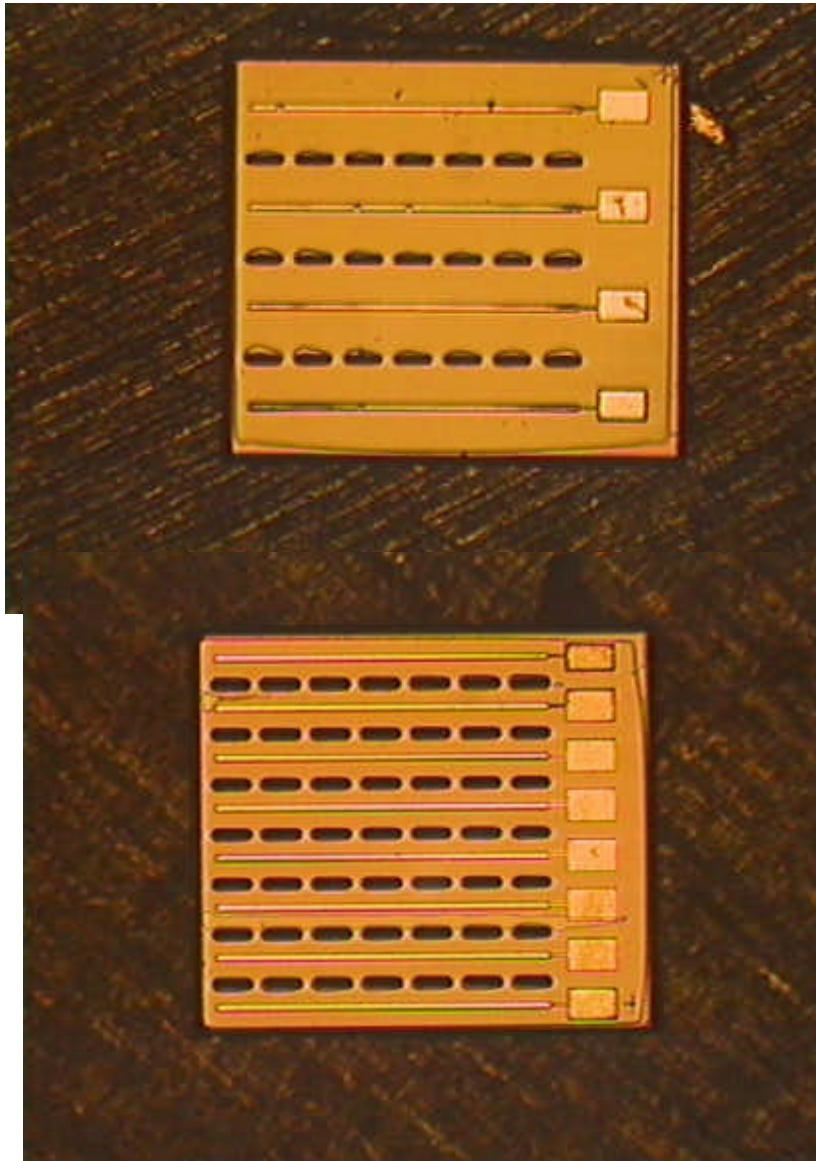
Unbiased ATLAS 3EQs

Will try to bond them to
an FE-I3 close to room
temperature

If bonding is successful,
use in fall CERN beam
test

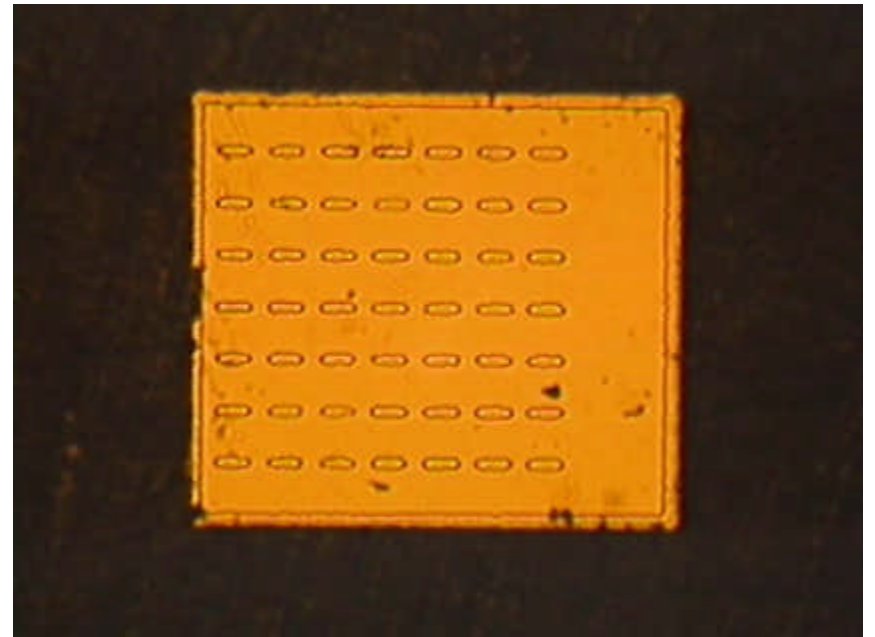


Planes 1 & 2



Unbiased trench sensors

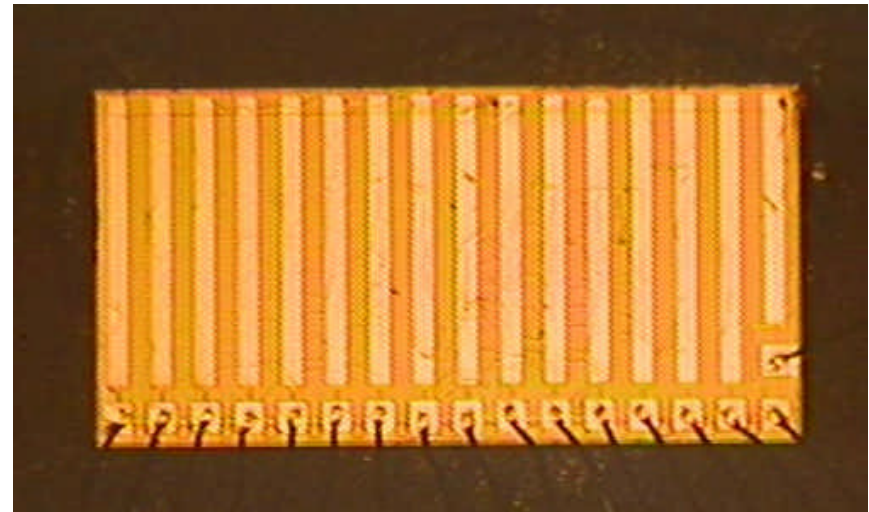
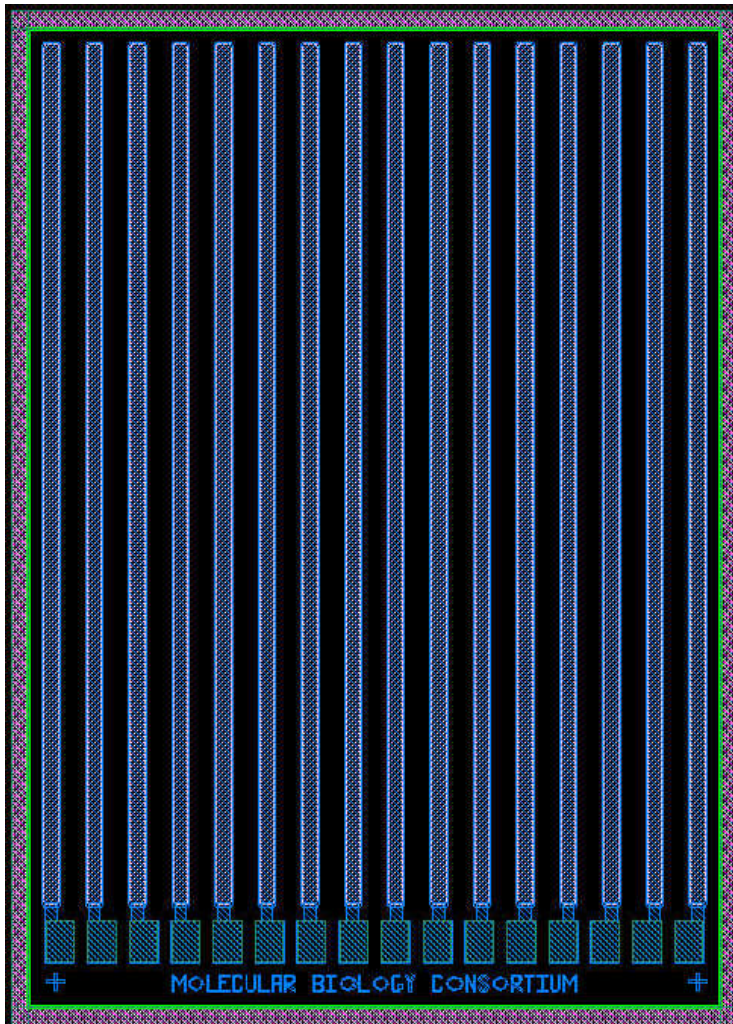
First irradiation of trench sensors



Planes 1 & 2

Unbiased active-edge
planar sensors

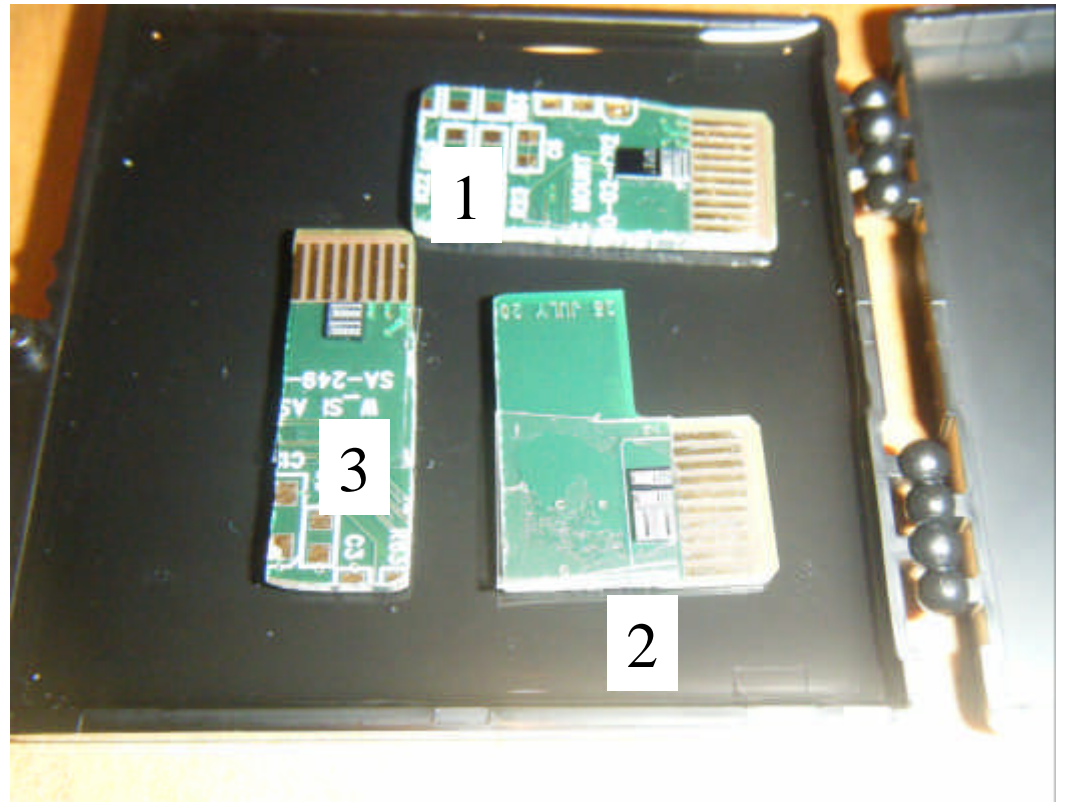
First irradiation of
active-edge planar
sensors



Biased 3D Devices

3 small printed circuit boards

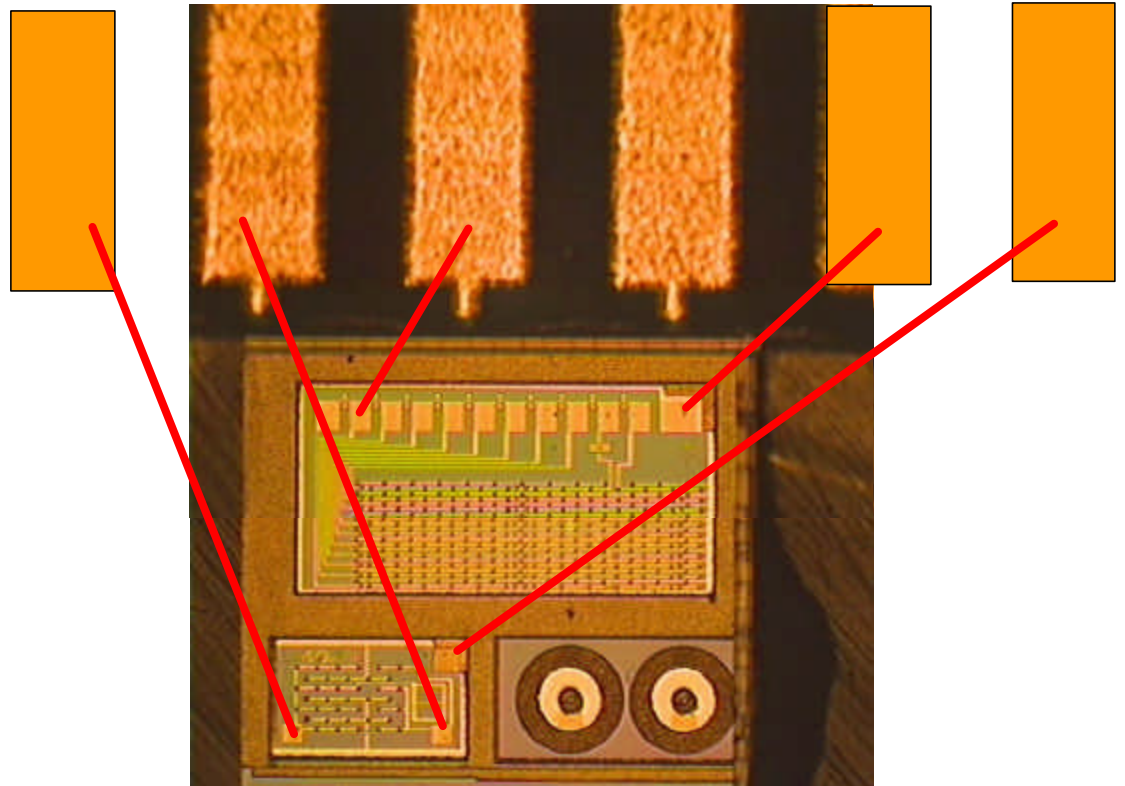
Irradiated under bias



Plane 3

3E ATLAS test sensor

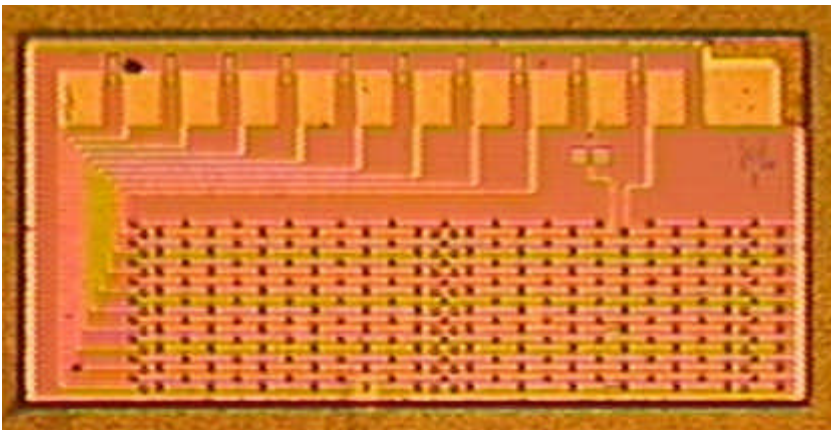
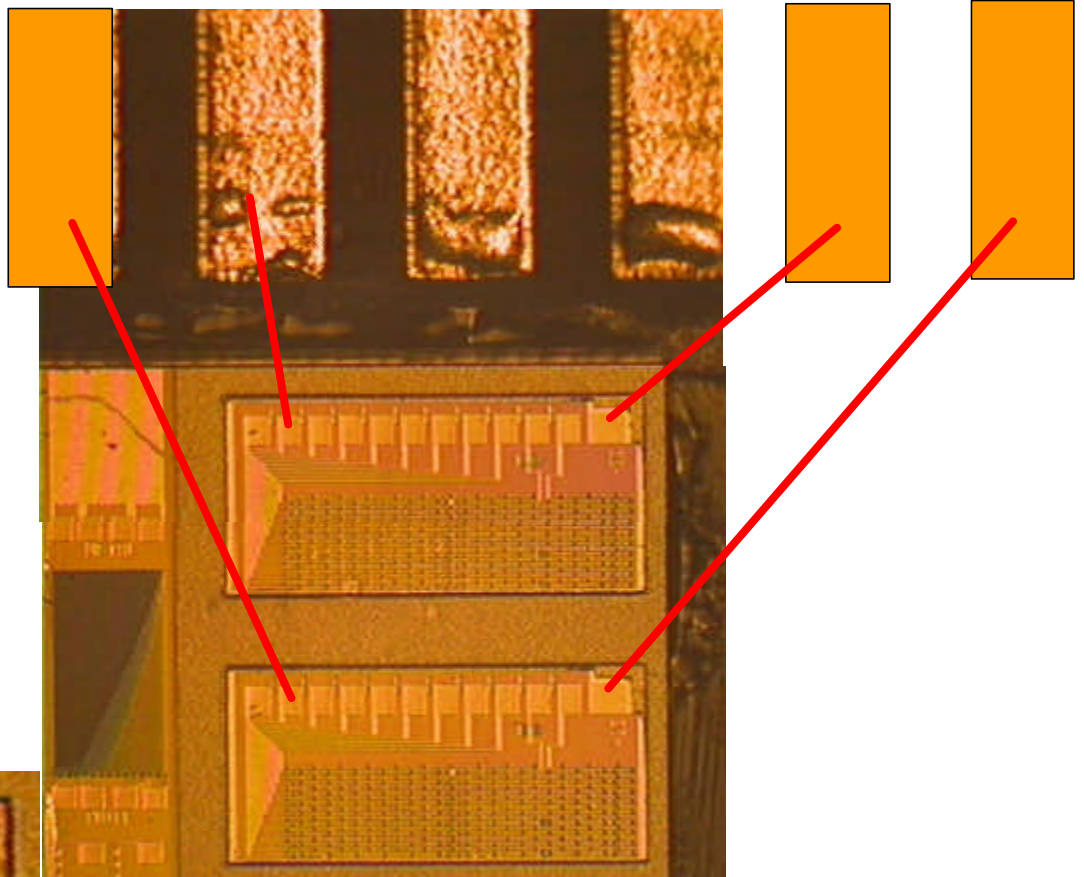
3D MOS switch



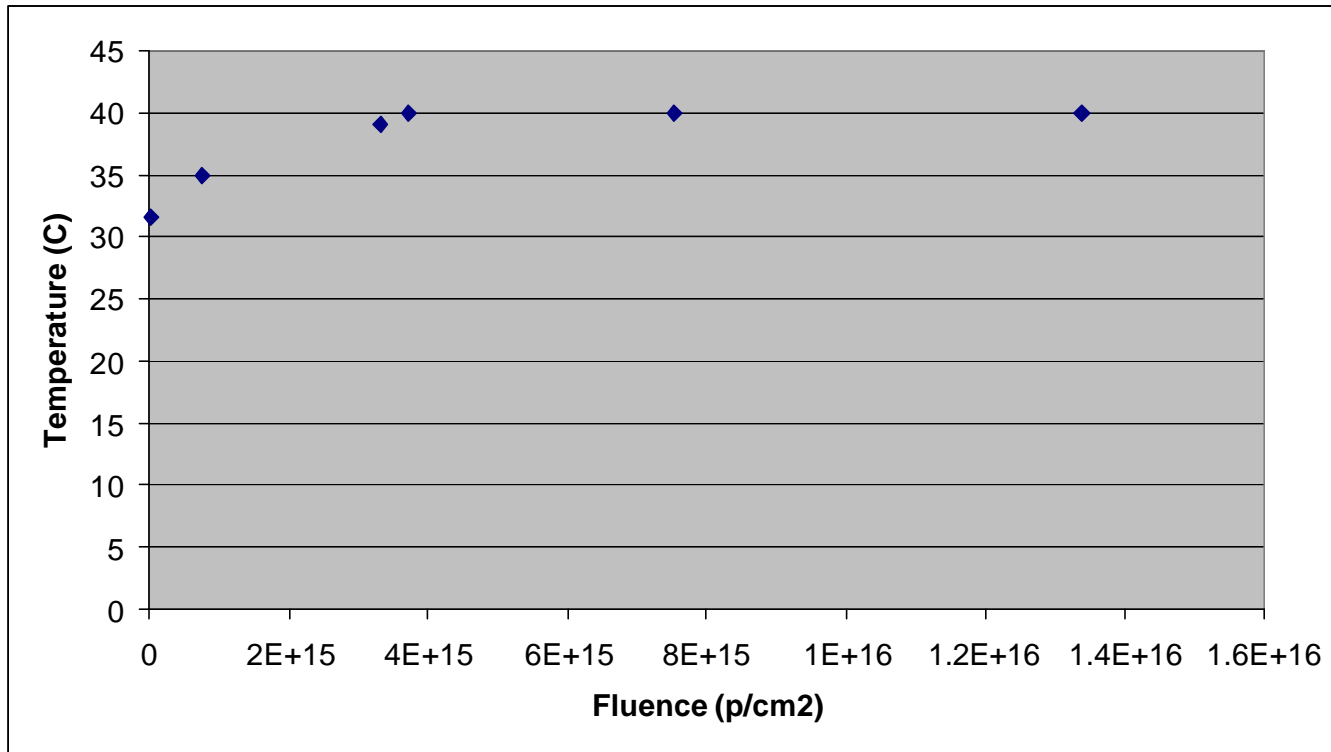
Boards 4 & 5

Pair of 3E ATLAS test
sensors

One biased

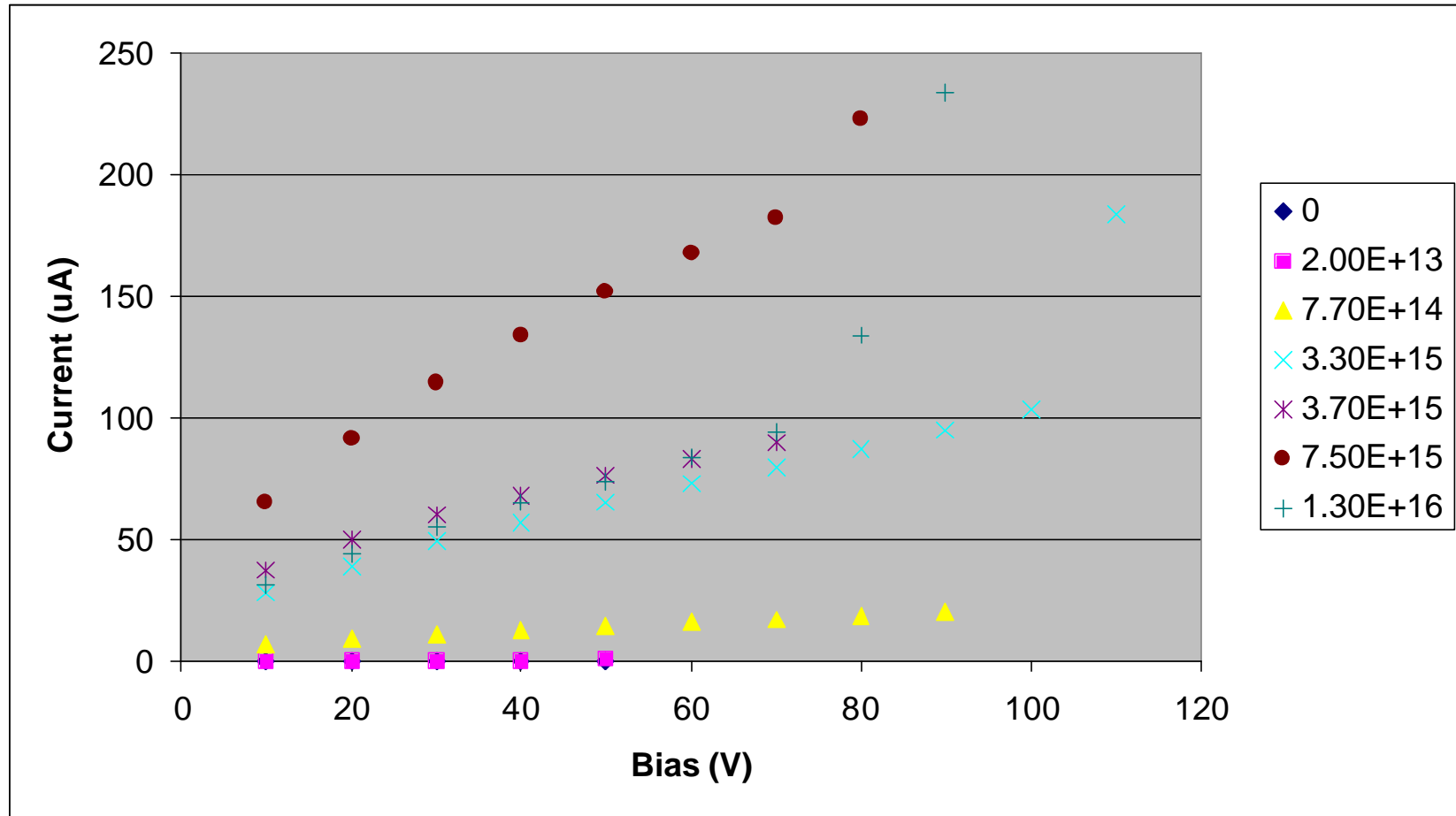


Sensor Temperature



Thermocouples attached near sensors
Separated by Kapton tape
Held in place by Kapton tape

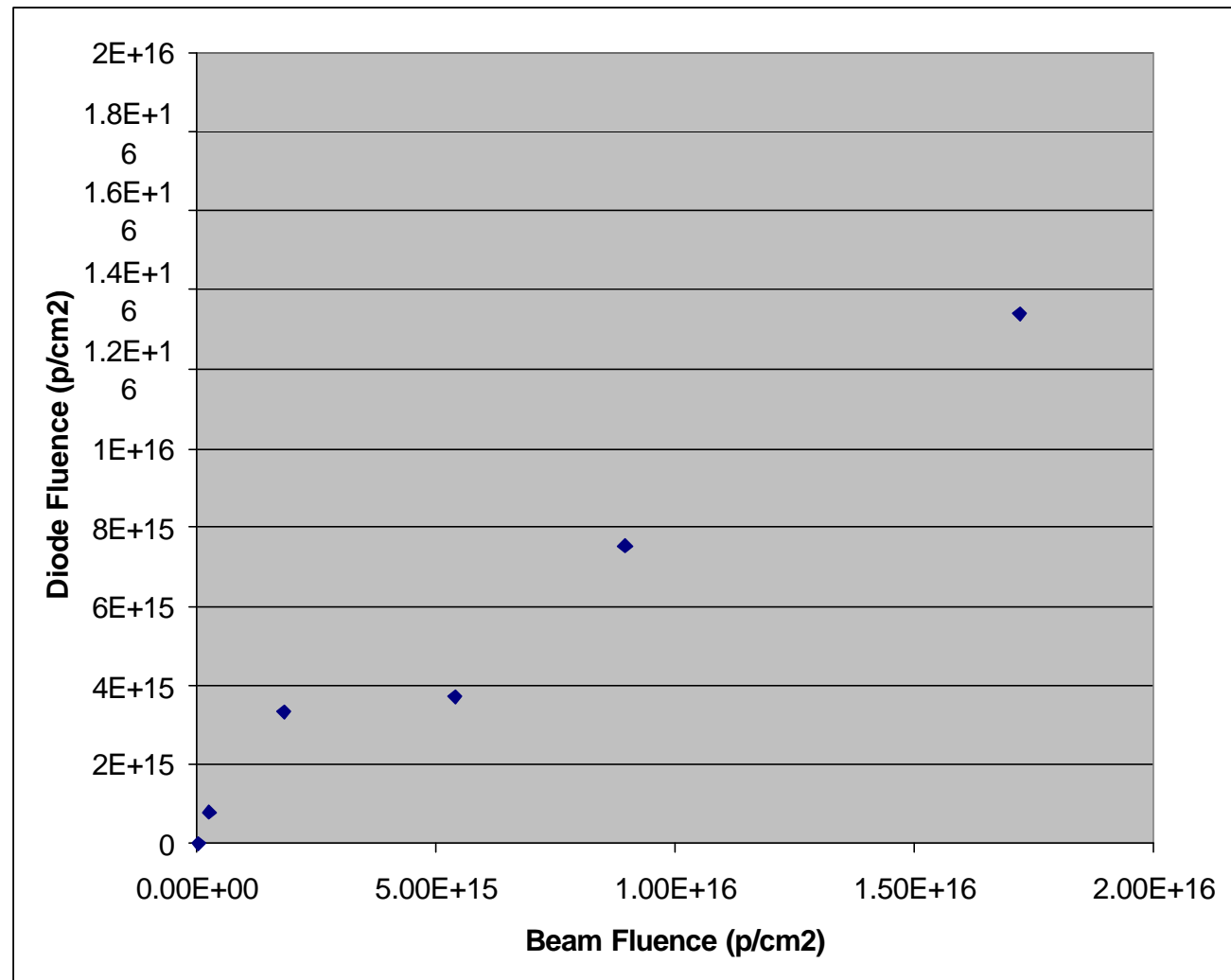
IV Curves



Highest fluence only has one device, so volume is about 0.3 of other curves

Delivered Fluence?

A steering
magnet died
partway into the
third run



Using an α of 4×10^{-17} A/cm

Summary

Plane	Devices	Beam Charge	Diode Fluence
1	Two 3EQs, Planar, Trench	1.80E+15	3.31E+15
2	Two 3EQs, Planar, Trench	8.95E+15	7.53E+15
3	Biased 3E Test Biased 3D MOS	8.95E+15	7.53E+15
4	Biased 3E Test Unbiased 3D Test	1.72E+16	1.33E+16
5	Biased 3E Test Unbiased 3D Test	8.95E+15	7.53E+15

Using an α of 4×10^{-17} A/cm

Plan

Expect devices at SLAC in mid September

Attempt “cold” bonding of 3EQs to FE-I3s

If bonding works, ship to CERN for beam test

Characterize 3D test, planar, and trench sensors

Proposed copper beam shield would have been way too hot

Need to carefully plan December irradiation

3D Upgrade Fabrication Tasks

- Bump bond FE13 to micro-pcb
- Attempt cold bump bonding FE13
- FP- XRF film
- Finish FP wafers ? IZM for bonding
- AP Atlas devices (strips...)
- HV bump bond studies
- Study electrode efficiency
- Assist SINTEF
- IBL coproduction

FE-I4 Fabrication Tasks

- MIMIC FE14
- Integrated cooling channels
- Bump bond FE14 prototypes
- FE14 capacitive calibration chips
- FE14 sensor strip adaptors
- FE14 bump bonding test structures
- HV bump bond

AFP Fabrication Tasks

- ATLAS-FP production
- Convert Fpix2 to strip detectors
- Dual Readout run