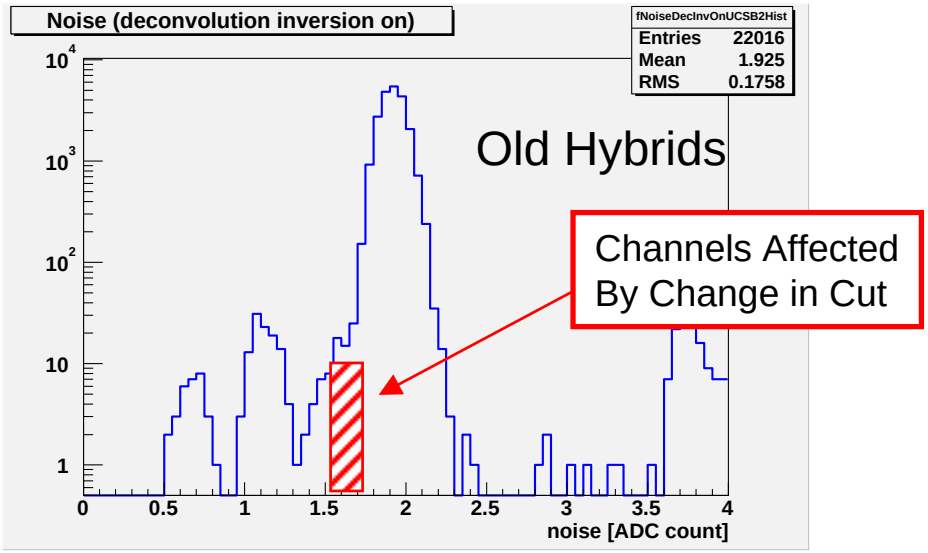
Update of US Testing Status

Anthony Affolder

On behalf of the US testing group

Fine Tuning of Fault Finding Cuts

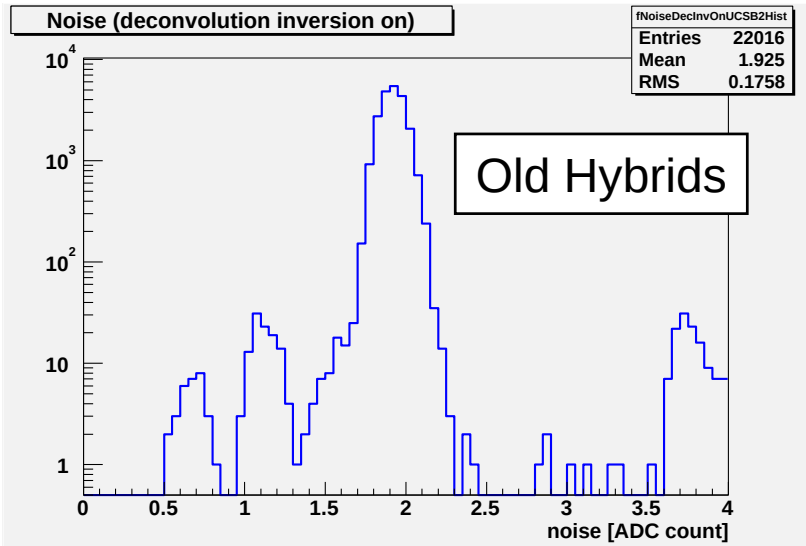
- Combined measurements of all modules produced with old hybrids (100 Ω resistor to inverter)
- Fit Gaussian to central core of each distribution
  - Found 5 σ region
  - All cuts now used (but 1) outside of this region
  - Low noise requirement too tight
    - 2.8 σ Deconvolution Mode
    - 3.2 σ Peak Mode
- Led to 33 false one sensor open flags
- Re-applied fault finding with 5 σ requirements
  - $N_i > 1.55$ (Deconvolution)
  - $N_i > 1.2$ (Peak)

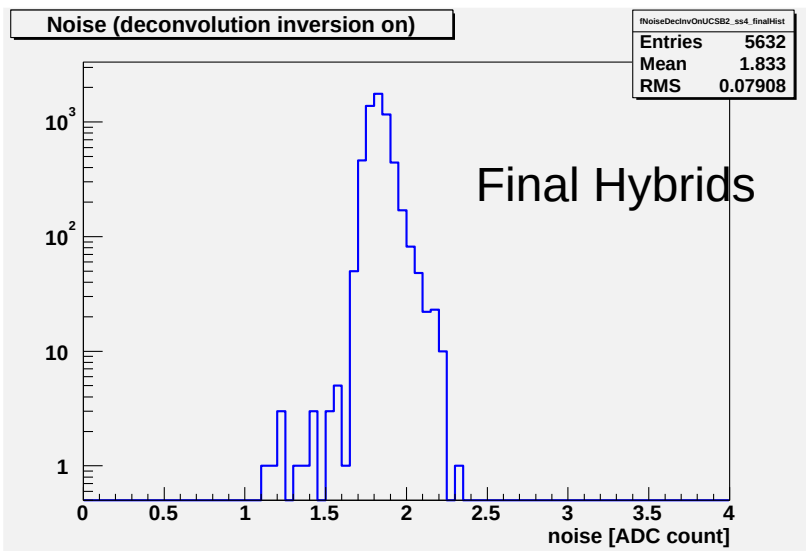


- Removes false flagging while not missing any new real faults
- This tuning should be done for each module type
  - Root combination software available from UCSB

Comparison of Modules With Old Vs. Final Hybrids

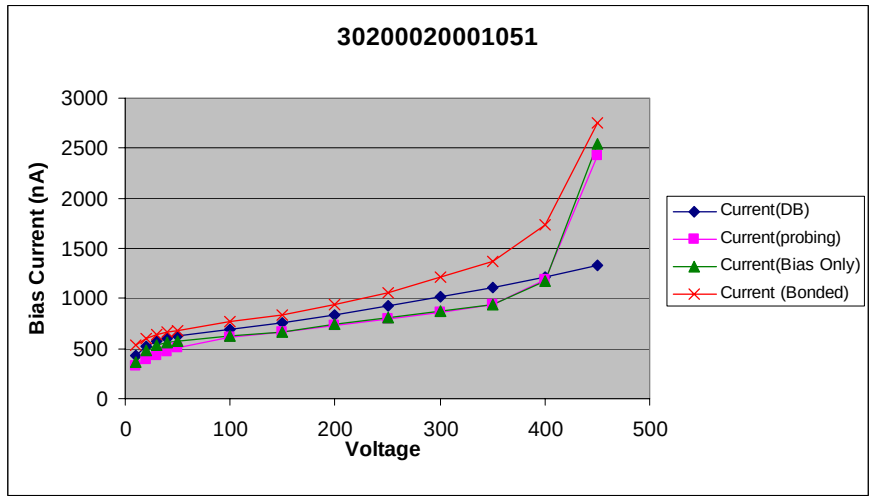
- Resistor to inverter stage changed from 100 Ω to 50 Ω
- Good News
  - A small number of each type of TOB modules made
  - All types have similar distributions of cut variables
    - Gives hope to idea that only two sets of cuts needed (1 sensor modules and 2 sensor modules)
- Bad News
  - The noise (or gain maybe) appears to be 5-10% lower
  - May have to re-tune again
  - Hopefully, gain changed due to resistor switch

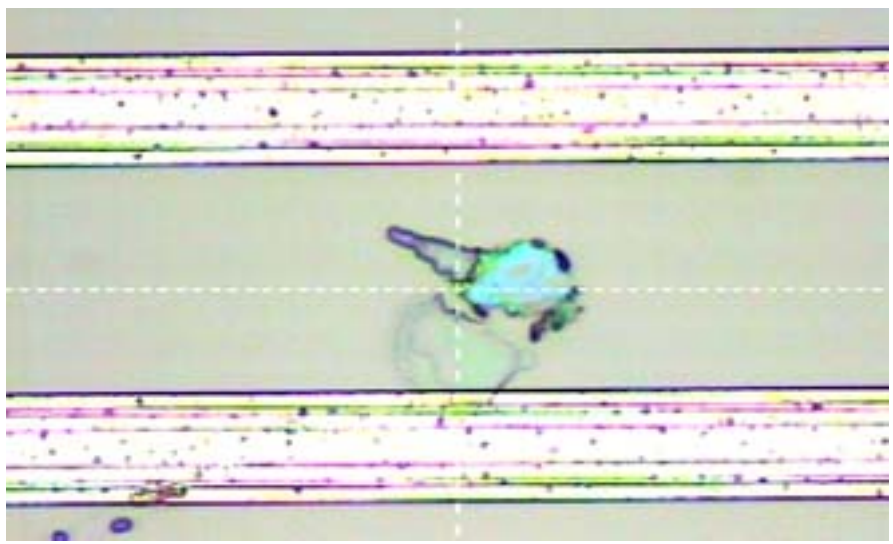




Newest CMN Problem Module (1051)

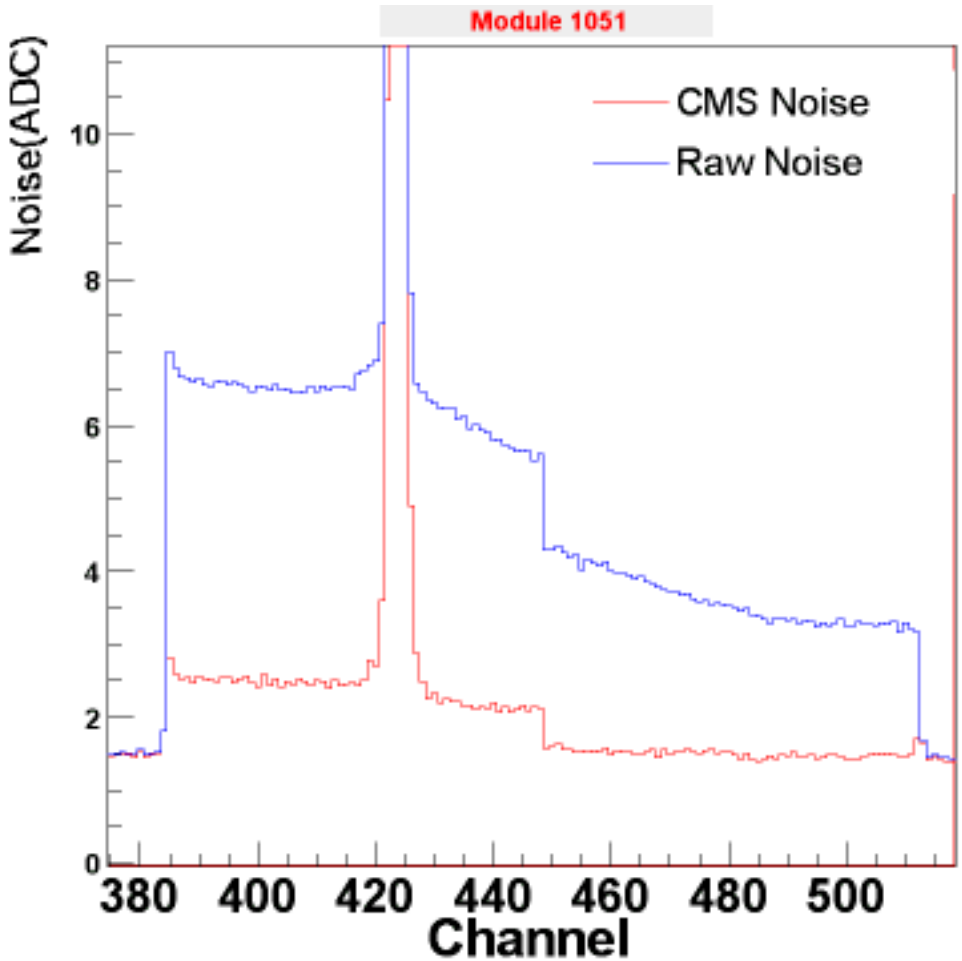
- Last SS6 module built using one sensor with 1.2 μA extra current (450 nA vs 1700 nA) in UCSB re-probing at 450 V.
  - Well within old selection criteria
  - No large addition increase in current during module assembly
  - Old sensors
    - 30210320274206
    - 30210320274214
- CMN seen in chip 46 with extremely high noise in channels 423-424
  - Sensor flaw seen between two channels
    - Not clear if flaw cause of problem
  - Begins at 400 V where database and measured bias current diverge
    - ~0.5 μA difference





New CMN Problem Module (1051)

- Module tested at slightly elevated voltage to measure effect as function of current
  - Bias current 3.7 µA, < 2 µA more than expected from database
- For first half of chip, CM subtracted noise a factor of ~1.75 higher than typical noise.
  - A very little amount of micro-discharge can cause the CM subtraction algorithm not to work properly
    - CM subtraction algorithm used is same as LT, and test beam software



IV Test Results (UCSB)

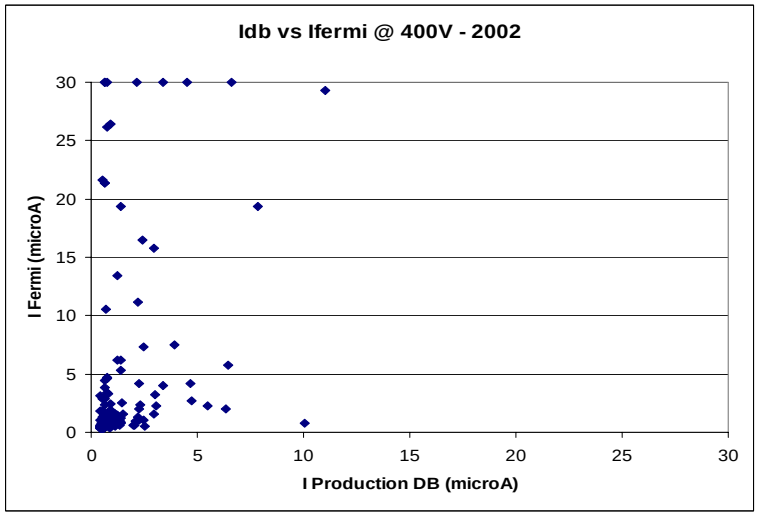
Probed Current @ UCSB (400 V) – QTC Measurement (400 V)

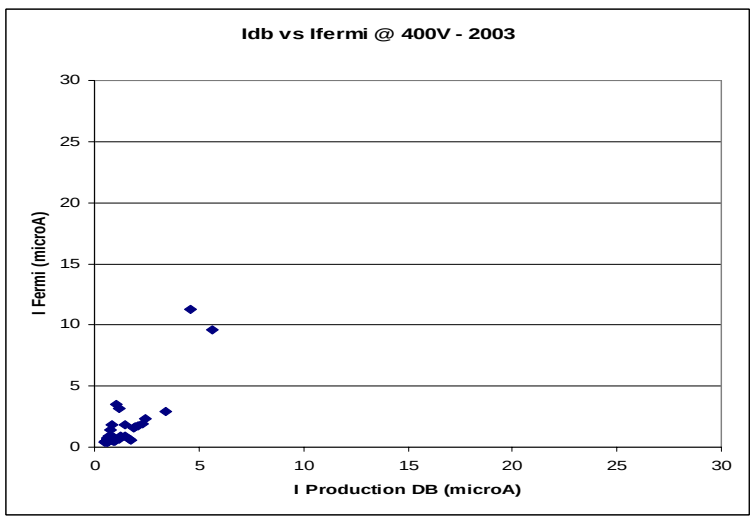
Sensors	> 2 µA	**> 5 µA**	**>10 µA**	**>20 µA**	**>100 µA**	< -2 µA	<-5 µA	<-10 µA
OB2 ('00-01)	15%	9%	8%	5%	1%	8%	3%	1%
OB1 ('00-01)	6%	3%	3%	3%	3%	3%	0%	0%
OB2 ('02)	3%	3%	0%	0%	0%	2%	2%	0%
OB2 ('03)	0%	0%	0%	0%	0%	0%	0%	0%

- Environmental conditions tightly controlled
  - Temperature 23.1-23.8 C
  - RH < 30% at all times
- An increase greater than 5 µA can cause CMN
- *Much better results with newer OB2 sensors (2002)*
- *None of the 20 newest (2003) OB2 sensor show any increase in bias current!!!*

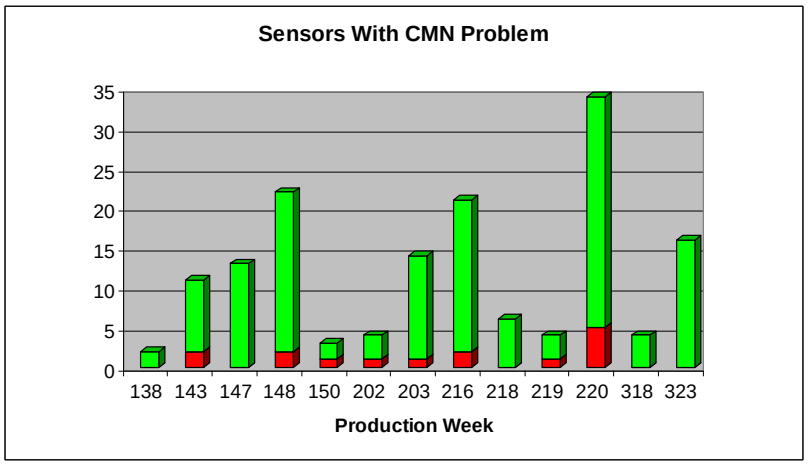
IV re-probing (FNAL)

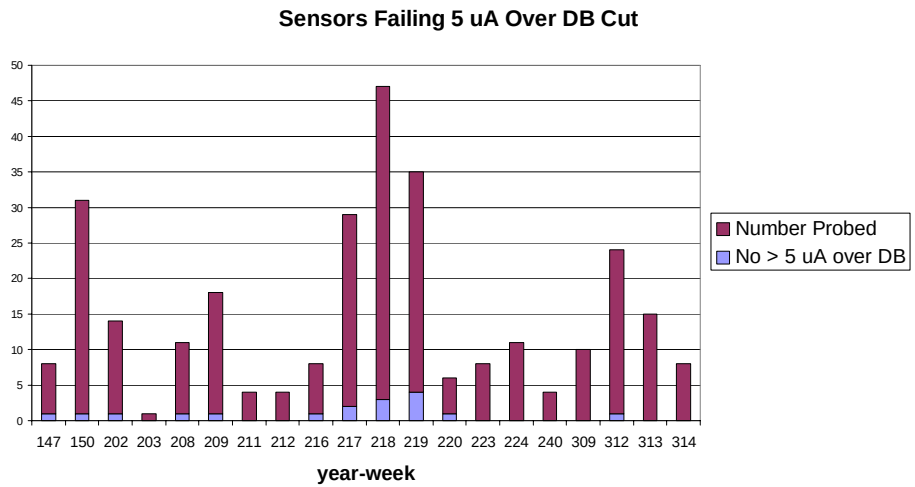
- FNAL has begun extensive re-probing program
  - See R. Demaria's talk in sensor meeting
  - Plan on re-probing all sensors received so far
- 328 sensors already re-probed
  - 24% are Grade B (>1.5 μA)
  - 6% have >5 μA increase in bias current relative to QTC measurements
    - Earlier indications are that the agreement between QTC and re-probing improved in 2003 sensors
      - 81 sensors from 2003 re-probed so far





CMN vs Batch

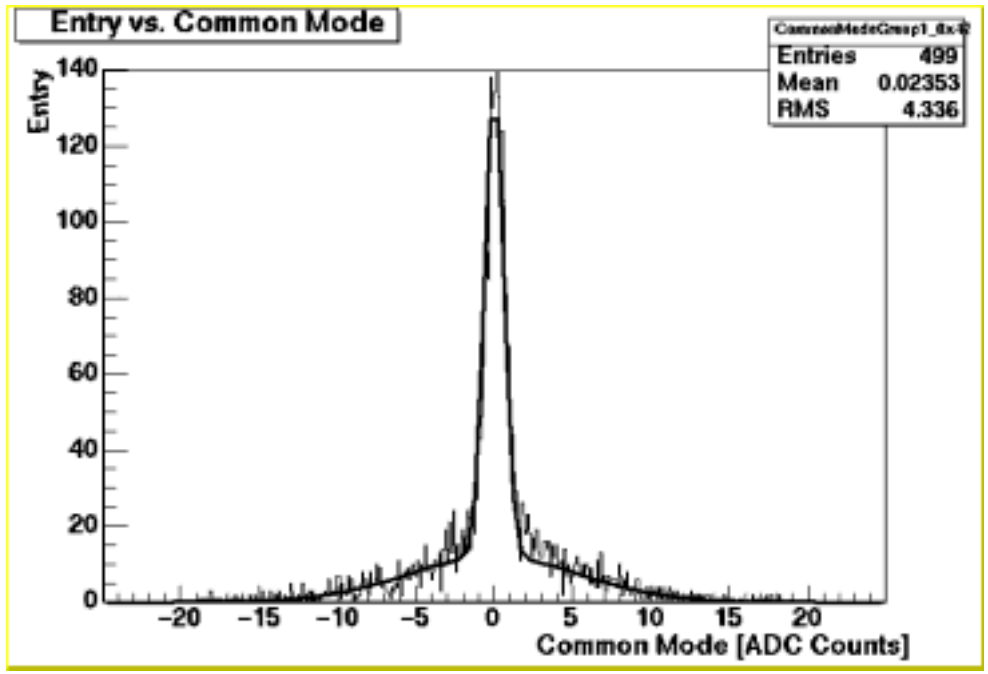




- Sensors which cause CMN are fairly evenly distributed throughout production years 2001-2002
- Early indications are that 2003 may be better
  - Extremely low statistics
  - Only low bias current sensors used

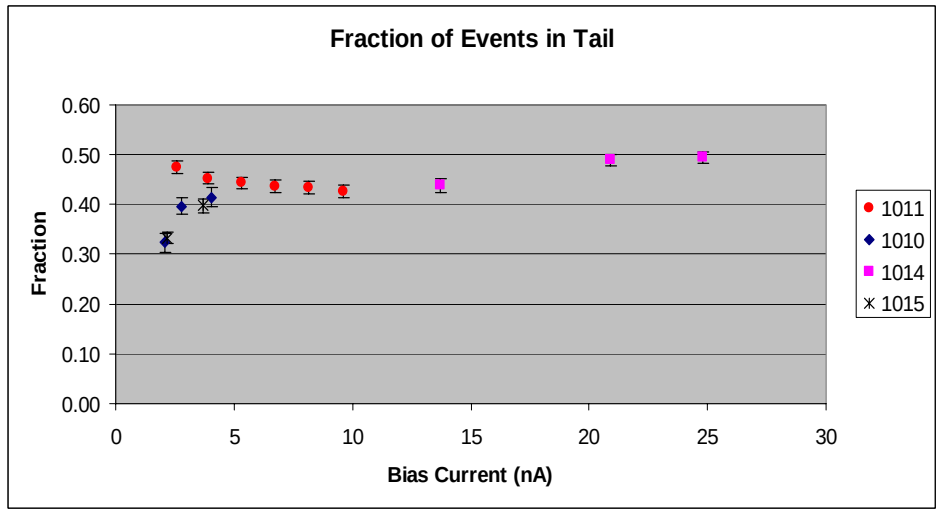
Study of Common Mode

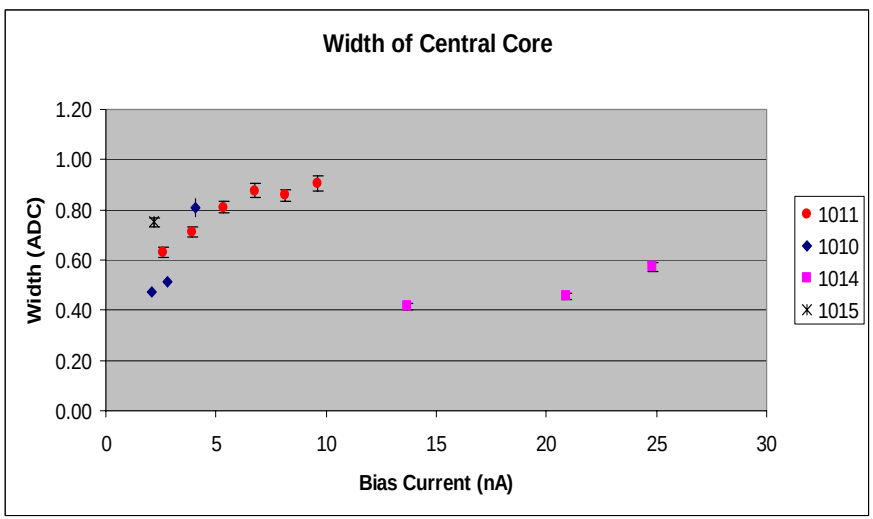
- The common mode point is calculated event-by-event for groupings of 32 channels
  - The spectra of the common mode is fit for groupings within a chip with CMN problems
    - Excluding the grouping with high noise channel
- Spectra is fit with two Gaussians
  - Central core plus tail
  - Fit parameters are:
    - Fraction of events in tail
    - Width of central core
    - Width of tail
- Study how parameters vary with current

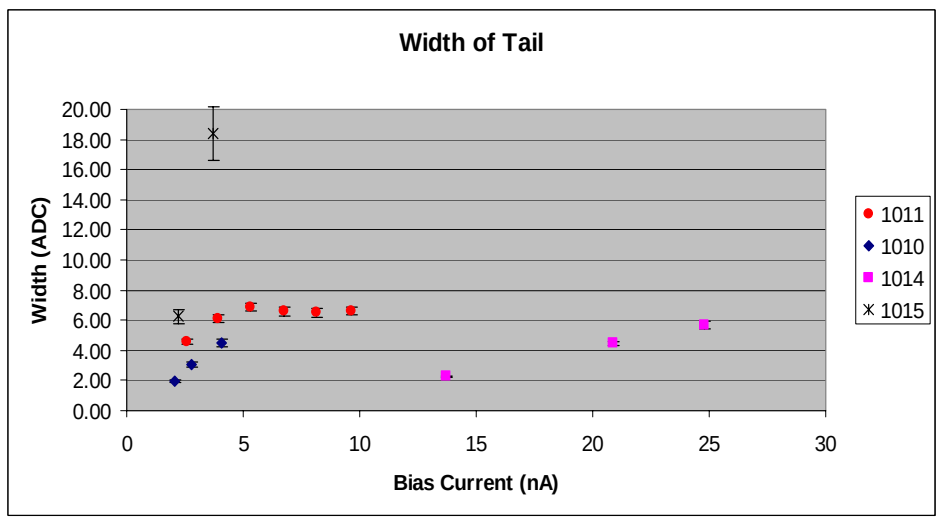


Fit Result of Common Mode Point

- Fraction of events is flat with bias current (~strip current)
- Width of central core increases with bias current (~strip current)
- Width of tail increases with bias current (~strip current) and may flattens out at some current





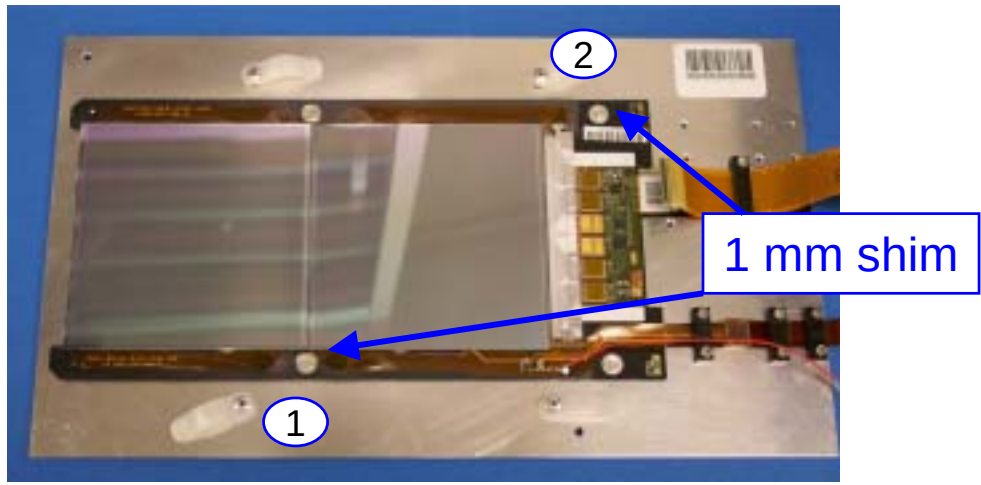


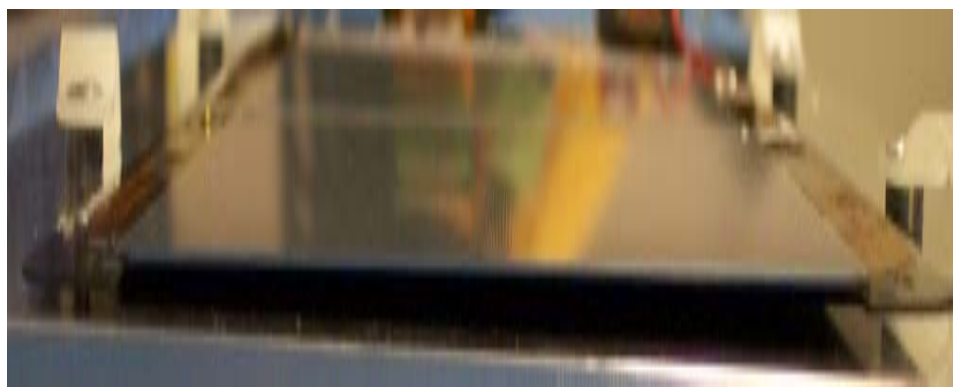
Studies with “Final” Sensors

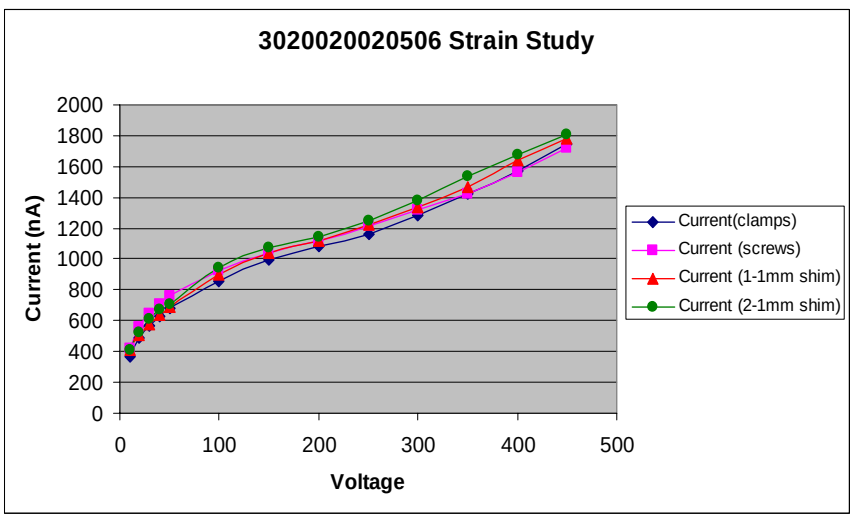
- 10 modules produced with 20 “final” production sensors
  - OB2 produced in weeks 18-23 of 2003
  - Extremely high quality
    - Bias currents between 1-2 μA
    - Only 2 pinholes not indicated in sensor database
      - No high noise channels
- Effects of thermal cycling/strain studied
  - Modules fixed to cold box plates at thermal contacts by screws
    - Modules thermal cycled for about a week
  - 1 mm shims added under 1 or 2 contact points in order to stress silicon
    - ~3× more than offset in rod attachment points

Effects of Strain on Modules

- Modules attached to cold plate with 4 screws through thermal contacts
- To test the effects of twisting modules, 1 mm shims added under thermal contacts
  - Bias current measured with 1 or 2 shims for all 10 modules
    - No change in current seen



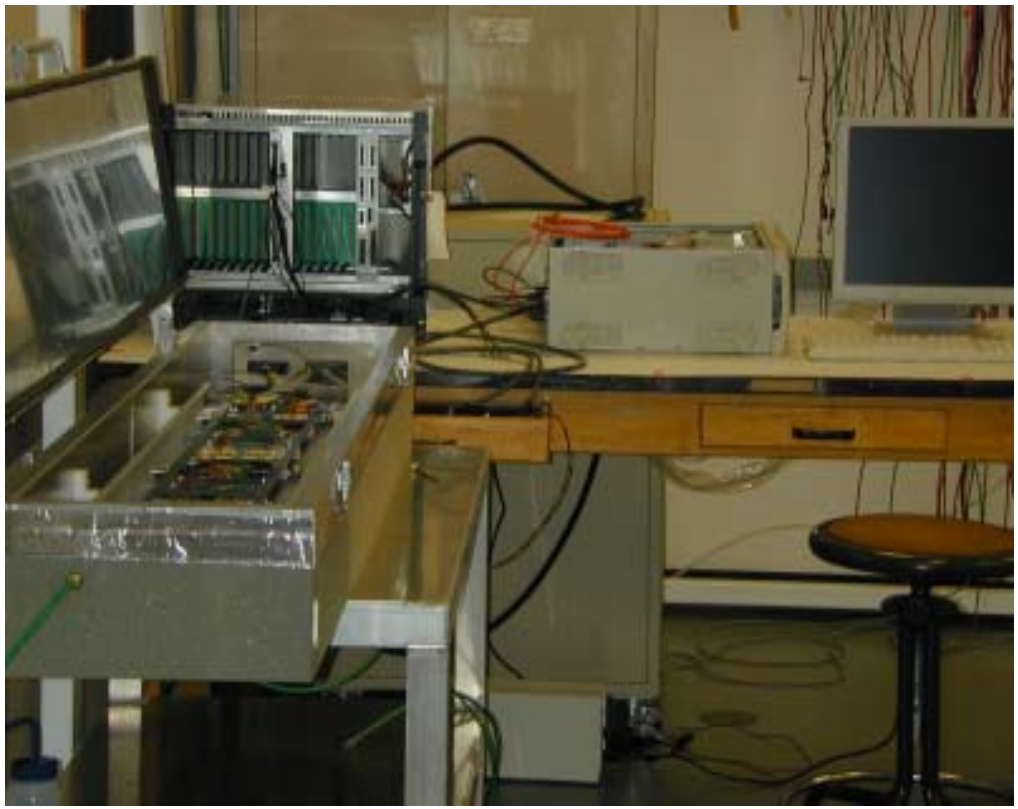




Modules Thermal Cycles

- Modules thermal cycled on modified cold plates with/without shims
  - 168 module-hours with a total of 36 thermal cycles without shims
  - ~1000 module-hours with a total of ~200 thermal cycles with 2 shims
- No change in bias currents or noise seen

Single Rod Test Stand at UCSB



- Complete set of electronic ready to test single rods
  - Test box provides dry, dark, and electrical isolated environment
  - Connects to Rod burn-in chiller for cooling
- First production rod tested in stand (J. Lamb & P. Gartung)

Rod Testing Results

- Faults clearly seen in rod using new LT
  - Only opens on rod so far
- Laser gain differences add complication to data analysis
  - Fixed noise cuts will NOT work due to 50% variation in laser gain
  - Hopefully laser gain can be measured by header height
- Similar work on optimization of calculation of pulse height & peak time variable needed as in module LT
  - See P. Gartung's talk
- More statistics needed in order to know how best to test rod