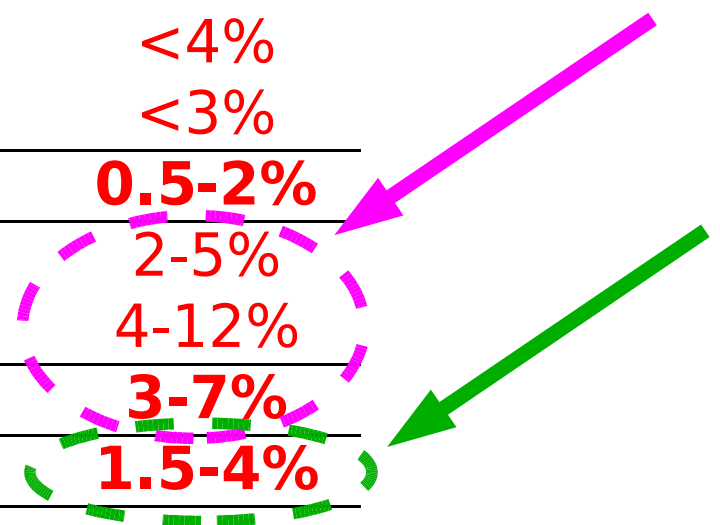


Short report on TIB modules IV

Raw numbers

- Conservative statistical analysis
 - Rate of failures rather uniform...
 - ...but in **May** sudden increase in PISA (3) and PADOVA (10!)

Center	#Tested	#BadIV	% range
Bari	89	1	<5%
Catania	77	0	<3%
Firenze	105	1	<4%
Torino	88	0	<3%
Bari Gantry	359	2	0.5-2%
Pisa	264	8	2-5%
Padova	140	11	4-12%
Perugia Gantry	404	19	3-7%
All	763	21	1.5-4%



The table is annotated with two arrows and two dashed circles. A magenta arrow points to the '0.5-2%' range for Bari Gantry. A green arrow points to the '1.5-4%' range for the 'All' category. A magenta dashed circle encloses the '2-5%' range for Pisa and the '4-12%' range for Padova. A green dashed circle encloses the '3-7%' range for Perugia Gantry and the '1.5-4%' range for the 'All' category.

Overview

- Qualitative analysis of IV failures
 - Problem of **scratches** in the early production (defective vacuum handling tool, solved) affecting IV behavior
 - Bulk of recent IV failures (**May problem**)
 - Mainly two sensor batches are affected
 - [338028](#): 4 modules failing IV, 2 in Pisa, 2 in Padova (**May**)
 - [319013](#): 9 modules failing IV, 8 in Padova (**May**), 1 in Pisa (Feb)
 - Both batches affected by 'scratch' problem
 - difficult to establish a clear relation between IV failures and scratches
 - QTC tests, HPK data and process analysis data are OK
- Many tests done on failing modules: presently impossible to identify other causes (deformations, ...)
 - IV failure behavior very unstable (change in BD voltage, time dependence...)
 - Still low statistics

Numbers again

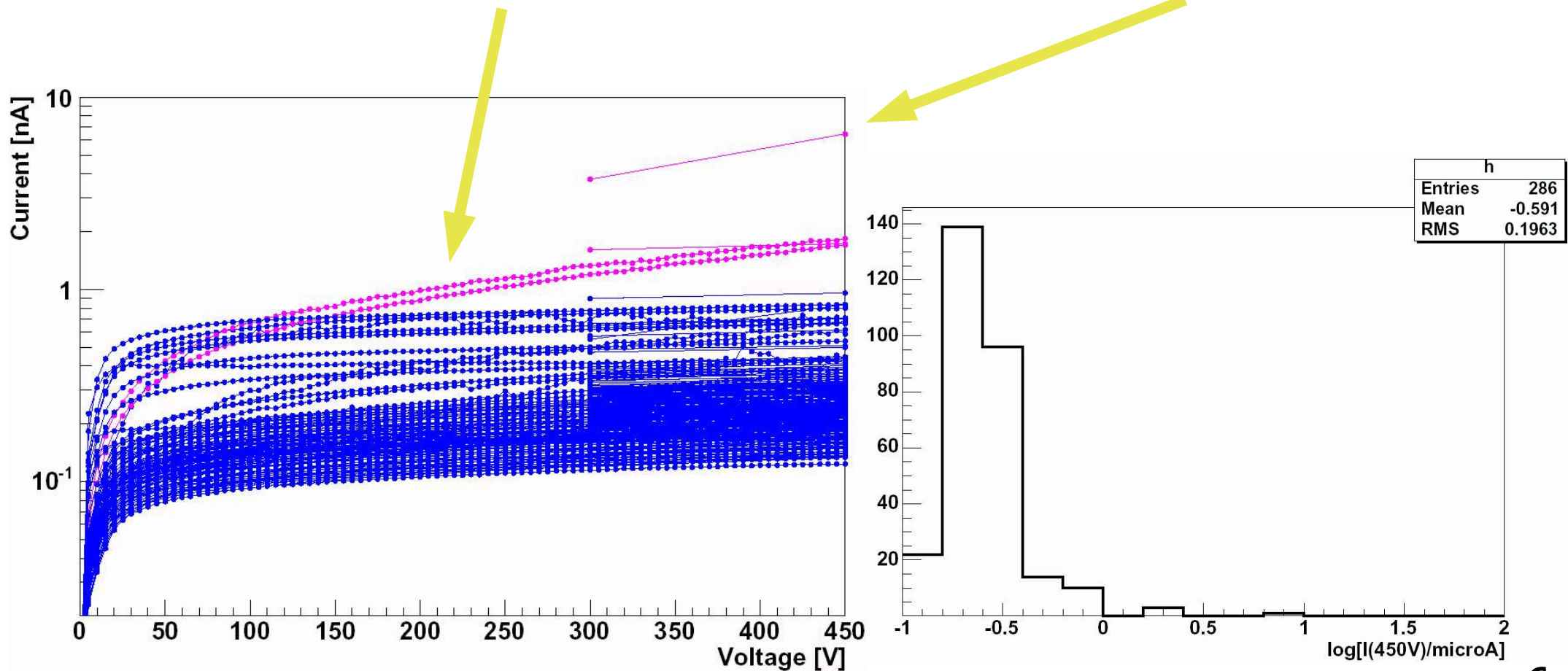
- No scratches, no 'May' problem

Center	#Tested	#BadIV not due to problems	% range
Bari	89	1	<5%
Catania	77	0	<3%
Firenze	105	1	<4%
Torino	88	0	<3%
Bari Gantry	359	2	<1.7%
Pisa	264	4	<3%
Padova	140	1	<2%
Perugia Gantry	404	5	0.5-2.5%
All	763	7	0.4-1.7%

Some IV studies
on
~300 modules
(to be redone with the full statistics!)

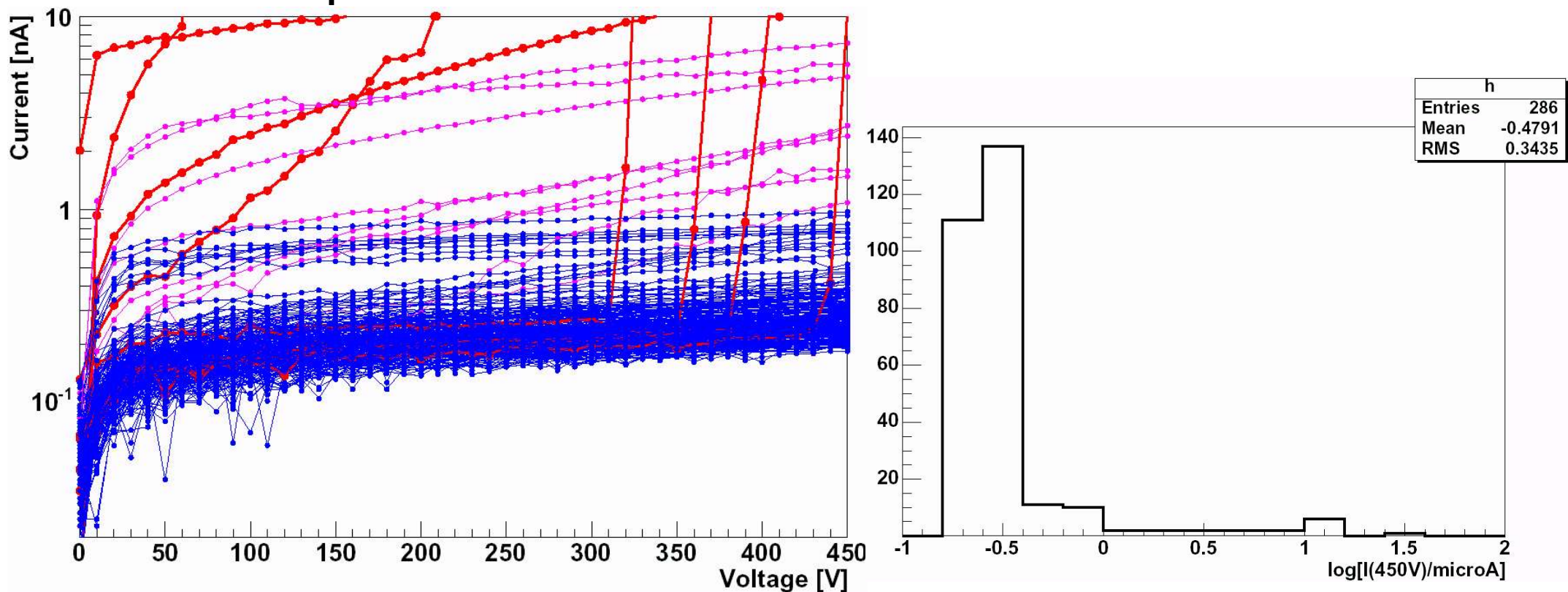
Sensor IV distribution

- \sim all sensors $I(450V) < 1\mu A$ (only 4 modules $> 1\mu A$)
 - QTC test \rightarrow Full curve, HPK measurements $\rightarrow I@300V, 450V$



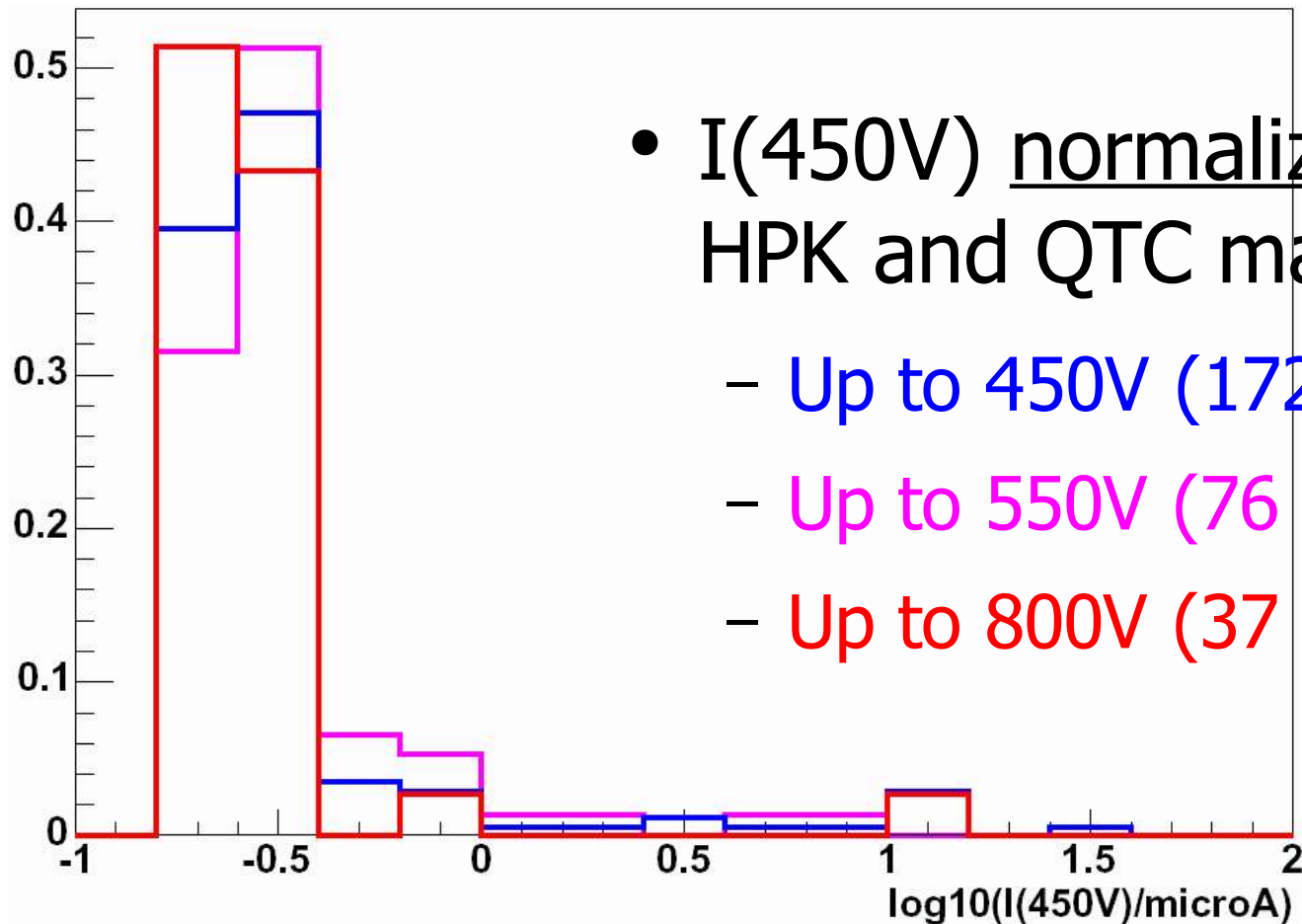
Module IV distributions

- Limited degradation after modules assembly
 - Bulk with $I(450V) \sim 200\text{nA}$ ($< 1\mu\text{A}$)
 - Few $> 1\mu\text{A}$, 8 modules $> 10\mu\text{A}$ (4 in clear BD)
 - No temperature correction



Max test voltage influence?

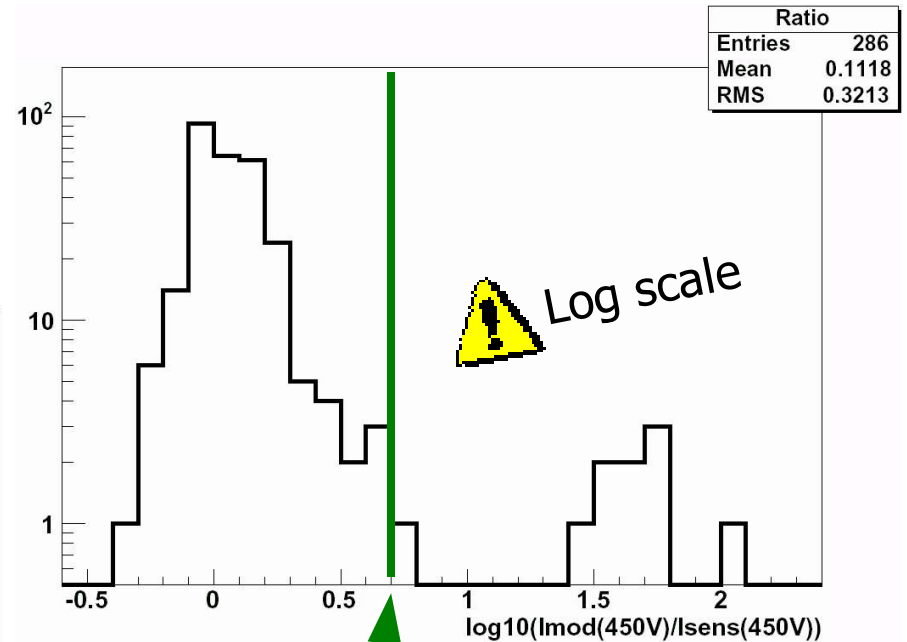
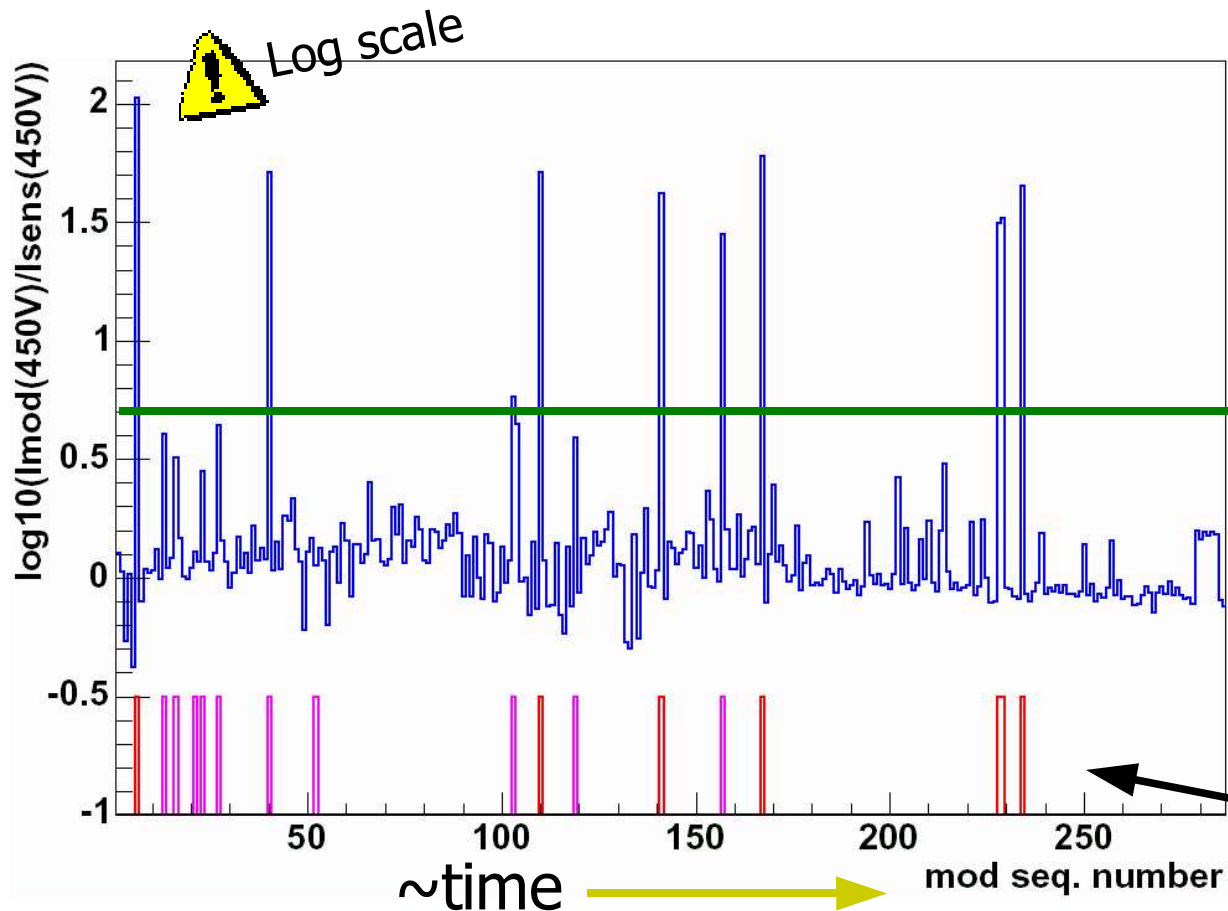
- Limited statistics but no evidence, not even hints



- $I(450V)$ normalized distributions wrt HPK and QTC max testing voltage
 - Up to 450V (172 modules)
 - Up to 550V (76 modules)
 - Up to 800V (37 modules)

Module vs. Sensors I(450V) ratio

- Bulk within few tenths of nA
 - No temperature correction!!!



$0.7 \sim \log_{10}(5)$

cut for *F module grading

$> 1\mu\text{A}$ module
 $> 10\mu\text{A}$ module
 (@450V)

Conclusions

- IV failures within 'intrinsic' % level
 - Some manipulation problem in the early production now solved
 - Degradation of IV characteristics after module assembly to be kept under control, but no worries up to now
- Padova and Pisa sudden increase in IV failures limited to specific sensor batches:
 - Open point: sensor processing or manipulation?
- We stay alert!

Extra

QTC story of 319013 & 338028 in PG

- 319013
- JUN/JUL03: all 39 sensors optically inspected (and potentially scratched by the vacuum pen); ten measured, batch qualified
- FEB/APR04
 - Some sensors turned in modules and sent to PI (**many** found scratched and 13 also in BD) and PD
- 338028
- JAN04
 - 4 sensors (2, 5, 21, 23) optically inspected (and potentially scratched by the vacuum pen);
 - 8 measured, batch qualified

Identification of the vacuum pen problem



- Some sensors (16, 17, 19, 25, 26, 27, 28, 29, 30, 31, 33, 39) retested; 30, 31 and 33 found bad for strip defects; good in modules
- FEB/APR04: sensors 5, 21, and 23 found scratched and retested; heavy scratch on 5, discarded
- MAY04: Found BD on sensors 11, 12 (PD) and 26, 27 (PI); all not scratched!
- MAY04: 8 IV failures in PD (22, 23, 34, 35, 37, 38, 27, 28)

Padova

- 11 modules in total
- 10 modules with $V_{BD} < 450V$ found in May: **the May problem**

#ModID	#SensID	BD Voltage [V]
30200020033341	302202 <u>338028</u> 11	300
30200020033342	302202 <u>338028</u> 12	?
30200020033367	302202 <u>319013</u> 22	370
30200020033368	302202 <u>319013</u> 23	260
30200020033369	302202 <u>319013</u> 34	250
30200020033370	302202 <u>319013</u> 35	385
30200020033372	302202 <u>319013</u> 37	390
30200020033373	302202 <u>319013</u> 38	>400
30200020033435	302202 <u>319013</u> 27	400
30200020033436	302202 <u>319013</u> 28	250

Pisa

- 8 bad IV modules in total:
 - Some with scratches:
 - 2 with scratches + localized electrical defects
 - 30200020033158: 10 μ A @300V, linear IV, pinhole within defects due to scratch, pinhole unbonded => perfect IV!
 - 30200020033207: 10 μ A @50V, several defects (pinhole and shorts) due to scratches; improvement but no recovery after defect unbonding!
 - 2 with scratches but correlation with IV failure not proved
 - **The May problem** - 3 modules with <450V breakdown:

#ModID	#SensID	BD Voltage [V]	
30200020033353	302202 33802826	350	Sent to HPK
30200020033354	302202 33802827	380	
30200020033359	302202 34102913	420	