



IFIC - Instituto de Física Corpuscular

# TestBeam September 2003

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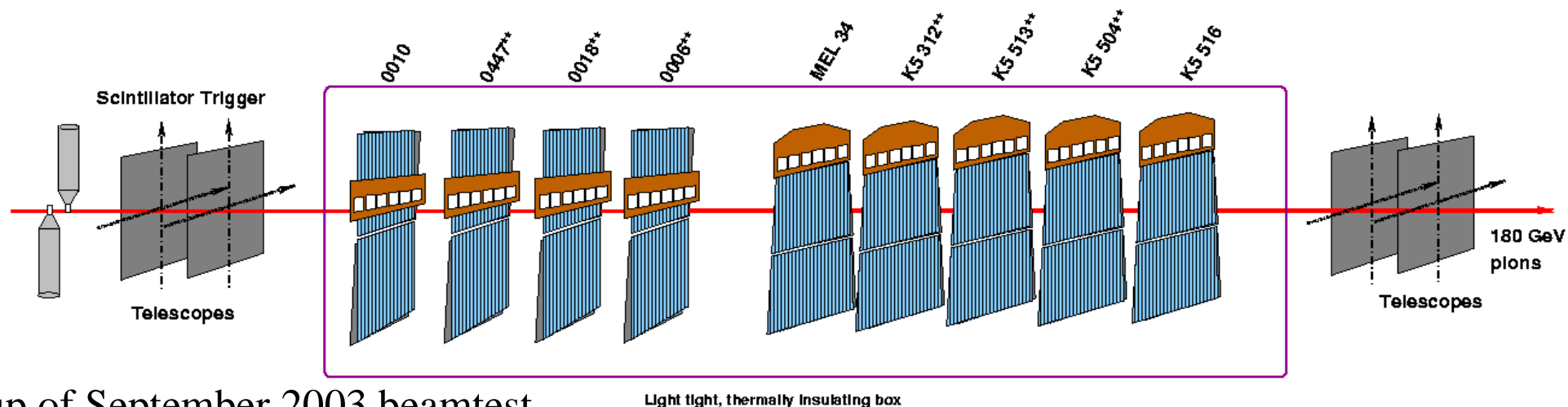
SCT Week September 2003 (CERN)

## Outline

- Testbeam program & setup
- DUTs
- Offline status
- Efficiency and noise occupancy (NO)
- S-curves
- Pulse-shape
- Preliminary results
- Charge and S/N
- Conclusions

## May 2003 Testbeam program & setup

- ◆ *First week* ⇒ **Standard SCT modules QA program**
  - Threshold scans with different types of modules
  - 5 sets of bias voltages + variation of chips hit by beam
  - Asynchronous beam, no magnetic field, normal incidence
  
- ◆ *Second week* ⇒ **Combined ATLAS run**
  - Integration of the SCT TB DAQ into the ATLAS DAQ
  - Trigger of the SCT by the Central Trigger Processor system (CTPD)



Setup of September 2003 beamtest.

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## DUTs

Module	Type	Ccal	Mask	Comments
0010	Barrel	1.089	[9] + (0)	Anchor module (negative offset)
0447*	Barrel	1.089	[18] + (7)	Large Gain Spread chip
0018*	Barrel	1.027	[24] + (3)	Large Oscillation module
0006**	Barrel	1.076	[13] + (6)	Large Oscillation module
MEL 34	Outer	n/a	[172] + (5)	Melbourne electrical
K5_312**	Outer	1.113	[26] + (2)	
K5 513*	Outer	1.040	[114] + (0)	Geneva prequa module 0002
K5 504**	Outer	1.030	[4] + (chip)	
K5_516	Outer	1.040	[16] + (5)	Geneva prequa module 0001

### NB:

- $C_{cal}$  is the calibration factor of the module.
- Masked channels have been divided in [hardware mask] + (offline) channels.
- Modules used in Sep03 BT:
  - ♦ **3 fully irradiated modules (\*\*)** ( $\sim 3 \times 10^{14}$  p/cm<sup>2</sup>)
  - ♦ **3 half irradiated modules (\*)** ( $\Rightarrow$  fluence to be checked)
  - ♦ **3 non-irradiated modules**
- 0010 (anchor module) has not been analysed, neither K5 504\*\* due to a problem in the discriminator threshold during calibration.

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## Offline status

- Analysis is in progress  $\Rightarrow$  first results presented in this talk.
- DST's are available in CASTOR at:

`/castor/cern.ch/atlas/testbeam/sct/2003/dst_sep`

- These results are **preliminary**.

Updates in:

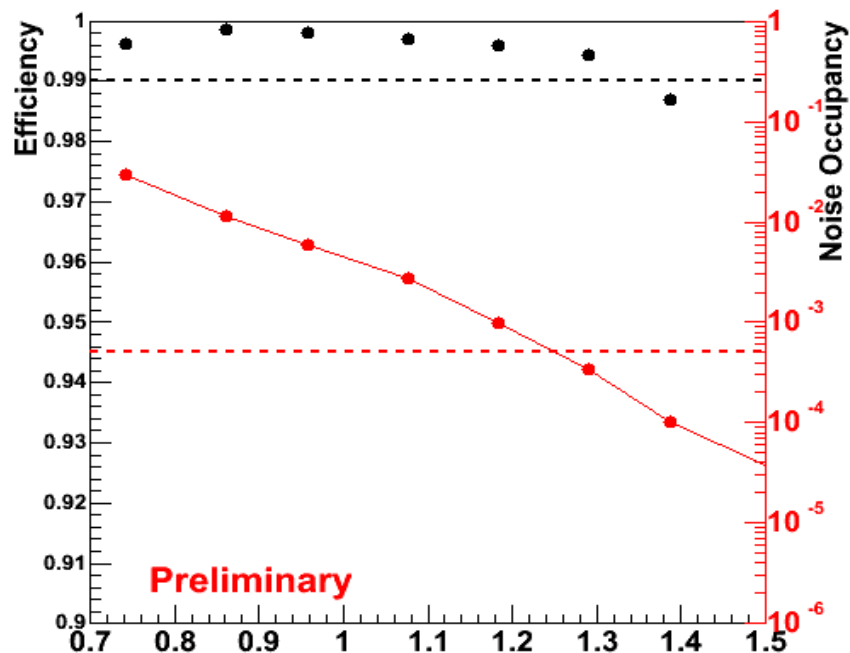
[http://ific.uv.es/~segonzal/testbeam/tbSep03/index\\_sep03.html](http://ific.uv.es/~segonzal/testbeam/tbSep03/index_sep03.html)

will be done regularly.

# Efficiency and NO

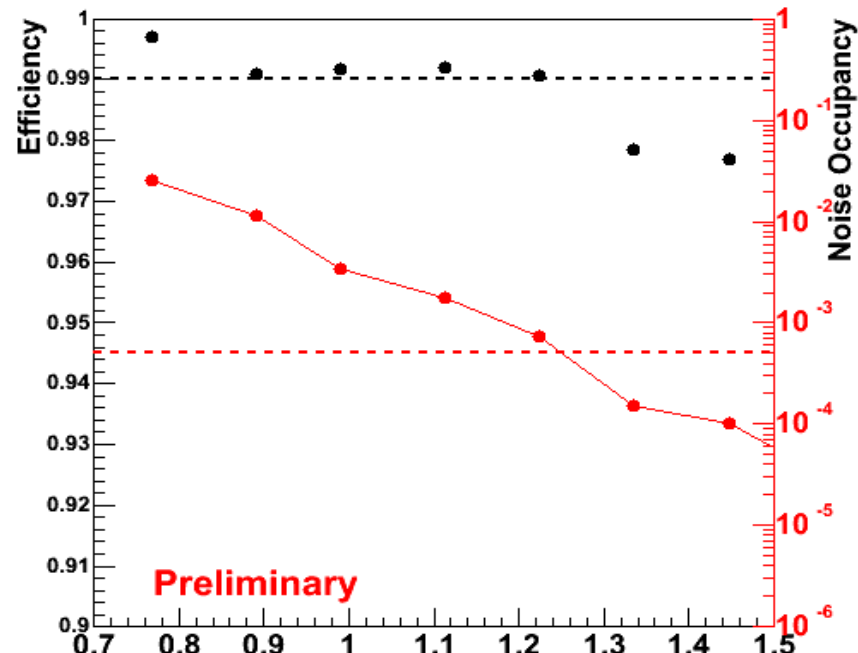
Fully irradiated

Barrel 0006\*\* (350V)



Fully irradiated

Endcap K5 312\*\* (350V)

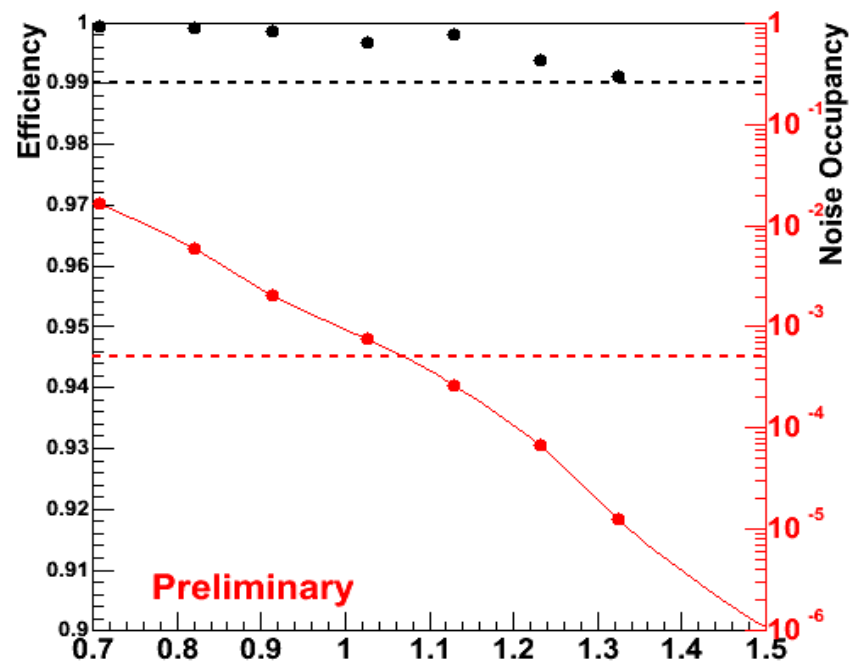


Efficiency and noise occupancy as function of the corrected threshold for module **0006\*\* link 1** (left) and **K5 312\*\* link 0** (right), both for a bias voltage of 350V. The dark markers correspond to efficiency measurements, being the red line the noise occupancy.

# Efficiency and NO

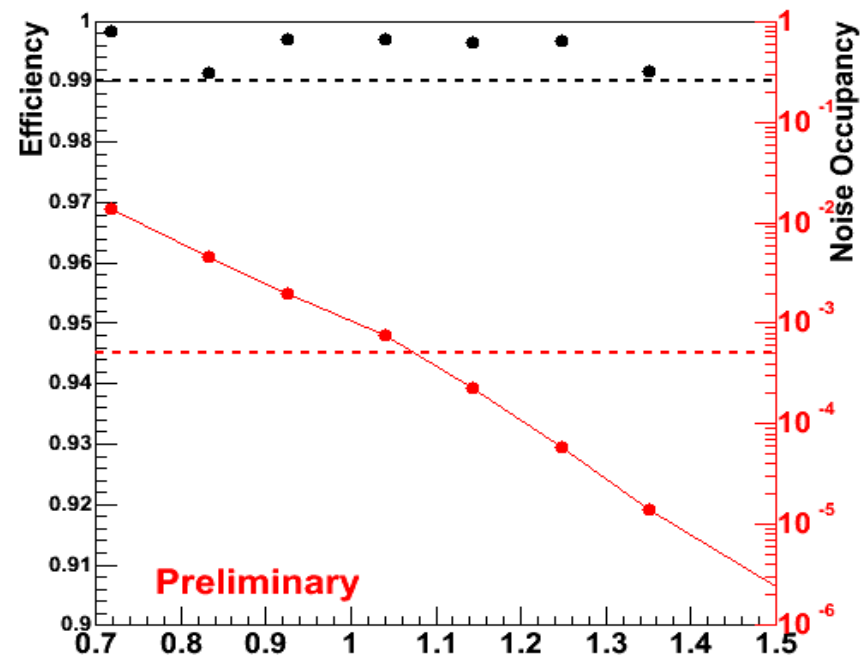
Half-irradiated

Barrel 0018\* (350V)



Half-irradiated

Endcap K5 513\* (350V)

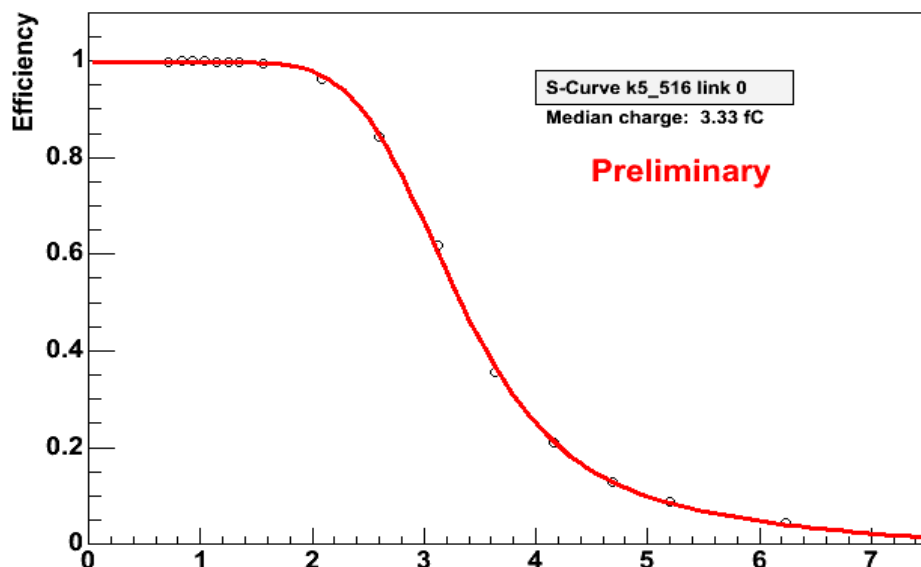


Efficiency and noise occupancy as function of the corrected threshold for module **0018\* link 1** (left) and **K5 513\* link 1** (right), both for a bias voltage of 350V. The dark markers correspond to efficiency measurements, being the red line the noise occupancy.

# S-curves

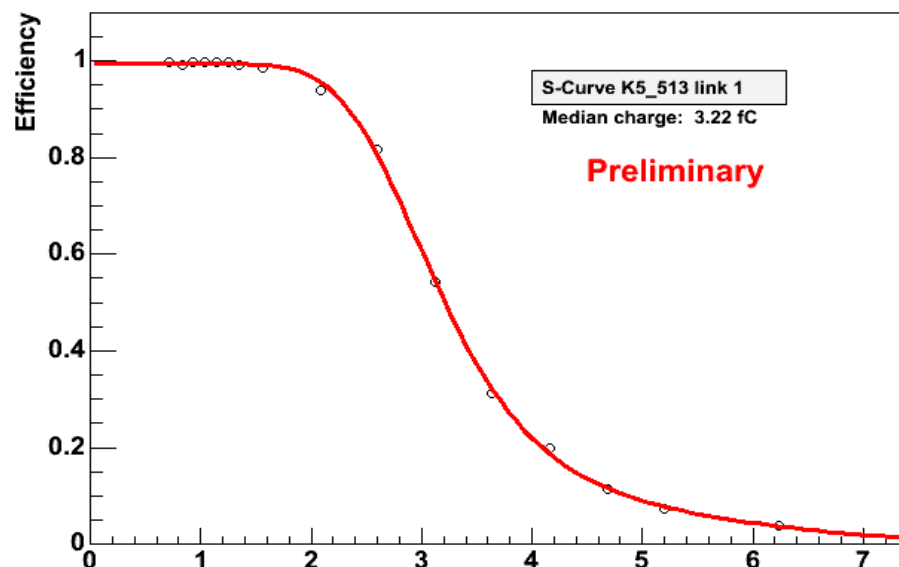
Non-irradiated

Endcap K5 516 (150V)



Half-irradiated

Endcap K5 513\* (350V)

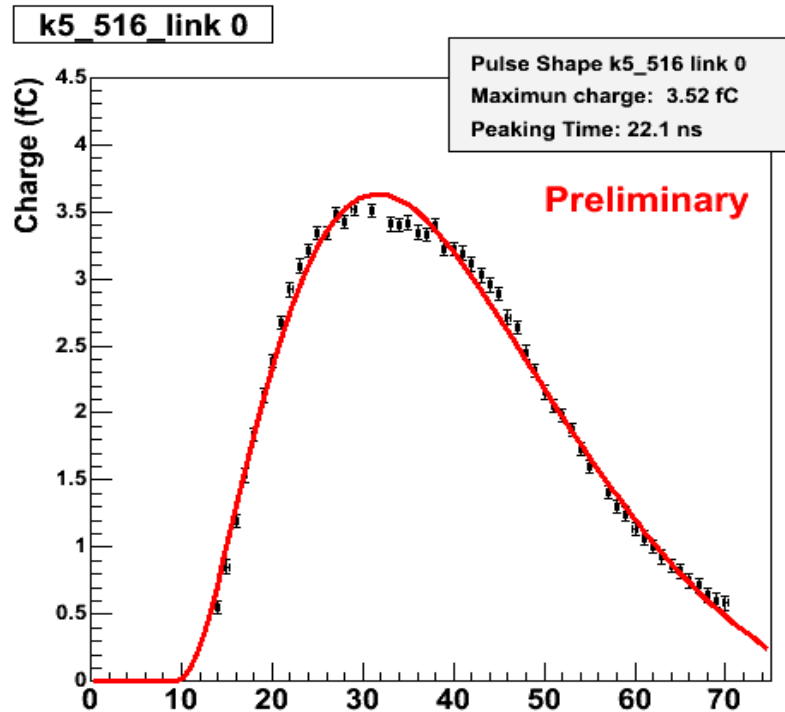


- Fit of the efficiency versus corrected threshold to a skewed complementary error function for a non-irradiated endcap module K5 516 @ 150V (left) and for an irradiated endcap module K5 513\* @ 350V (right).
- The threshold value that matches the 50% efficiency is the median of the charge distribution.

# Pulse shape

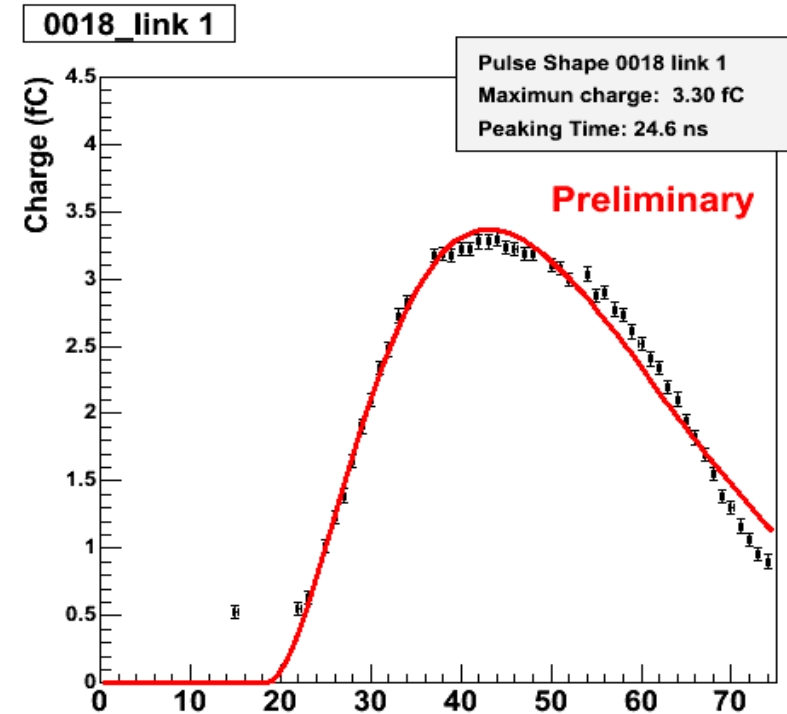
Non-irradiated

Endcap K5 516 (150V)



Half-irradiated

Barrel 0018\* (350V)



- Pulse shape reconstruction for a non irradiated module (left) @150V and for a irradiated module (right) @150V bias voltage. The continous line is the fit of the ABCD function.

## Preliminary results

- 2 beam positions pointing different chips

Module	Eff @ 1fC	NO @ 1fC	Qmed (fC)	S/N	Bias (V)	Chips
0447*	99.8	$1.8 \times 10^{-2}$	$3.4 \pm 0.2$	$10.9 \pm 0.4$	350	$(M0,S1)_0$ & $(S12,E13)_1$
	99.8	$2.7 \times 10^{-2}$	$3.4 \pm 0.1$	$10.1 \pm 0.2$		$(S2,S3)_0$ & $(S10,S11)_1$
0018*	99.8	$1.8 \times 10^{-3}$	$3.3 \pm 0.1$	$10.9 \pm 0.4$	350	$(M0,S1)_0$ & $(S12,E13)_1$
	99.9	$1.3 \times 10^{-3}$	$3.2 \pm 0.2$	$10.3 \pm 0.3$		$(S2,S3)_0$ & $(S10,S11)_1$
0006**	99.8	$5.0 \times 10^{-3}$	$3.1 \pm 0.1$	$8.8 \pm 0.2$	350	$(M0,S1)_0$ & $(S12,E13)_1$
	99.8	$5.9 \times 10^{-2}$	$3.1 \pm 0.1$	$8.4 \pm 0.2$		$(S2,S3)_0$ & $(S10,S11)_1$

- Efficiency and NO calculated by linear interpolation for 1 fC corrected thr.
- Chips: (*chips pointed by beam*)<sub>link</sub>
- No magnetic field, normal incidence

## Preliminary results

Module	Eff @ 1fC	NO @ 1fC	Q <sub>med</sub> (fC)	S/N	Bias (V)	Chips
<b>K5 312**</b>	98.7	$4.1 \times 10^{-3}$	$2.8 \pm 0.1$	$7.7 \pm 0.7$	350	(S2,S3) <sub>0</sub> & (S10,S11) <sub>1</sub>
	99.1	$3.4 \times 10^{-3}$	$3.2 \pm 0.5$	$8.5 \pm 1.3$		(S4,E5) <sub>0</sub> & (M8,S9) <sub>1</sub>
<b>K5 513*</b>	-	-	-	-	350	-
	99.6	$1.1 \times 10^{-3}$	$3.2 \pm 0.1$	$10.3 \pm 0.4$		(S4,E5) <sub>1</sub> & (M8,S9) <sub>2</sub>
<b>MEL 34</b>	99.8	$1.0 \times 10^{-3}$	$3.4 \pm 0.2$	$10.1 \pm 0.6$	150	(S2,S3) <sub>0</sub> & (S10,S11) <sub>1</sub>
	99.9	$9.8 \times 10^{-4}$	$3.4 \pm 0.3$	$10.3 \pm 0.4$		(S3,S4) <sub>0</sub> & (M8,S9) <sub>1</sub>
<b>K5 516</b>	99.8	$4.3 \times 10^{-3}$	$3.3 \pm 0.2$	$13.9 \pm 0.4$	150	(S4,E5) <sub>0</sub> & (M8,S9) <sub>1</sub>
	99.9	$3.5 \times 10^{-5}$	$3.3 \pm 0.1$	$13.2 \pm 0.3$		(S3,S4) <sub>0</sub> & (S9,S10) <sub>1</sub>

- Efficiency and NO calculated by linear interpolation for 1 fC corrected thr.
- Chips: (*chips pointed by beam*)<sub>link</sub>
- No magnetic field, normal incidence

## Results cross-check: module K5 312\*\*

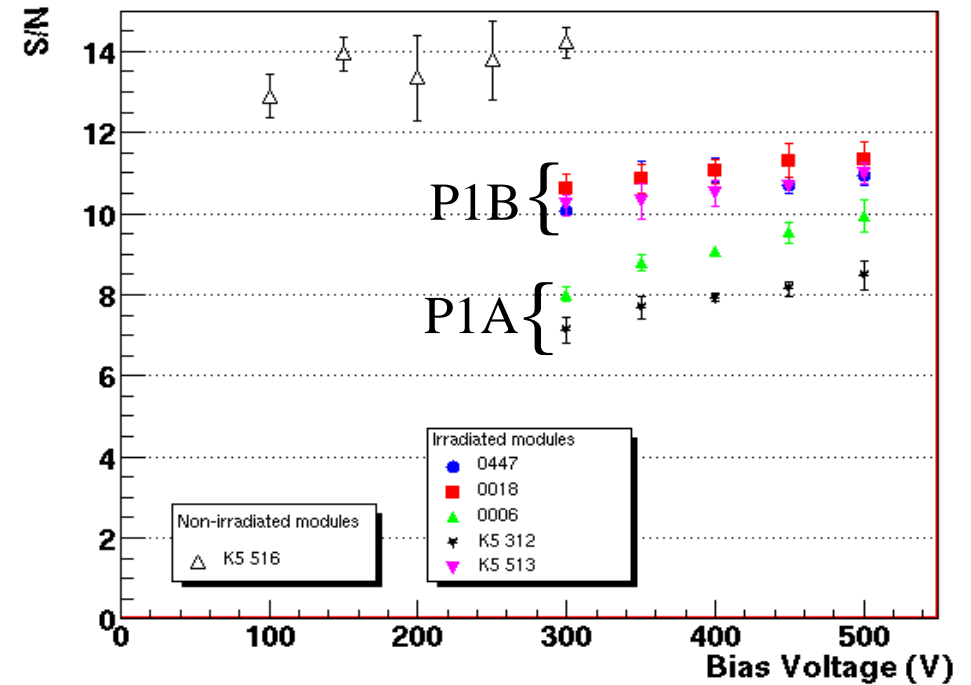
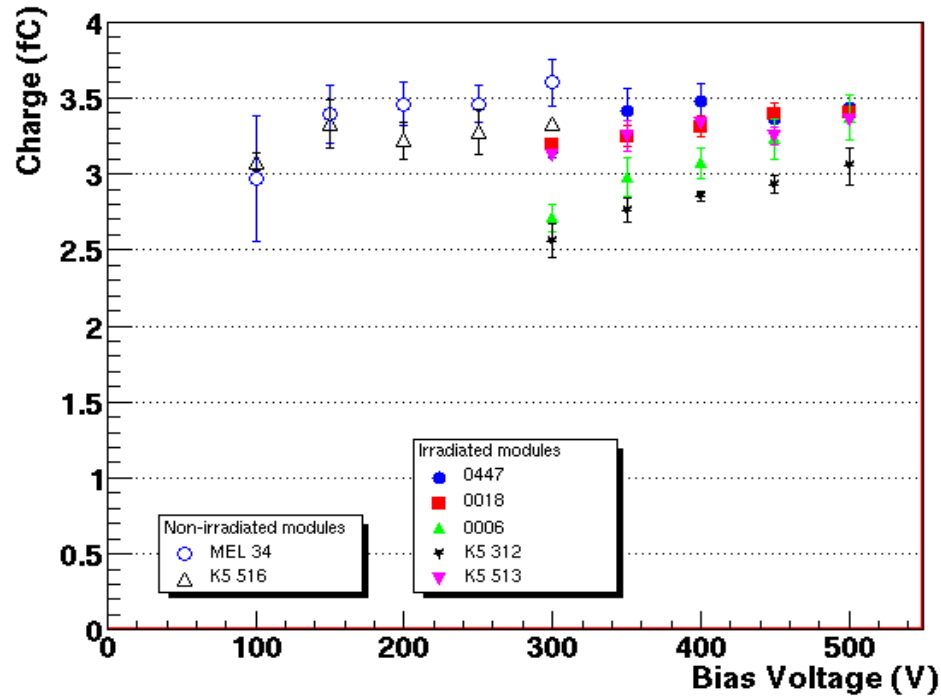
- The only module present at May and September beamtests with the same irradiation level was endcap module K5 312\*\*.

May 2003 beamtest						
Module	Eff @ 1fC	NO @ 1fC	Qmed (fC)	S/N	Bias (V)	Chips
<b>K5 312**</b>	99.2	$3.9 \times 10^{-3}$	$2.7 \pm 0.2$	$7.8 \pm 0.4$	350	(S1,S2) <sub>0</sub> & (S11,S12) <sub>1</sub>
	99.5	$9.0 \times 10^{-3}$	$3.0 \pm 0.1$	$7.8 \pm 0.3$	500	(M0,S1) <sub>0</sub> & (S12,E13) <sub>1</sub>

September 2003 beamtest						
Module	Eff @ 1fC	NO @ 1fC	Qmed (fC)	S/N	Bias (V)	Chips
<b>K5 312**</b>	98.7	$4.1 \times 10^{-3}$	$2.8 \pm 0.1$	$7.7 \pm 0.7$	350	(S2,S3) <sub>0</sub> & (S10,S11) <sub>1</sub>
	99.1	$3.4 \times 10^{-3}$	$3.2 \pm 0.5$	$8.5 \pm 1.3$		(S4,E5) <sub>0</sub> & (M8,S9) <sub>1</sub>
	98.8	$3.9 \times 10^{-3}$	$3.0 \pm 0.1$	$8.5 \pm 0.4$	500	(S2,S3) <sub>0</sub> & (S10,S11) <sub>1</sub>

⇒ different performances depending on the chips pointed by the beam.

## Median Charge and S/N vs bias



- Variation of the median charge (left) and signal to noise ratio (right) with the detector bias voltage.

- Test beam Sep 2003 has taken the conventional module characterisation data on newly irradiated modules.
- Offline and analysis are starting to produce results.
- Preliminary results confirm: high noise leaves little margin on fully irradiated end-cap and barrel modules.

## Results cross-check: module K5 312\*\*

May 03

Run 5951 (@350V, thr = 0.9 fC)

	LINK 0						LINK 1					
	M0	S1	S2	S3	S4	E5	M8	S9	S10	S11	S12	E13
Eff		99.7	99.2						98.7	99.6	99.7	
NO		$5.8 \times 10^{-3}$	$2.3 \times 10^{-3}$						$2.3 \times 10^{-3}$	$2.9 \times 10^{-3}$	$5.6 \times 10^{-3}$	
Events		1524	4970						970	4982	717	

Run 6069 (@350V, thr = 0.9 fC)

	LINK 0						LINK 1					
	M0	S1	S2	S3	S4	E5	M8	S9	S10	S11	S12	E13
Eff		99.5	99.8							99.5	99.8	
NO		$5.6 \times 10^{-3}$	$2.4 \times 10^{-3}$							$3.3 \times 10^{-3}$	$5.6 \times 10^{-3}$	
Events		2033	1661							2264	1300	

Run 6141 (@350V, thr = 0.9 fC)

	LINK 0						LINK 1					
	M0	S1	S2	S3	S4	E5	M8	S9	S10	S11	S12	E13
Eff		99.7	99.3							99.5		
NO		$5.6 \times 10^{-3}$	$2.3 \times 10^{-3}$							$3.0 \times 10^{-3}$		
Events		730	2015							2161		

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## Results cross-check: module K5 312\*\*

September 03

First beam position: run 6360 (@350V, thr = 0.9 fC)

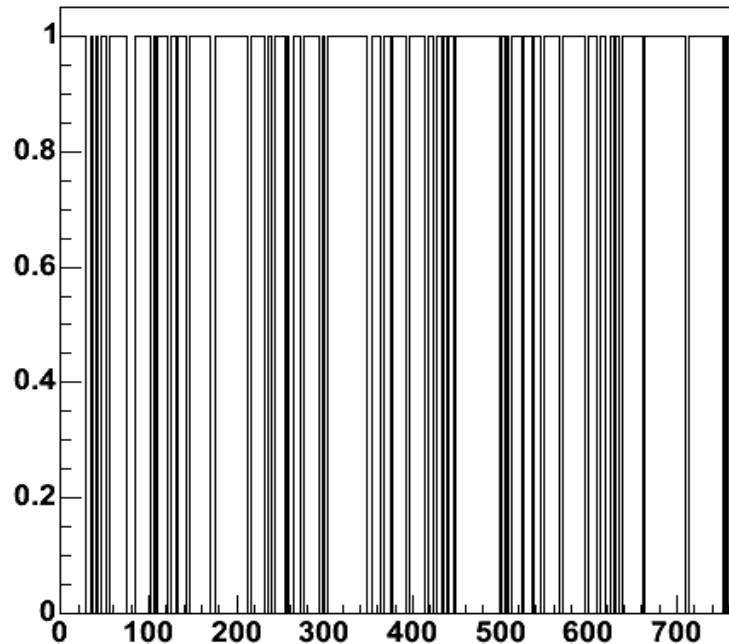
	LINK 0						LINK 1					
	M0	S1	S2	S3	S4	E5	M8	S9	S10	S11	S12	E13
Eff			99.4	99.1					97.6	99.5		
NO			$3.1 \times 10^{-3}$	$3.4 \times 10^{-3}$					$3.5 \times 10^{-3}$	$4.7 \times 10^{-3}$		
Events			2953	2509					3616	1561		

Second beam position: run 6446 (@350V, thr = 0.9 fC)

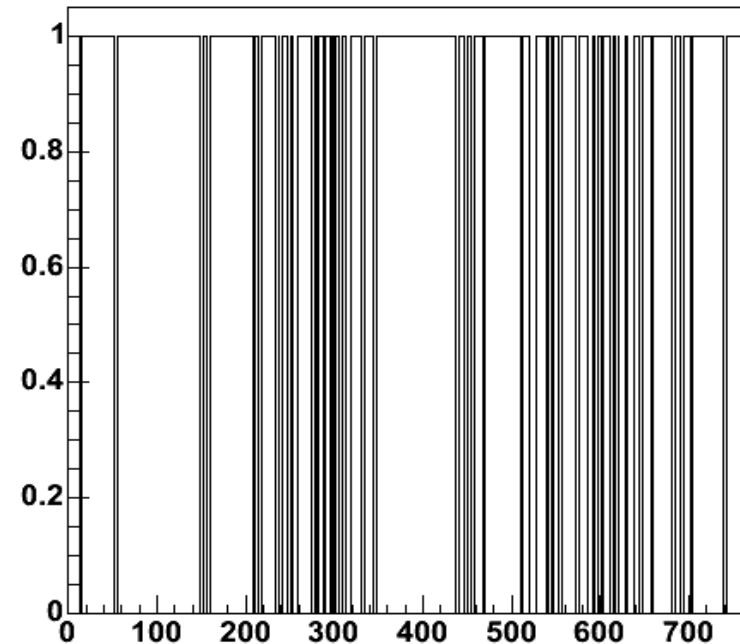
	LINK 0						LINK 1					
	M0	S1	S2	S3	S4	E5	M8	S9	S10	S11	S12	E13
Eff					99.2	98.9	99.6	98.6				
NO					$4.4 \times 10^{-3}$	$5.0 \times 10^{-3}$	$5.6 \times 10^{-3}$	$3.0 \times 10^{-3}$				
Events					4110	1036	2039	3183				

## Module K5 513\*\*

badmap14



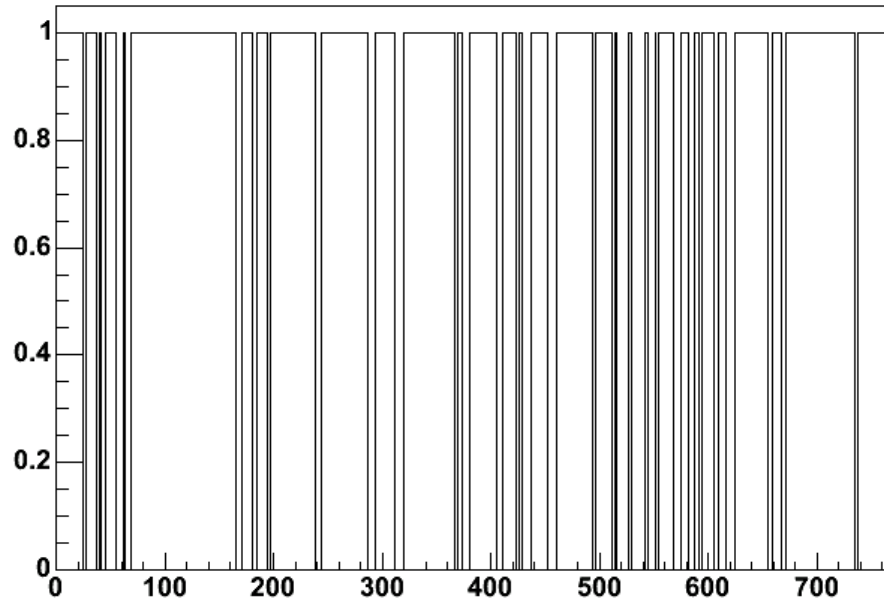
badmap15



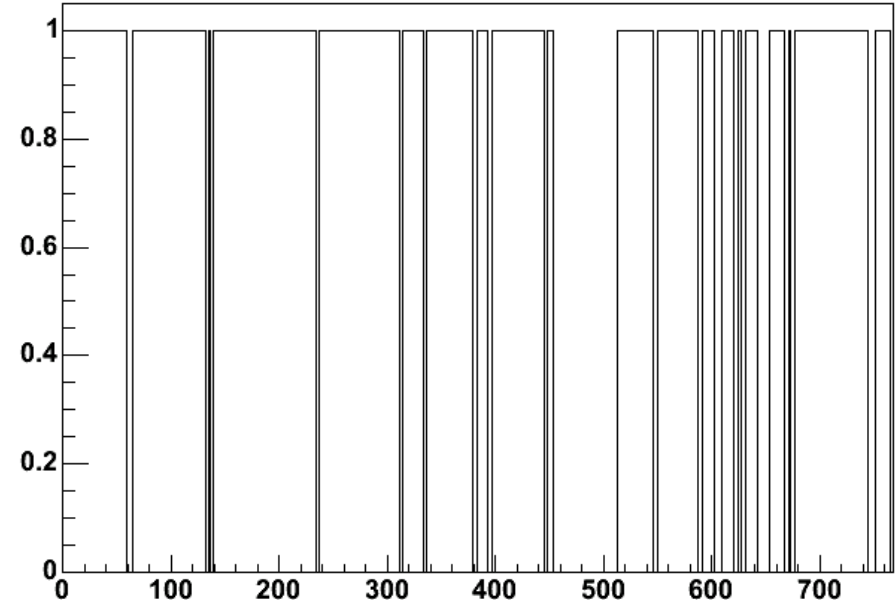
- Masked channels during calibration (hardware mask) for both links of module K5 513\*\*. For the non-masked channels, a value equal to 1 have been assigned in the histograms.
- Total #masked channels (hardware) = 114

## Module MEL 34

badmap10



badmap11



- Masked channels during calibration (hardware mask) for both links of module MEL 34. For the non-masked channels, a value equal to 1 have been assigned in the histograms.
- Total #masked channels (hardware) = 172