Analysis of the binary detectors data in the 96 beam-test

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Binary detectors under test

The binary modules from LBL installed at H8 were ATT7 and ATT8

ATT8

- Hammamatsu detector
- n^+ strips over n bulk
- $75\mu m.$ pitch
- AC coupling
- 2 CAFEs + 2 CDPs : 256 readout channels

ATT7

- Hammamatsu detector
- n^+ strips over n bulk
- $75\mu m.$ pitch
- AC coupling
- 2 CAFEs + 2 CDPs : 256 readout channels

Same specifications but detector and electronics irradiated separately to a fluence equivalent to $10^{14} mips/cm^2$

In addition we used LBIC2, LBIC1 (2nd period), which are fully populated modules and UCSC2 (3 chips) as anchor planes

Analysis scheme

The program used is an extension of the on-line software (G. Moorhead + W. Kroeger)

Makes use of binary anchor planes instead of telescope planes (foreseen to be used too)

1. decodification of binary information associated to channels
2. assignment of channel to strip number
3. masking of bad and hot channels
4. clusterization of hits (>= 1 hit)
5. correlation plots produced
6. alignment file modified to match clusters for all modules
7. a) 1st period : require match inside ± 4 strips between LBIC2_0 and LBIC2_1
   b) 2nd period : no match required due to dead chip in LBIC2_1
8. a) 1st period : look for match with UCSC2 inside ± 2 strips
   b) 2nd period : require match between LBIC2_0 or LBIC2_1 and UCSC2 accordig to data availability
9. build track with cluster positions and z positions of planes
10. look for cluster inside ± 2 strips of extrapolated track position in ATT7 or ATT8 if no bad or hot channels inside

Information on data

1^{st} PERIOD

Sets of runs at the following thresholds :

$0.6fC$, $0.8fC$, $1.0fC$, $1.2fC$, $1.4fC$, $1.7fC$, $2.0fC$, $2.5fC$
$3.0fC$, $3.5fC$, $4.0fC$, $4.5fC$

for different bias voltages of ATT7 and ATT8 :

$V_{ATT7}(V)$	50	100	150	200	250	275
$V_{ATT8}(V)$	50	75	100	125	150	175

to study fully and partially depleted operation of both modules

2^{nd} PERIOD

Sets of runs at the following thresholds :

$0.6fC$, $0.8fC$, $1.0fC$, $1.2fC$, $1.4fC$, $2.0fC$, $2.5fC$
$3.0fC$, $3.5fC$, $4.0fC$

with $V_{ATT8} = 125V$ and $V_{ATT7} = 250V$ (usually)

Magnet was on for most of the runs

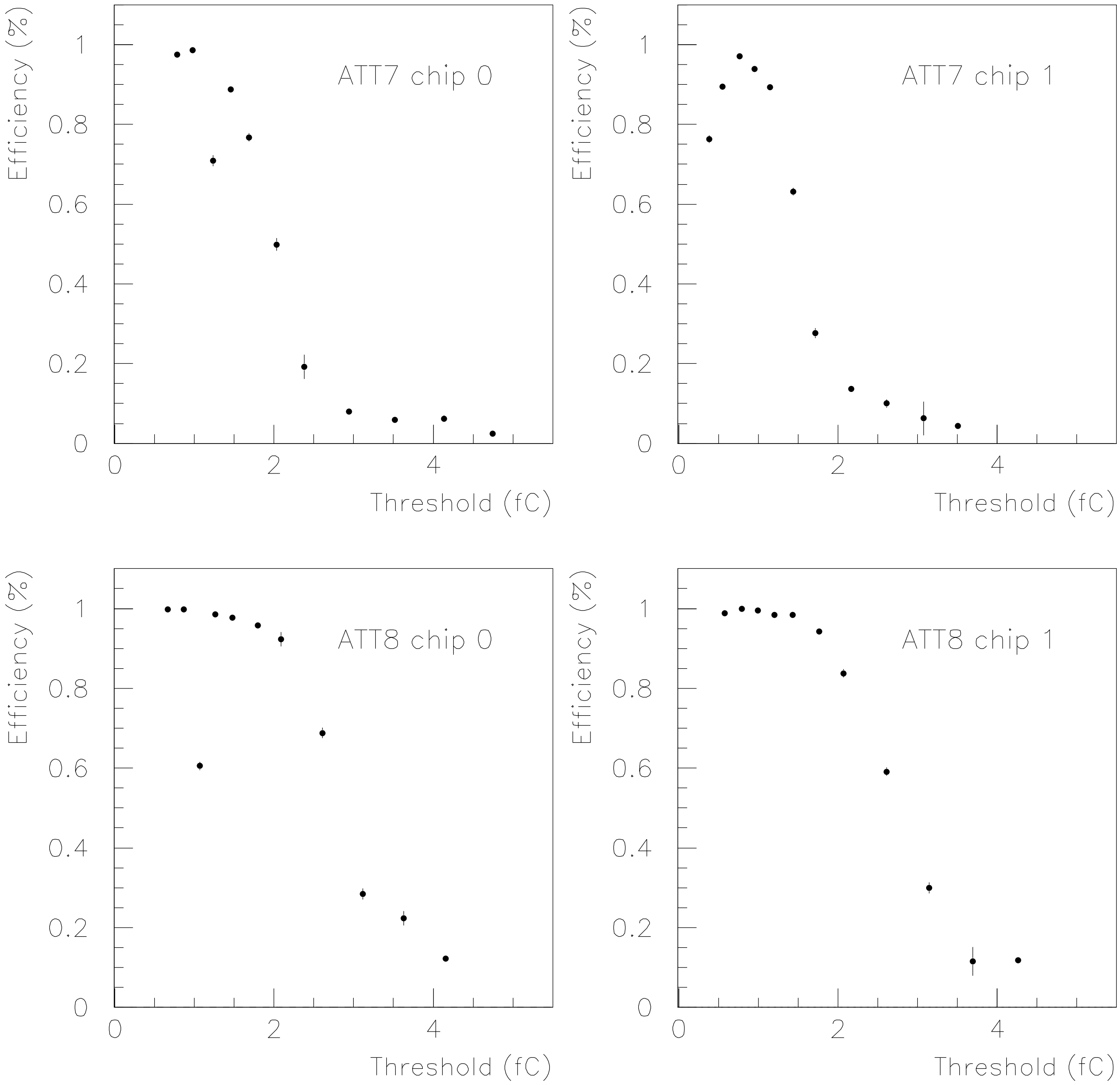
for different rotation angles :

-12^0, -8^0, -3^0, 0^0, 4.5^0, 12^0, 19.5^0, 27^0
($\approx \pm 15^0$ of expected Lorentz angle)

Threshold scans for different voltages

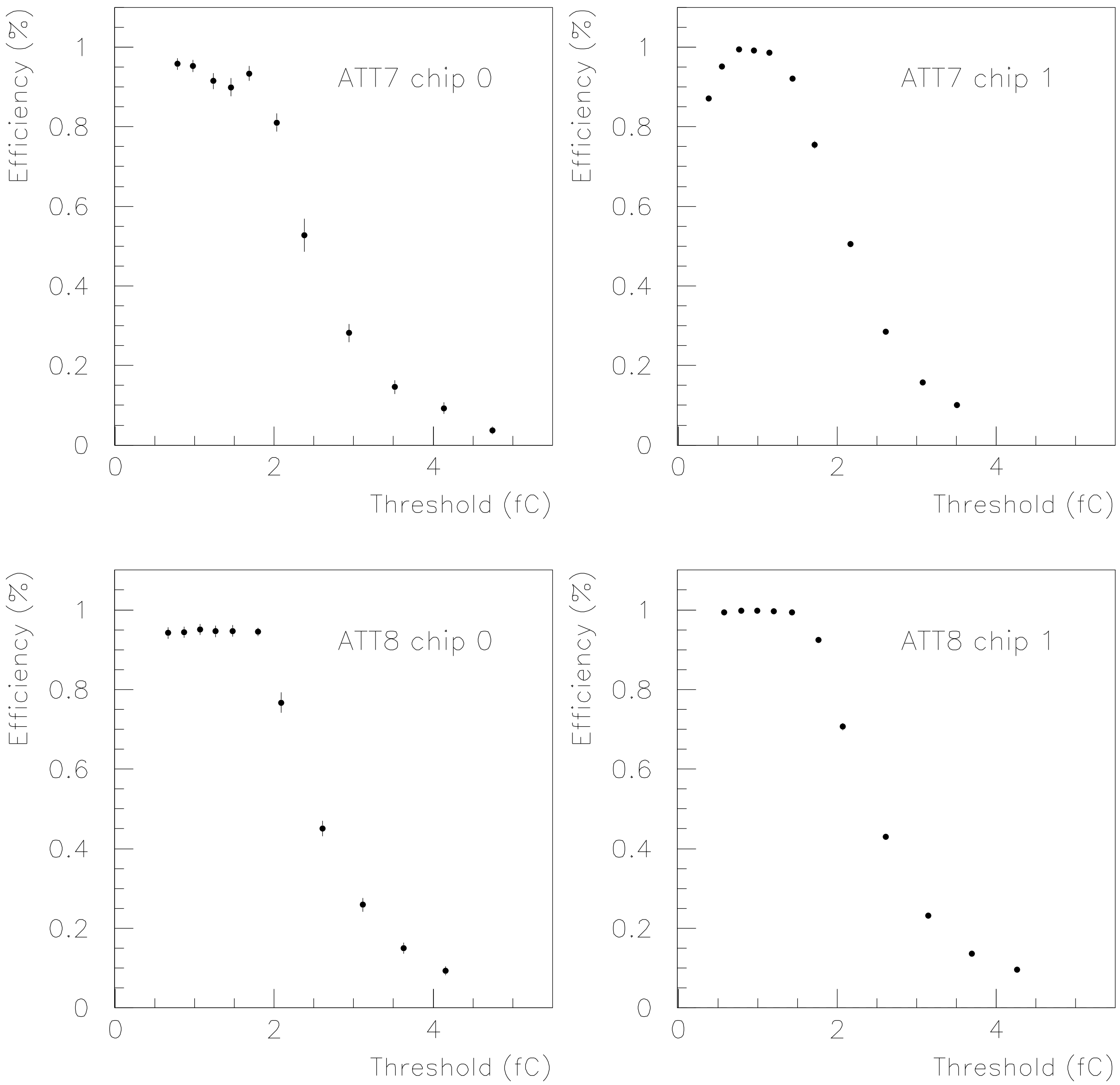
Only some relevant sets of runs have been selected
During the first part of data taking some problems make data unusable

$V_{ATT7} = 150V$ and $V_{ATT8} = 100V$



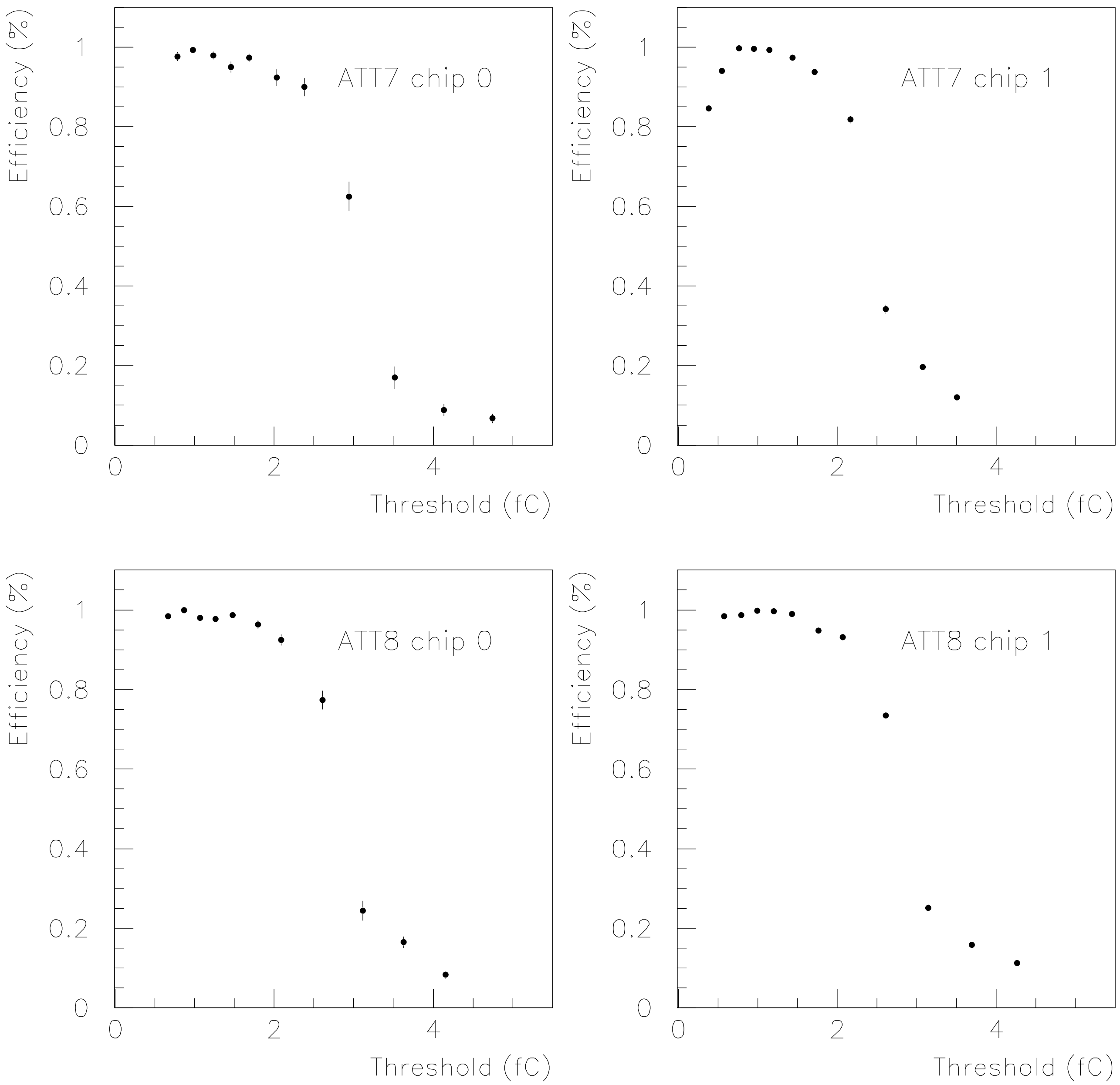
- low threshold points show evidence of possible oscillations
- drop of efficiency is only seen for 2 clusters of channels
- still η close to 1 at 0.8 fC for partially depleted ATT7

$V_{ATT7} = 250V$ and $V_{ATT8} = 150V$



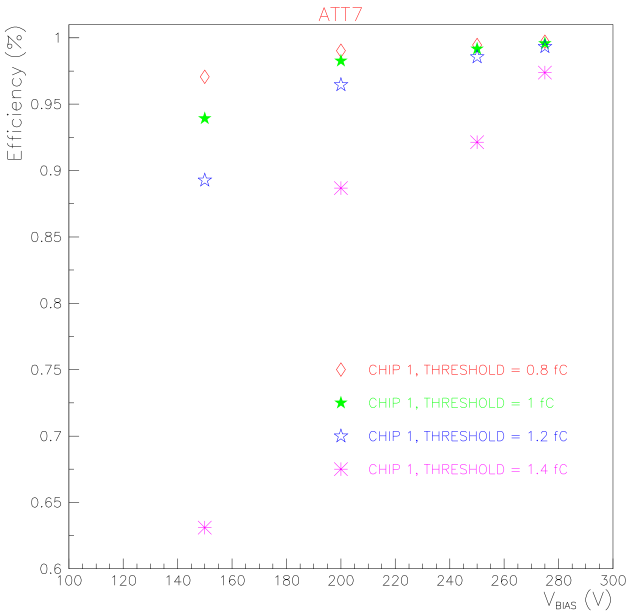
- possible tracking problem on chip 0 (lack of statistics to determine it)
- plateau at $\eta = 1$ for some threshold values

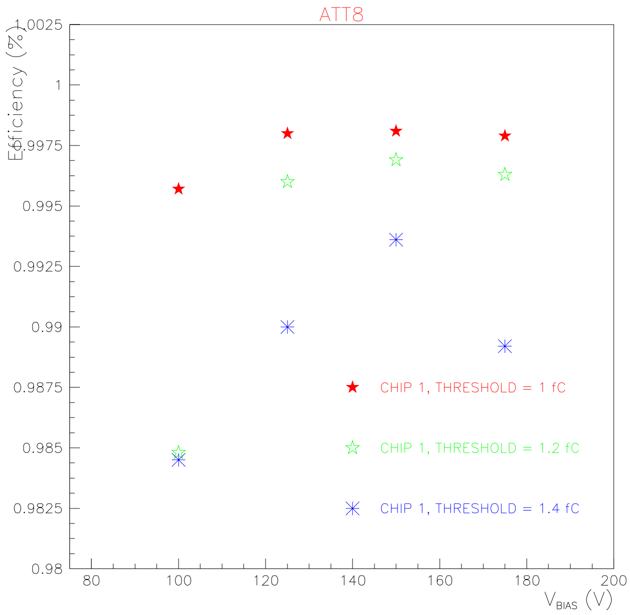
$V_{ATT7} = 275$ and $V_{ATT8} = 175V$



- slightly improved plateau at $\eta = 1$ for ATT7
- ATT8 shows same curves

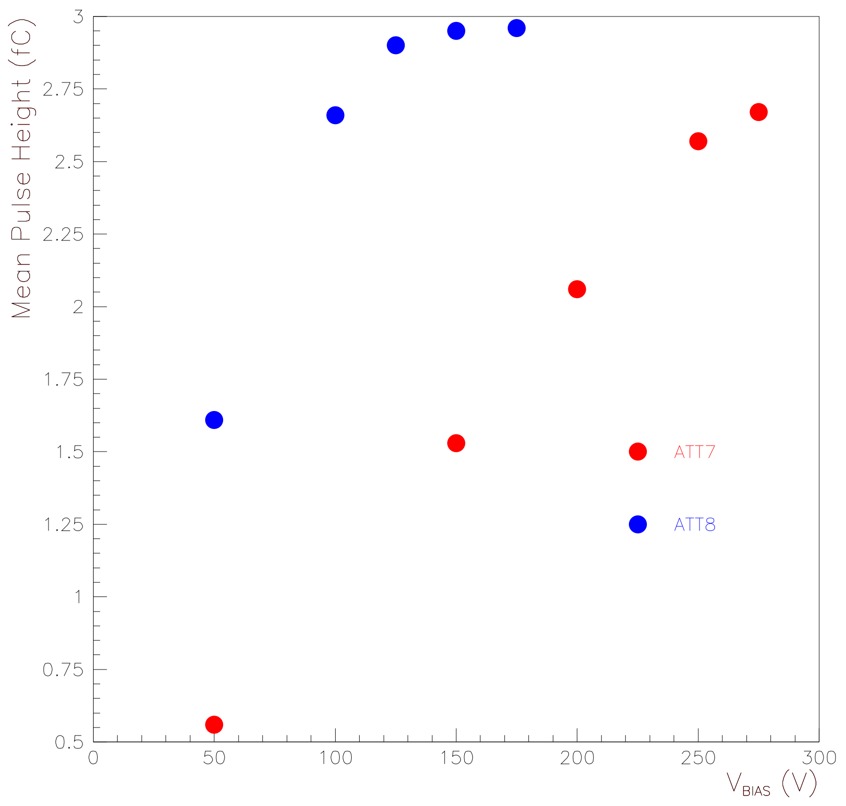
MPH and efficiency as function of bias voltage





- ATT8 also looses a bit of efficiency below $V_{ATT8} = 110V$
- good efficiency for some low threshold values in ATT7; also at intermediate bias voltages
- $\eta > 97\%$ for values as high as $1.4fC$ for ATT8

MPH : mean pulse height; $\eta = 50\%$ (averaged over all the channels of a chip) value of the threshold

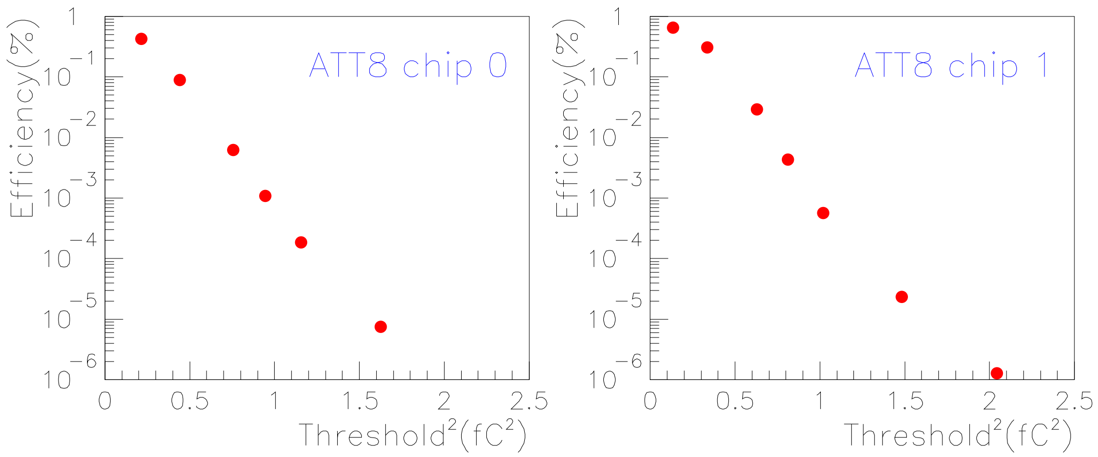


ATT7 is close to be completely depleted in terms of response to input charges

MPH a bit low at the peak, but the MPH is averaged for all the tracks traversing also intrstrip positions

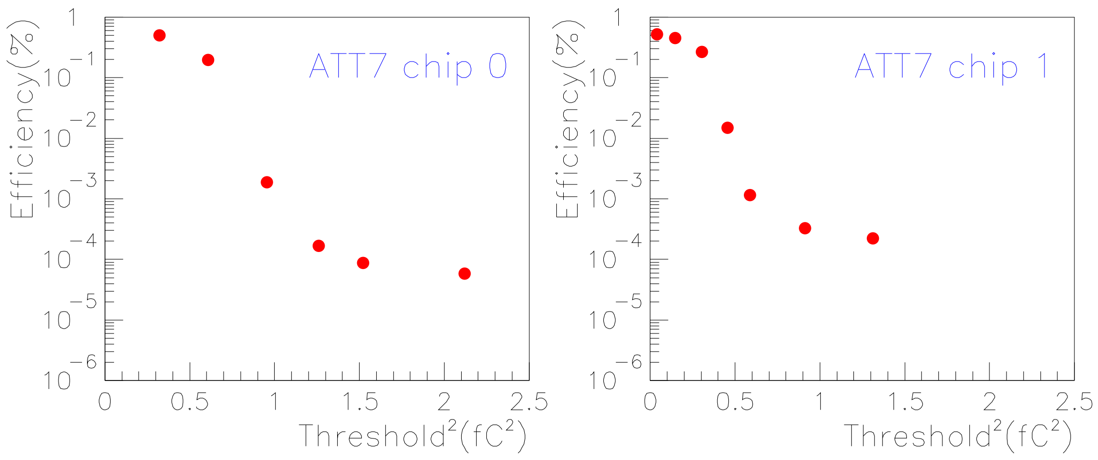
Noise occupancy and efficiency vs. noise occupancy

ATT8 fully depleted



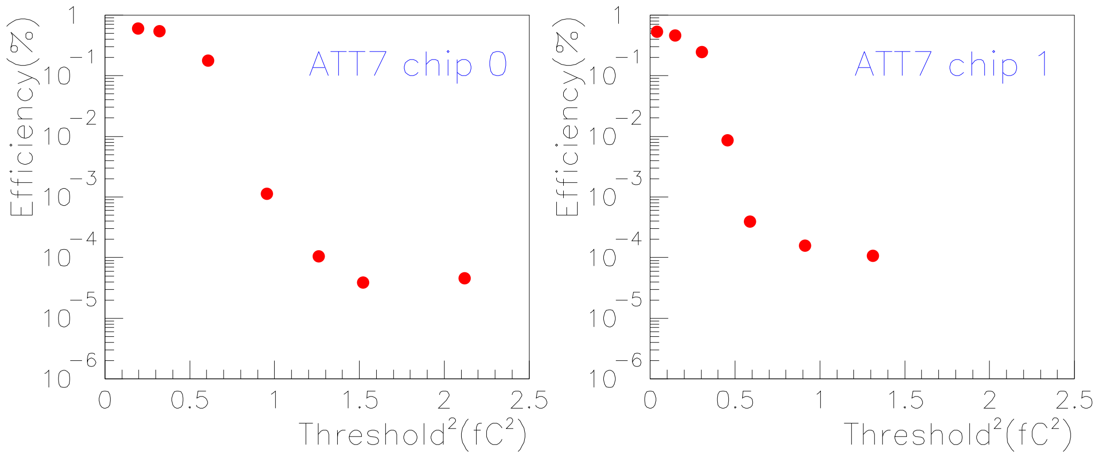
- good behaviour showing a straight line
- noise occupancy close to 10^{-4} for $1fC$

ATT7 fully depleted ($V_{bias} = 250\mathrm{V}$)

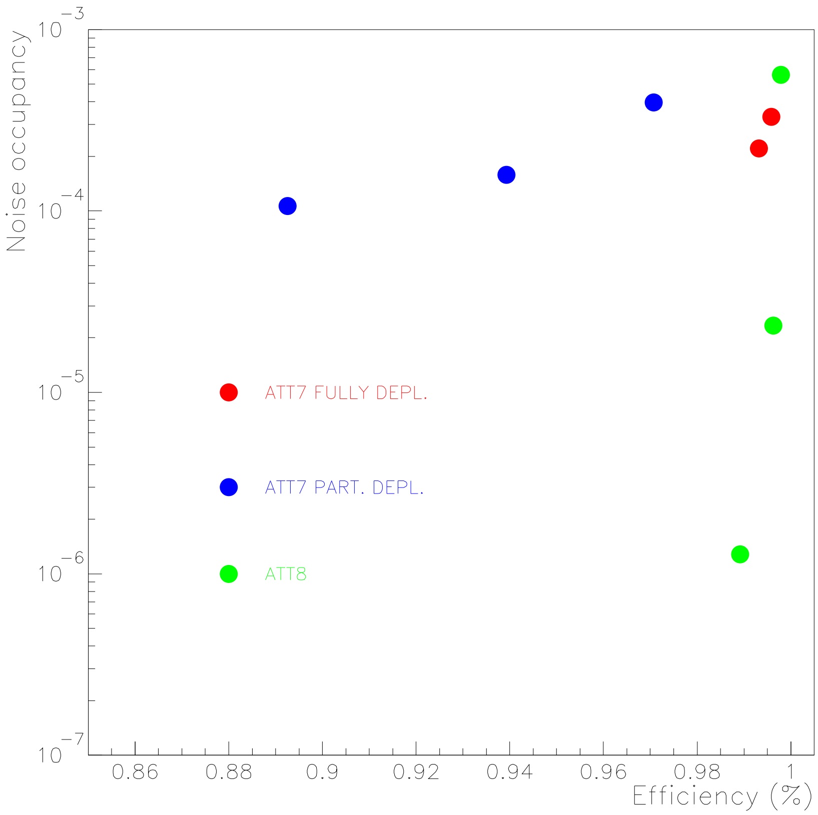


- some oscillating noisy (not always on) channels still present
- noise iccupancy also close or lower than 10^{-4} for low thresholds

ATT7 partially depleted ($V_{bias} = 150\mathrm{V}$)



Noise occupancy vs. efficiency



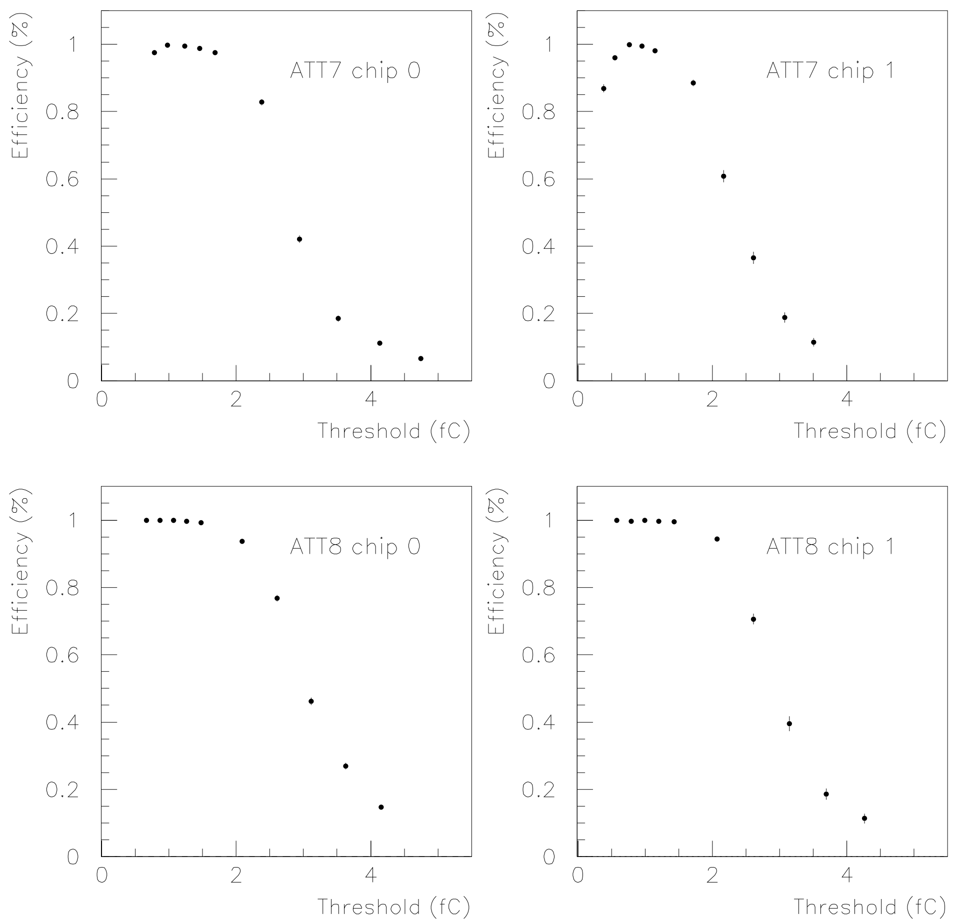
Conclusion : good efficiency at occupancies of the order of 10^{-4} or lower for both detectors

Threshold scans varying rotation angle

Magnet was on most of the data taking time

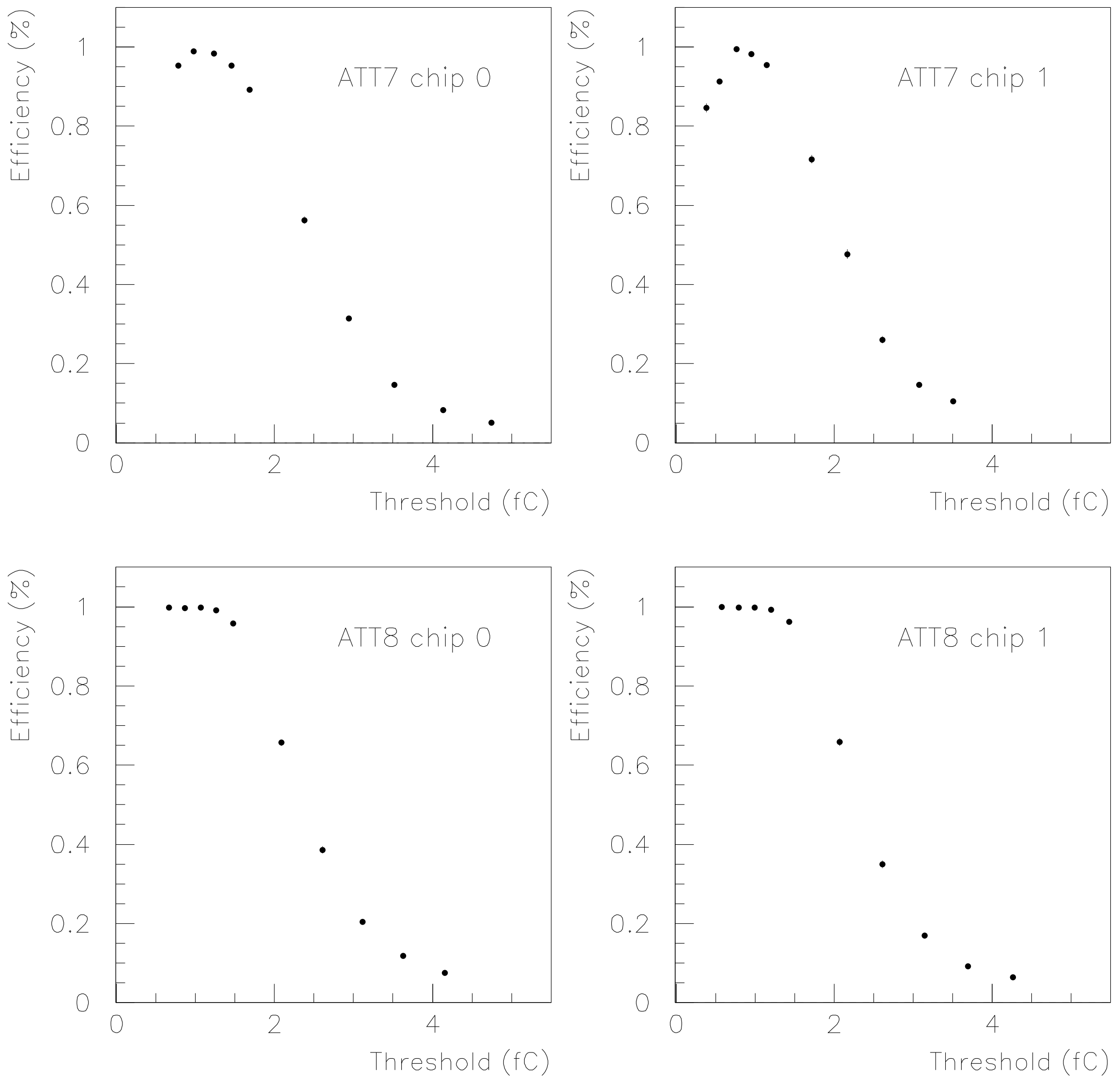
First set of runs with same conditions and at the end of first period

- angle : 0^0
- magnet off



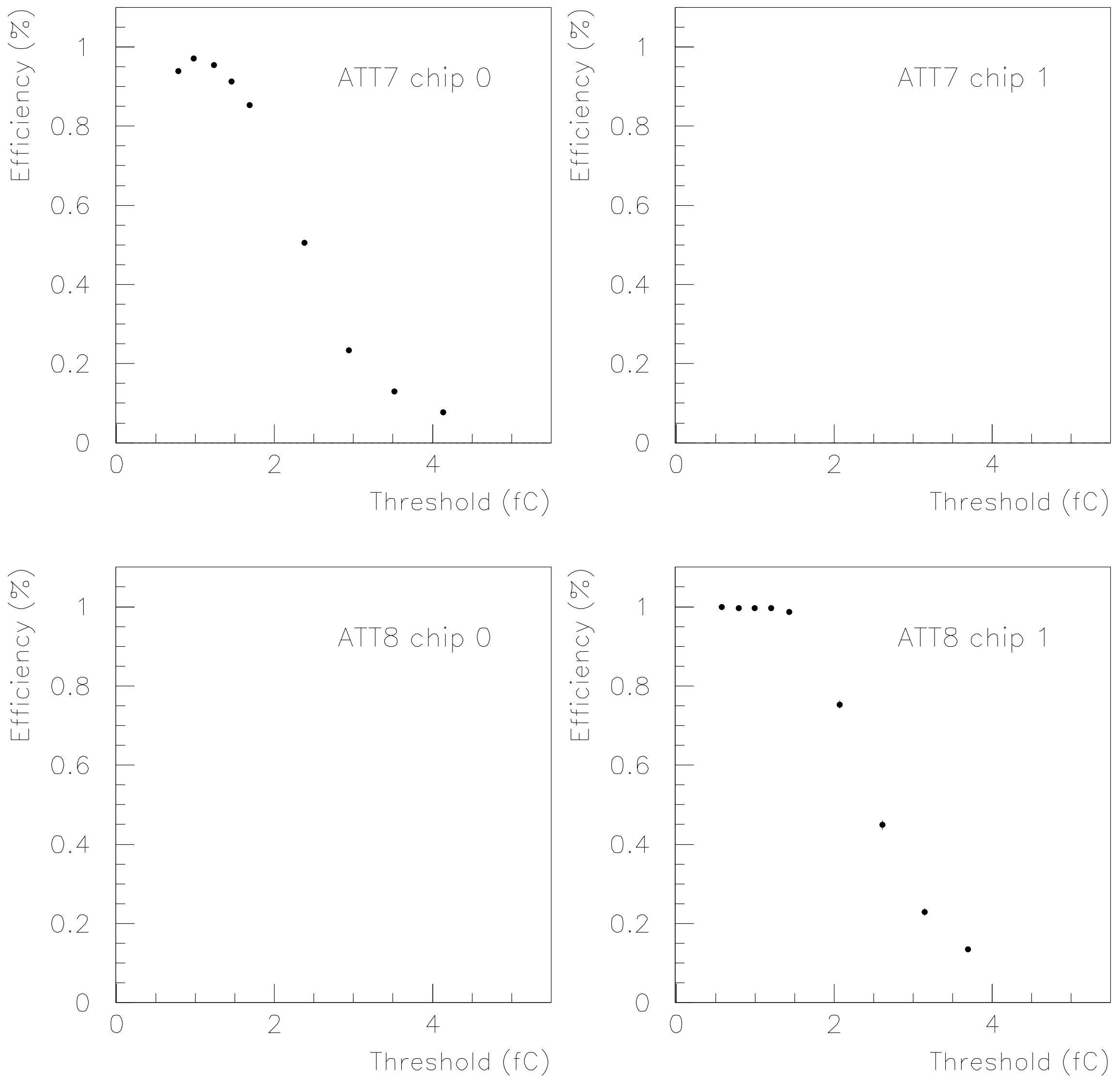
- both chips show equally good response for both detectors

Angle : -3^0



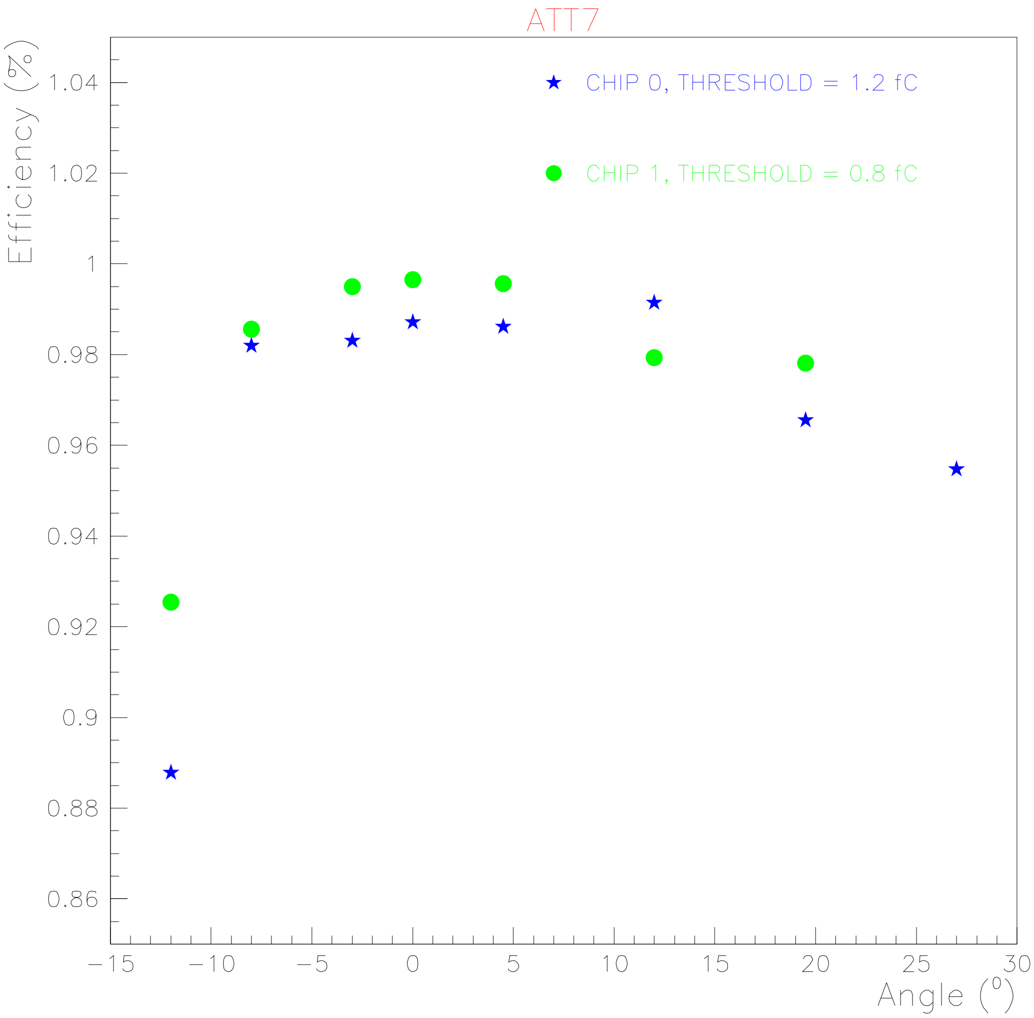
At 15^0 outside the expected Lorent angle, efficiencies are very close to 1 in spite of low MPH

Angle : 27^0

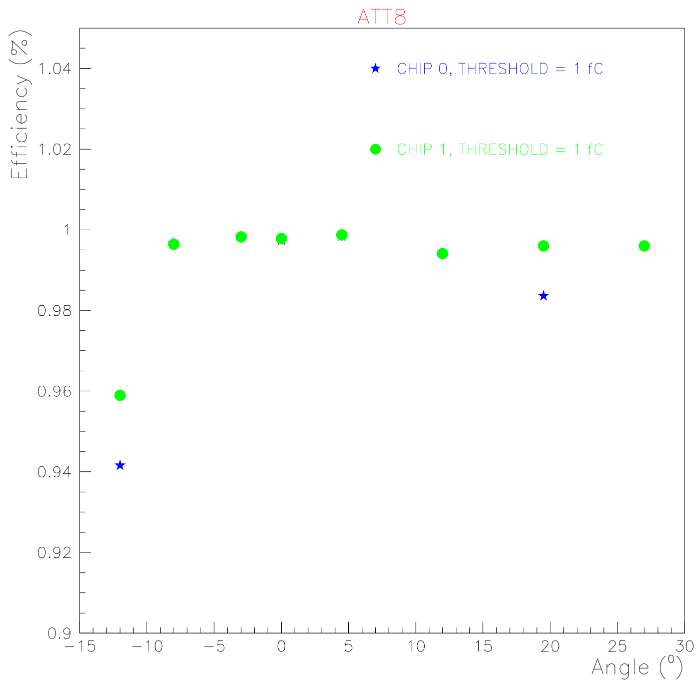


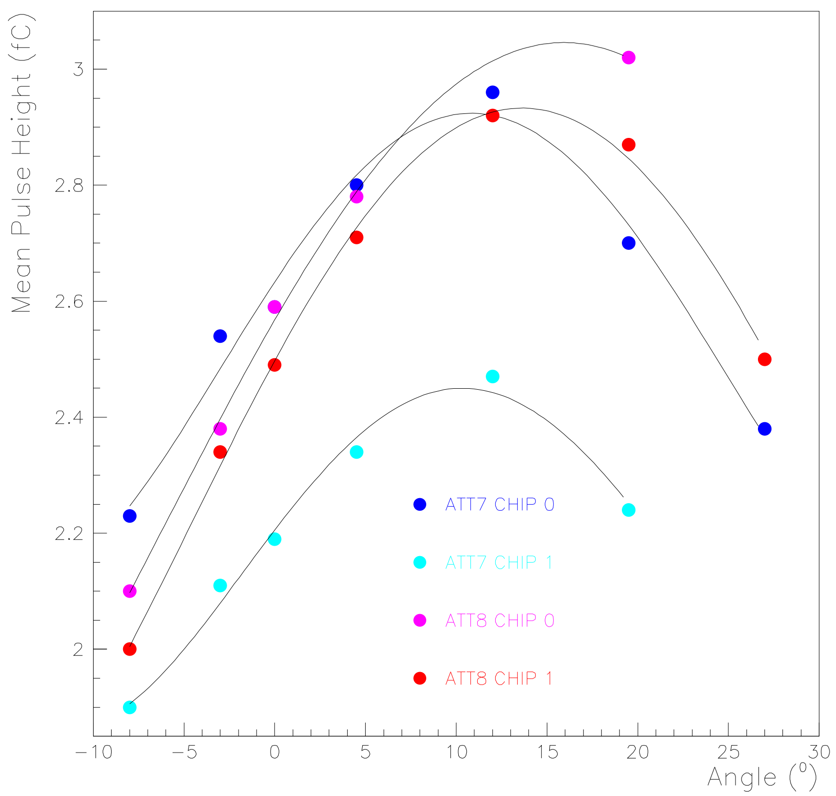
No data on ATT7 chip 0 and ATT8 chip 1, because of the rotation. Same comments as before apply

MPH and efficiency vs. angle



Efficiency close to 1 except for -12^0 for a wide range of angles


ATT8
Efficiency (%)
CHIP 0, THRESHOLD = 1 fC
CHIP 1, THRESHOLD = 1 fC
Angle (°)


Mean Pulse Height (fC)
ATT7 CHIP 0
ATT7 CHIP 1
ATT8 CHIP 0
ATT8 CHIP 1
Angle (°)

In spite of the diminishing MPH, the efficiency remains very high

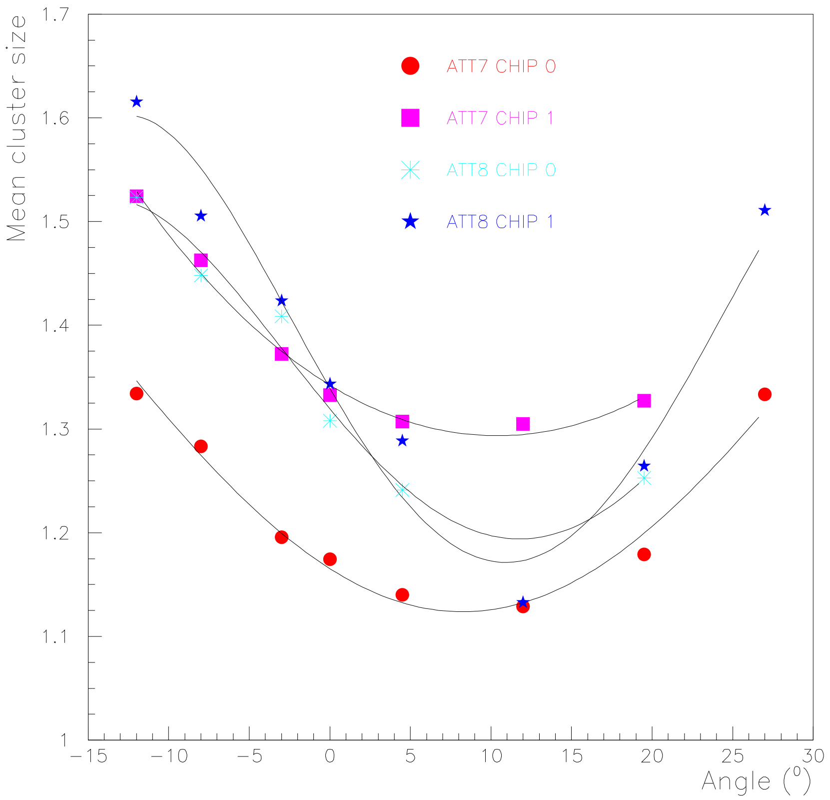
Lorentz angle :

ATT7 (0) $\rightarrow 10.79^0$; ATT7 (1) $\rightarrow 10.38^0$

ATT8 (0) $\rightarrow 15.89^0$; ATT8 (1) $\rightarrow 13.63^0$

Consistent values for both chips of each module are obtained; the values are smaller for the irradiated module ATT7

Lorentz angle from cluster width



The results of the fits are :
ATT7 chip 0 $\Rightarrow$ 8.20
ATT7 chip 1 $\Rightarrow$ 10.27
ATT8 chip 0 $\Rightarrow$ 11.19
ATT8 chip 1 $\Rightarrow$ 10.93

Irraditated module tends to give a lower value for the Lorentz angle

Conclusions

- Certain number of dead and noisy channels present (≈ 15 for ATT8 and ≈ 30 for ATT7)

- Operation voltages have been determined (V_{ATT7} might be increased slightly

- Calibration not completely understood

- Very good response and noise occupancy for ATT8

- Good behaviour of irradiated ATT7 showing good capabilities