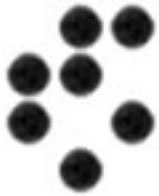
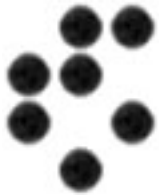


Beam test 2004 – some results

Peter Križan

University of Ljubljana and J. Stefan Institute

Contents



Test set-up

Performance of the system

Dual radiator schemes

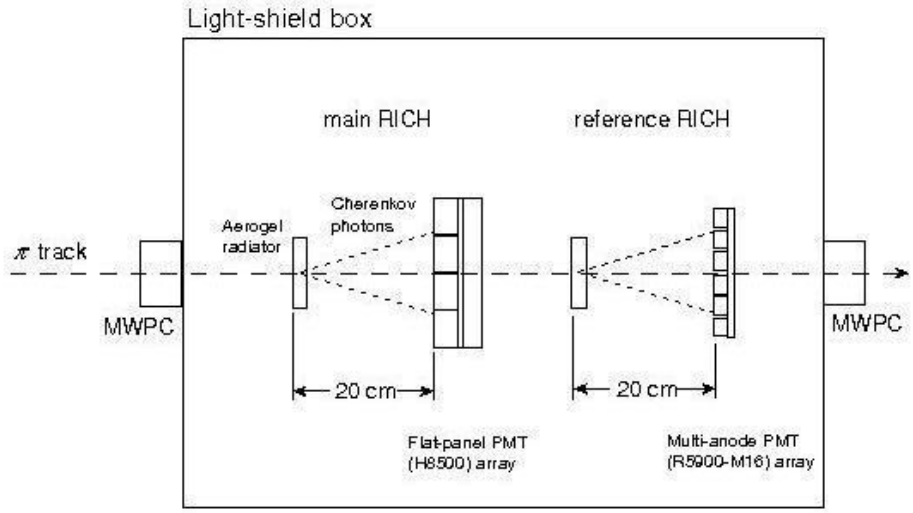
Beam test results, selection

Beam test set-up

Beam test Nov. 2002 set-up

RICH1: array of Hamamatsu H8500 (flat pannel PMTs)

RICH2: reference, R5900-M16



Beam test March 2004:

RICH1: same

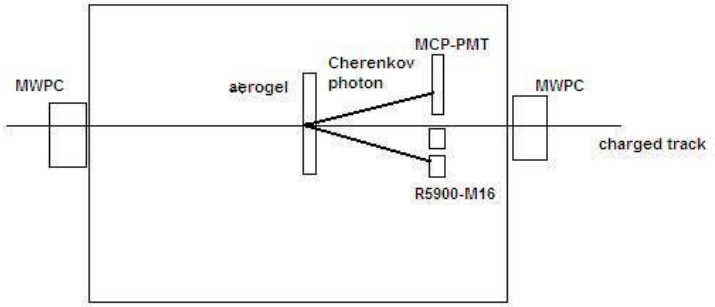
RICH2: Burle 85011 MCP PMT (+Hamamatsu R5900-M16 as reference)

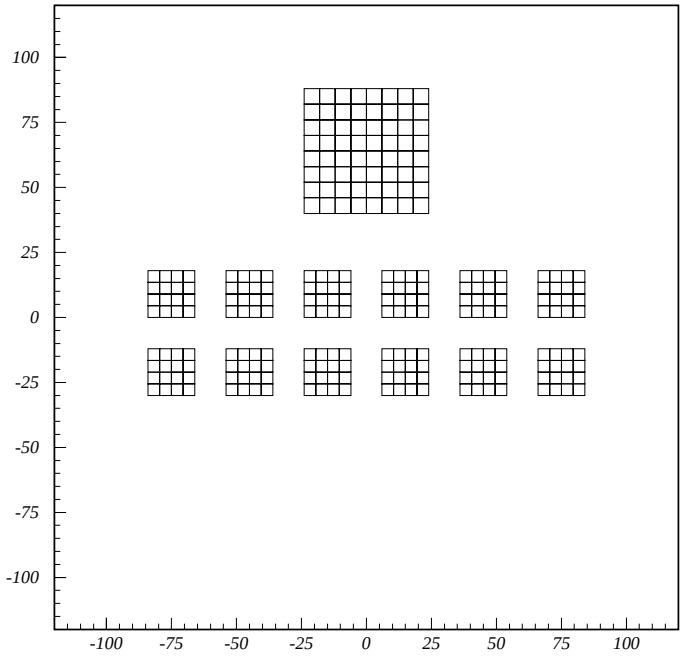
Beam test set-up

RICH2:

Burle 85011 MCP PMT

R5900-M16 as reference



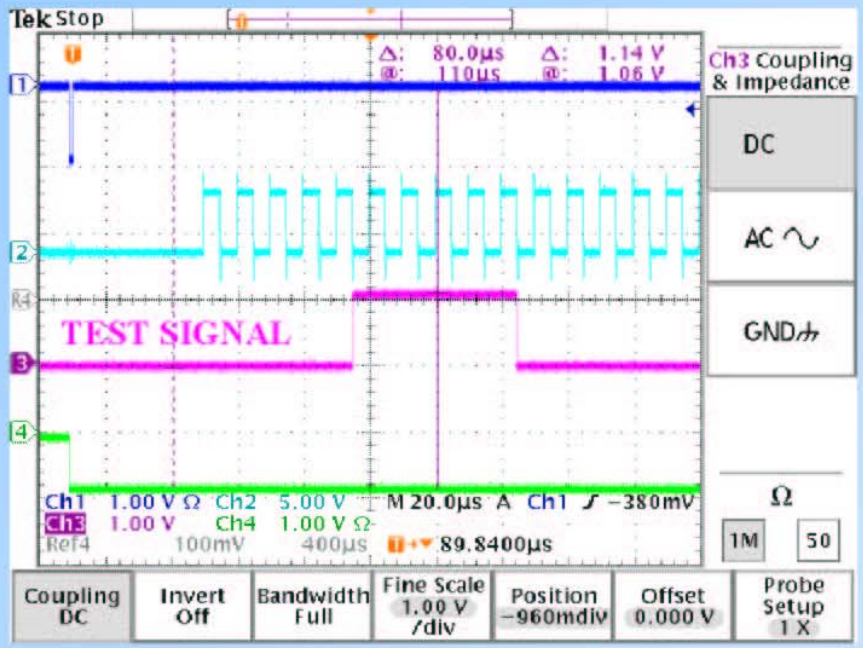


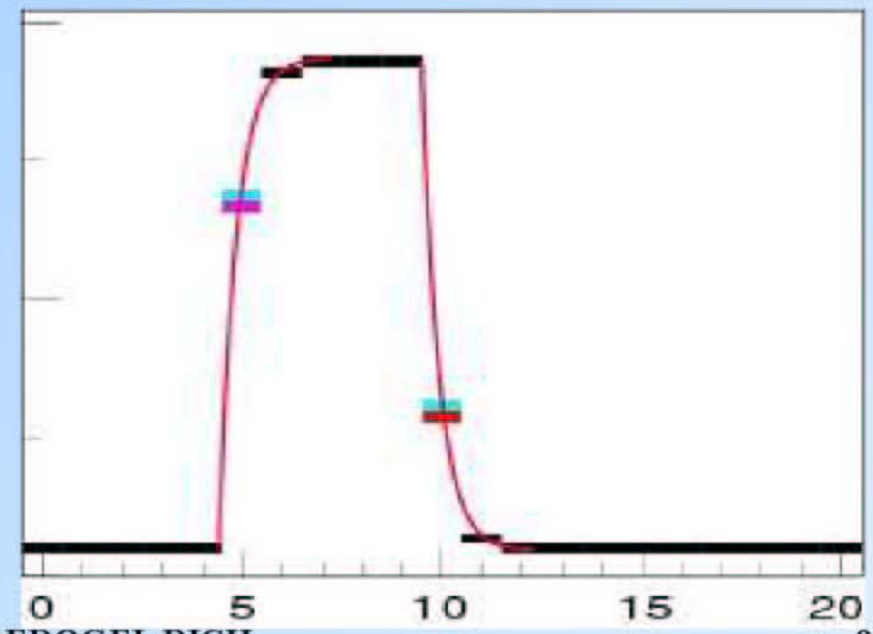
Was discussed yesterday

Beam test set-up

- Optimized DAQ (in 2002 we had synchronisation problems, loss of useful events)
- Problems with beam (a magnet broke down, had to be repaired during our 20 shift time slot)
- However, number of recorded useful events is about 4M (more than in 2002)

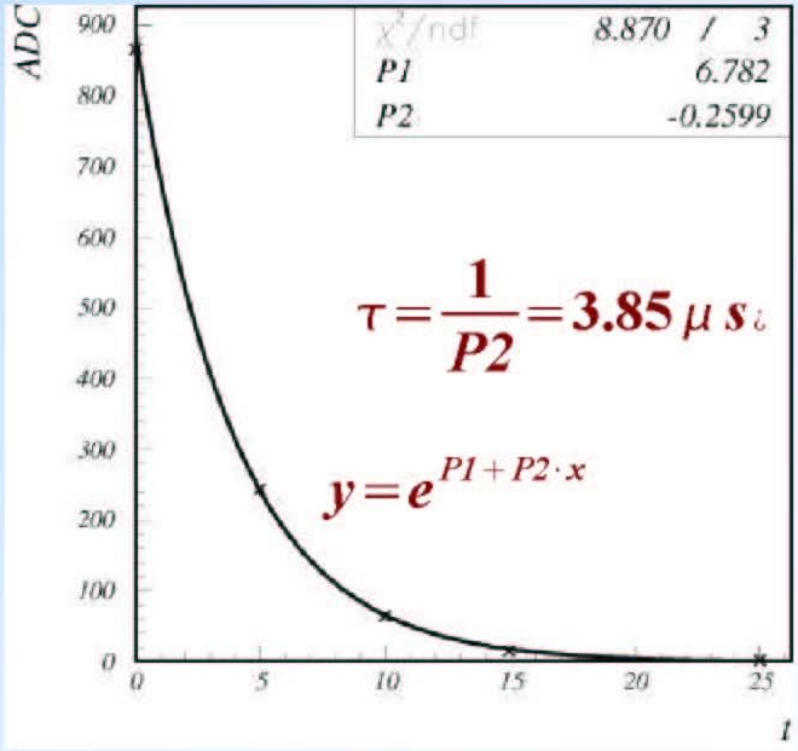
ADC "CROSS TALK"





- ADC time constant (RC)

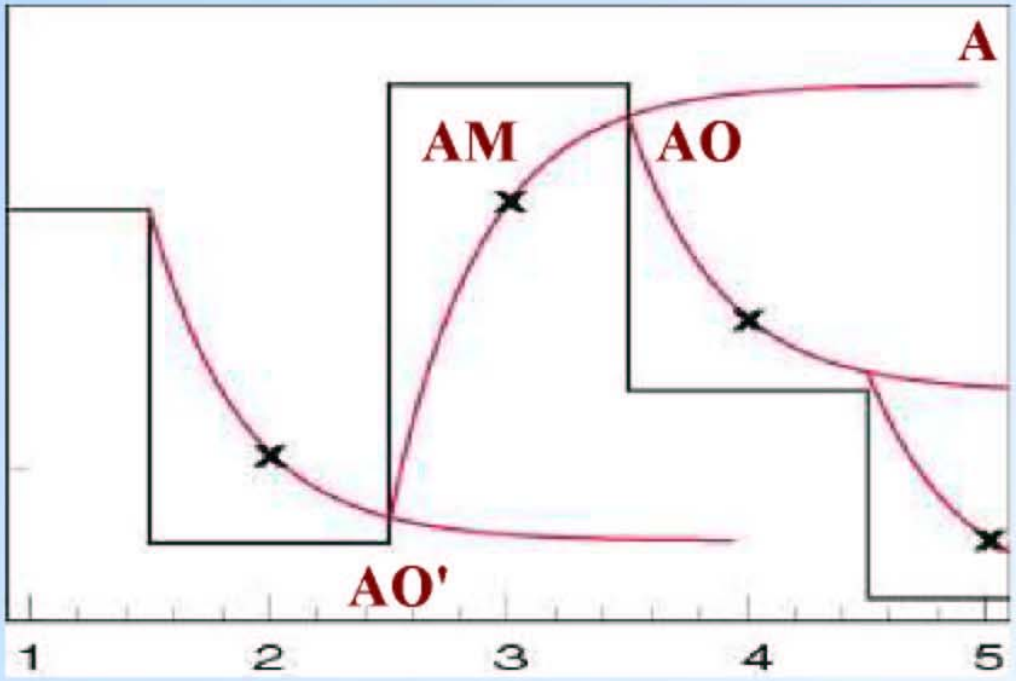
$$AM = AO + (A - AO)(1 - e^{-t/\tau})$$



ADC correction

$$AM = AO' + (A - AO')(1 - e^{-t_1/\tau})$$

- AO' - starting signal
- AM - measured signal
- AO - start for the next channel
- A - “real” value

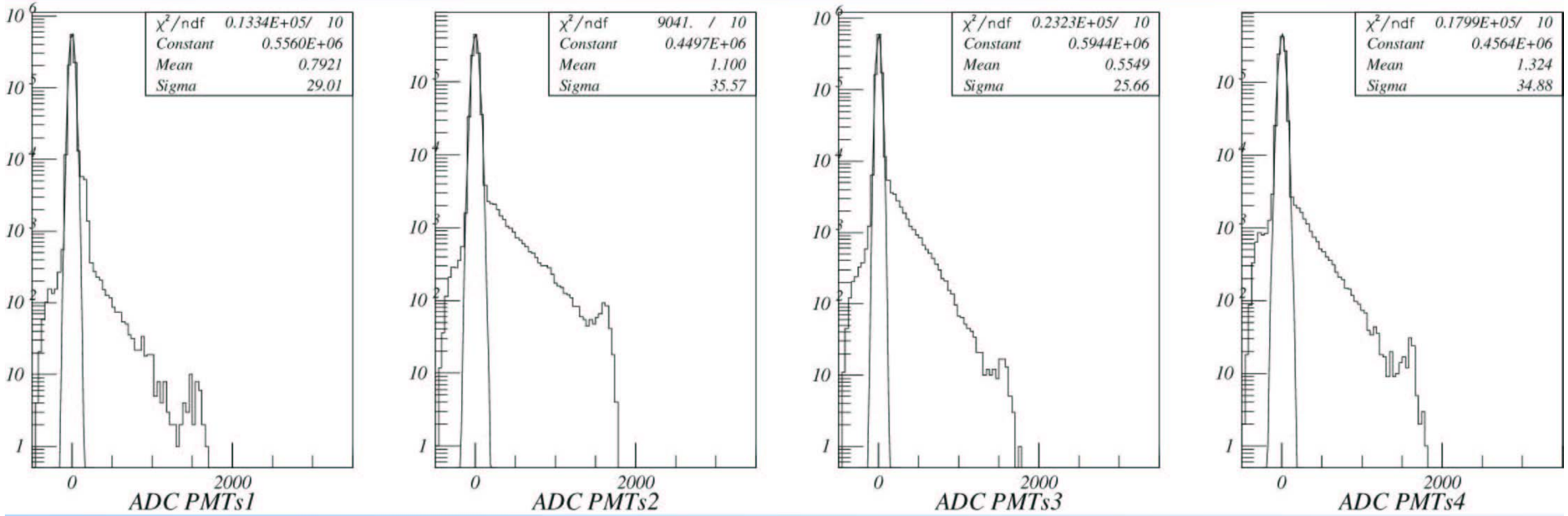


$$A = AO' + \frac{(AM - AO')}{(1 - e^{-t_1/\tau})}$$

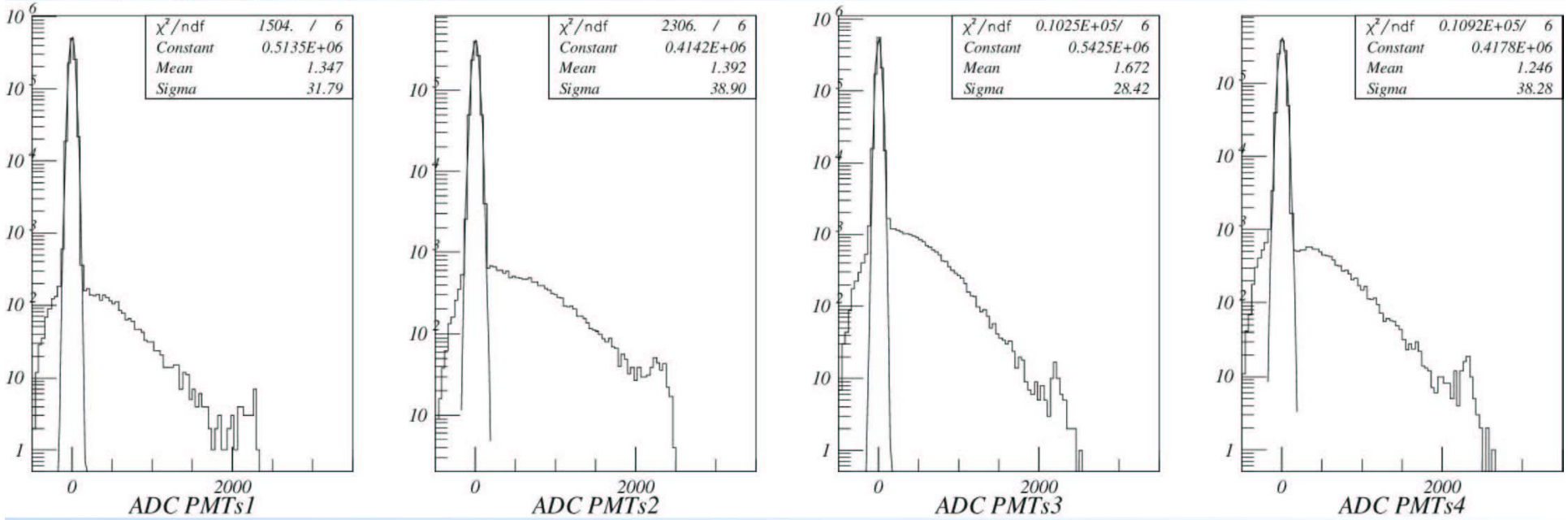
$$AO = AO' + (AN - AO')(1 - e^{-t_2/\tau})$$

- t1 ~ 4.65 us
- t2 ~ 10 us

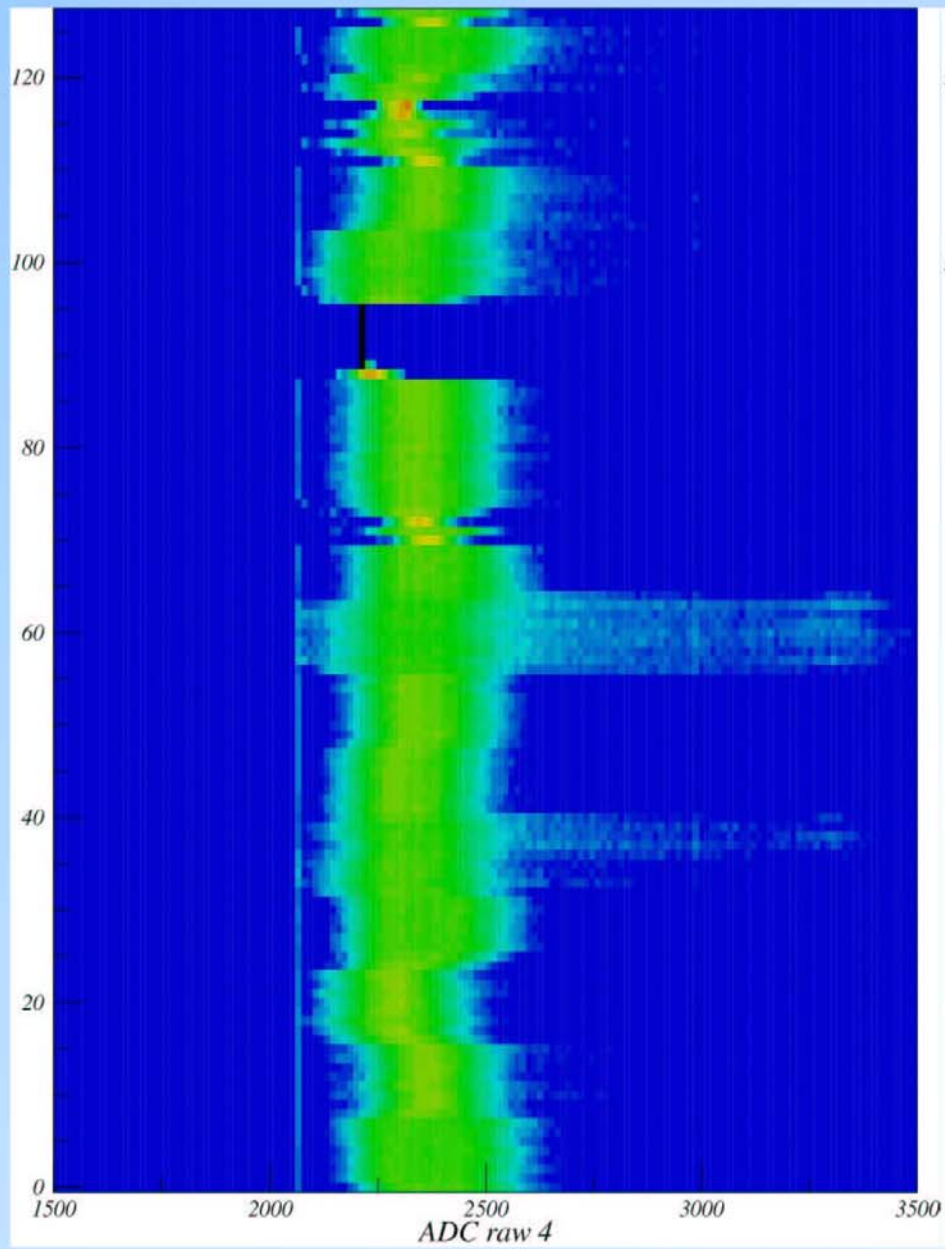
- ADC no correction

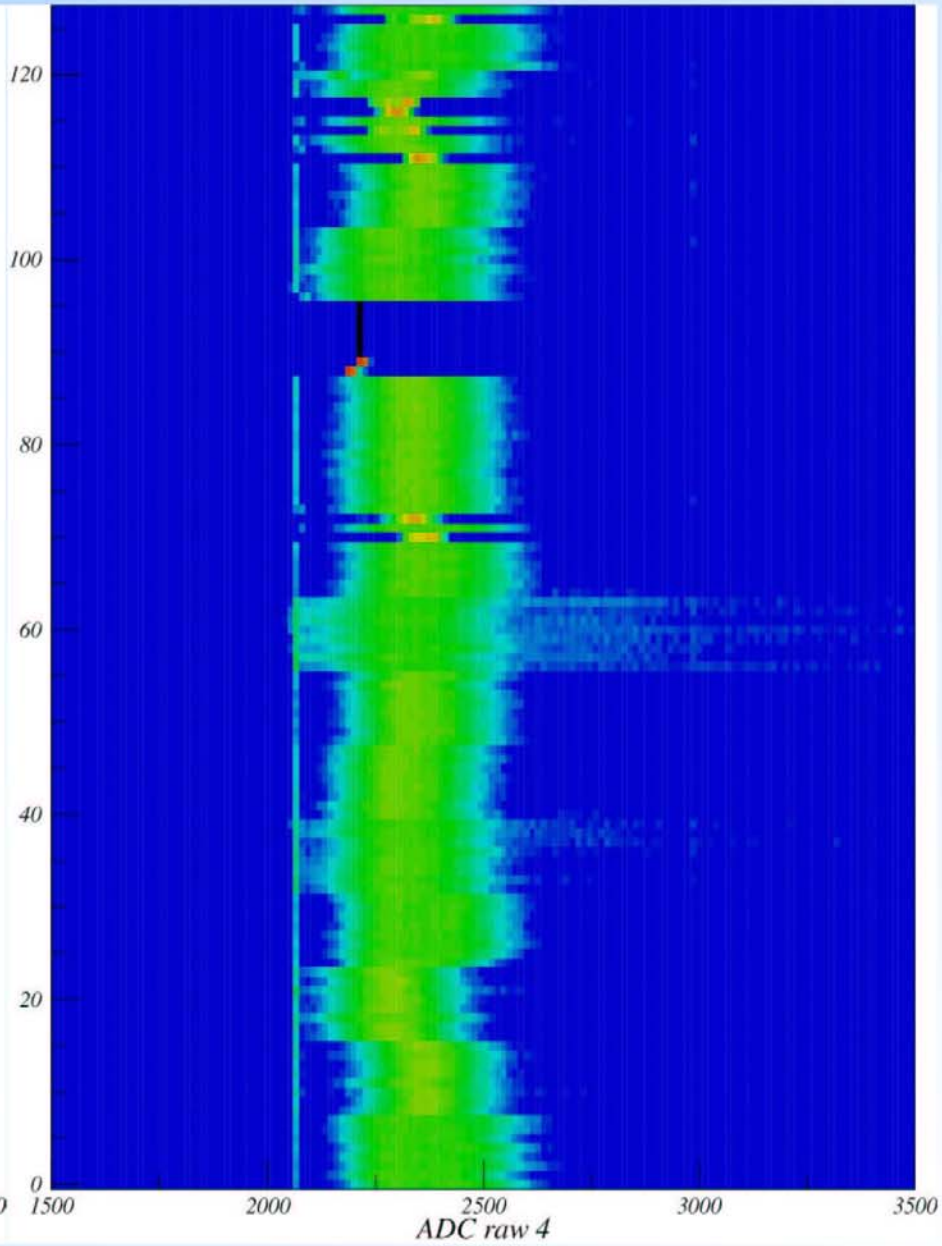


- ADC with correction

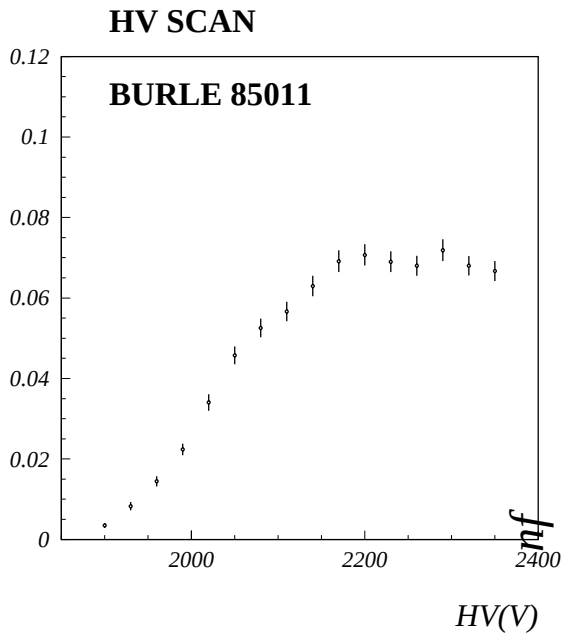


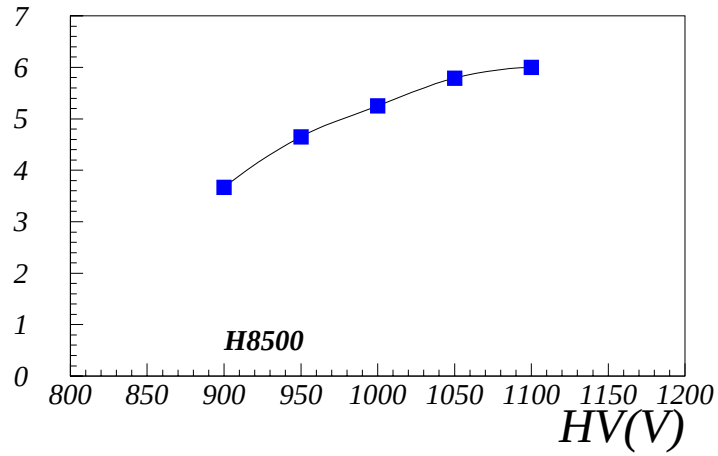
- ADC no correction
- ADC with correction

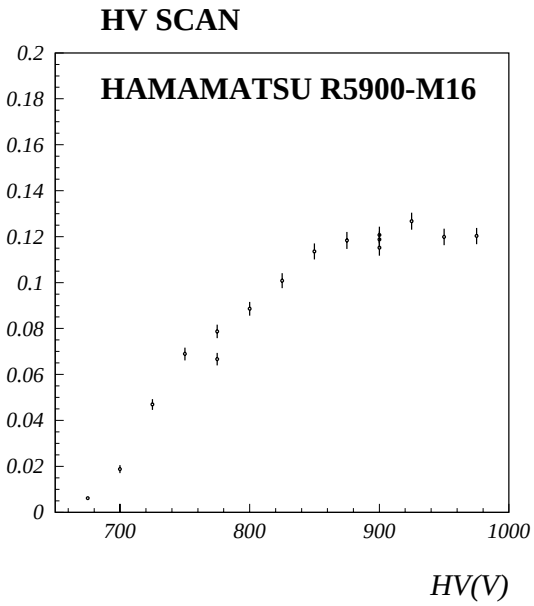




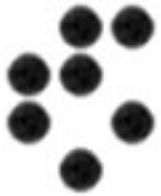
HV scans: yield







Beam test program



An ambitious program:

- Test new aerogel samples
- Test fixing of aerogel on substrates (mounting)
- Investigate aerogel uniformity
- Study the dual radiator scheme
- Momentum scans, angle of incidence scans
- Test Burle MCP PMT
- .....

Most of it carried out in spite of the trouble!

Some beam test data

Average tracking efficiency (at least one space point reconstructed): 0.92

Average tracking efficiency (two space points reconstructed): 0.58

Run information

http://www-f9.ijs.si/~rok/aerorich/beamtest2004/run.html

Measurement setups

http://www-f9.ijs.si/~rok/aerorich/beamtest2004/run_aerogel.html

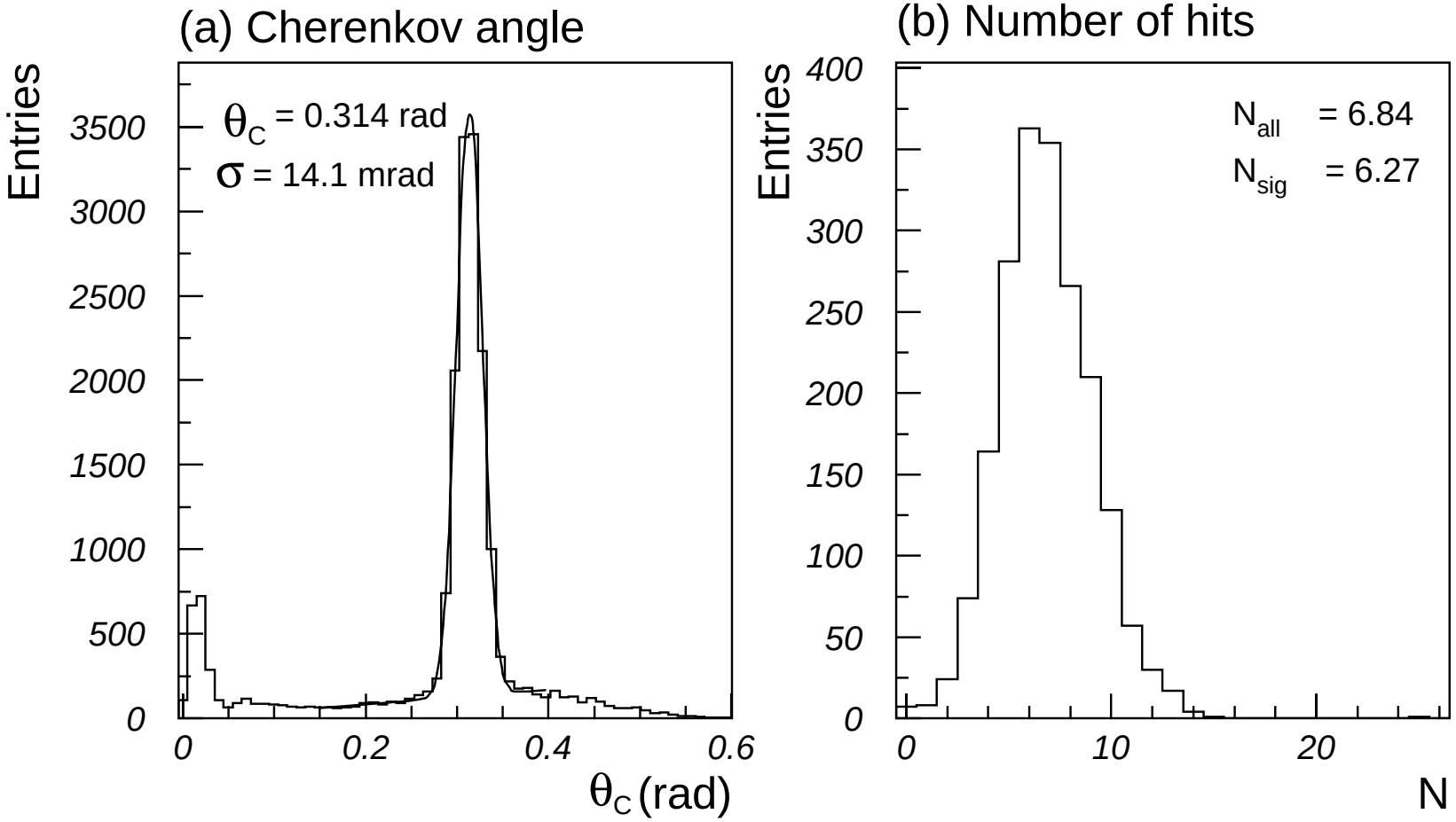
Preliminary results for Hamamatsu H8500, Hamamatsu R5900-M16 and Burle MCP

http://www-f9.ijs.si/~rok/aerorich/beamtest2004/results_1.html

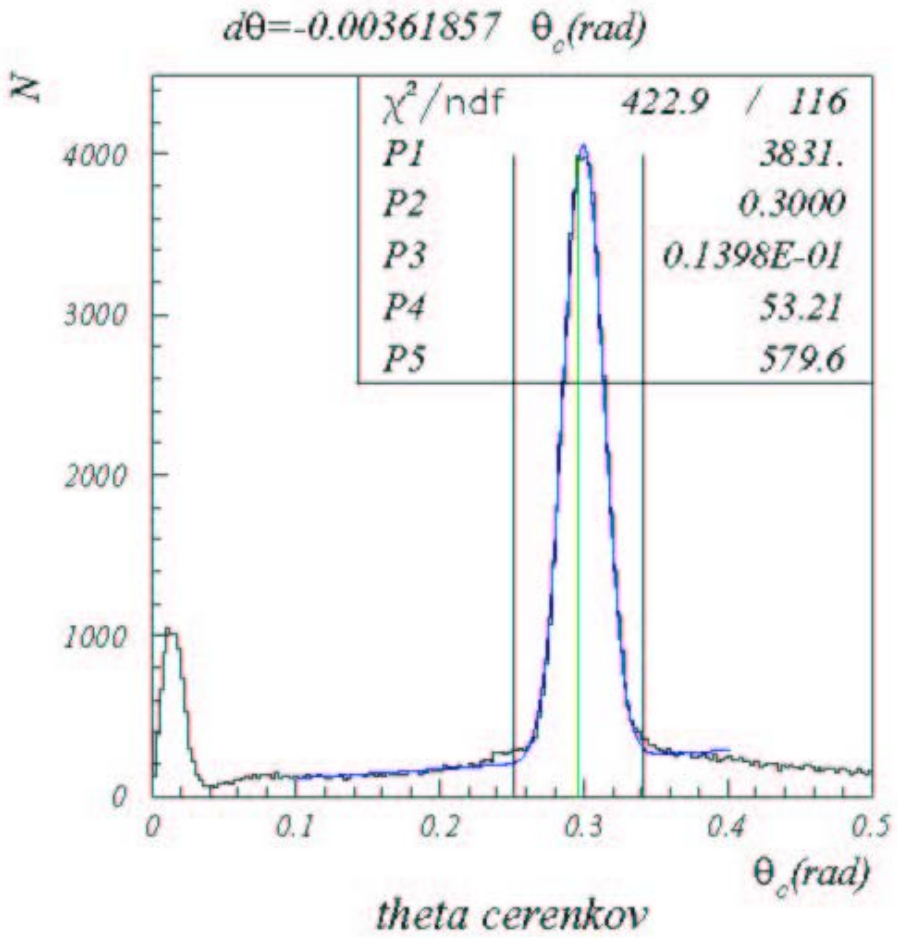
http://www-f9.ijs.si/~rok/aerorich/beamtest2004/results_2.html

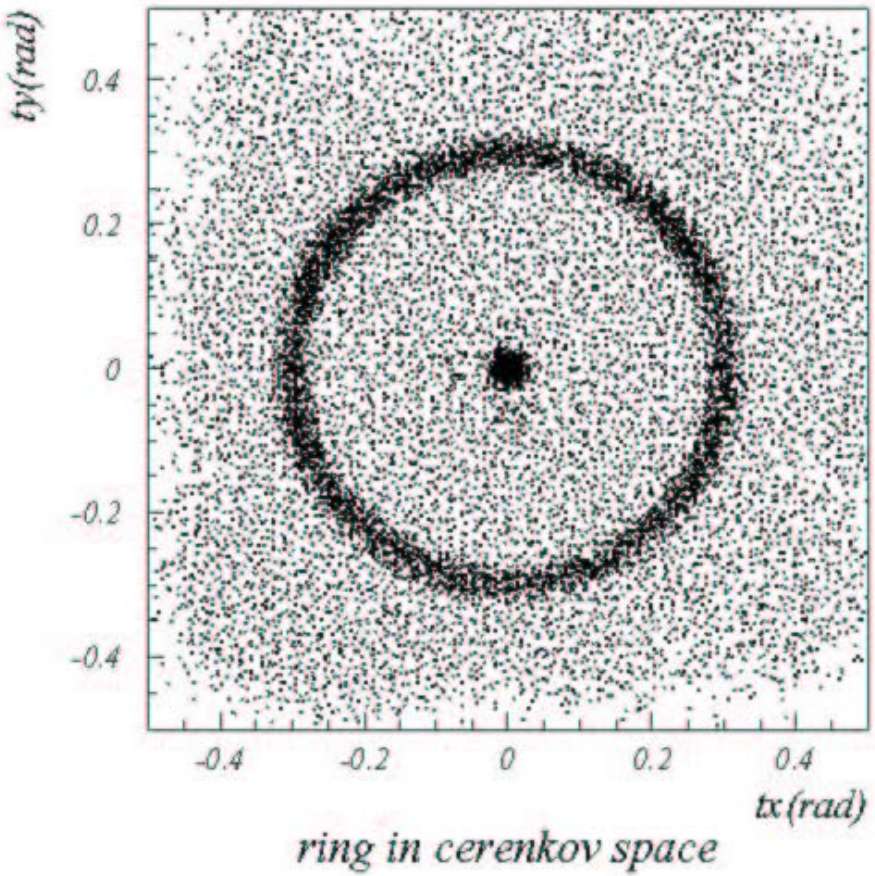
http://www-f9.ijs.si/~rok/aerorich/beamtest2004/results_3.html

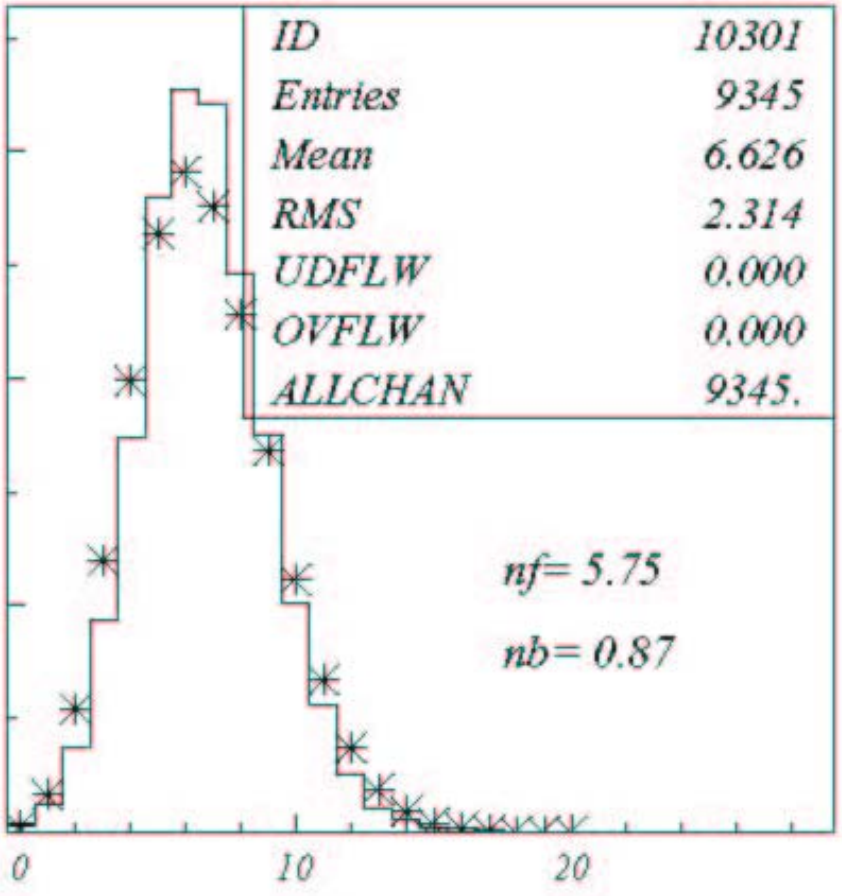
Cherenkov angle resolution and number of photons - 2002



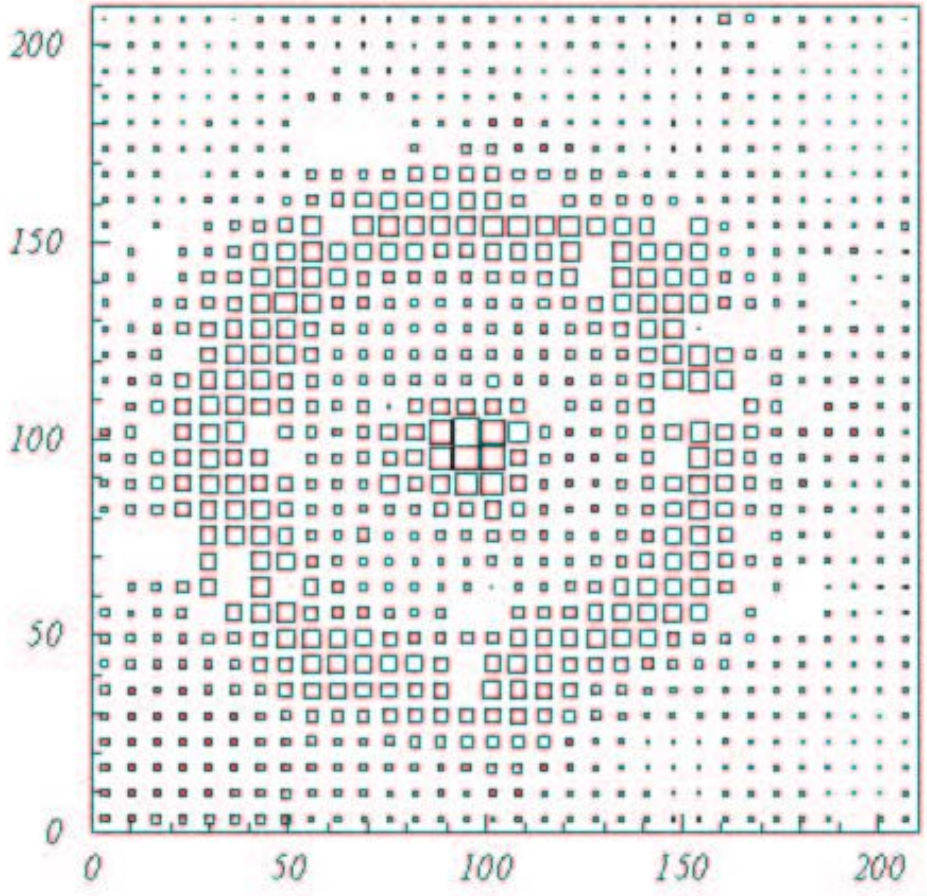
2004 looks very much OK







NHIT, thc in 3 sigma



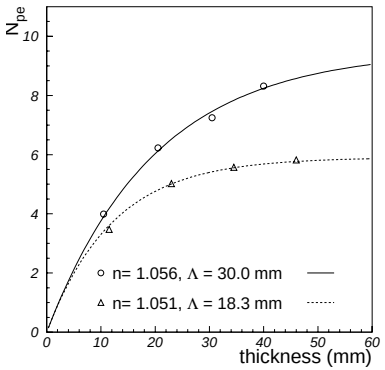
PMT hits

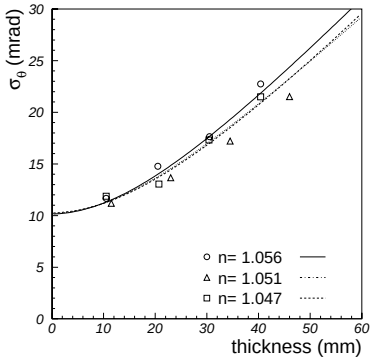
Number of photons, occupancy on the photon detector

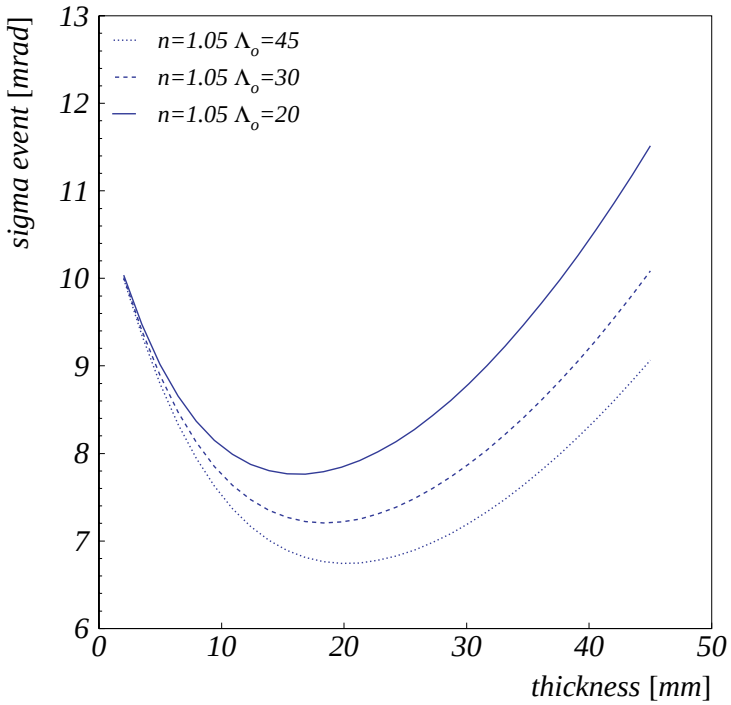
Limitations of a single radiator

What is the optimal radiator thickness?

Use 2002 beam test data on σ_0 and N_{pe}







Minimize the error per track: $\sigma=\sigma_0/\mathrm{sqrt}(N_{pe})$

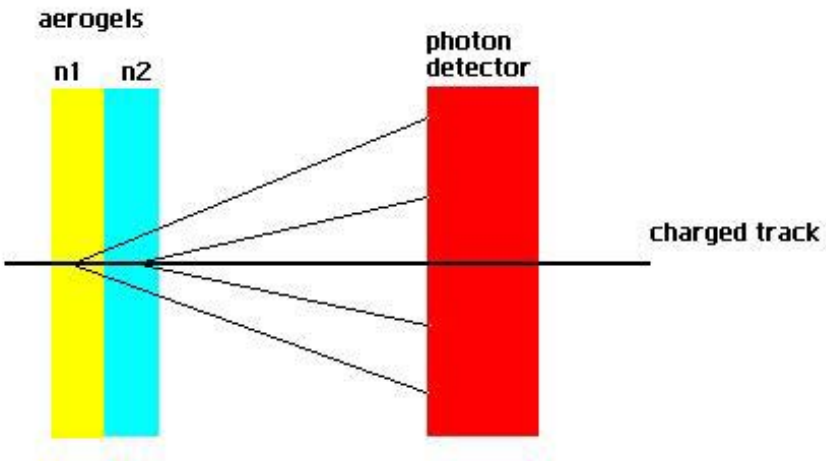
→ Optimum is close to 2 cm

How to increase the number of photons without degrading the resolution?

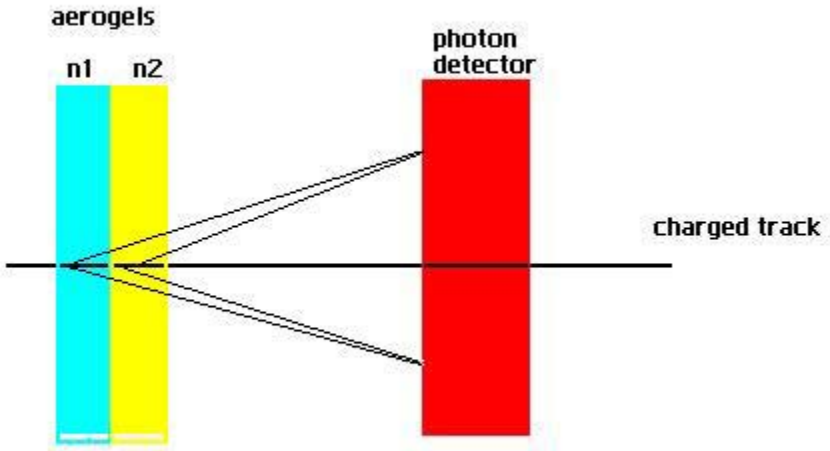
More photons: need thicker radiator -> poorer resolution

Way around: use two radiators.

n1>n2: two rings



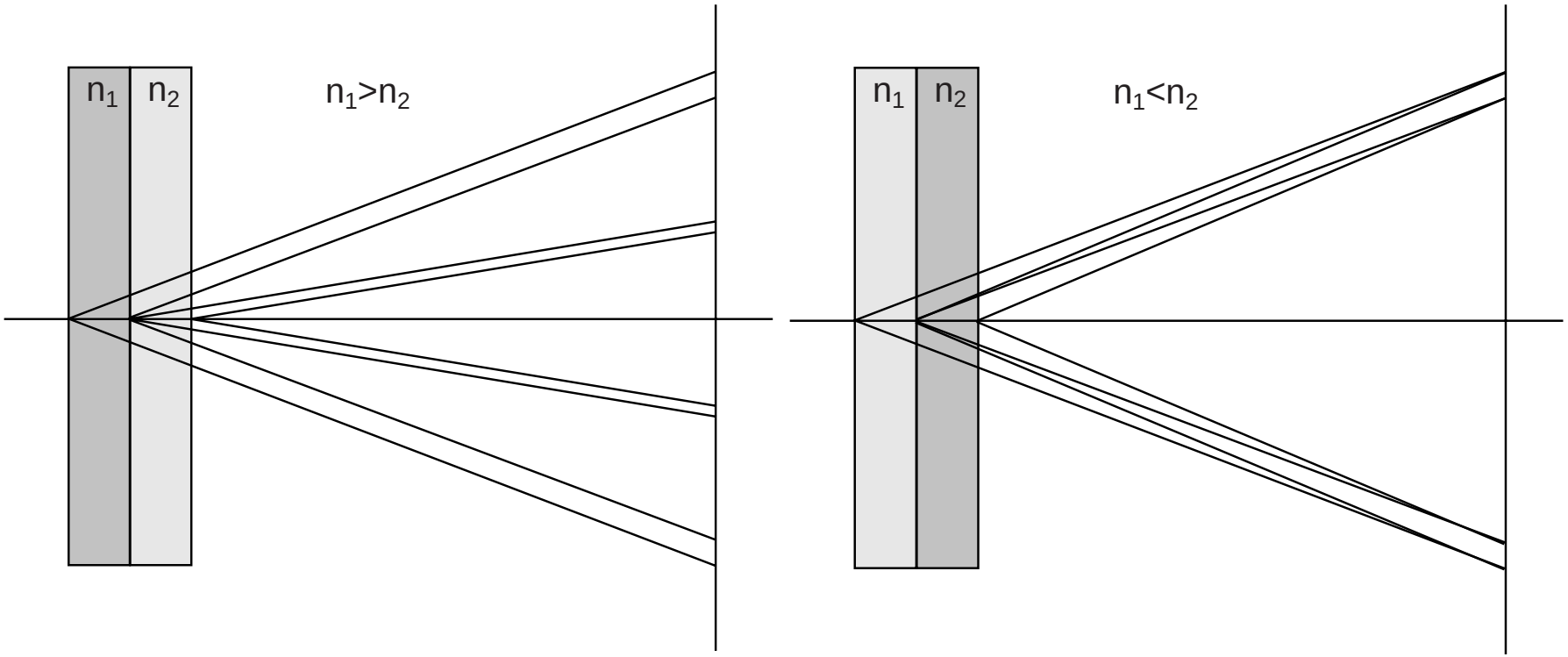
n1<n2: rings can be made to overlap



Dual radiator schemes

n1>n2: ring splitting

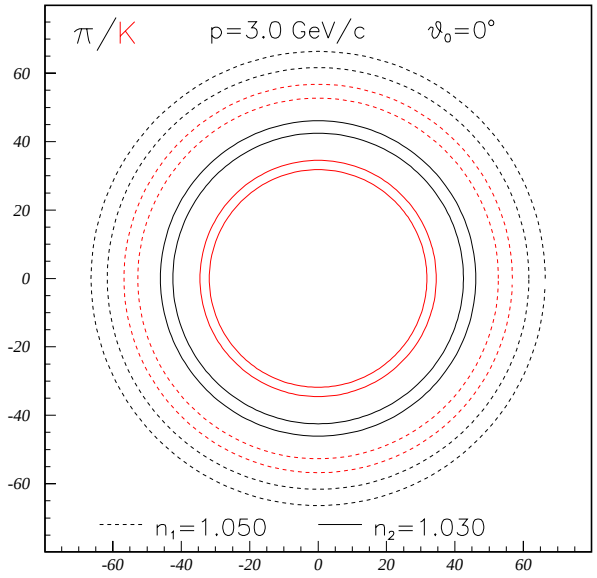
n1<n2: focusing



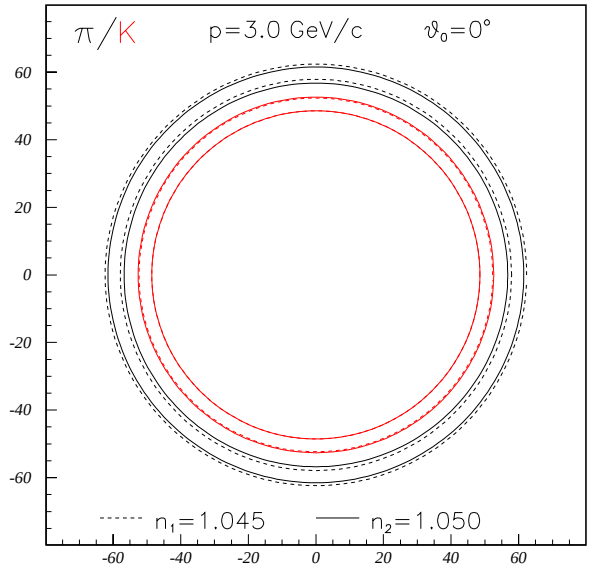
Dual radiator

Pion and kaon rings for the two dual radiator shemes

n1>n2



n1<n2

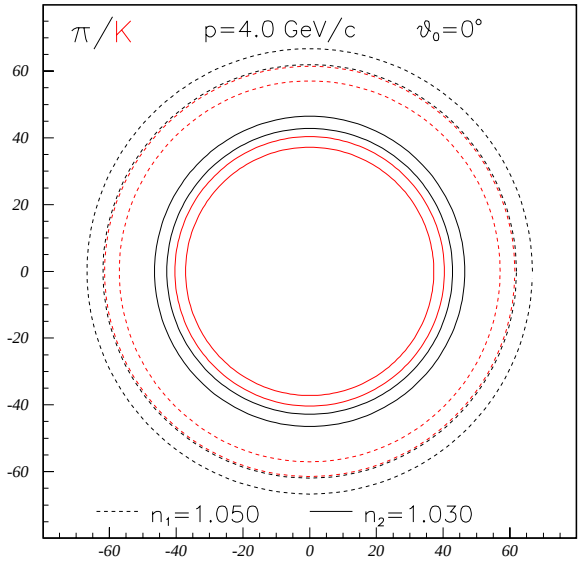


p=3GeV/c, θ_i=0°

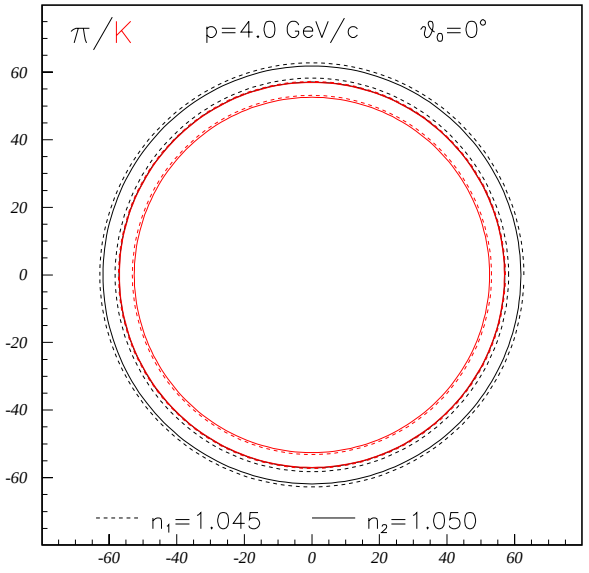
Dual radiator

Pion and kaon rings for the two dual radiator shemes

n1>n2



n1<n2

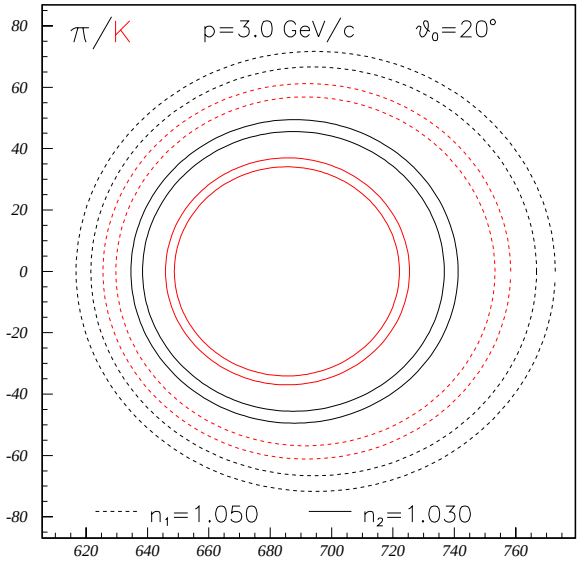


$p=4GeV/c, \theta_i=0^o$

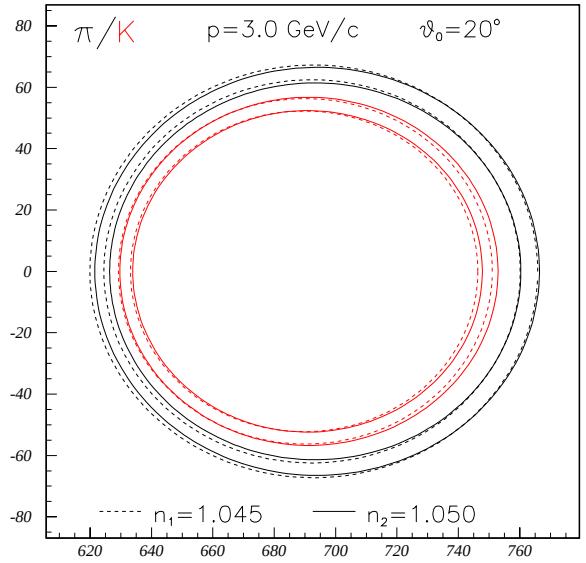
Dual radiator

Pion and kaon rings for the two dual radiator shemes

n1>n2

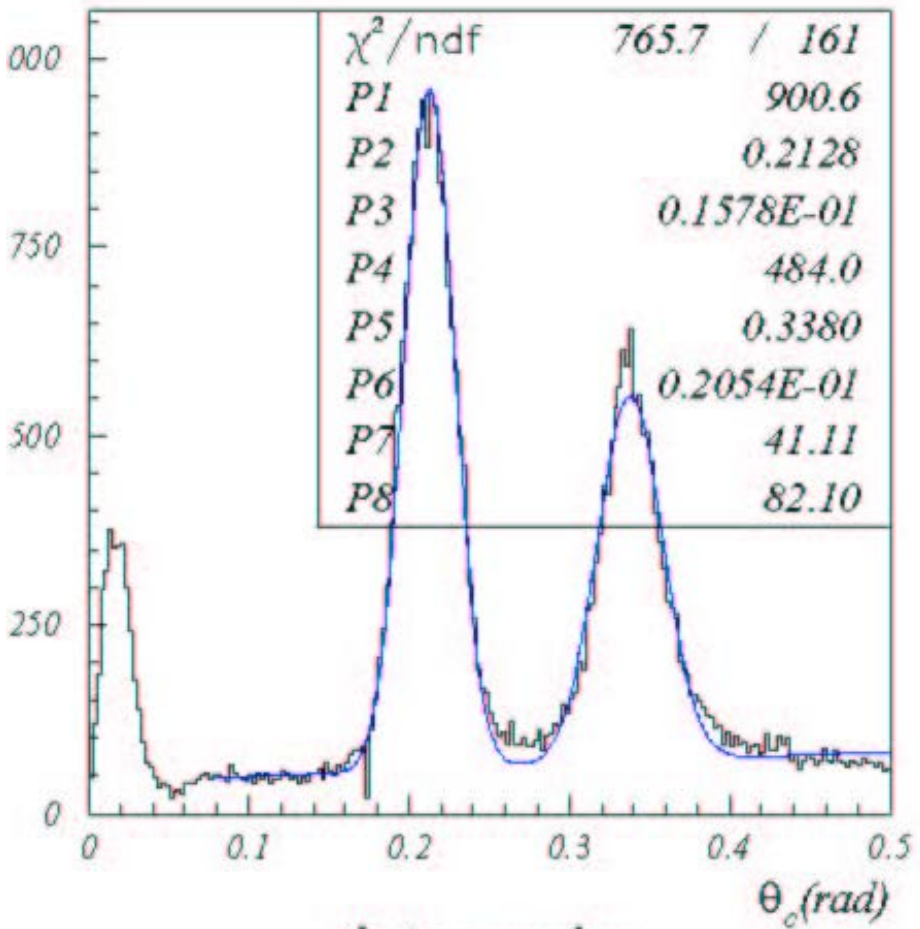


n1<n2

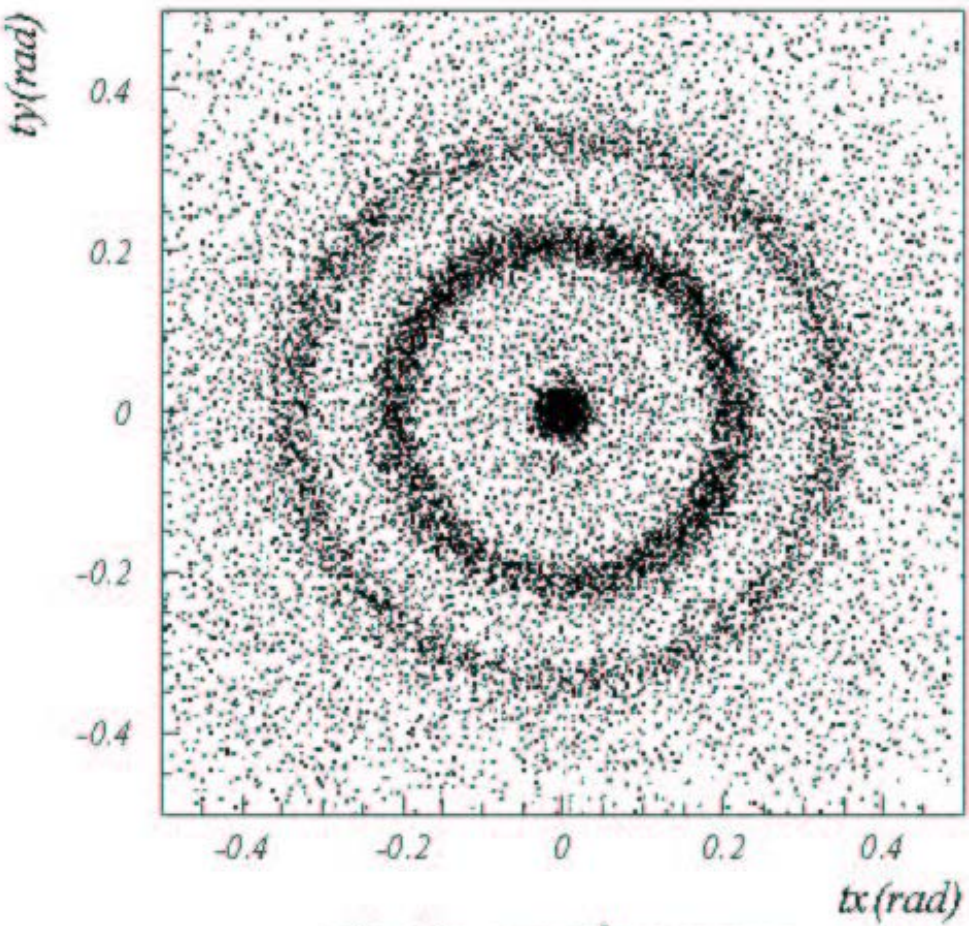


$p=3GeV/c,\theta_i=20^o$

How does a dual radiator look like in the data

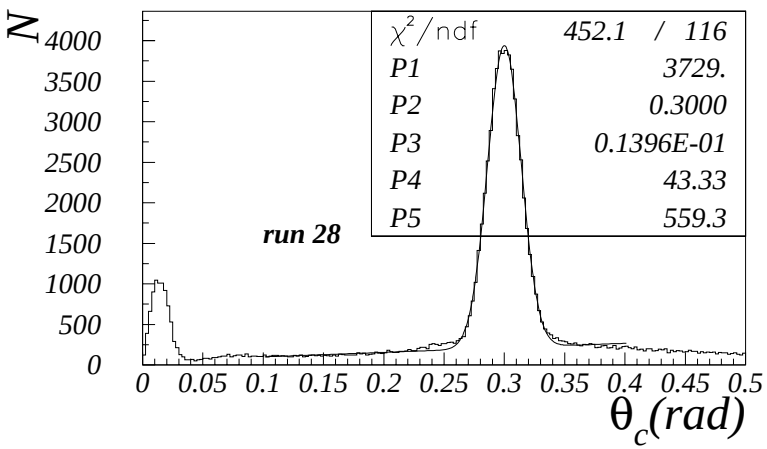


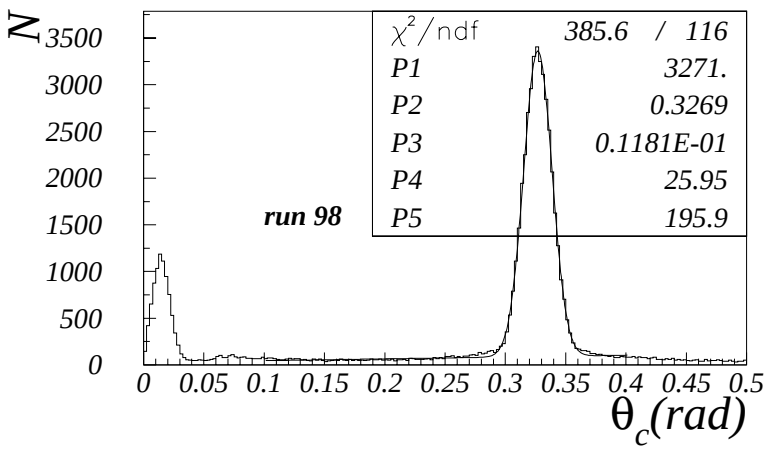
theta cerenkov



ring in cerenkov space

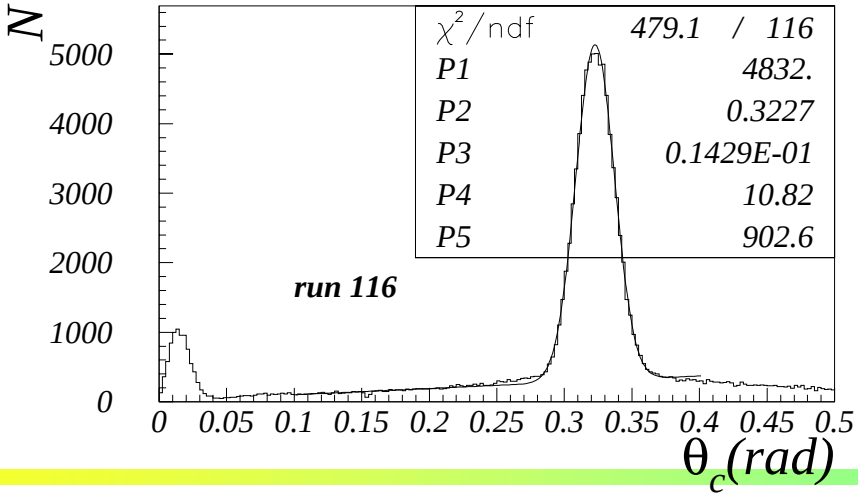
Dual radiator, focusing scheme





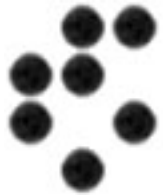
n1=1.046

n2=1.056



n1,n2

Dual radiator, focusing scheme



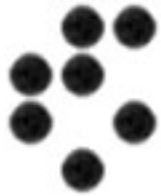
ref.index	thickness	att.length	resolution	number of photons
n1=1.046	2cm	45mm	14.0	5.5
n2=1.056	2cm	30mm	11.8	6.2
n1,n2	2+2cm		14.3	7.3

sigma(1+2)~sigma1, number of photons could go up to about 10.5 if n2 had a larger att. length (same as n1, 45mm)

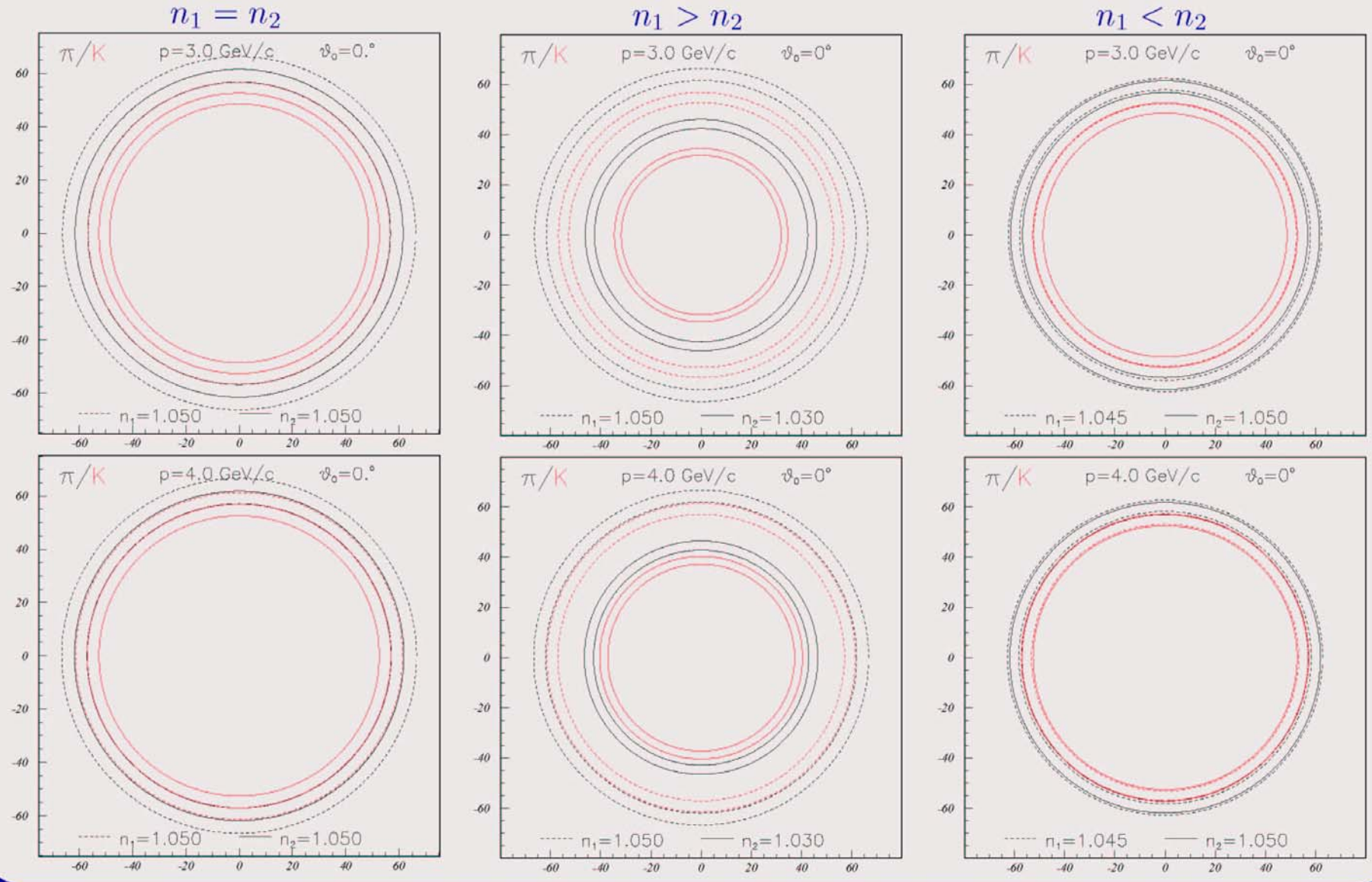
Summary

- Beam test with ambitious goals
- In spite of problems with the beam most of program could be carried
- Only first very preliminary results available – test finished two days ago
- Dual radiator schemes look as expected, promissing
- More on the beam test -> next talk
- Next beam test, June: test HAPD with ASIC read-out

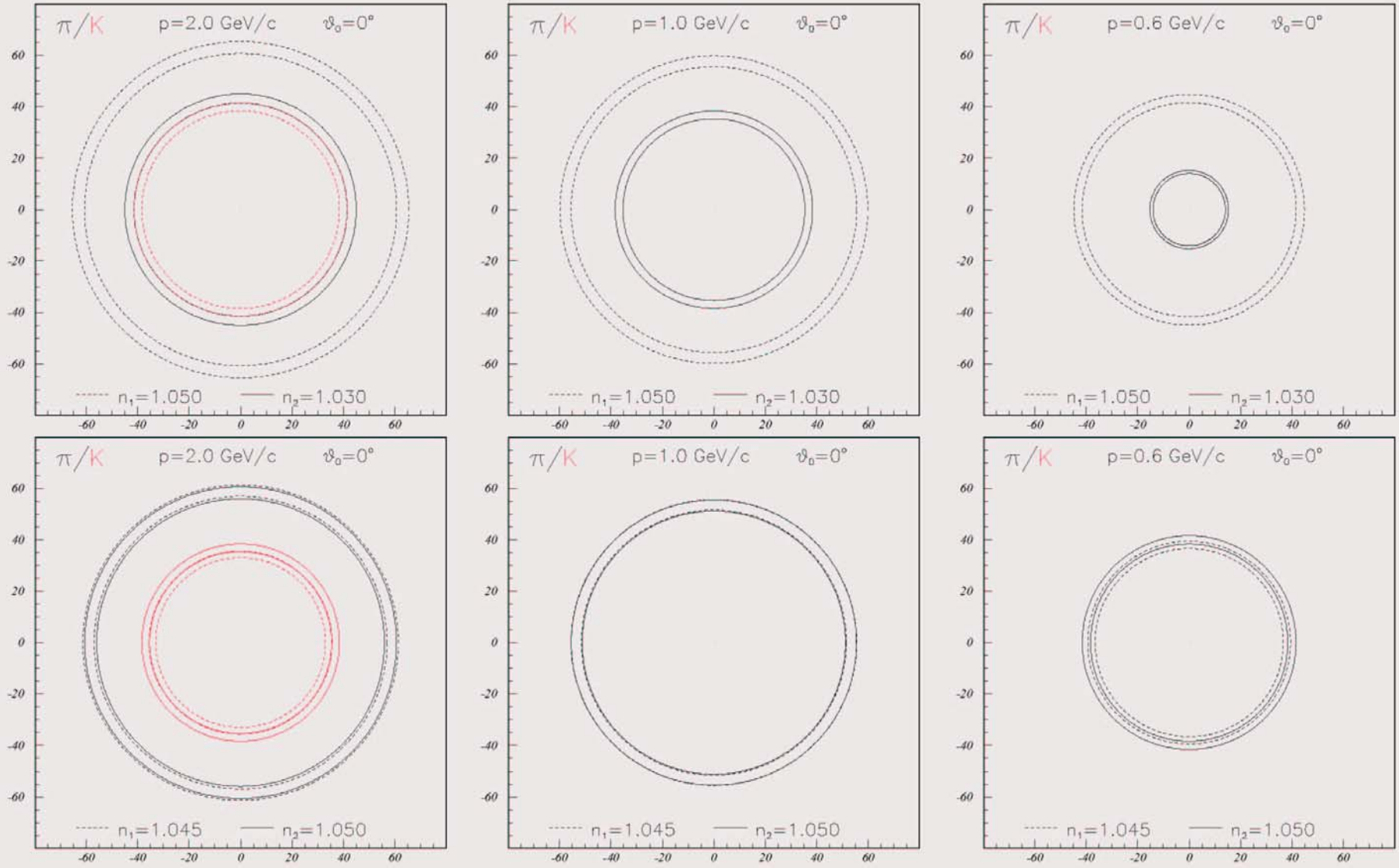
Back-up slides



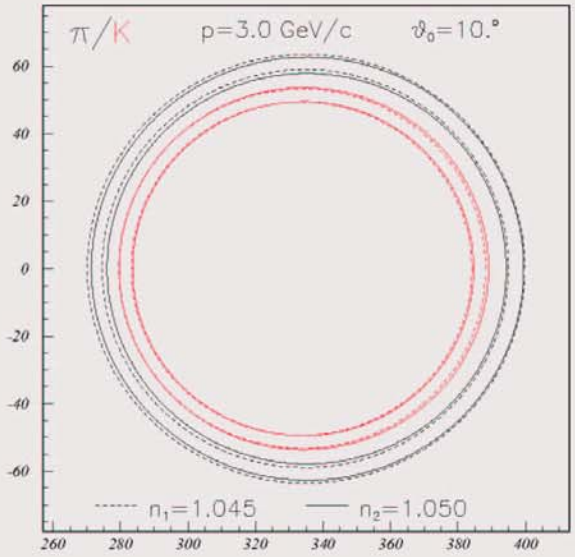
Rings of different scenarios

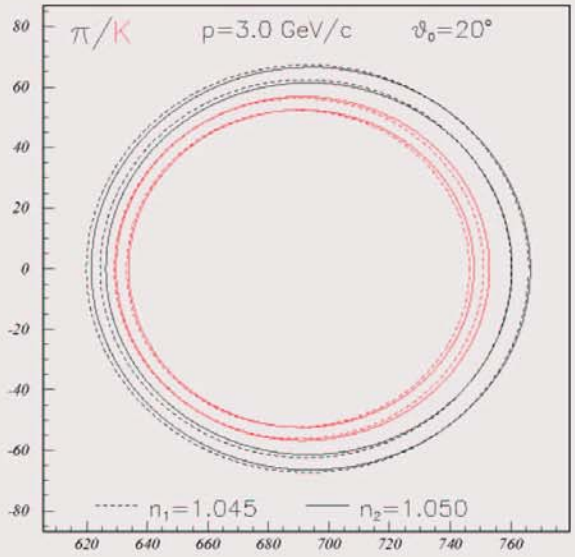


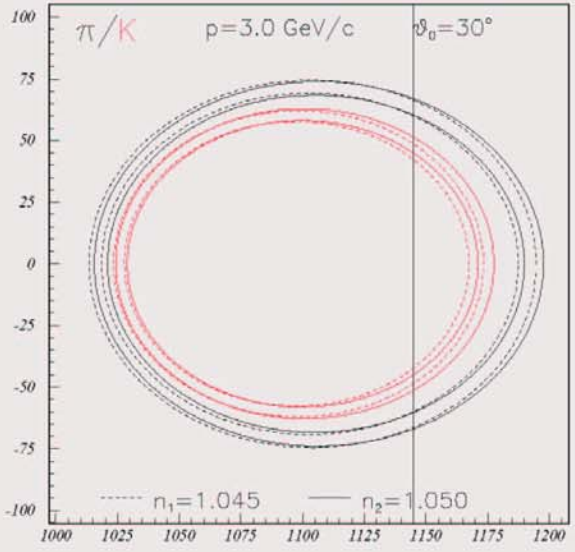
Lower momentum



Incident angle

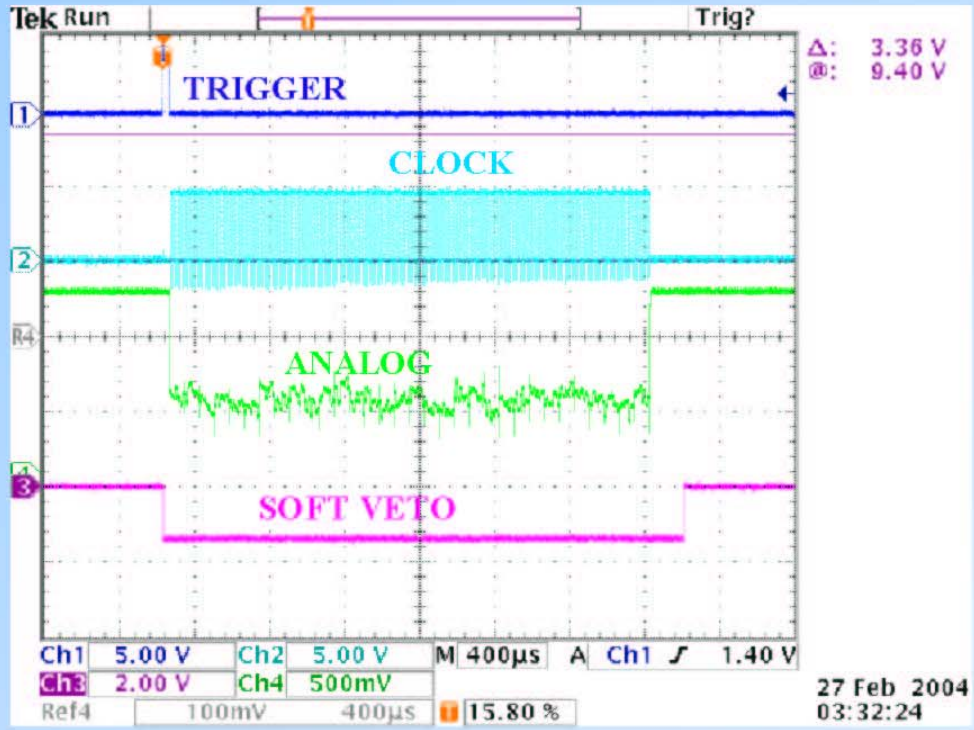






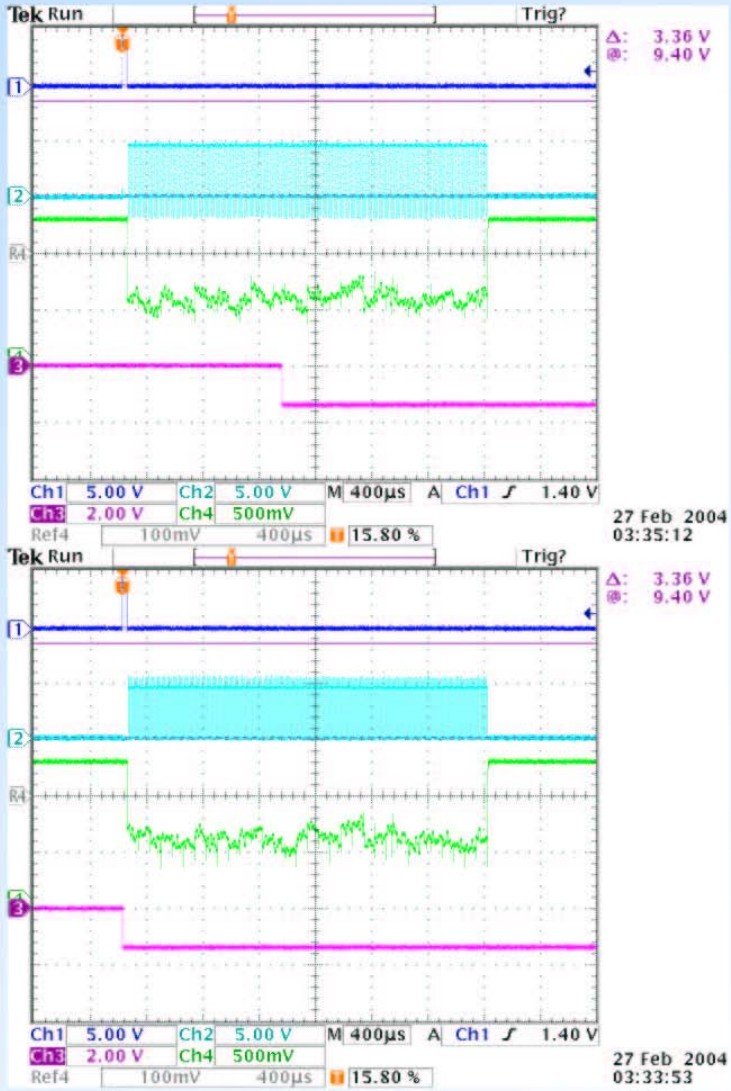
2002 DAQ ISSUES

NORMAL READOUT SEQUENCE



- readout not interrupted

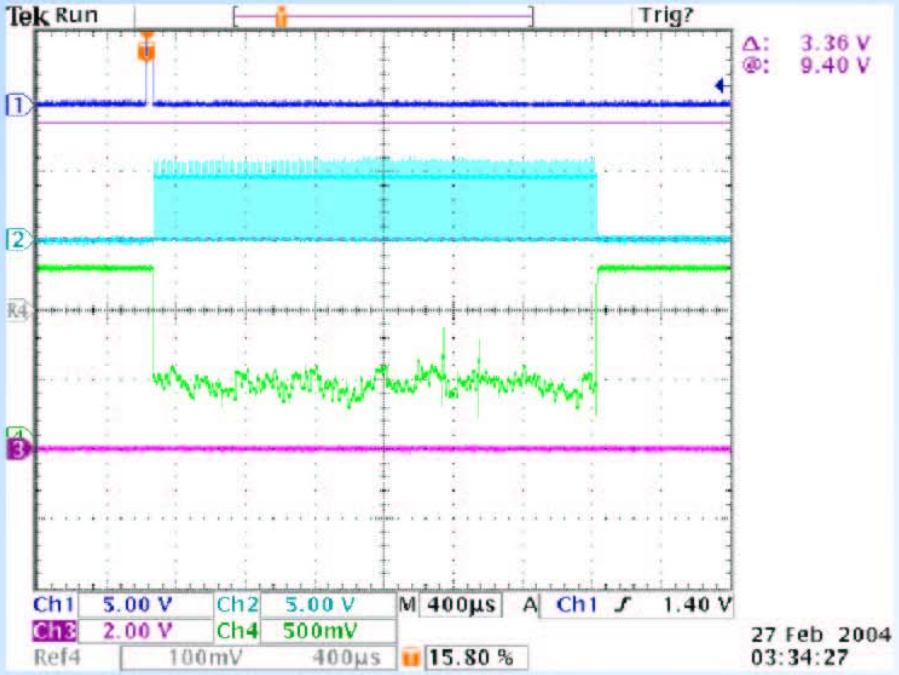
INCOMPLETE BUFFERS



- readout starts late or interrupted (CPU busy)

ADC SHIFT & CAMAC - ADC SYNCRONISATION LOST

- ADC reading waiting from previos event
- event is missed (CPU busy) but CAMAC triggered
- 2 events before VETO



CHANGED FOR 2004 DAQ

- VETO: HARD ON - SOFT OFF
- clear VETO just before entering the waiting loop
- clear ADC before read