

**Статус В1-коллаборации  
на ускорителе ELSA (Бонн)**

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University of Edinburgh, UK  
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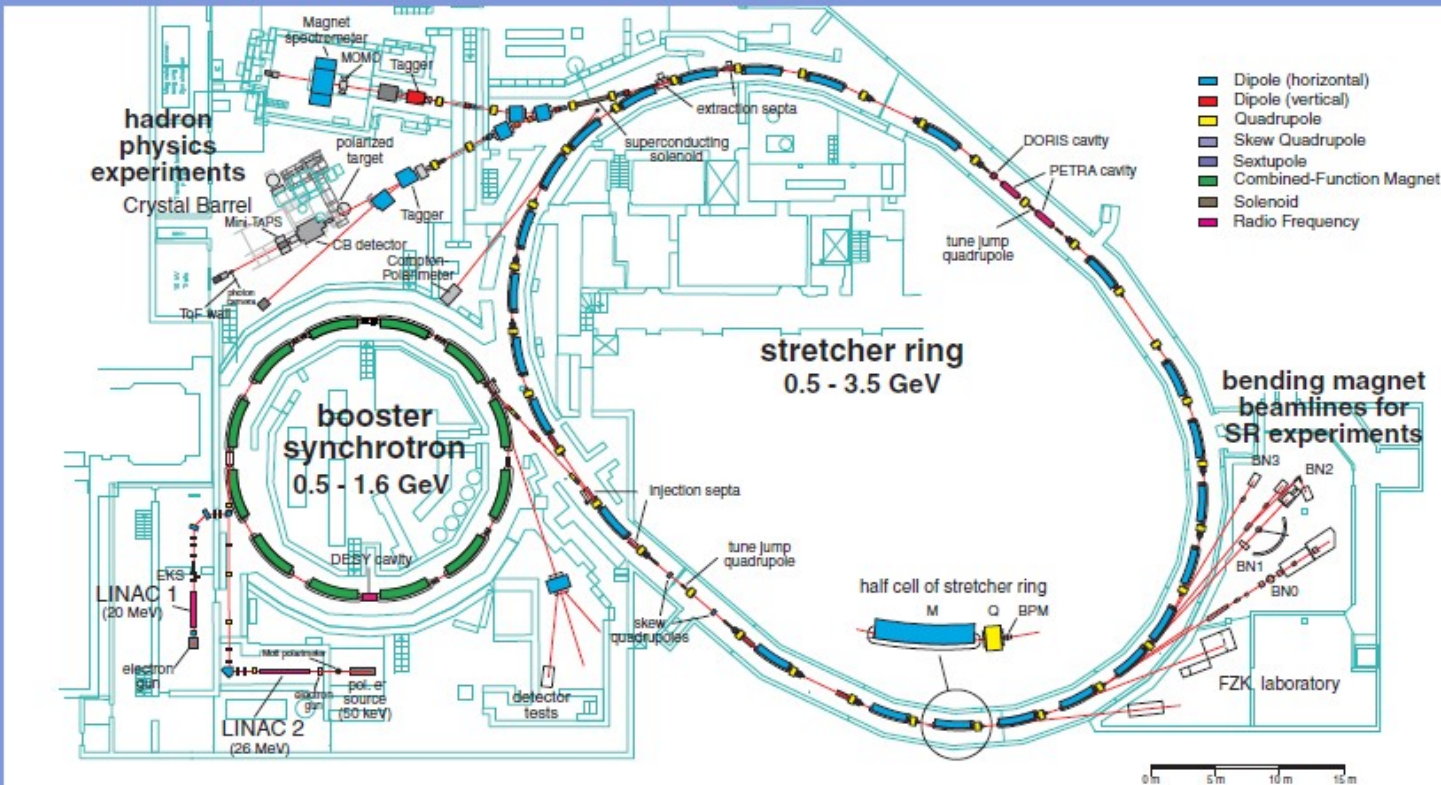
*Петербургский институт ядерной физики, Гатчина.*

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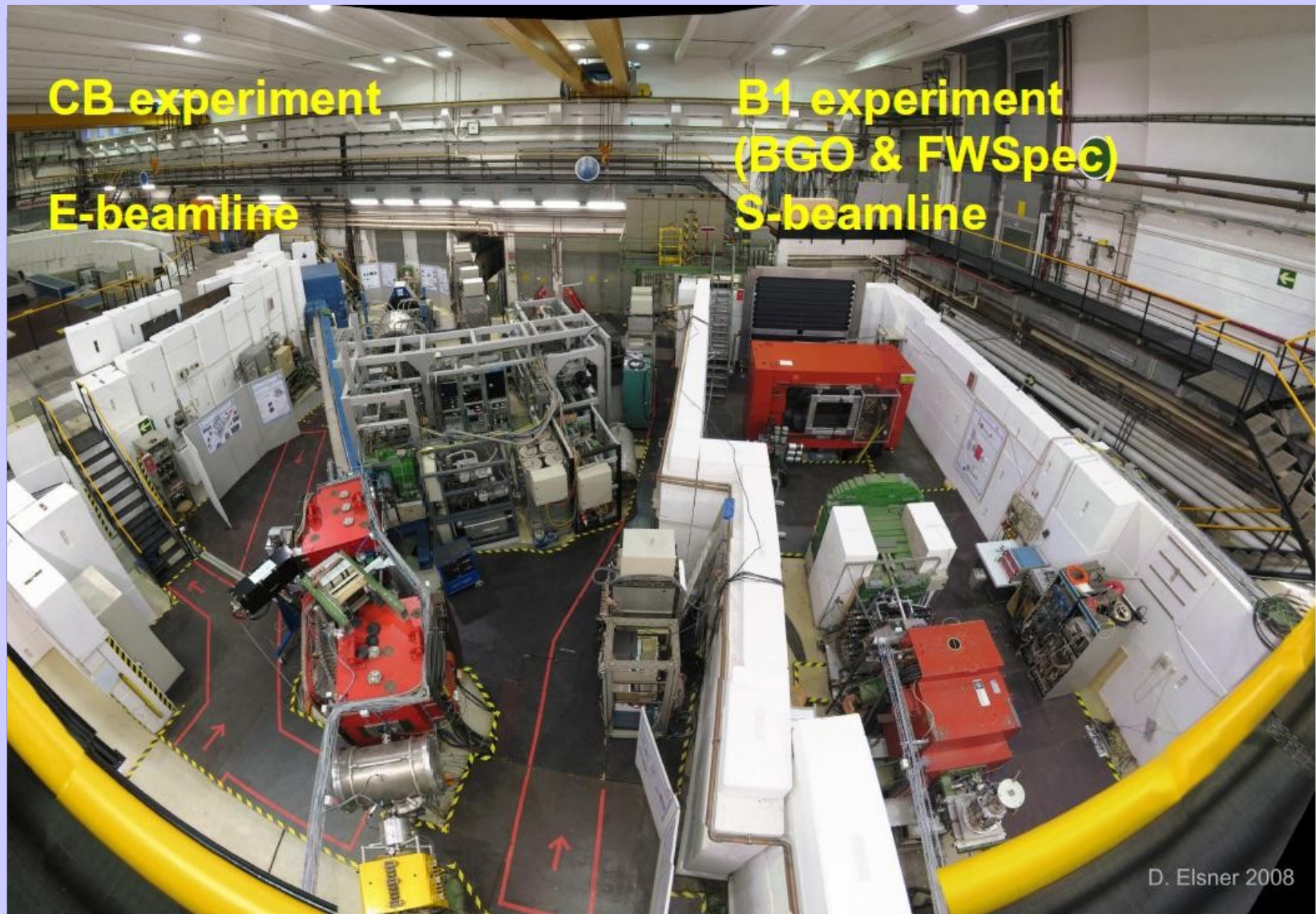
- Проект В1 – ВГО-ОД
- Ускоритель ELSA, схема установки
- Физическая мотивировка
- Форвардный спектрометр, дрейфовые камеры
- Результаты тестирования камер
- Заключение

# ELectron Stretcher Accelerator (ELSA)

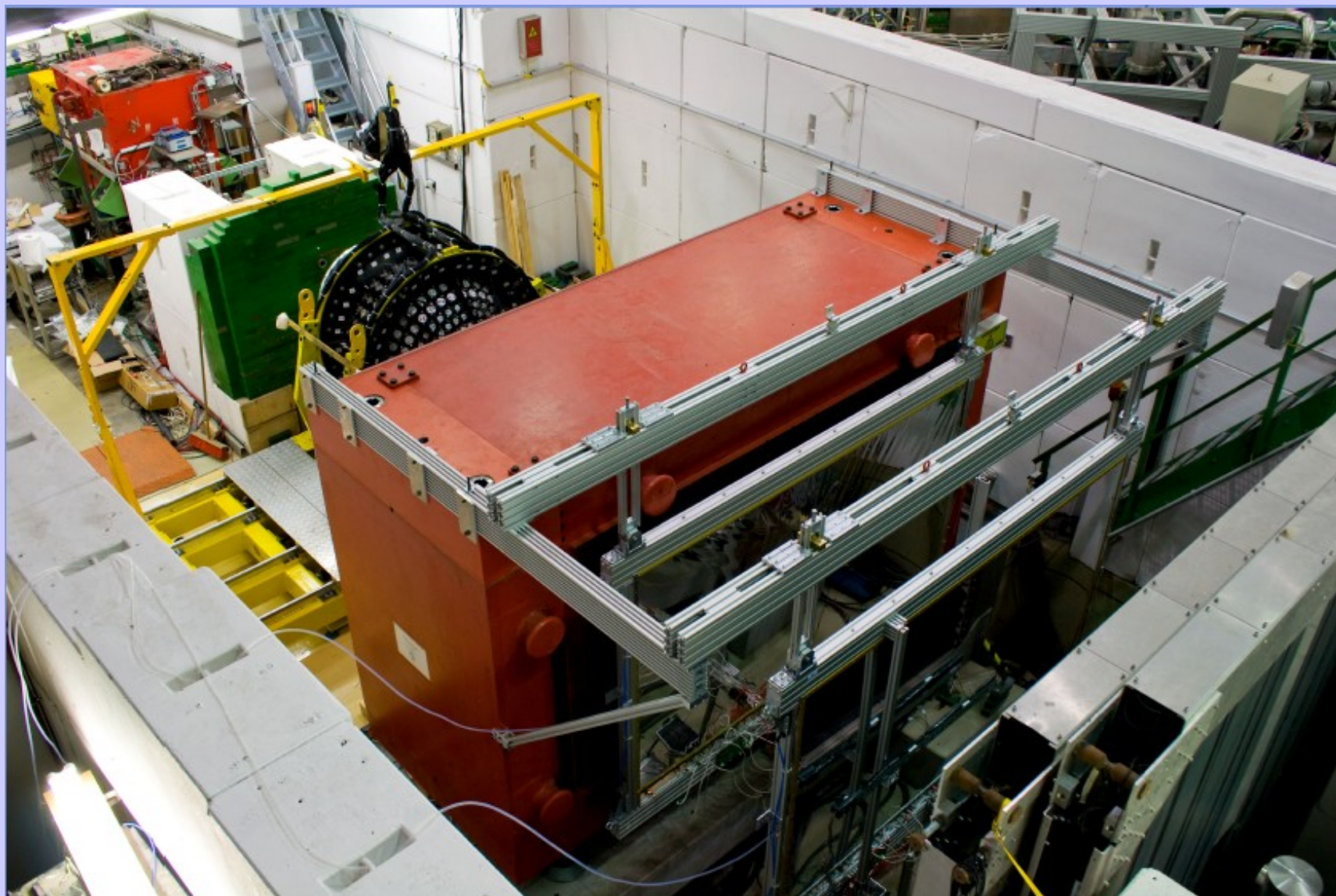
- Energy range 0.5–3.5 GeV
- Max. extracted intensity  $\sim 1\text{nA}$
- Electron polarisation  $\sim 60\text{--}80\%$



# Cryslal Barrel and B1 (BGO-OD), ELSA

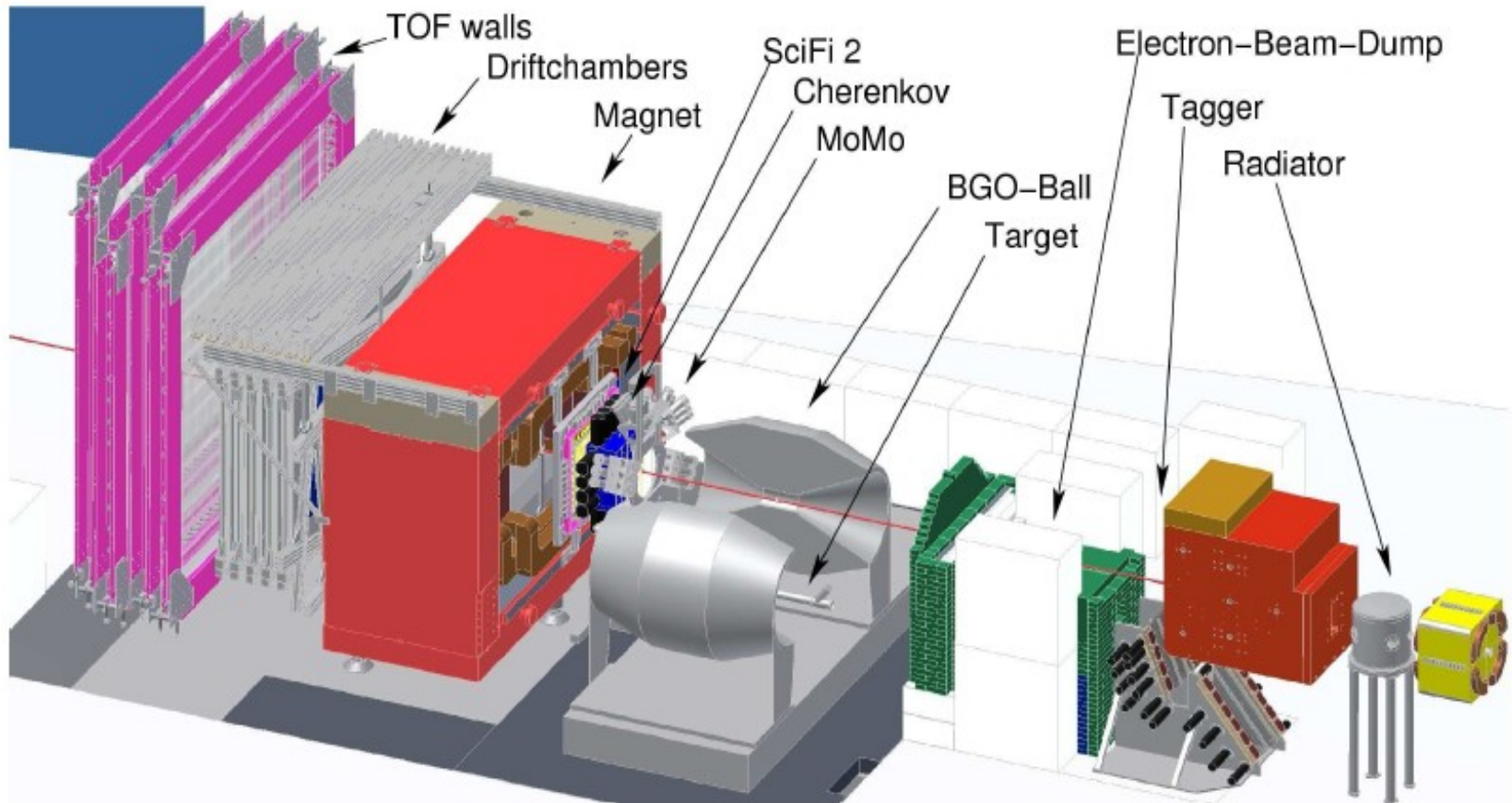


# B1 (BGO-OD), ELSA, 25.11.2010



D. Novinsky (PNPI), 25.01.2011

# Experimental setup



# Experimental setup, BGO Rugby Ball



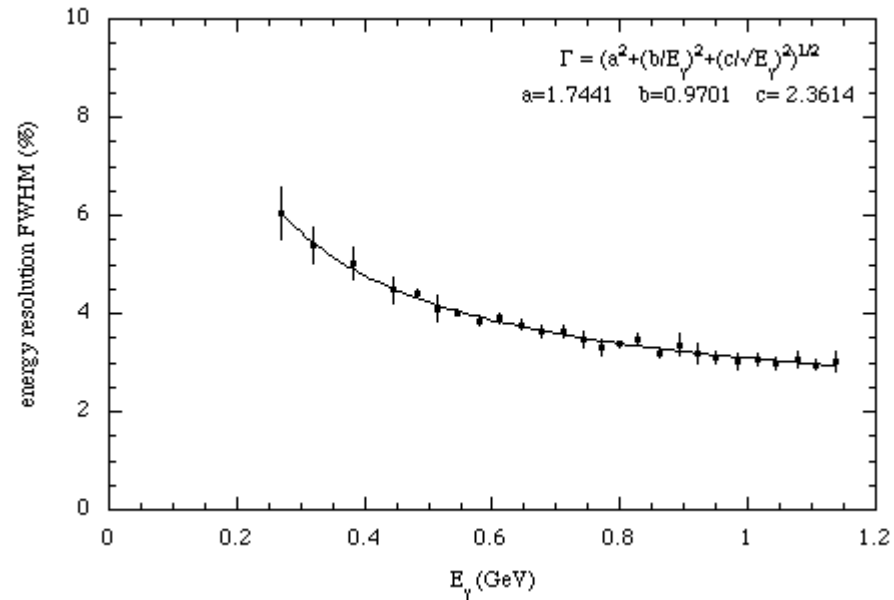
GRAAL → ELSA

480 crystals

24 cm length (~ 21 R.L.)

15 sectors of  $\theta \in [25^\circ; 155^\circ]$

32 sectors of  $\varphi \in [0; 1360^\circ]$



$\Delta\theta \sim 6^\circ \div 10^\circ$

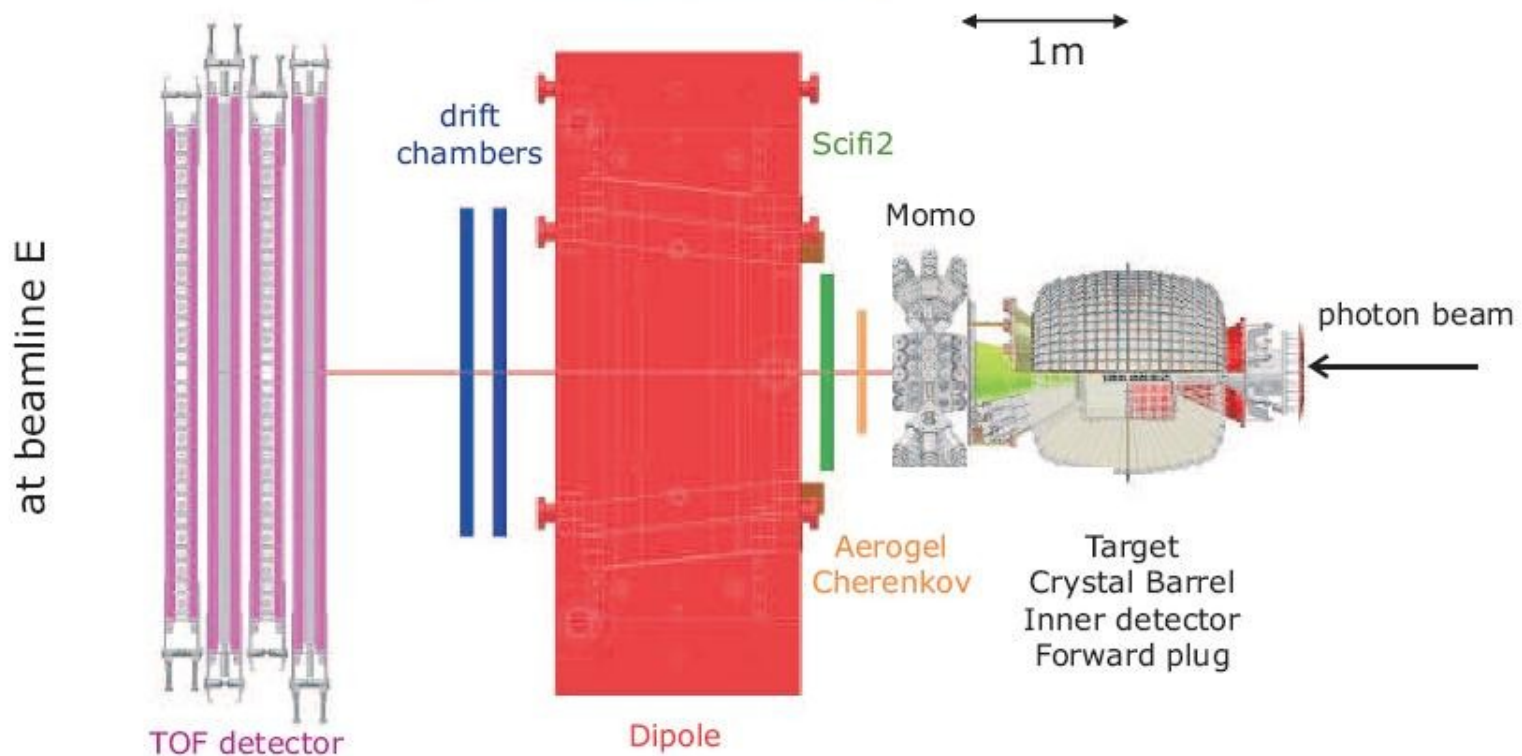
$\Delta\varphi \sim 11,5^\circ$

$\Omega = 0,9 \times 4\pi$



# Experimental setup

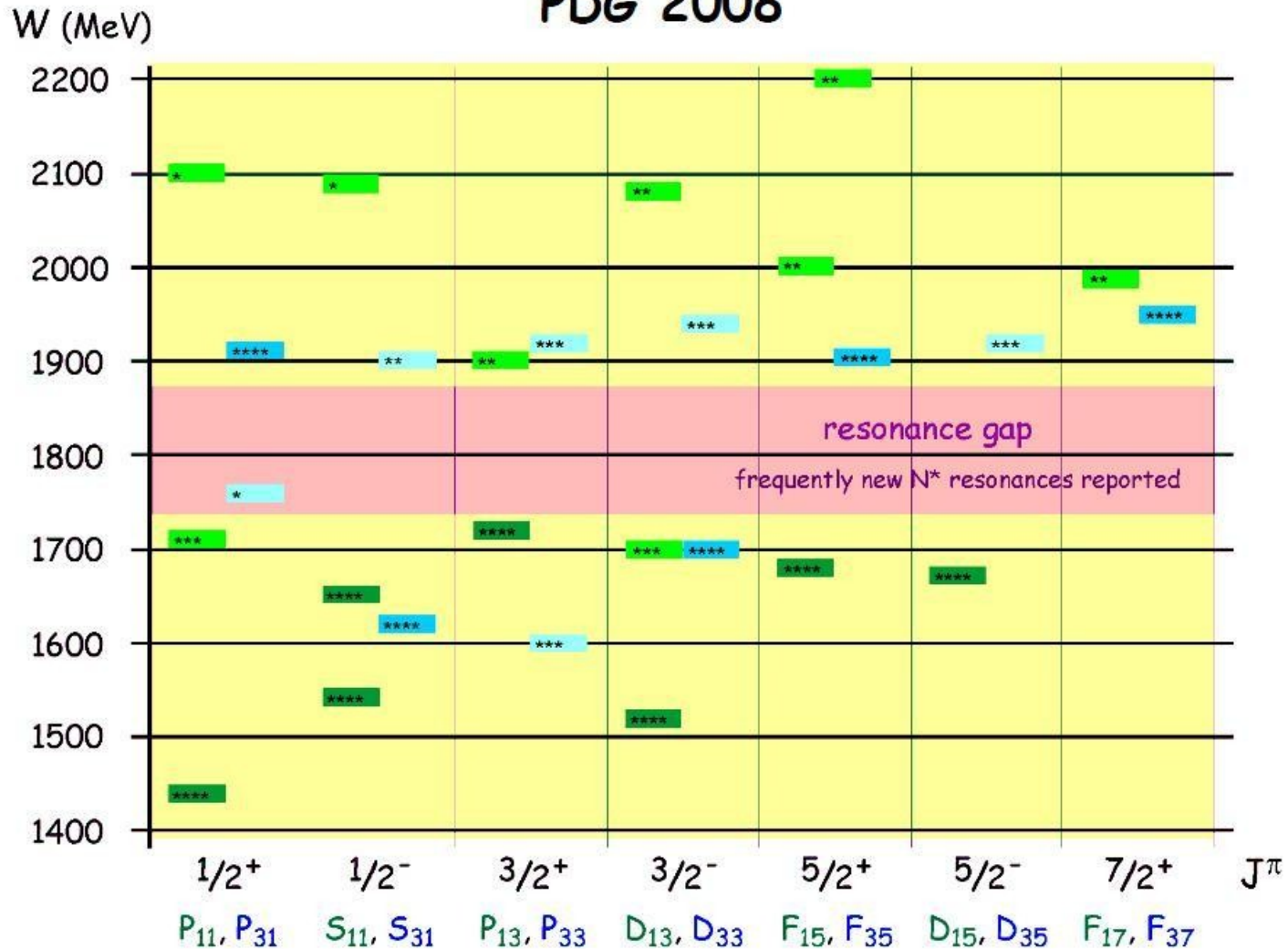
## B1 Setup



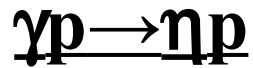
# Physics motivation

$N^*$  and  $\Delta^*$  in the region  $1400 \text{ MeV} < W < 2200 \text{ MeV}$

PDG 2008



# Physics motivation



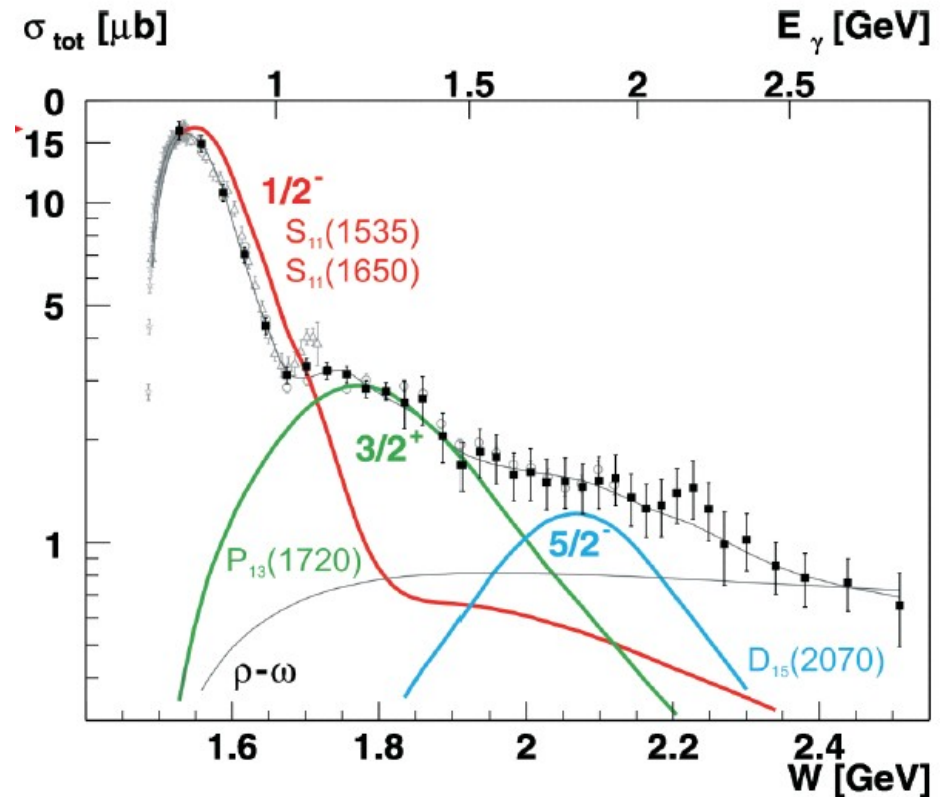
~ threshold region

$S_{11}(1535)$ , structure - ?

$I(\eta)=0$ ,  $N^*$ -contribution

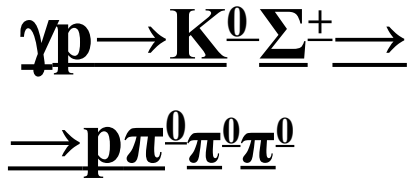
Dominant resonance

$d\sigma/d\Omega$ , T, P,  $\Sigma$

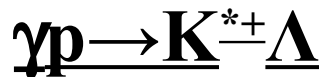
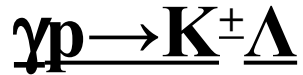


PWA (BnGa): Anisovich et al. Eur. Phys. J A 25 (2005)

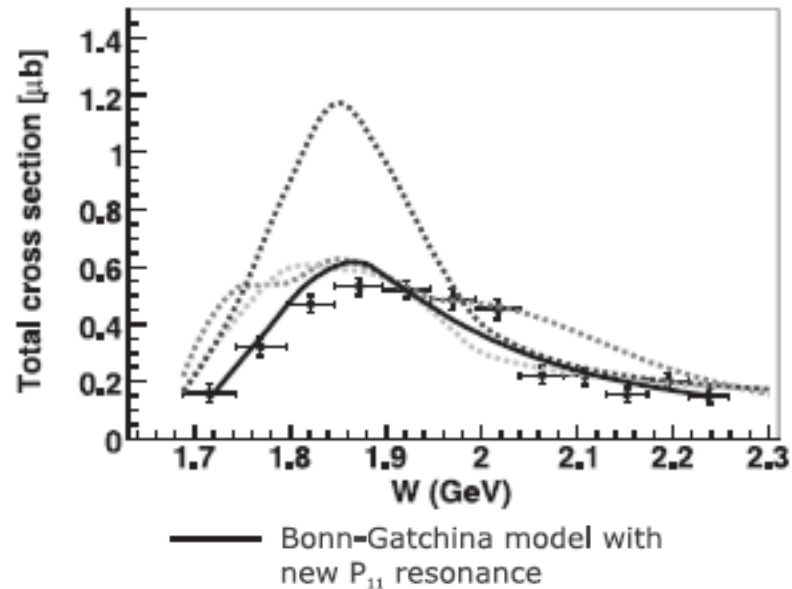
# Physics motivation



$N^*$ -contribution  
 $M \sim 1,84 \text{ GeV}$

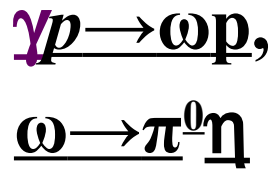


$N^*, \Delta$ -contribution  
 $d\sigma/d\Omega, T, P, \Sigma$



some of 'missing' resonances are predicted to couple strongly to  $K\Lambda$  and  $K\Sigma$   
 (S. Capstick, W. Roberts, PRD 58 (1998) 074011)

# Physics motivation



## $\omega$ -Meson

Mass	$782.65 \pm 0.12$ MeV	total neutral mode $\pi^0 \xrightarrow{98.8\%} \gamma\gamma$
Width	$8.49 \pm 0.08$ MeV	
Decay	$\pi^+ \pi^- \pi^0$	$(89.1 \pm 0.7)\%$
	$\pi^0 \gamma$	$(8.9 \pm 0.3)\%$
	$\pi^+ \pi^-$	$(1.7 \pm 0.3)\%$
$I^G$	$0^-$	
$J^{PC}$	$1^-$	

isoscalar

same as photon  
 $\omega \leftrightarrow \gamma$

PDG 2006

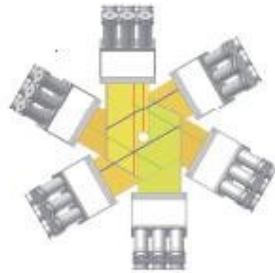
— Bonn-Gatchina model with new  $P_{11}$  resonance

BGO-OpenDipole setup is ideally suited to detect the forward going high momentum proton

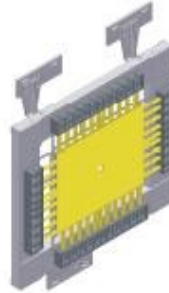
## Momentum Reconstruction

### Tracking detectors

Momo



Scifi2



drift chambers



cell structure

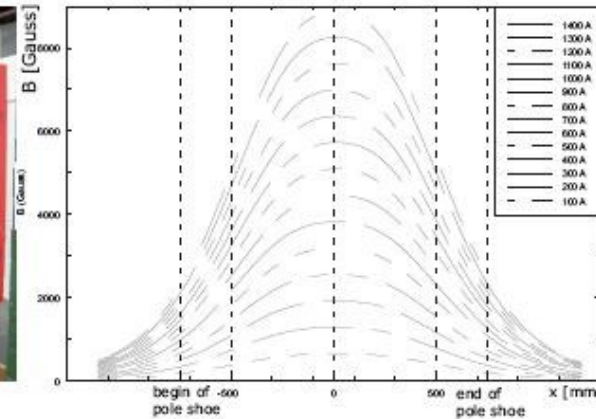
prototype

### Magnetic field

dipole



field along beam direction



- outer dimensions: HxWxD 2.2m x 3.9m x 1.5m
- field dimensions: HxWxD 0.54m x 1.5m x 1.5m
- maximal deflection power:  $Bd_l \sim 0.9 \text{ Tm}$

# Tracking and Forward Spectrometer

$$m = 90 \text{ t}$$

vertical gap size of 54 cm

→ 84 cm

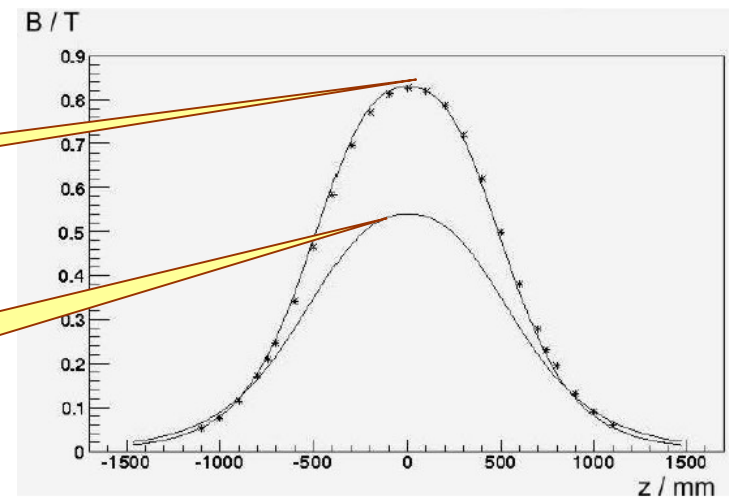
$$I_{\max} = 1340 \text{ A}$$

$$8,2^\circ \rightarrow 12,1^\circ$$



Simulation for 54 cm

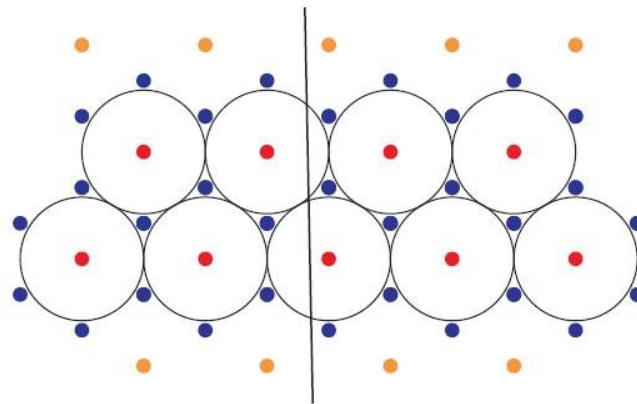
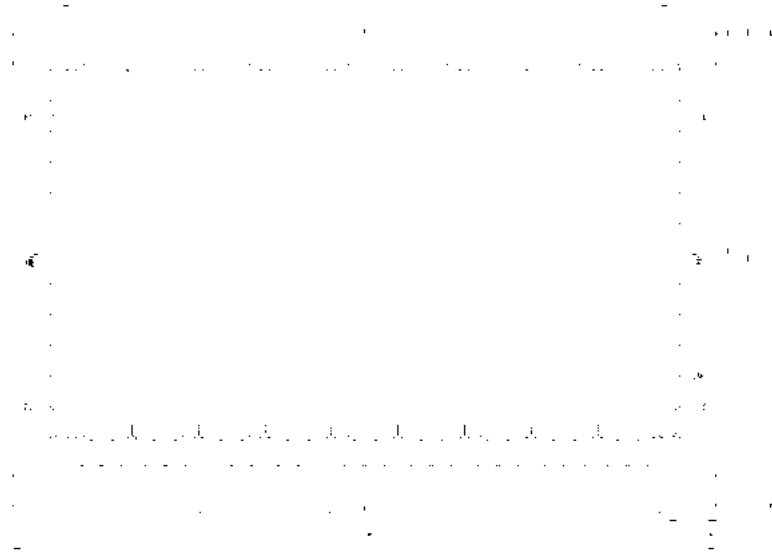
Simulation for 84 cm



# Drift Chamber

- ✧ Точность позиции горизонтали 30 мкм
- ✧ Точность по вертикали 60 мкм
- ✧ Усредненная точность 32 мкм
- ✧ Размер рабочей области ~ 1,2\*2,4 м<sup>2</sup>

- ✧ Гексагональная структура ДК
- ✧ Радиус ячейки 10 мм
- ✧ Расстояние между сигнальными проволочками ~ 17 мм





# CROS3-B for DC, Functional Description

The Coordinate Readout System (CROS3-DC) consists of the following boards:

- ✓ AD16-B – a 16-channel Amplifier/Discriminator – Front-End;
- ✓ CCB10 – a 10-channel Concentrator;
- ✓ CCB16 – a 16-channel Concentrator;
- ✓ CSB – a System Buffer PCI-Interface.

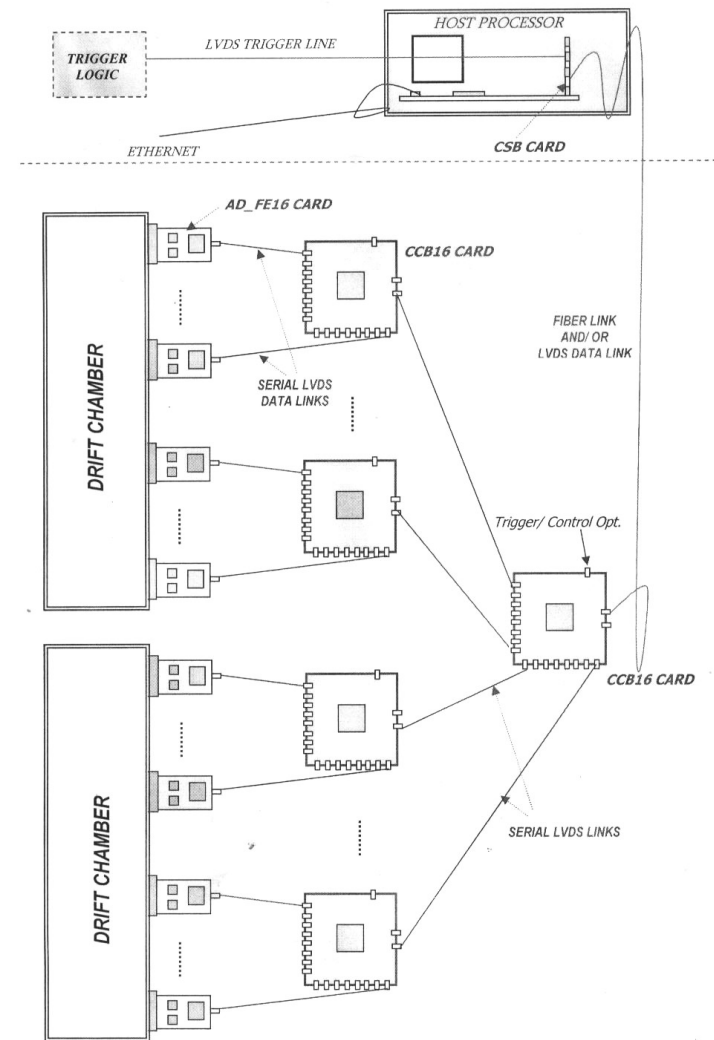


Fig. 1. CROS3-DC System Configuration

# Experimental Setup for DC tests

## Gas mixture:

Ar+CO<sub>2</sub> 70:30

## Trigger:

Scintillation counter behind the chamber

## PC with Linux:

Acquisition by means of PCI-card with Fiber-Interface, **Trigger** transfer by special module at NIM-to-LVDS converter

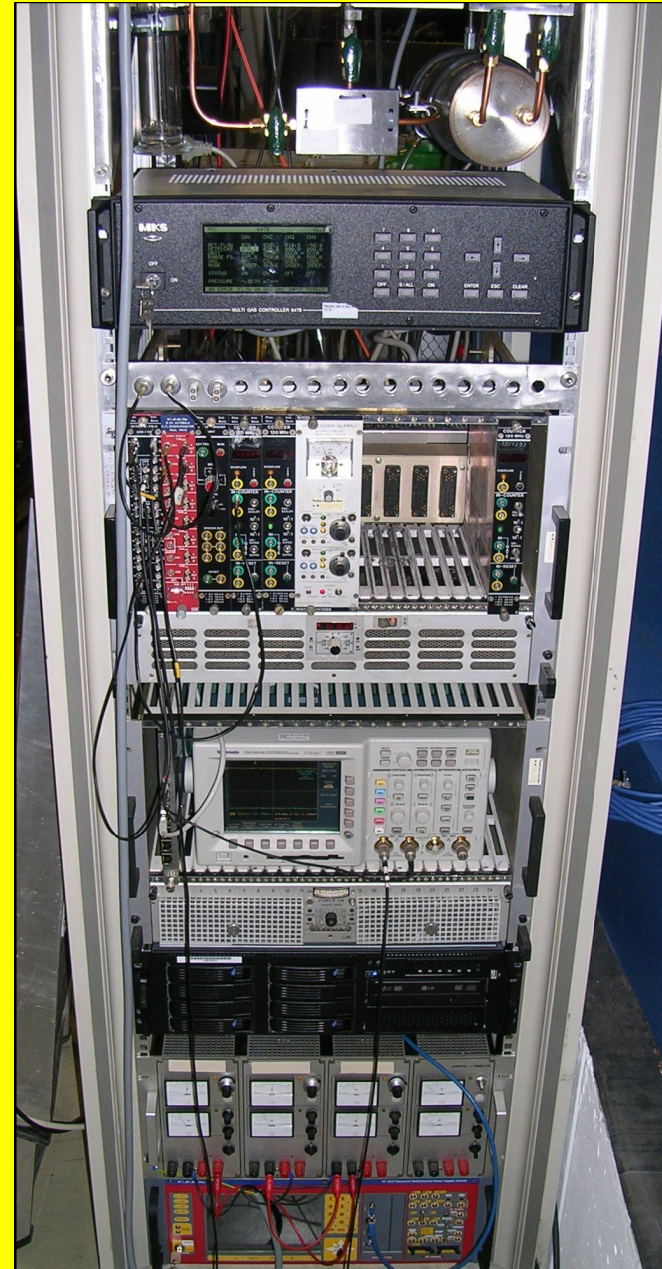
## LV:

+5V at 1,6A

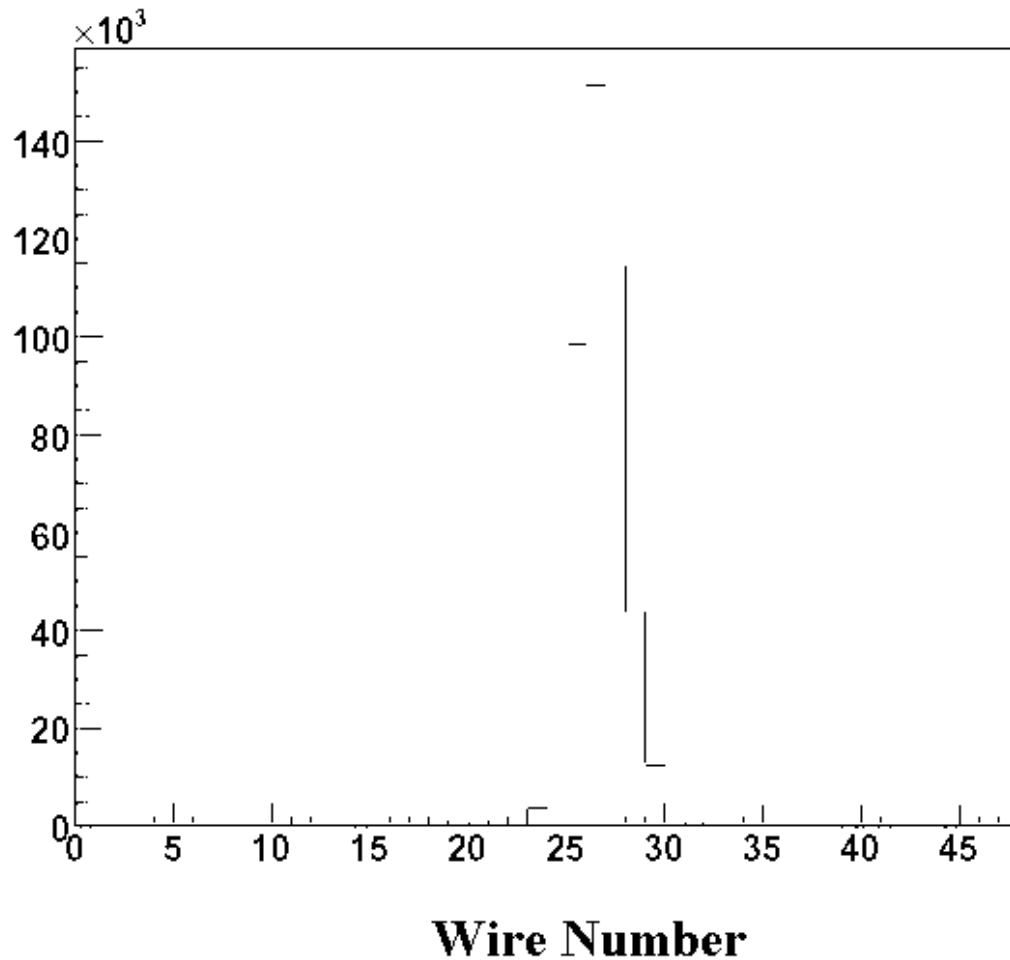
+6V; -6V at 0,5A

## HV:

typ. 2,5-3,1 kV 150nA

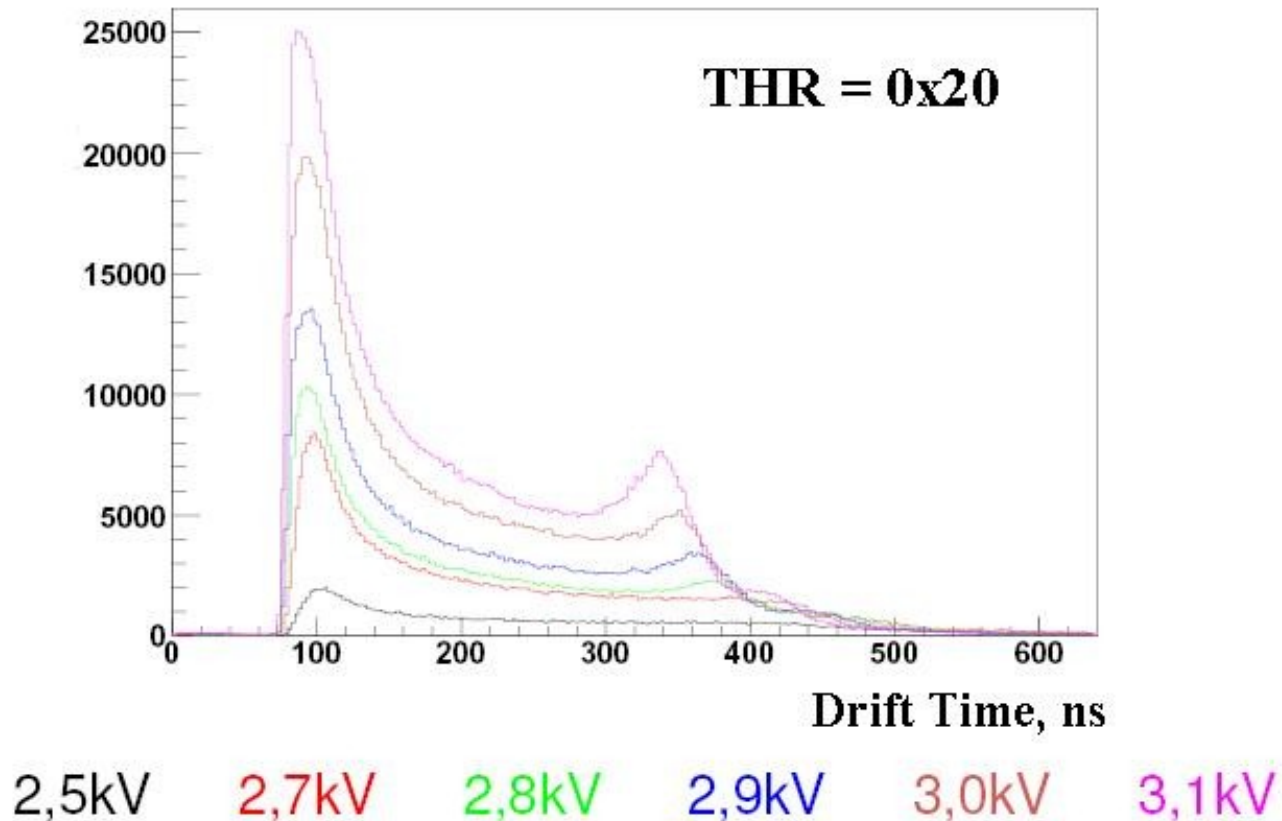


# Test at Source Sr-90: Profile



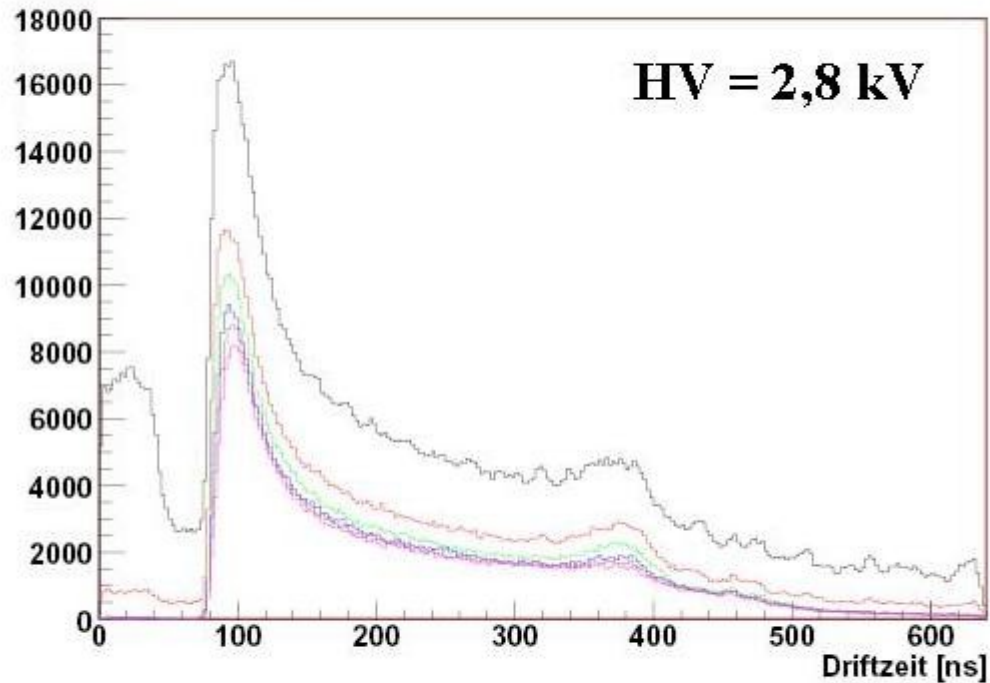
# Test at Source Sr-90: Drift Time vs. HV

## Drift Time Spectrum



# Test at Source Sr-90: Drift Time vs. THR

## Drift Time Spectrum



0x10

0x18

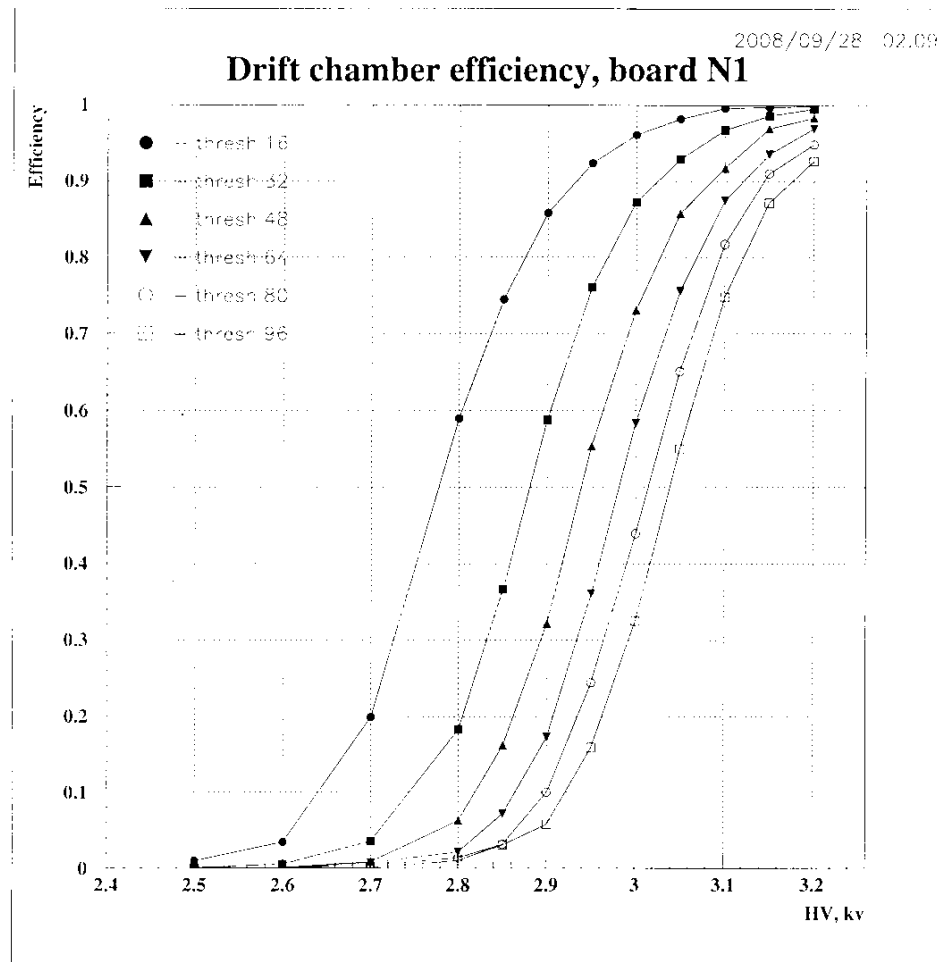
0x20

0x28

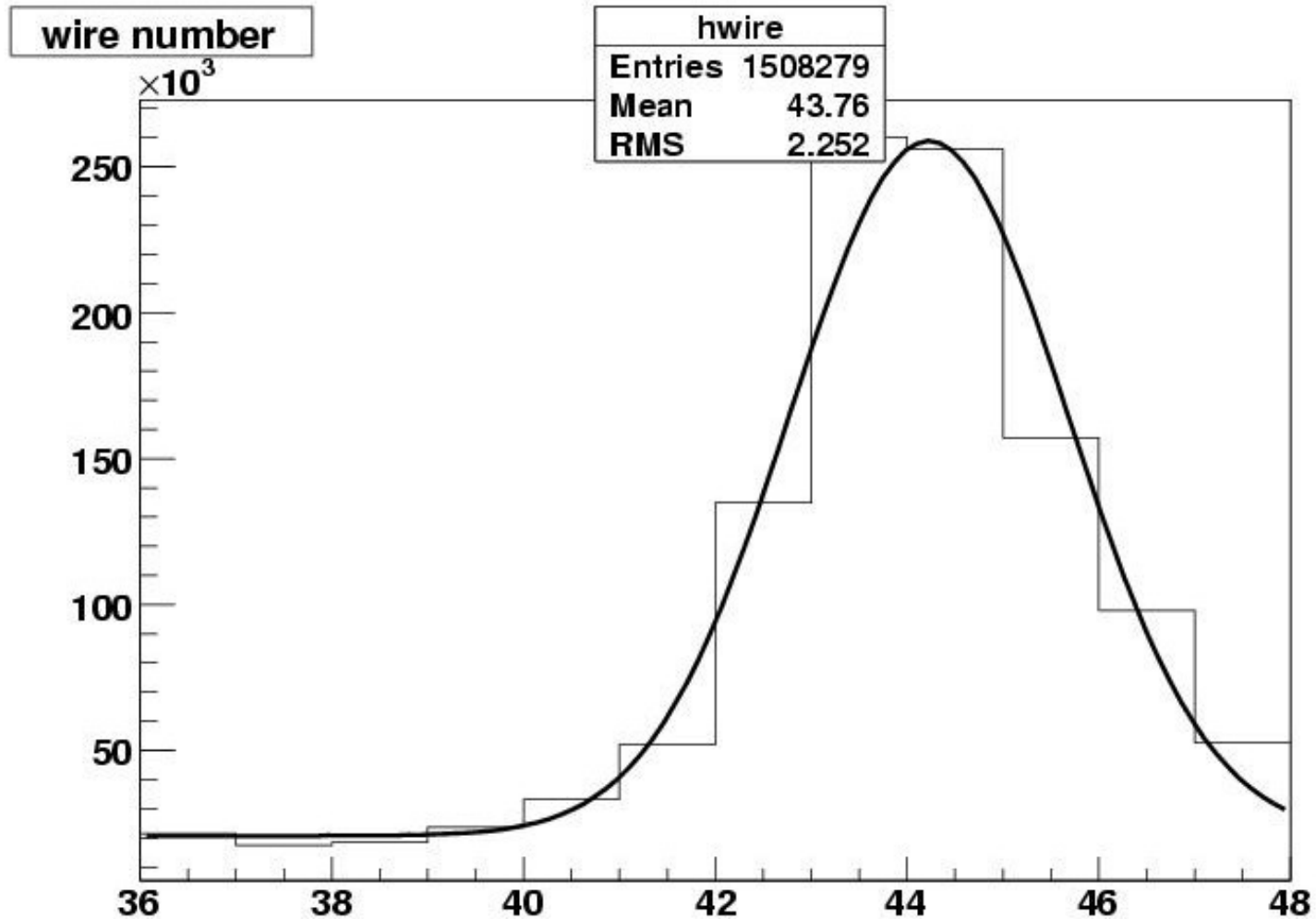
0x30

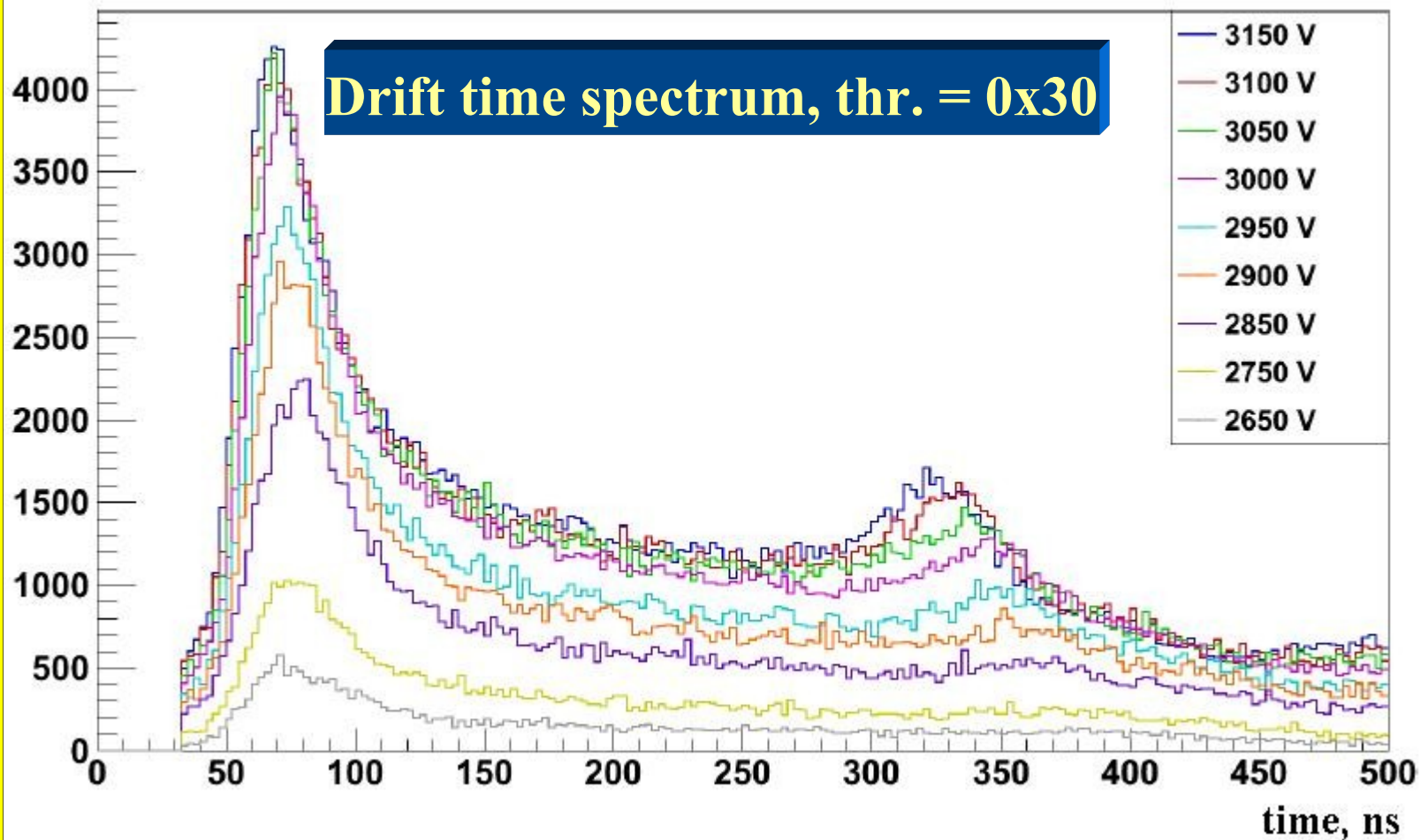
0x38

# DC: Test at Source Sr-90



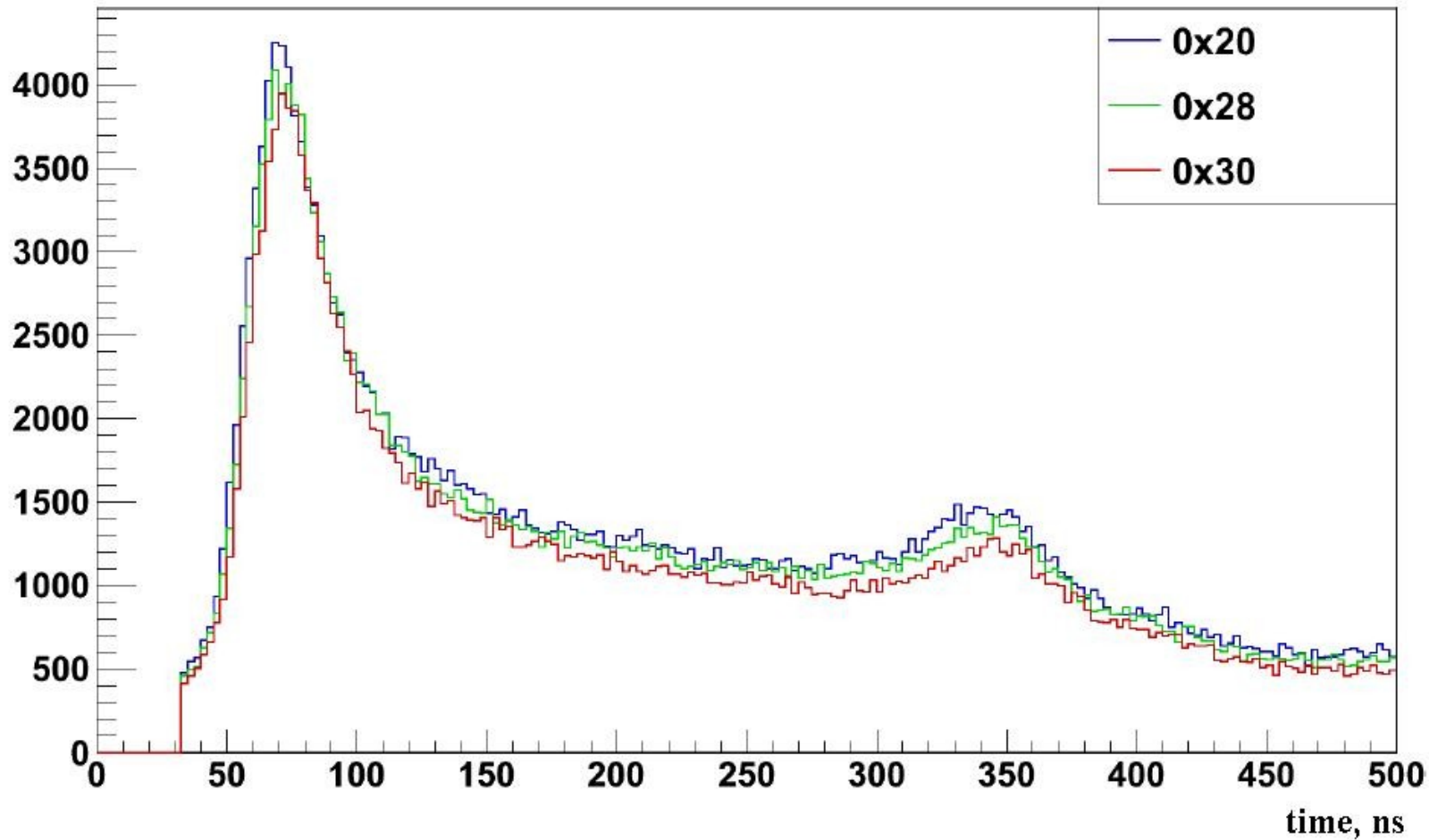
# Test at ELSA: Profile



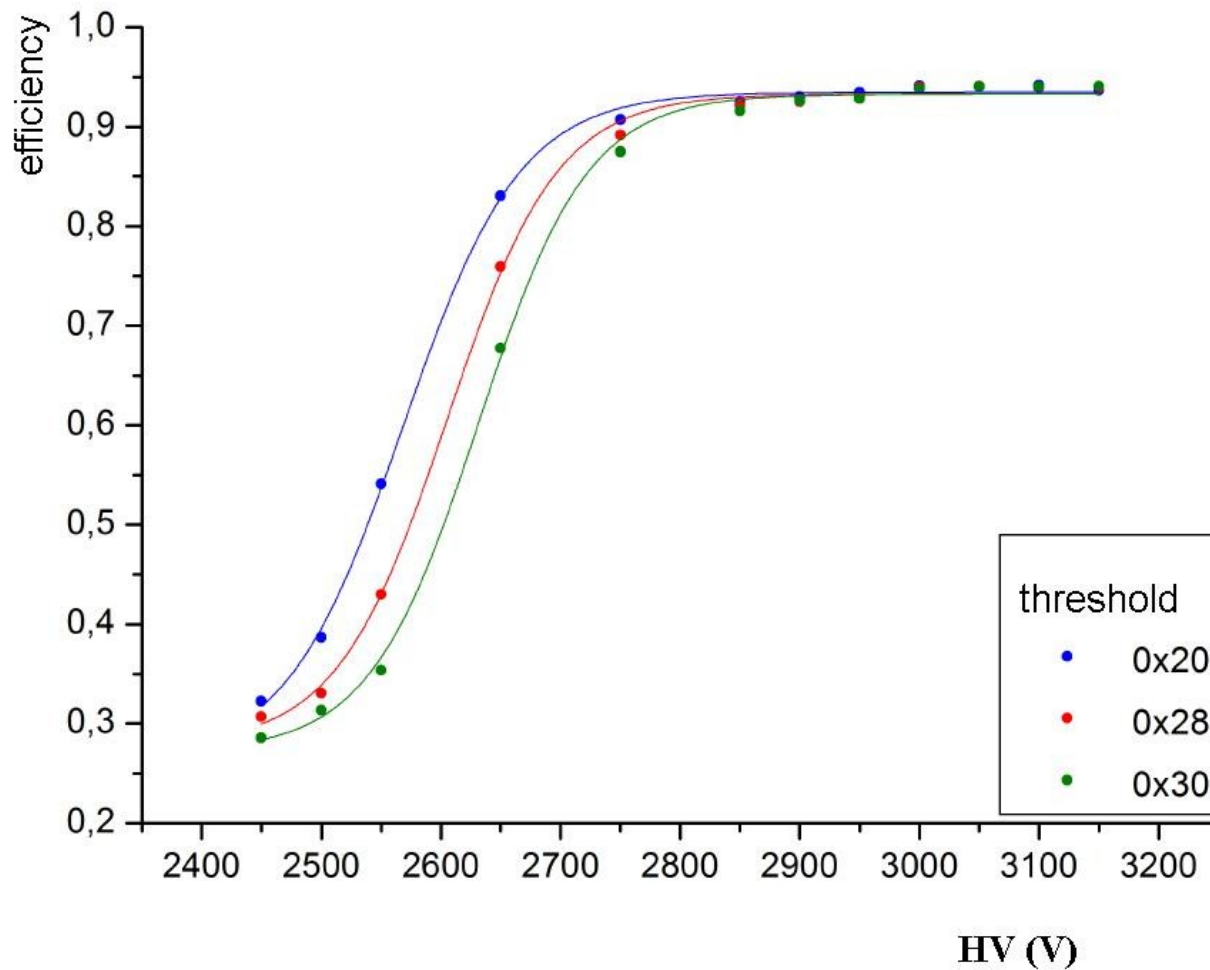




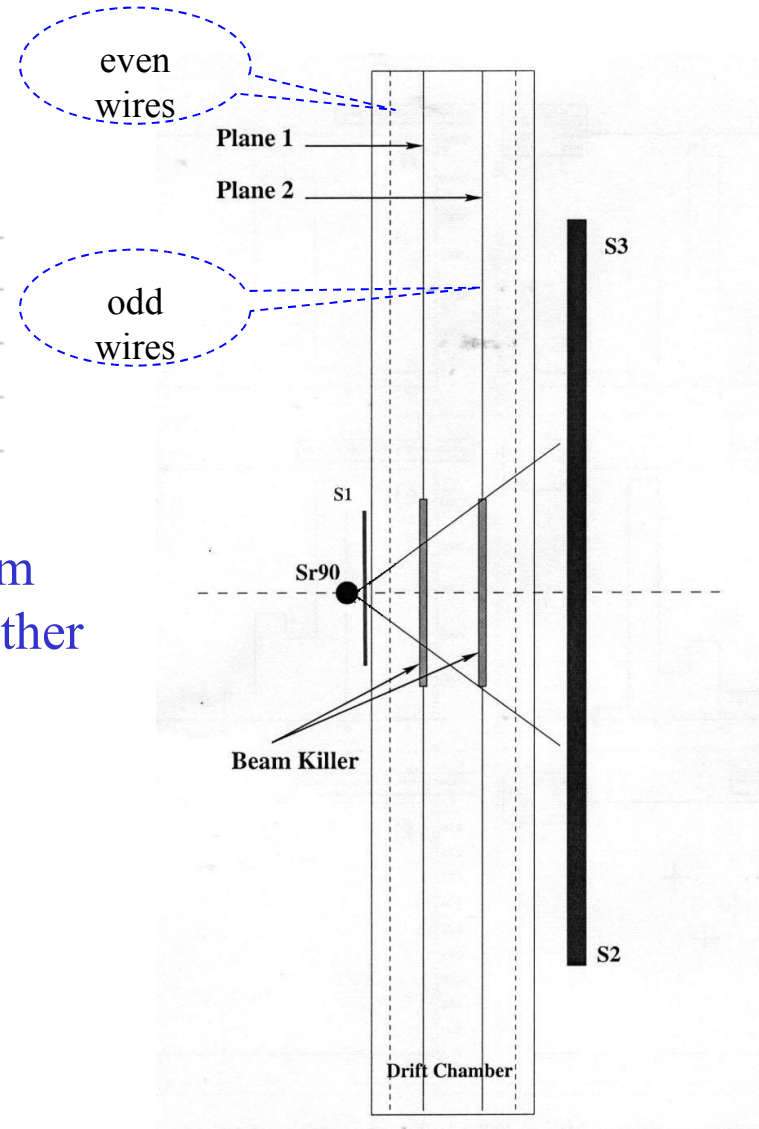
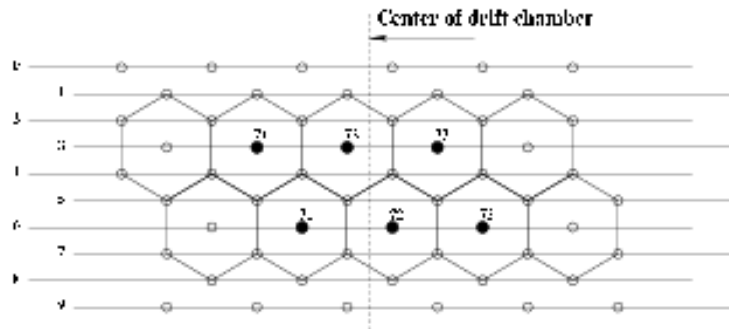
# DC: Test at Beam, $U = 3,00$ kV



# DC: Test at Beam, Efficiency



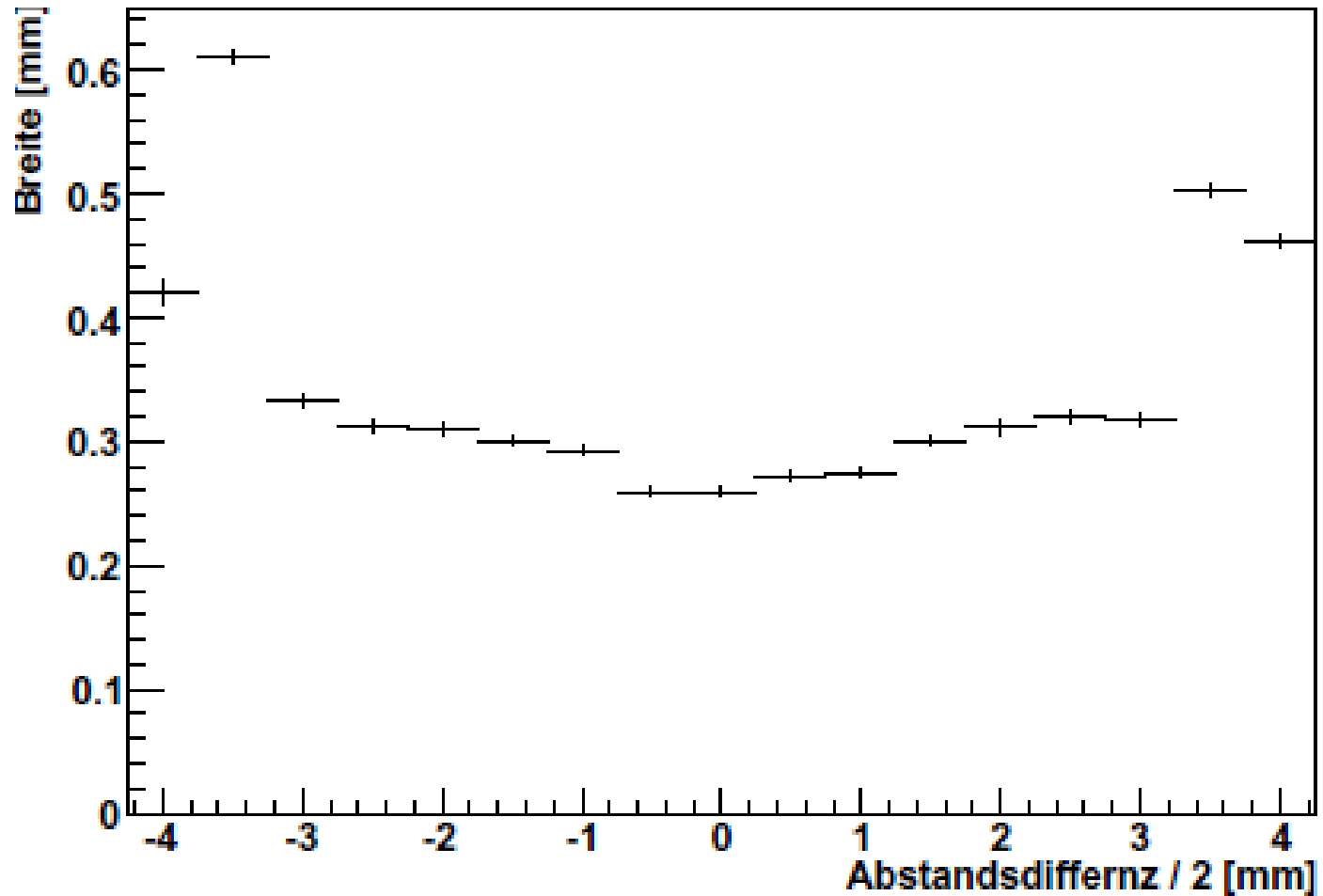
# DC-Test, “Beam Killer”, Experimental Setup 1 (PNPI)



- Halvamic anodization up to  $100 \mu\text{m}$
- 3 wires in one plane and 3 in the other
- S1  $50 \times 50 \times 1 \text{ mm}^3$
- S2, S3 – counter with two PMT's  $300 \times 300 \times 5 \text{ mm}^3$

**0,25%**

# DC: Test at Beam, Spatial Resolution



## Summary

- В Бонне создана коллаборация B1 (BGO-Open-Dipole)
- Физическая программа: предложения рассматриваются в течение 1-ой половины 2011 г.
- В ПИЯФ, согласно контракту 153к/300 созданы прототип, 8 камер (ОМК) и считывающая электроника CROS3 (ОРЭ)
- В Гатчине и Бонне проведены тесты от Sr-90 и на пучке, эффективность более 98% при рабочих значениях порога

**Предложение от ПИЯФ: исследование фоторождения  $\eta$ -мезона**