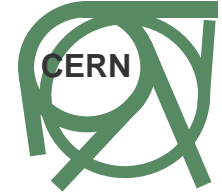




Commissioning of the LHCb RICH Detector



C. D'Ambrosio
(CERN, Geneva, Switzerland)

on behalf of the LHCb – RICH Collaboration

Outline

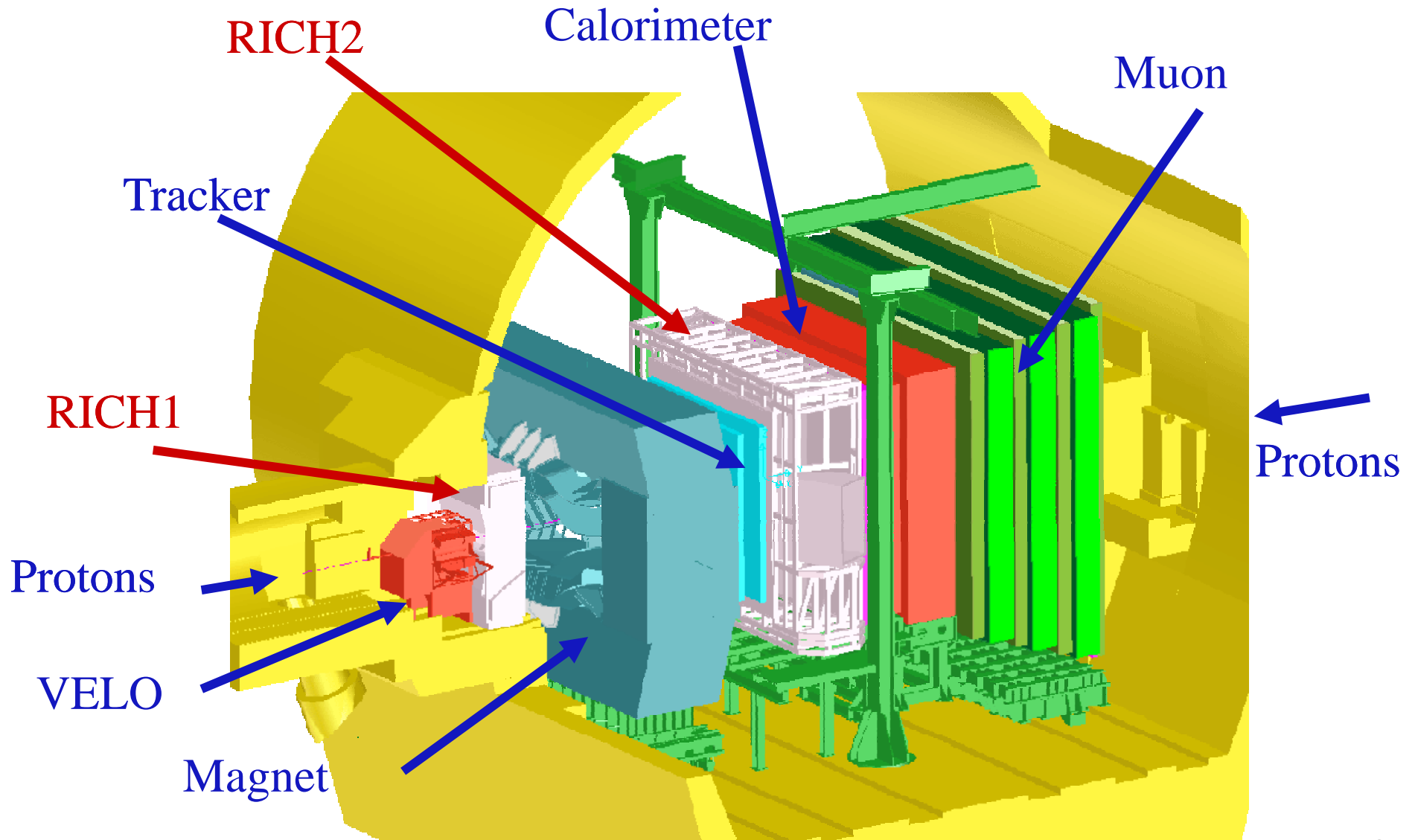
LHCb and its RICHes

What is Commissioning and Commissioning Strategy

RICH Commissioning, a (hi)Story

First Results

Conclusions and Outlook



RICH1 detector challenge: **very small material budget**

(see Neville, Tito and Fabio)

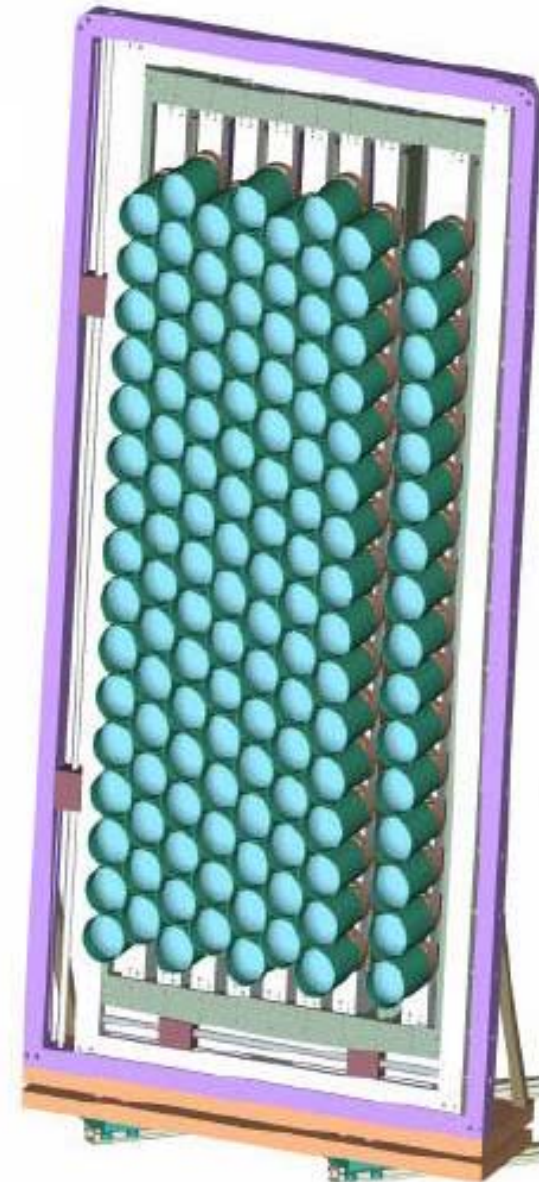
RICH2 detector challenge: **optomechanical system aligned in the lab. and transported as is in the pit**

(see Neville)

Common challenge: **Photodetectors** (see Thierry and Stephan)

Most of the commissioning at present is focused on the Optoelectronic, Control and Data Acquisition and Calibration Systems

HPDs array as in one photodetector plane for RICH2
RICH1 two arrays are essentially similar

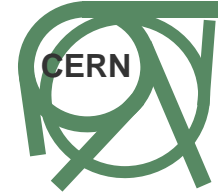




RICH 2007, Oct 16, 2007



Safety (...and more)



- **Regular Meetings** (everyday coffees and weekly phone-conferences)
- Hard and soft **interlocks** enabled from the beginning
- **Monitoring** systems
 - Vessel, HPD boxes, electronics and electric temperature, pressure and humidity sensors
 - Voltages and currents
- Distributed and **smart** alerts, alarms, feedbacks and **reactions**
- **No development at the pit** (at least we tried as much as we could...)

(see Mario)



RICH Commissioning



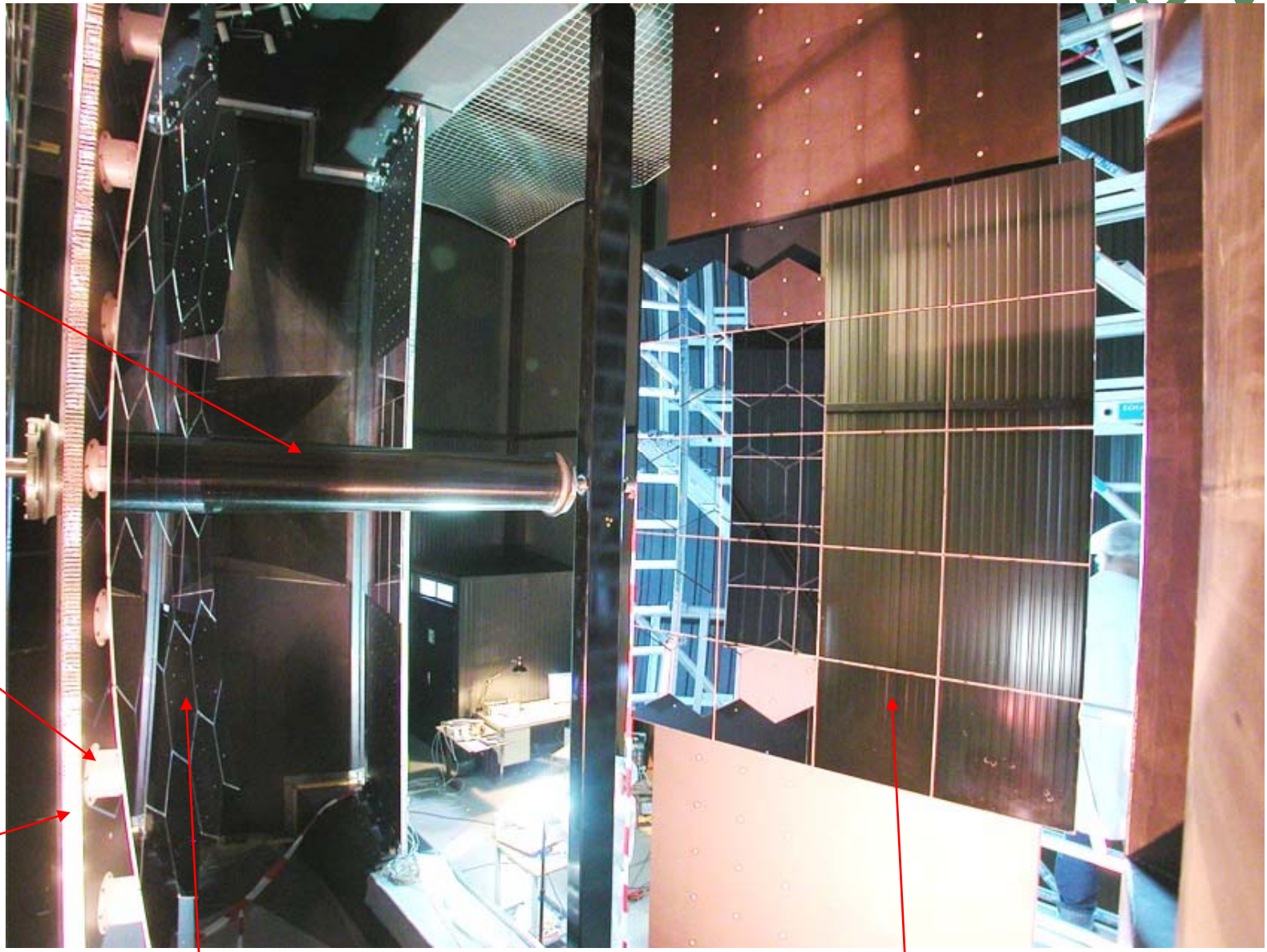
A closer look and a (hi)story of RICH2 commissioning,
(looking forward to do the same for RICH1 soon!!)

RICH2 optics are mounted and aligned

Central carbon fibre tube to allow for the beam pipe

Mirror support and fine adjustment

Panels honeycomb structure



RICH 2007, Oct 16, 2007 Spherical mirrors array

Flat mirrors array

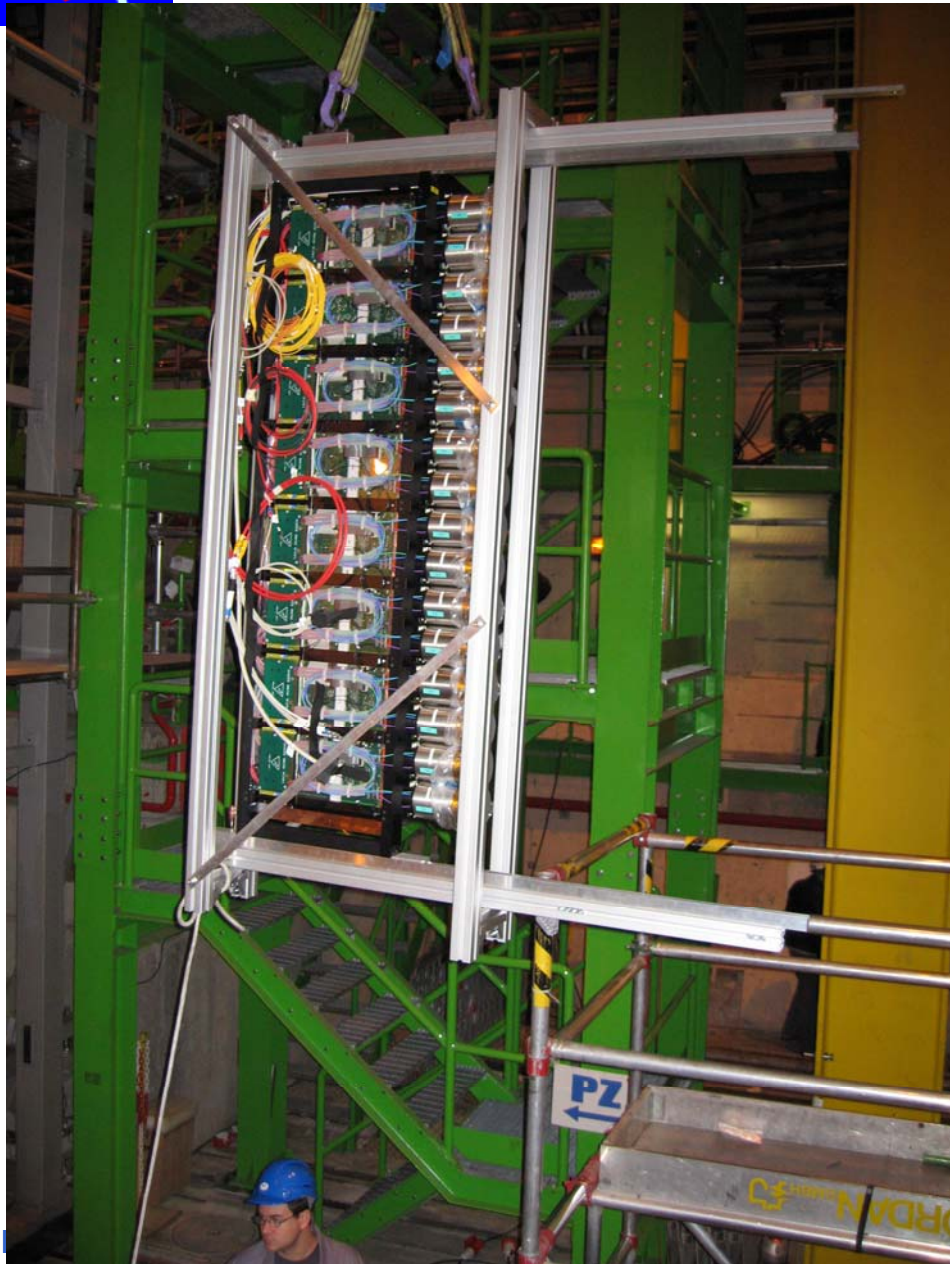


RICH2 is closed and transported to the pit

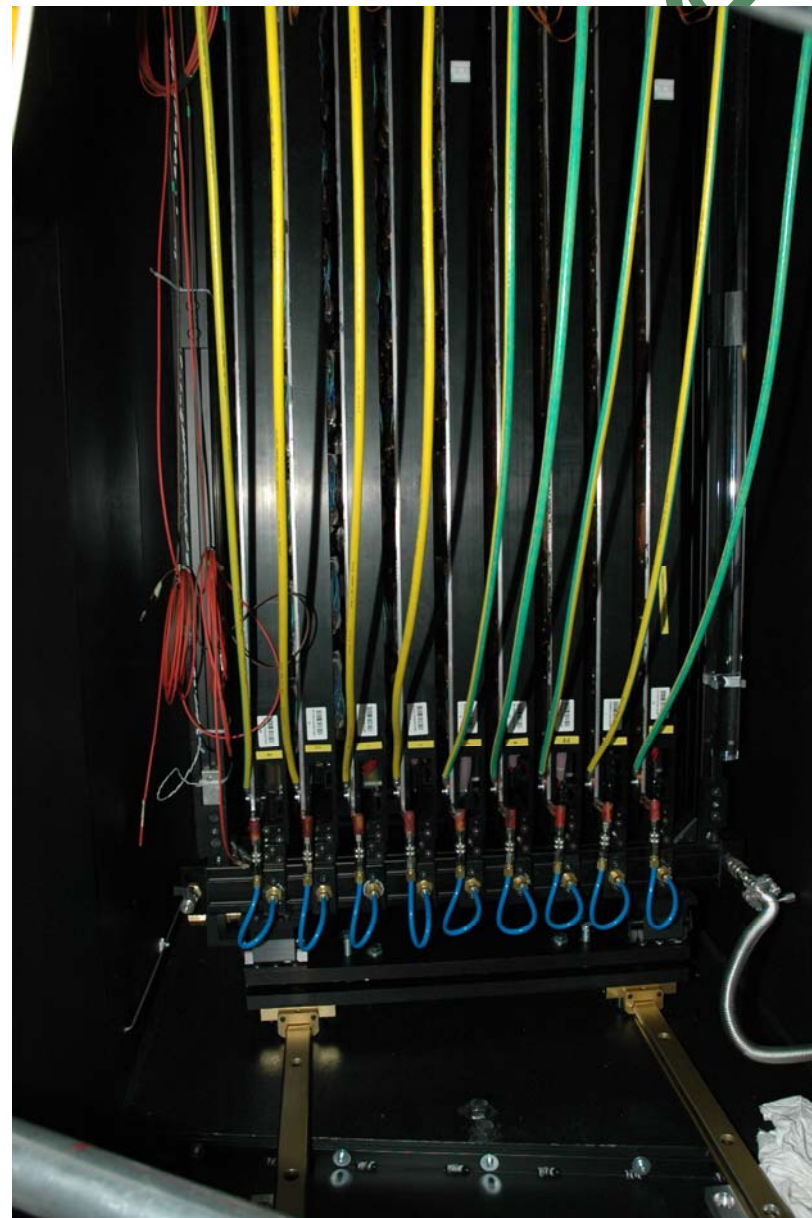
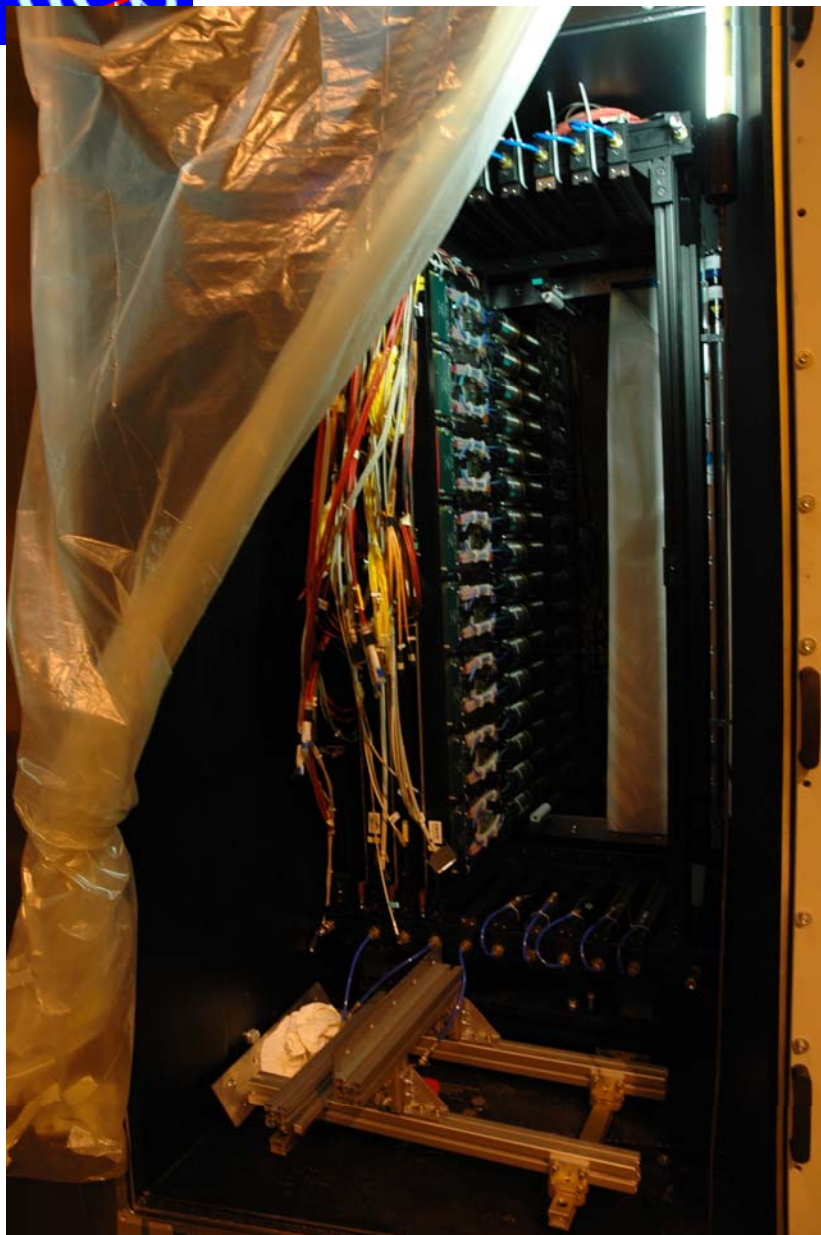


RICH 2007, Oct 16, 2007

RICH2 columns assembly

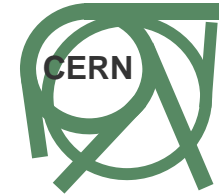


Columns are installed

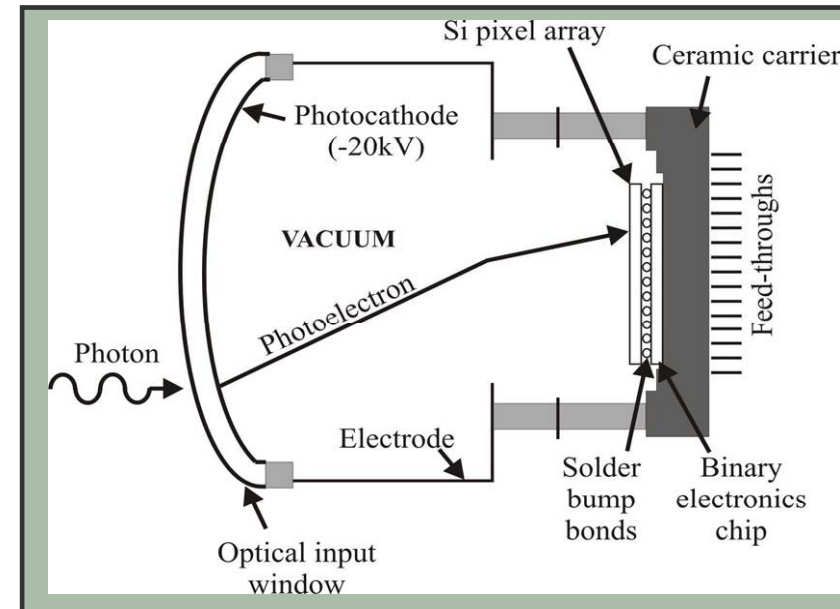




Pixel Hybrid Photon Detectors



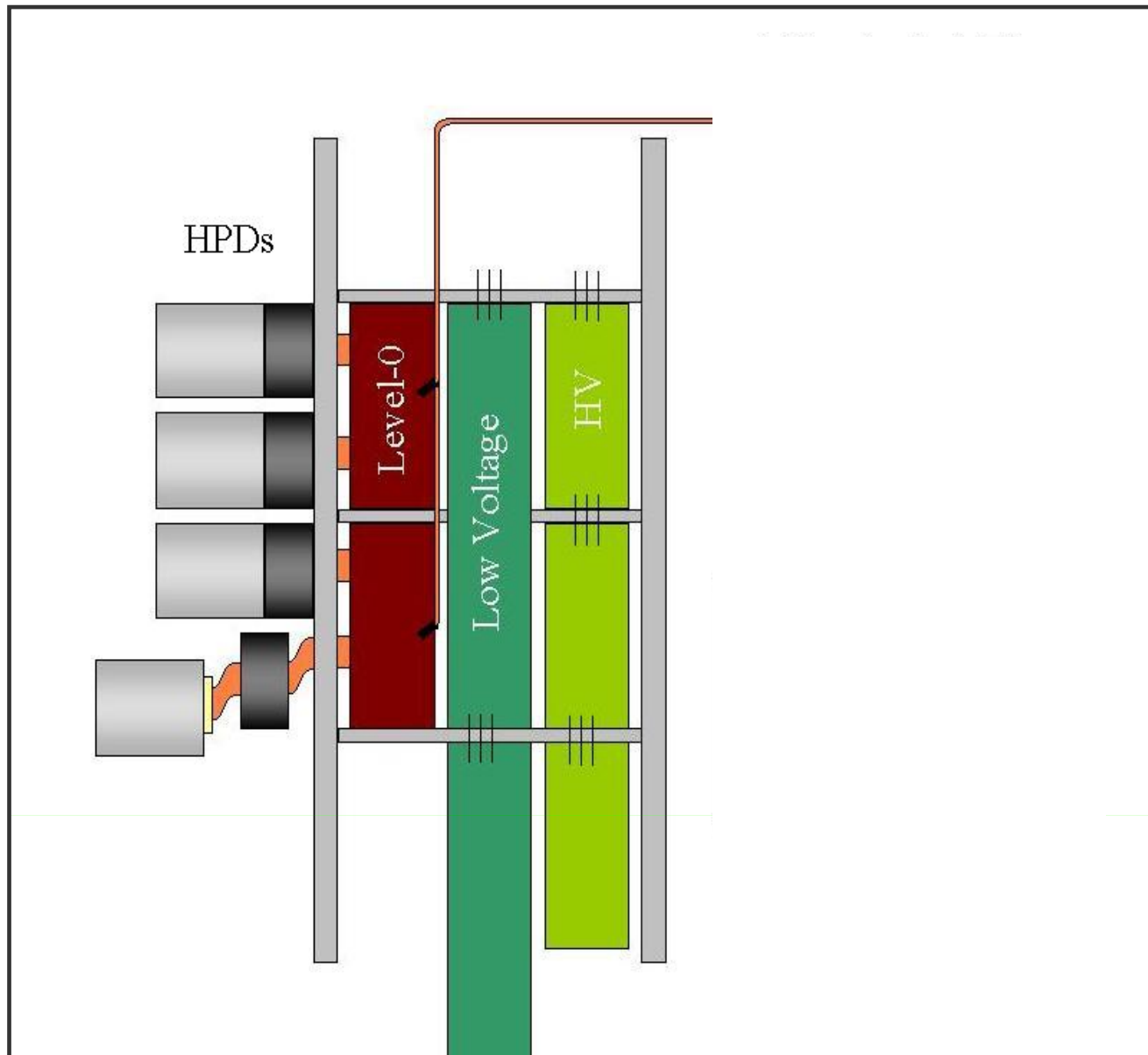
- Combines vacuum technology with silicon pixel readout (Quartz window with S20 photocathode).
- Operates at the LHC bunch crossing frequency (40MHz)
- 20 kV operating voltage, factor 5 demagnification
- It can work in “Alice mode”, that means a square array of 8192 pixels, or in “LHCb mode”, where 8 pixels are or-ed together to give 1024 pixel array



To operate, it needs:

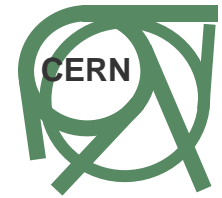
High Voltage, Si bias voltage and Low Voltages to power the electronic chip.

The HPD on-detector chain





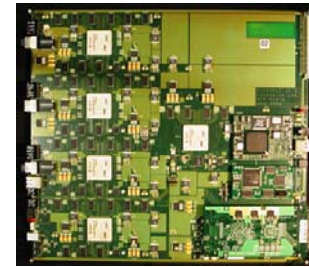
From your keyboard to your screen (ECS)



144 L0



10^6 Hz



8 UKL1 cards

10^6 Hz

Online network

Storage

10^4 Hz

RICH Online monitoring

10^{-1} Hz

To your screen

10^{-1} Hz

Monitoring System

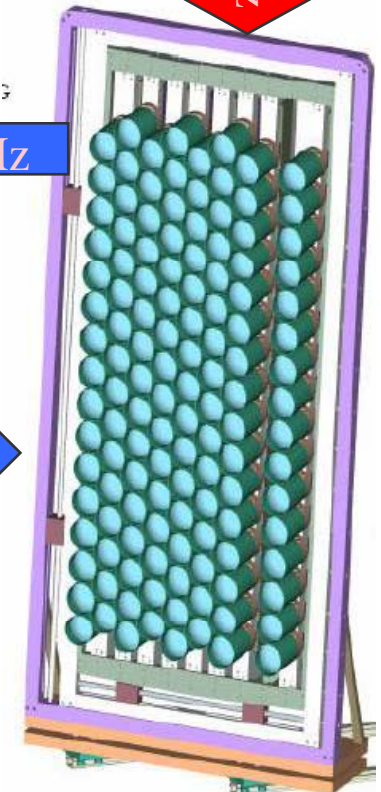
10^0 Hz



ELMB cards

10^1 Hz

10^7 Hz



288 HPDs

Power LV, HV
L0 configuration
Run commands

10^{-7} Hz

From your keyboard or mouse





RICH Starting Procedure



RICH2 ECS panel

RICH2: TOP Tue 04/09/2007 11:18:58
root

System: RICH2 State: READY

Sub-System State

RICH2_DCS	READY
RICH2_DAQ	READY
RICH2_RunInf	READY

Run Number: 0 Activity: PHYSICS Save

Nr. Triggers: 0 Max Nr. Triggers: Unlimited

Nr. Steps Left: 0 Automated Run with Steps: No Steps

Trigger Rate:

Live time: 0.00% Run Live time: 0.00%

Partition Settings RICH2 User Panel

HPD box conditions

R2A Pt100_1 (°C)	22.2	R2C Pt100_1 (°C)	21.9
R2A Pt100_4 (°C)	22.2	R2C Pt100_4 (°C)	22.0
R2A Humidity (%)	0.5	R2C Humidity (%)	1.2
R2A Dew Point (°C)	-42.4	R2C Dew Point (°C)	-34.8
R2A Cool Press (bar)	1.2	R2C Cool Press (bar)	1.1

DCS

DAQ (L0 & L1)

RICH 2

	LV_LO		LV_HI		SiBias		HV_20 (kV)		Temperature State
	V	A	V	A	V	uA	Up	Down	
Col A0	4.13	18.59	5.60	2.25	80.20	6.00	-0.00	-0.01	READY
Col A1	4.11	18.66	5.60	2.32	79.85	11.14	0.00	0.01	READY
Col A2	4.13	18.46	5.59	2.54	79.75	4.67	0.00	-0.00	READY
Col A3	4.12	18.12	5.60	2.33	79.35	5.84	-0.01	0.01	READY
Col A4	4.13	17.72	5.59	2.34	80.05	3.57	0.00	-0.00	READY
Col A5	4.13	18.24	5.59	2.22	79.60	5.62	0.00	-0.01	READY
Col A6	4.13	18.61	5.61	2.45	79.10	3.76	0.00	-0.00	READY
Col A7	4.14	18.36	5.61	2.53	80.10	4.63	-0.00	-0.01	READY
Col A8	4.12	19.00	5.61	2.54	79.40	3.41	0.00	0.00	READY
Col C0	4.13	18.27	5.61	2.25	80.00	4.20	0.01	-0.01	READY
Col C1	4.12	18.69	5.61	2.22	80.10	2.80	-0.00	0.00	READY
Col C2	4.12	18.70	5.59	2.28	79.80	11.70	-0.00	0.01	READY
Col C3	4.11	19.67	5.58	2.37	79.90	8.50	-0.01	0.01	READY
Col C4	4.11	18.75	5.59	2.25	80.10	22.70	-0.00	0.00	READY
Col C5	4.12	18.44	5.59	2.09	79.80	4.20	0.00	0.00	READY
Col C6	4.12	18.44	5.57	2.13	80.00	8.10	-0.00	0.00	READY
Col C7	4.13	18.77	5.56	2.54	79.90	24.70	0.00	0.01	READY
Col C8	4.11	18.32	5.57	2.59	79.80	53.90	-0.00	0.00	READY

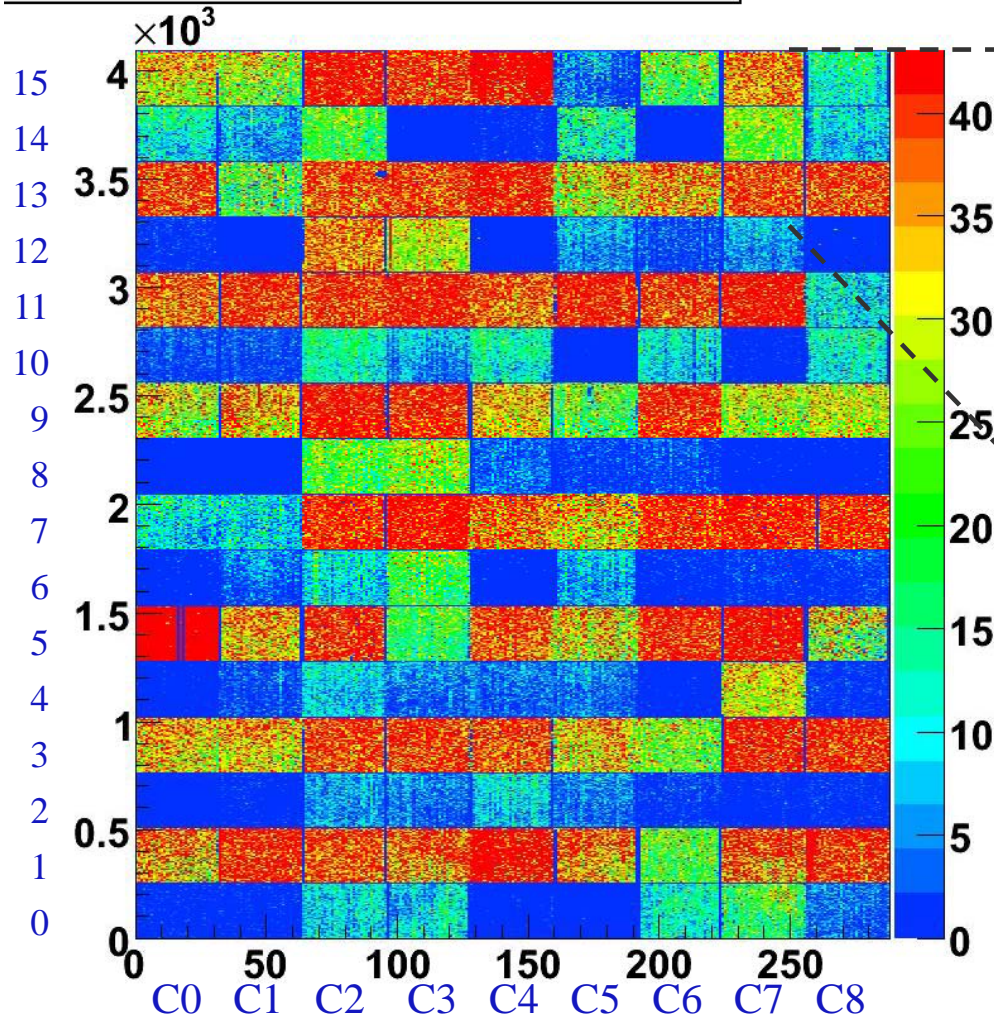
RICH2 Overview

...or the so called "one click startup" ...
(well, two clicks at the moment!)

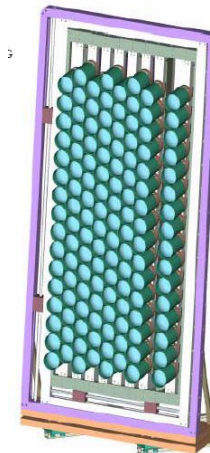
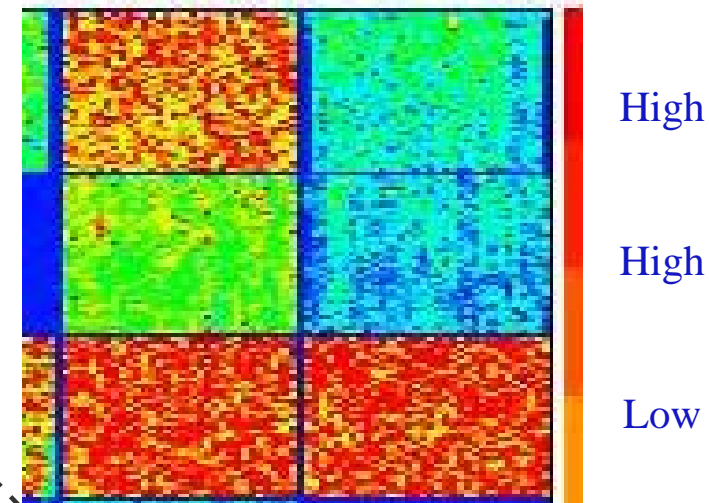
First electrical images from RICH

With Si bias off HPD on-chip detectors provide a nice source of signal to check the data flow

H2D/RichMonitor/HitMaps/R21PixelRC_Alice



Threshold set

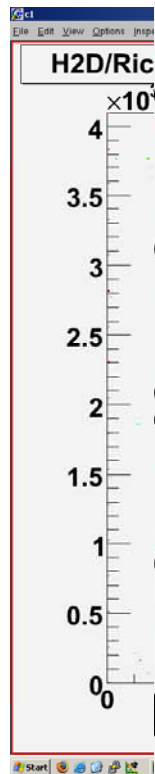
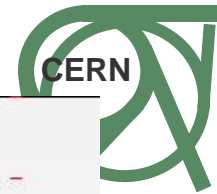


In reality HPDs are closely packed to achieve maximum active area. What is shown, is the “chips space” rather than the “photocathode space”

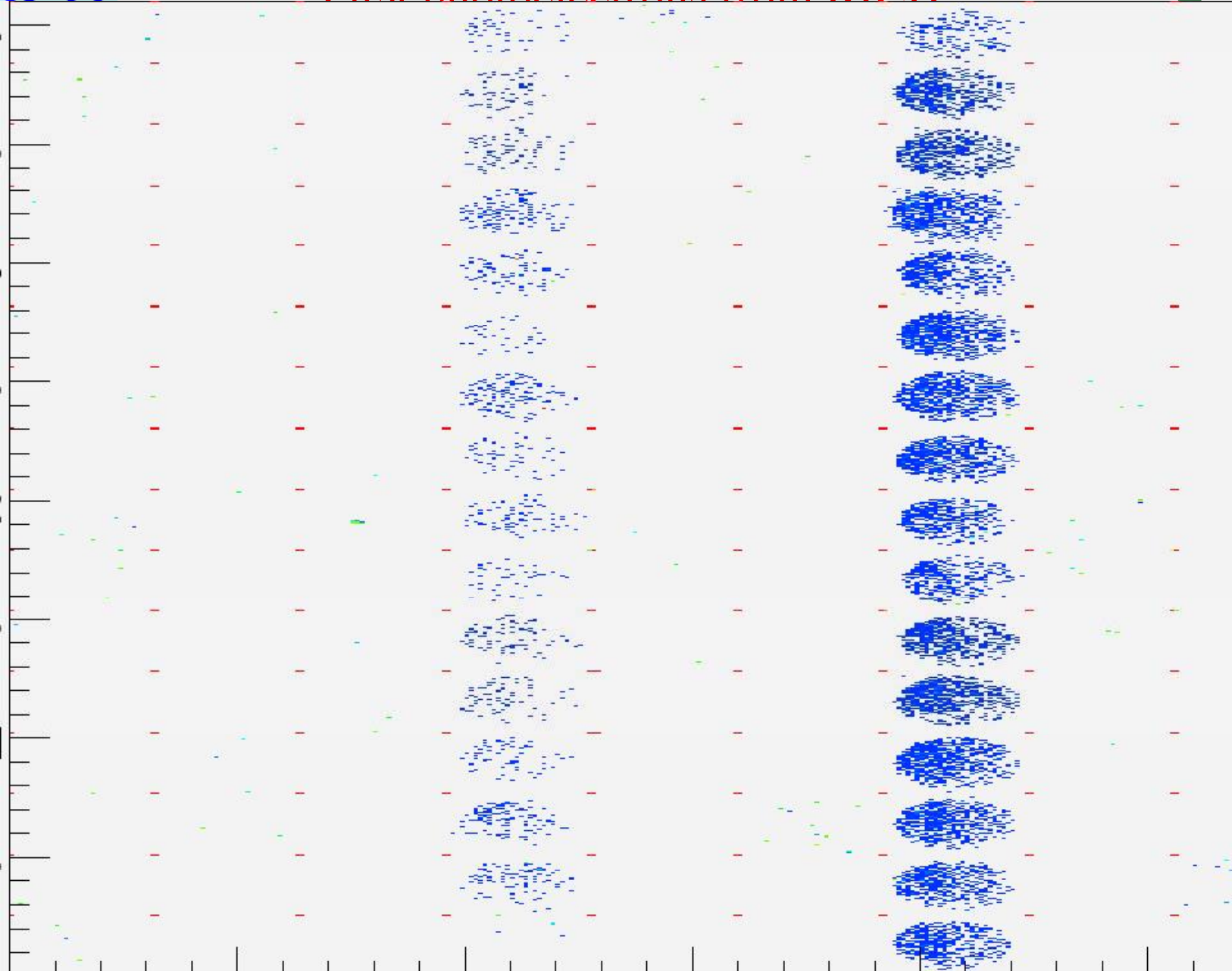
Here 144 x 8192 pixels (~1.2 millions channels, clocked at 40 Mhz) are coloring our life!



First photoelectrons from RICH



...t



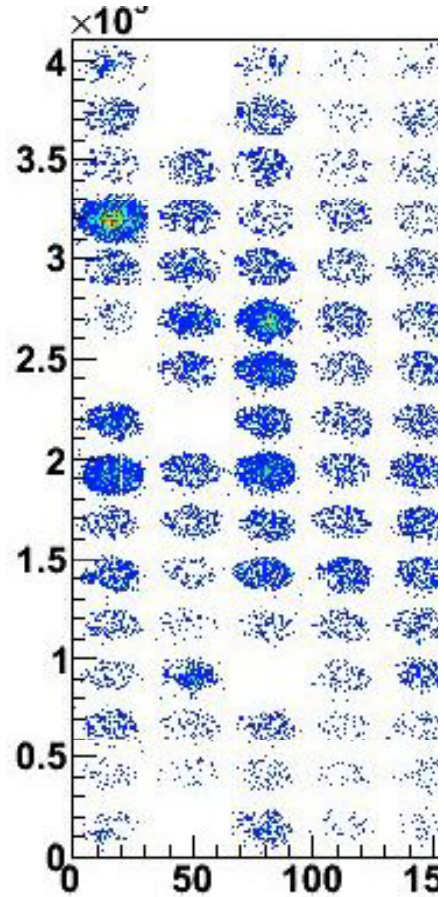


FIAT LUX (first photons detected)

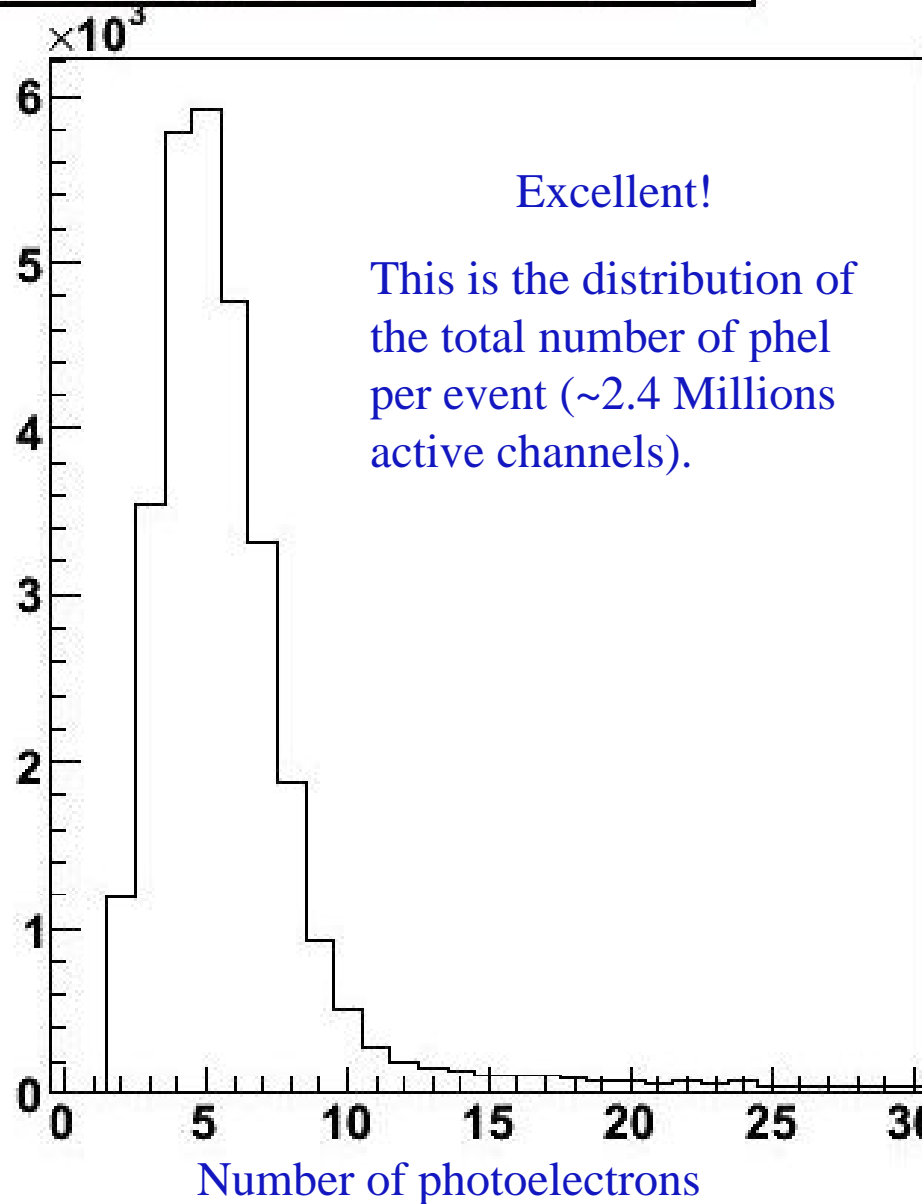


D/RichMonitor/ComMon/ALL-Inclusive

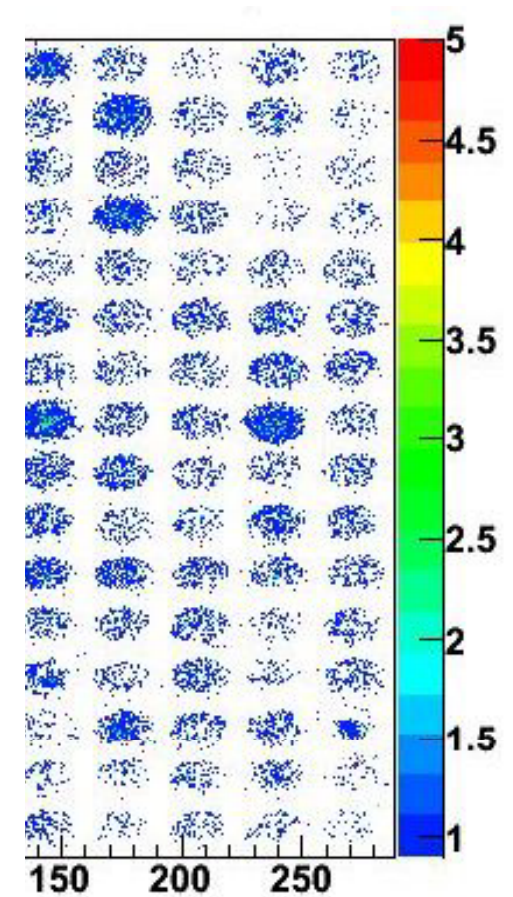
High Voltage was r
in real time the HP



A red light emitting



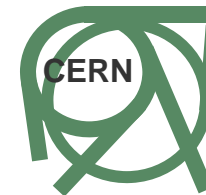
order to monitor



photons in the vessel



RICH2 is routinely running



- To **test** and to **improve** its calibrations, stability, reliability, robustness;
- To **exercise** HPDs and keep them powered and under high voltage;
- **Gain** experience (also in critical situations) and confidence;
- And possibly to **acquire** useful data to prepare the future (see Antonis and Claus).

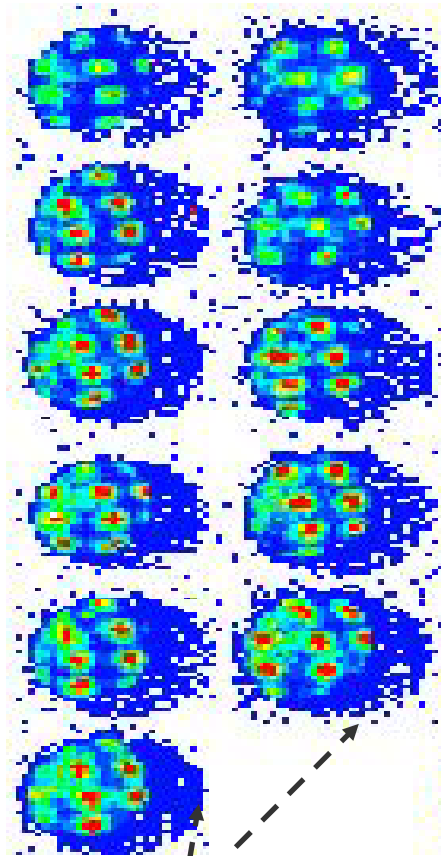
Example: when the magnet is on, HPD images are distorted



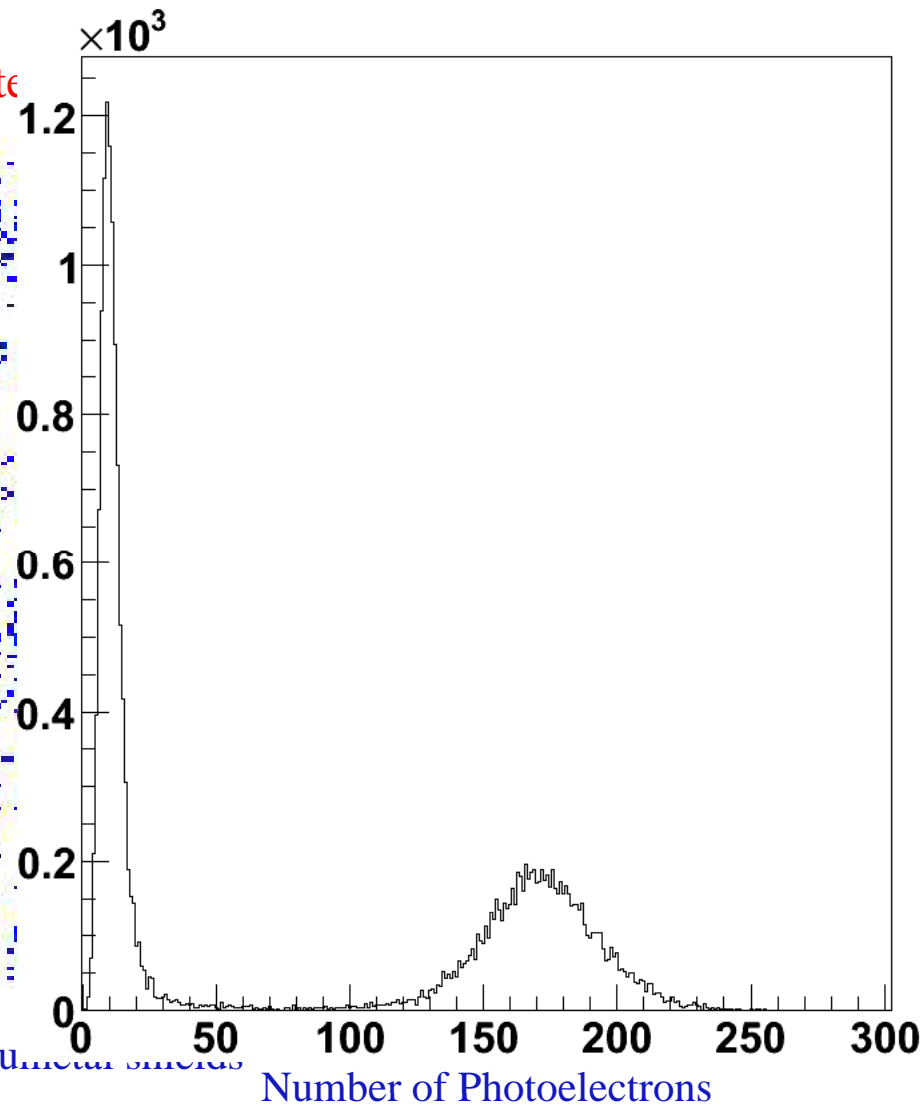
system to monitor and correct for the distortion

First optical images from RICH2

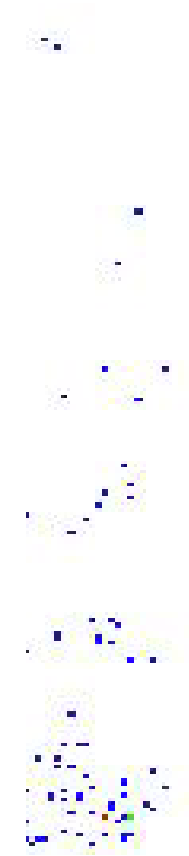
We shine a defined pattern



The shadows from the muon chambers



magnetic field.



The shadow of the photon funnel

A DLP projector together with an optical system to ensure low light levels and safe operation was used



Conclusions



LHCb RICH detectors are well under way for a successful commissioning:

RICH2 is deep in its commissioning phase and it is ready for global commissioning;

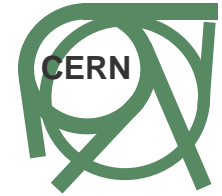
RICH1 is at its last stages of installation and integration and will jump speedily in the commissioning, as the whole opto-electronic, control and readout system is identical to RICH2.

We are **NOT** looking forward,
we are **DYING** to see the light from the LHC particle beams!

IN ANY CASE...



...whenever it happens, we will be ready for it!





Acknowledgements



It is difficult to convey an idea of the enormous amount of work, new technologies, R&D, tests, sweat and years, which embeds a 20 min presentation ...and the **amount to come...**

I wish I managed a bit!

Whatever the case, I would like to respectfully thank all the people who worked, are working and will work on our project and on whom behalf I am here today.