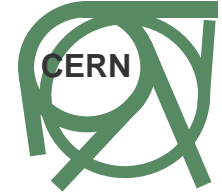




# Commissioning of the LHCb RICH Detector



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

on behalf of the LHCb – RICH Collaboration

## Outline

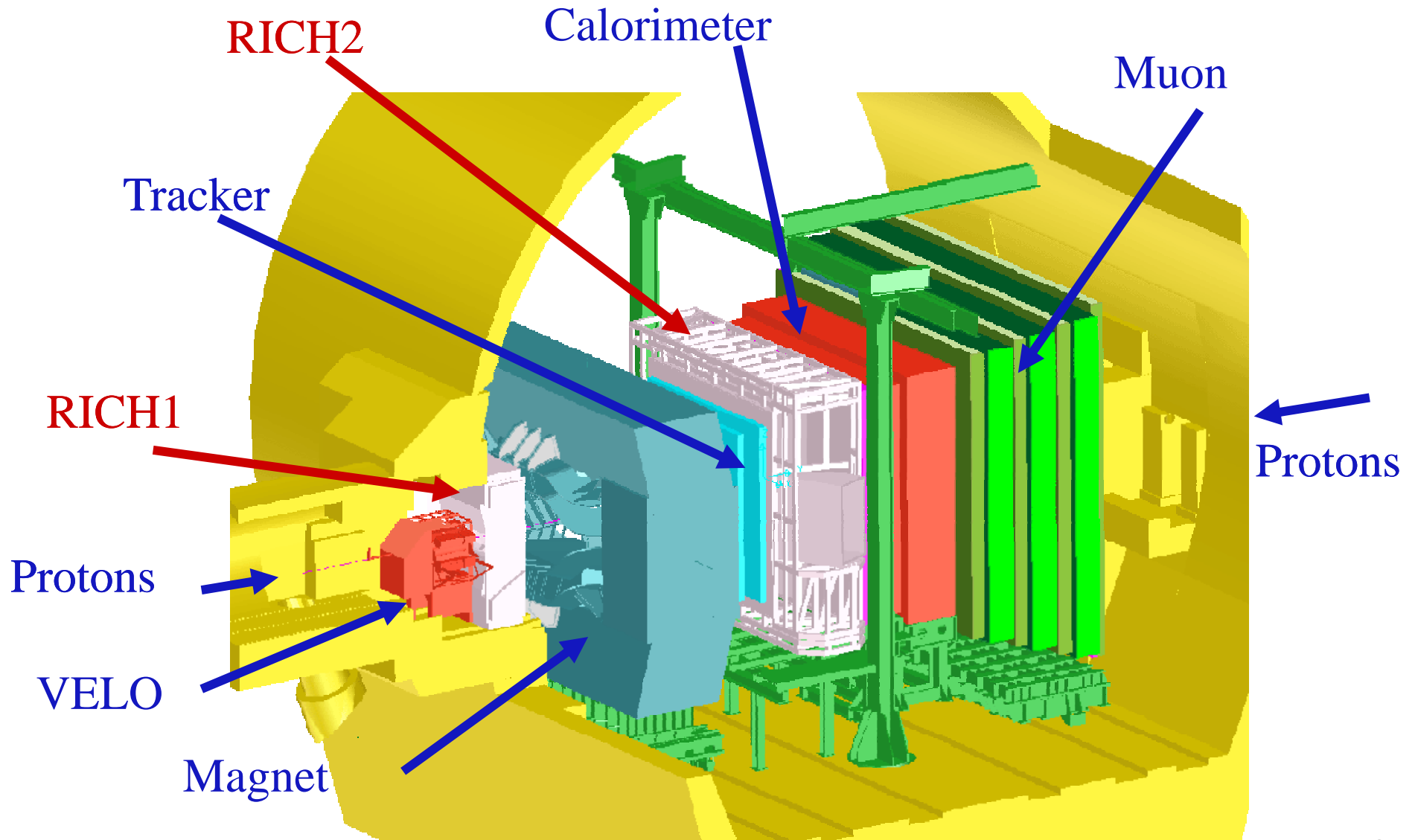
LHCb and its RICHes

What is Commissioning and Commissioning Strategy

RICH Commissioning, a (hi)Story

First Results

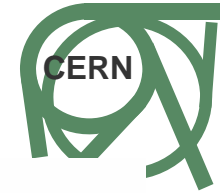
Conclusions and Outlook





The two

detector planes



RICH1 detector challenge  
(see Neville, Tito and Fabio)

RICH2 detector challenge  
in the lab. and transported  
(see Neville)

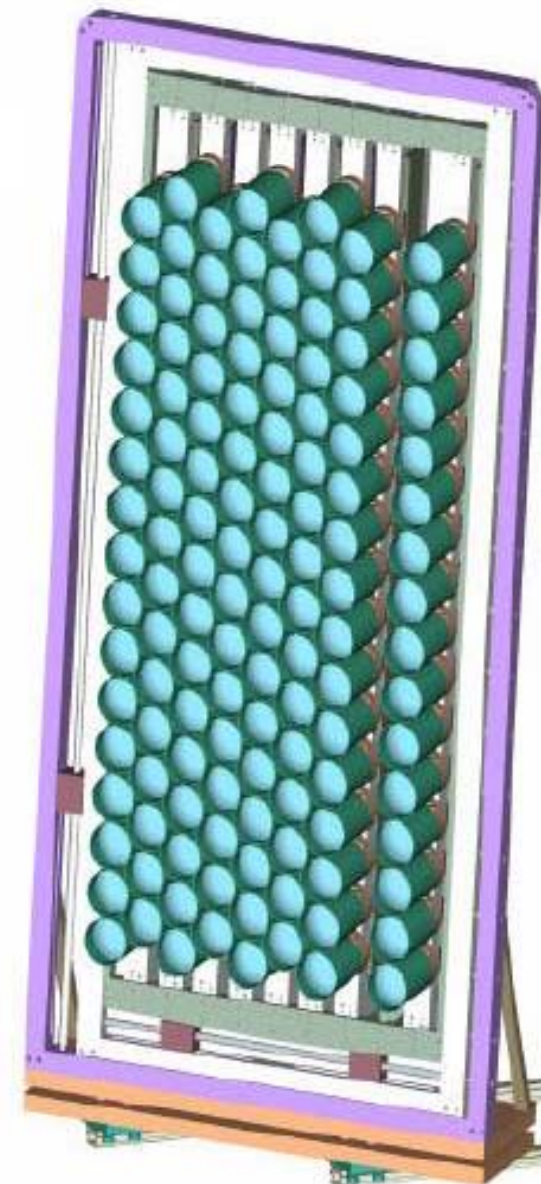
Most of the commissioning  
Optoelectronic, Control and  
Calibration Systems

HPDs array as  
RICH1 two ar



d

CH2

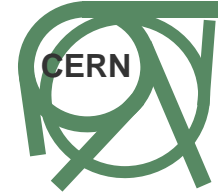




RICH 2007, Oct 16, 2007



## Safety



- **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



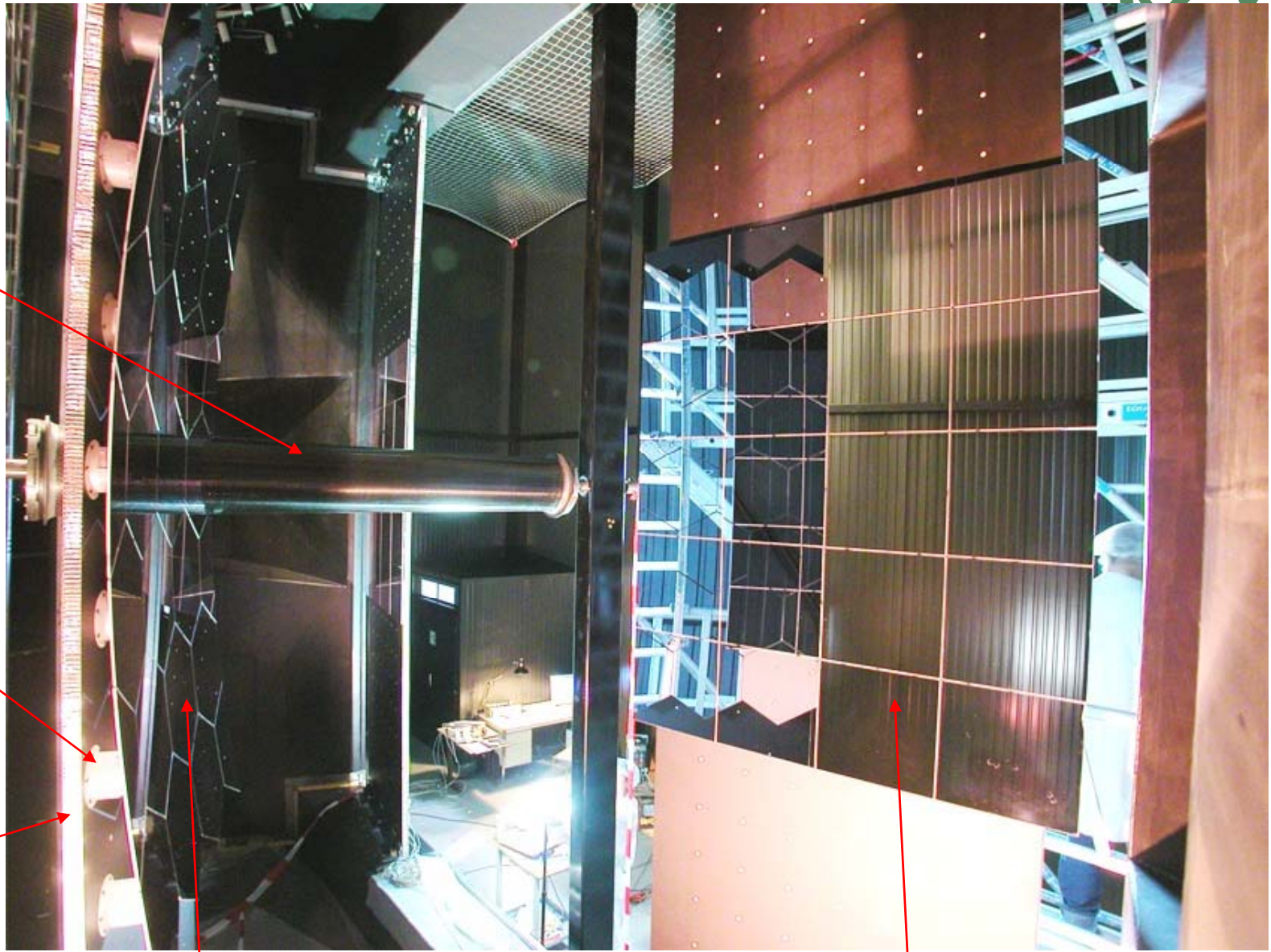
A closer look and a (hi)story of RICH2 commissioning,  
(looking forward to do the same for RICH1 soon!!)

# 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

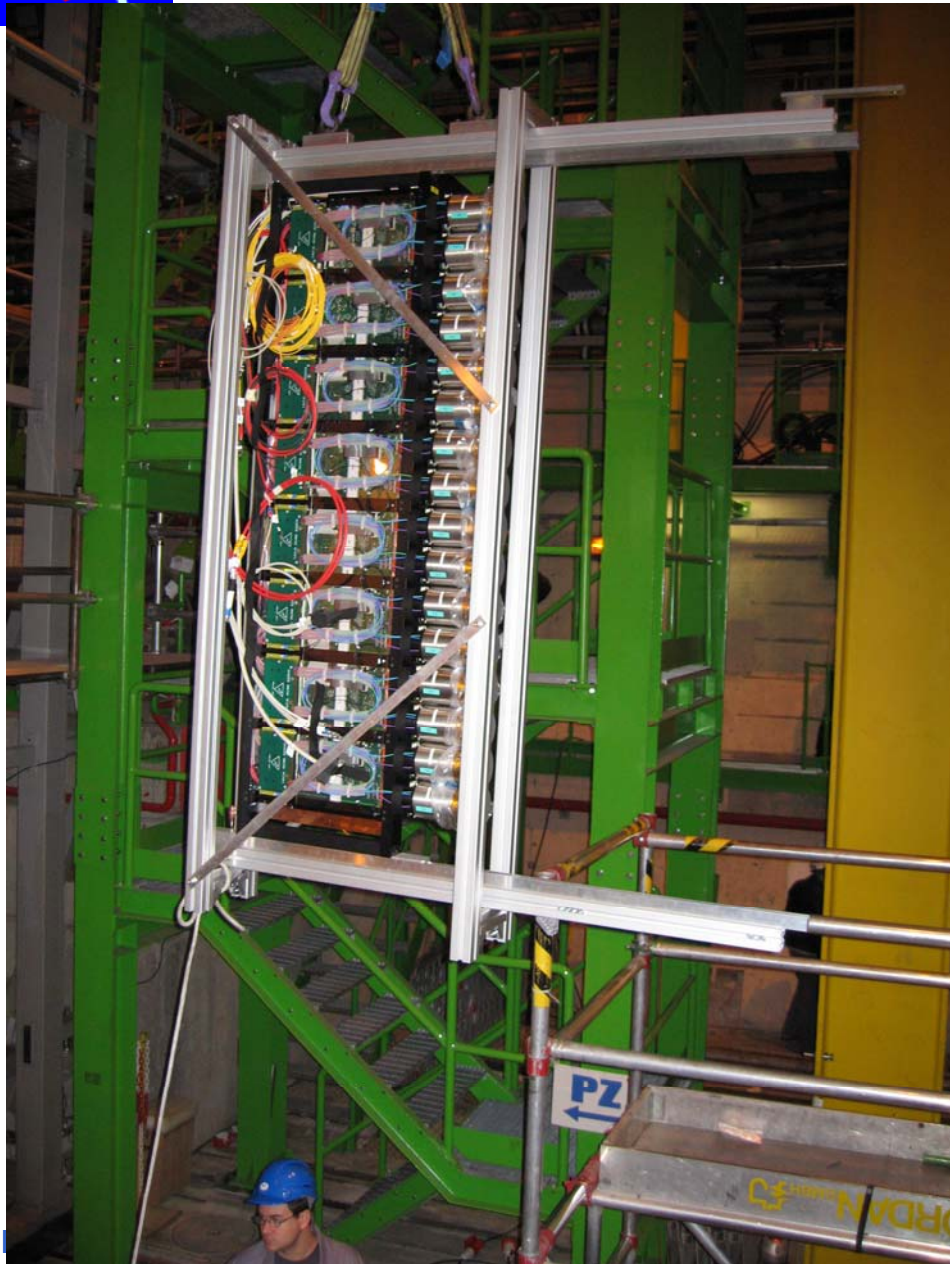
Flat mirrors array

# RICH2 is closed and transported to the pit

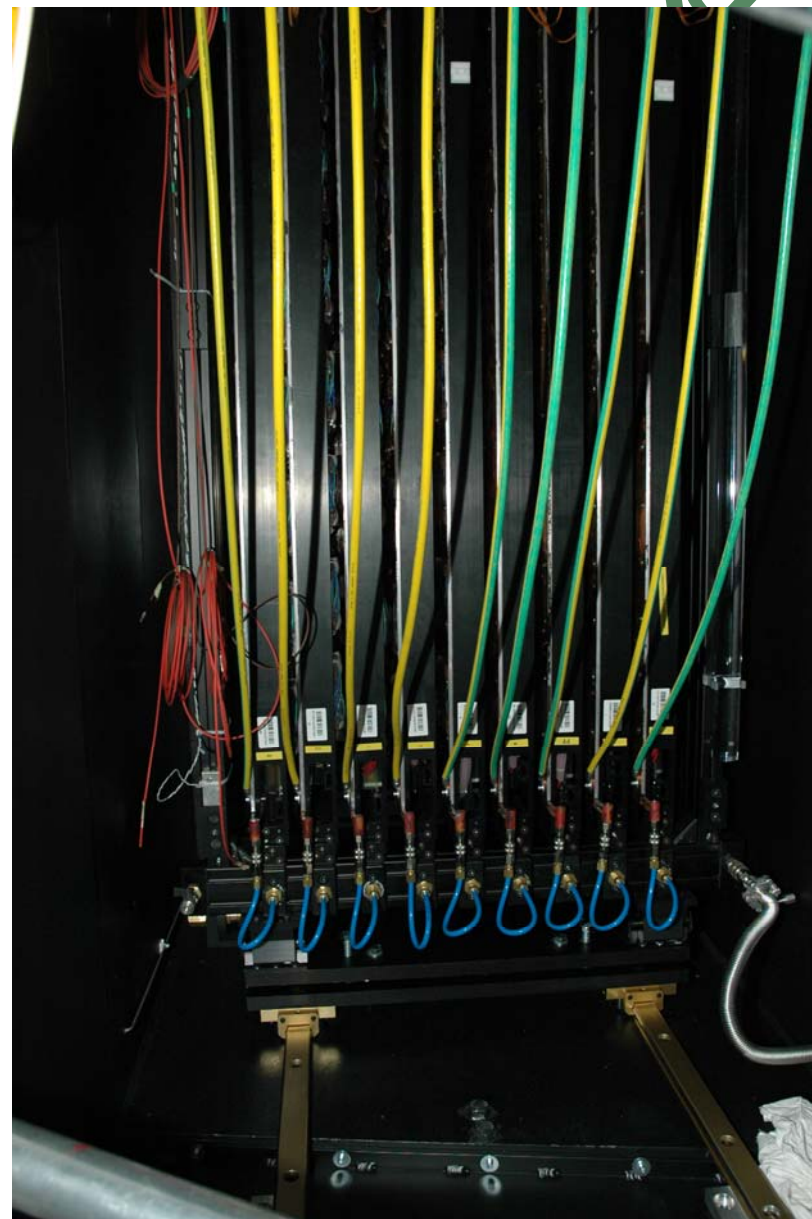
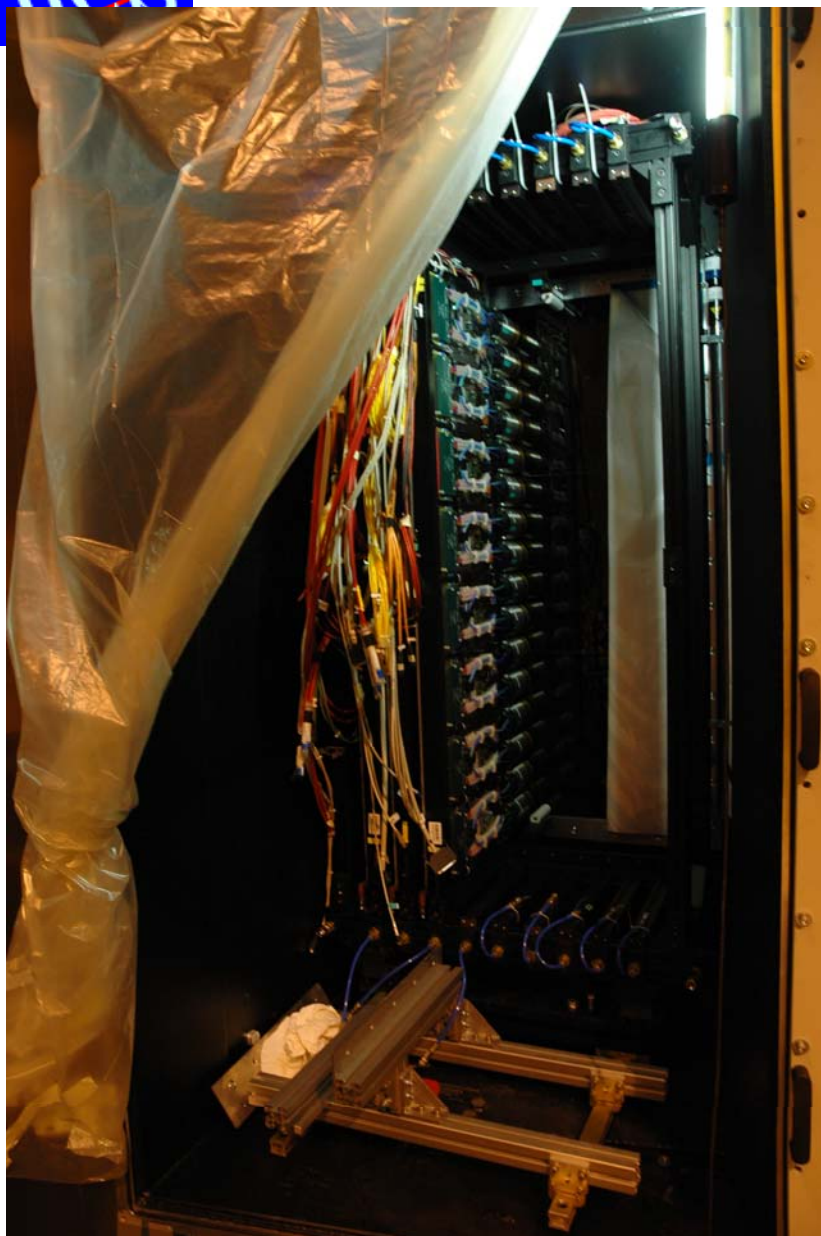




# RICH2 columns assembly

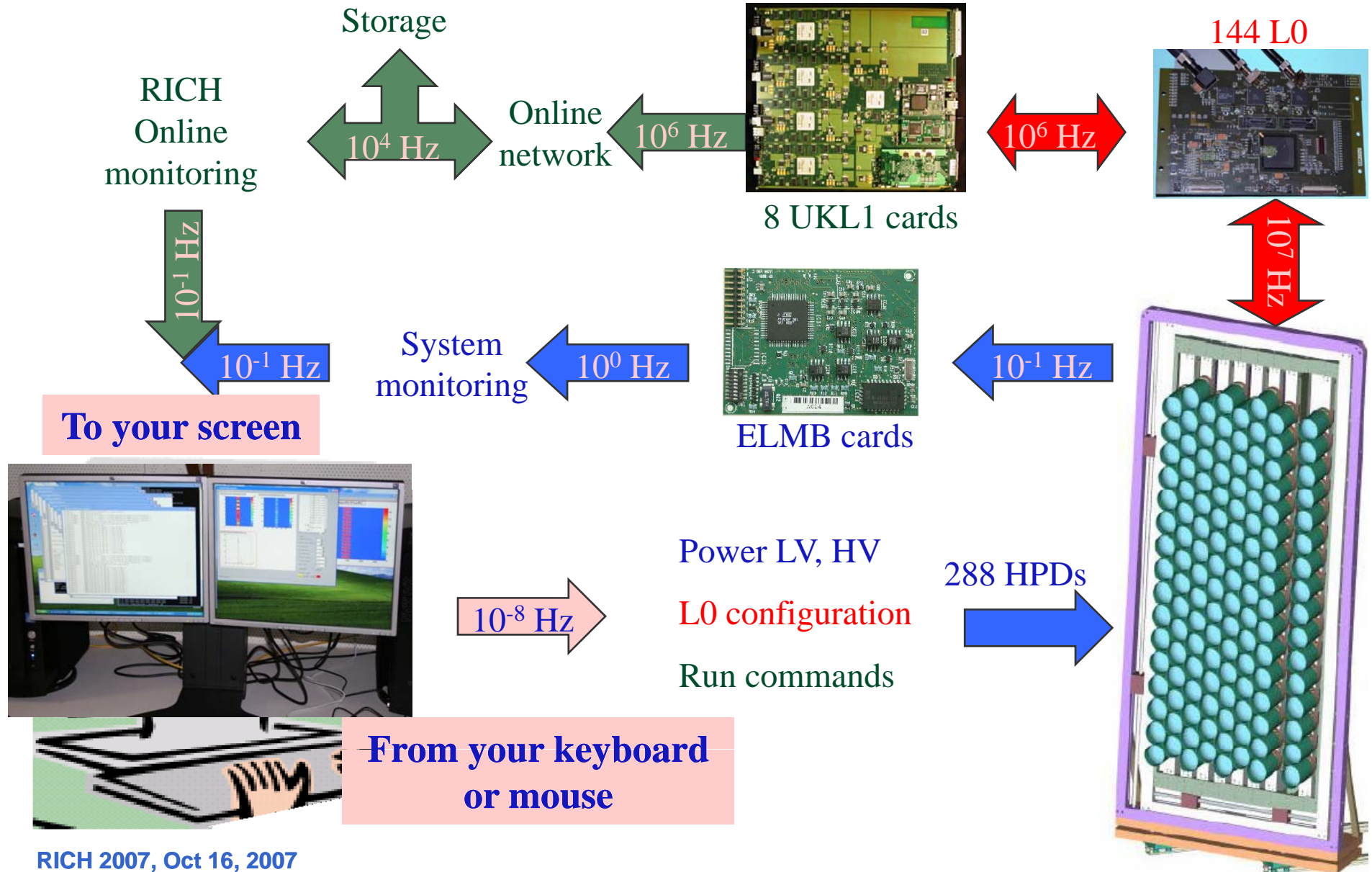


# Columns are installed





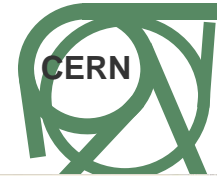
# From your keyboard to your screen (ECS)





# RICH2 ECS panel

# RICH Starting Procedure



**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  
Max Nr. Triggers: Unlimited  
Nr. Triggers: 0  
Nr. Steps Left: 0  
Trigger Rate: 0 Hz  
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

**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

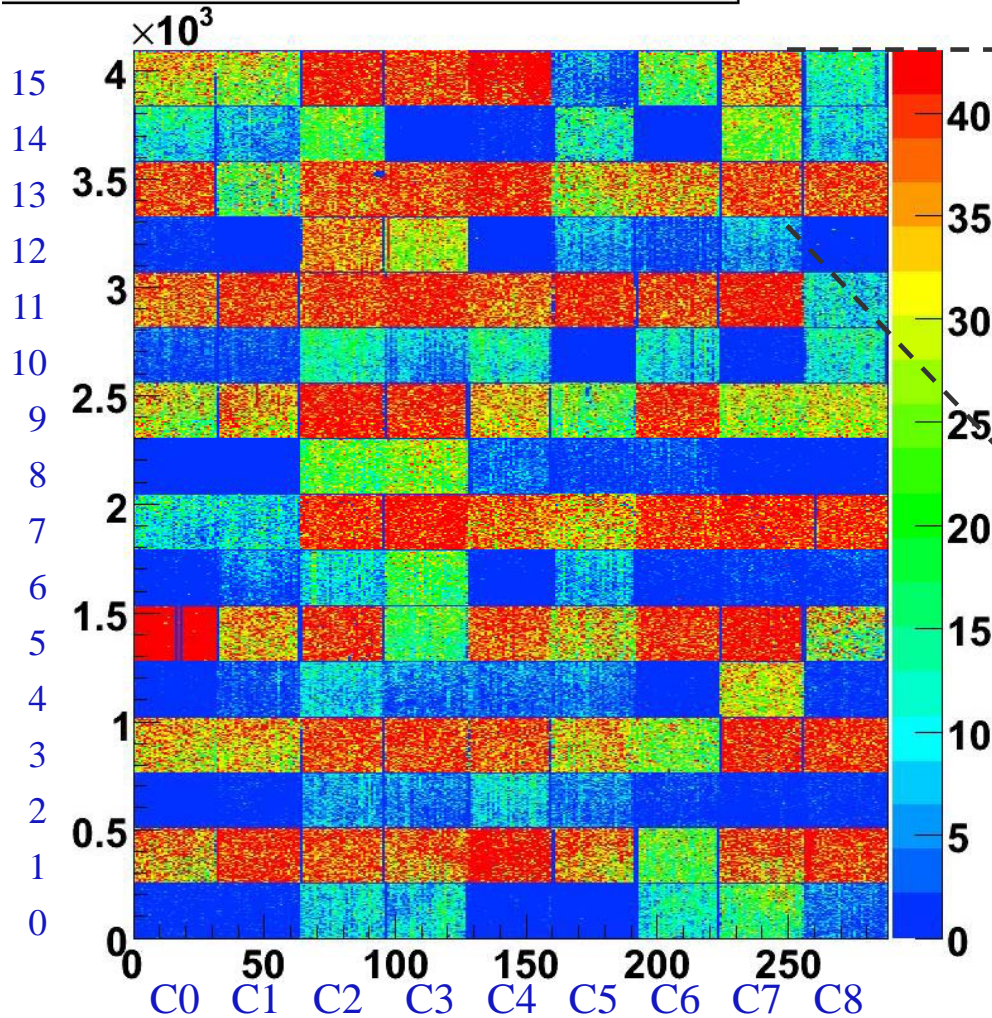
RICH2 Overview

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

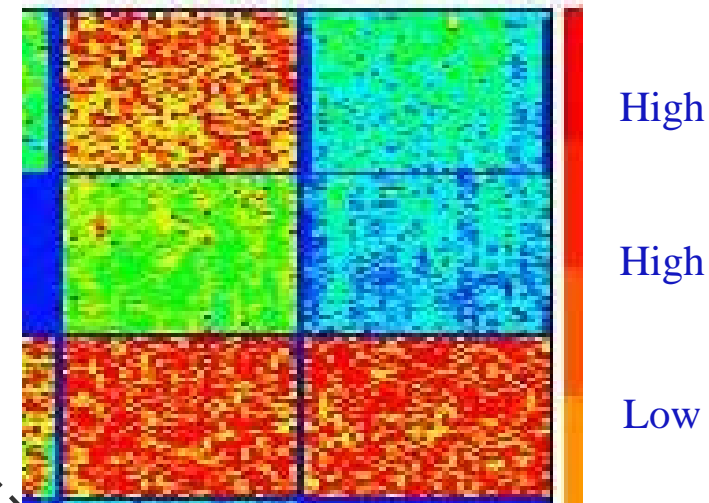
# First electrical images from RICH

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

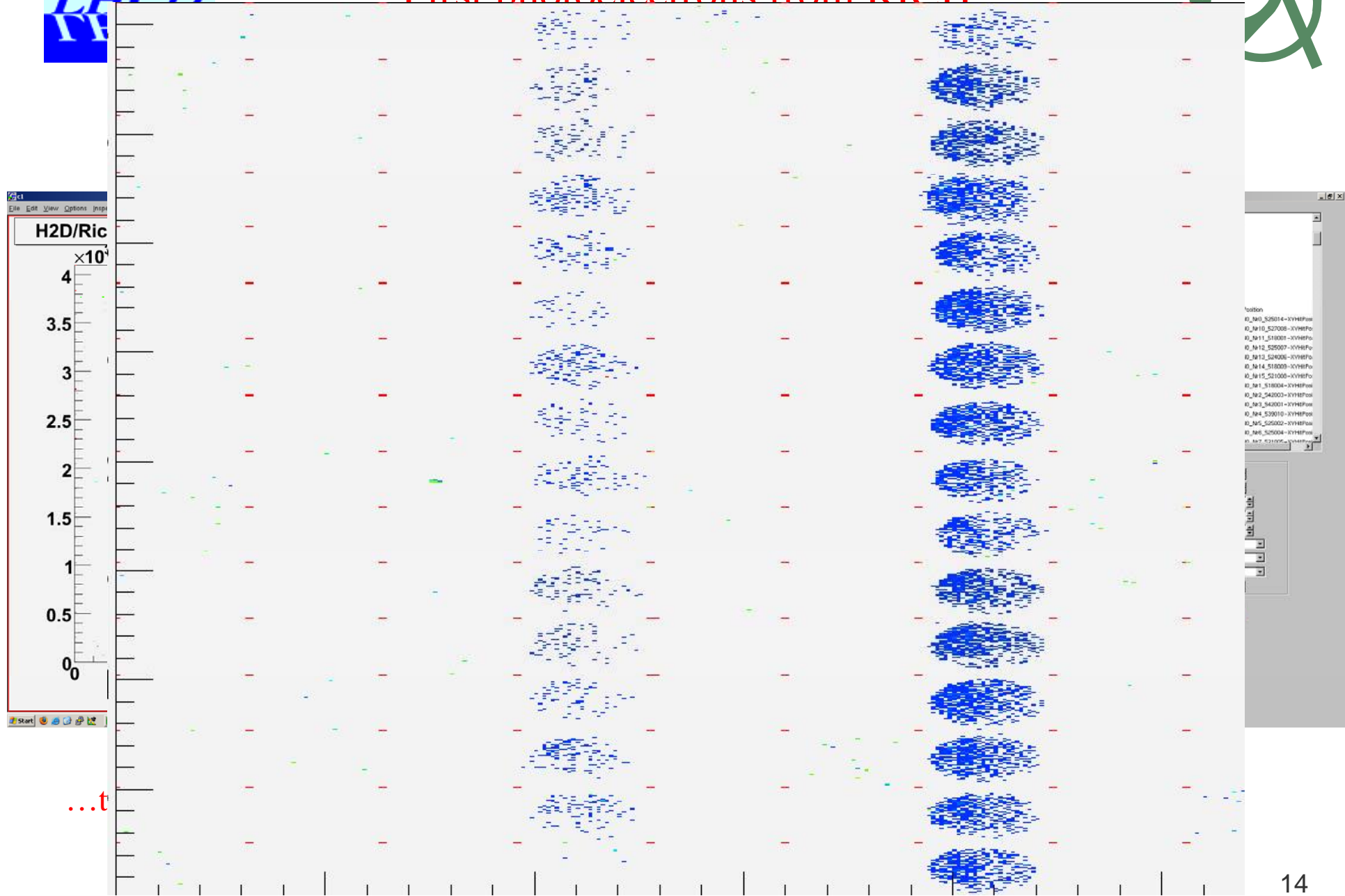
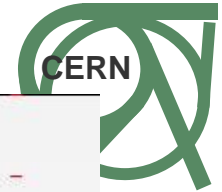


In reality HPDs are staggered to achieve maximum active area. What is shown, is the “chips space” rather than the “photocathode space”

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



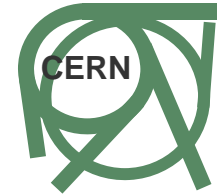
# First photoelectrons from RICH



...t

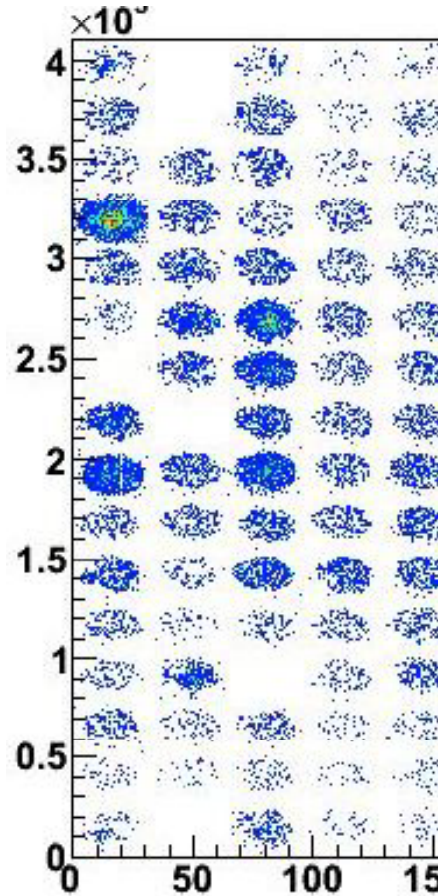


# FIAT LUX (first photons detected)

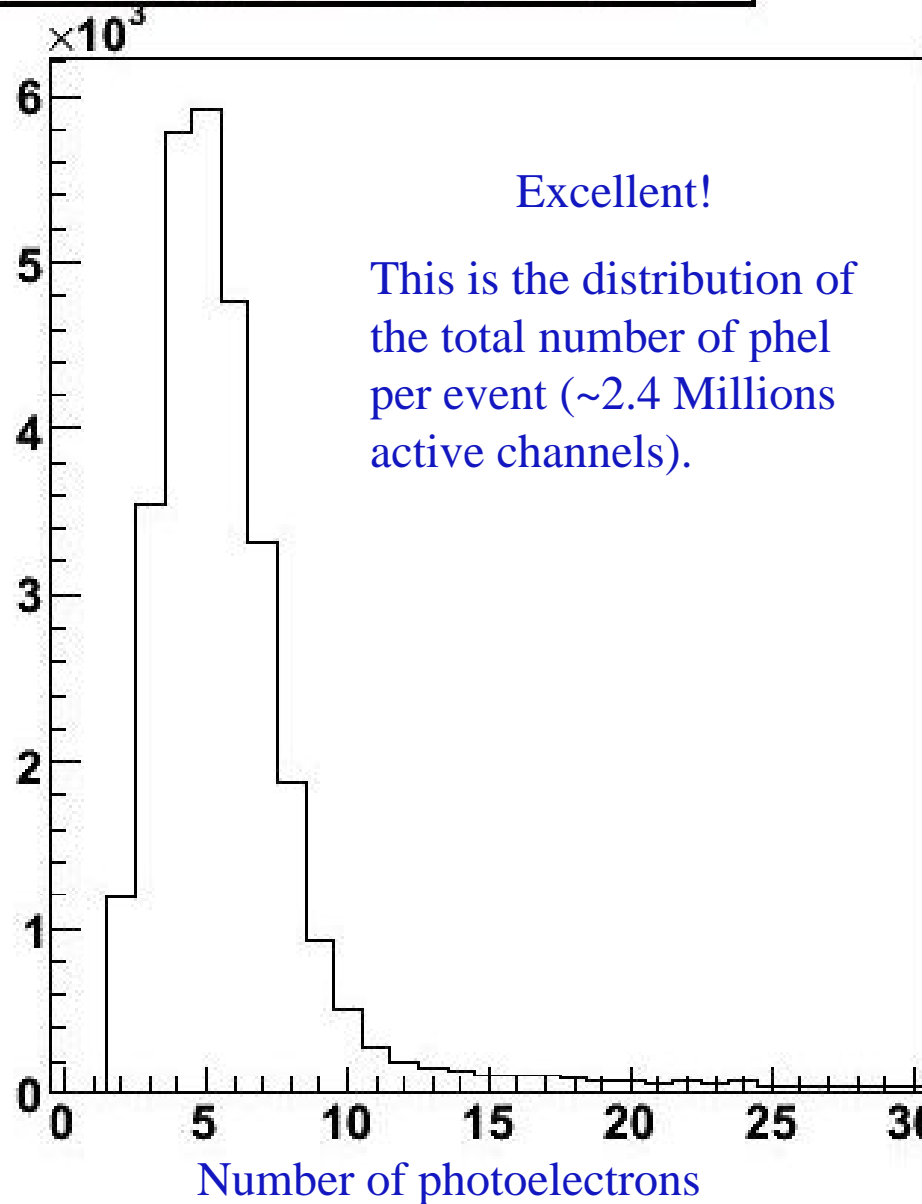


D/RichMonitor/ComMon/ALL-Inclusive

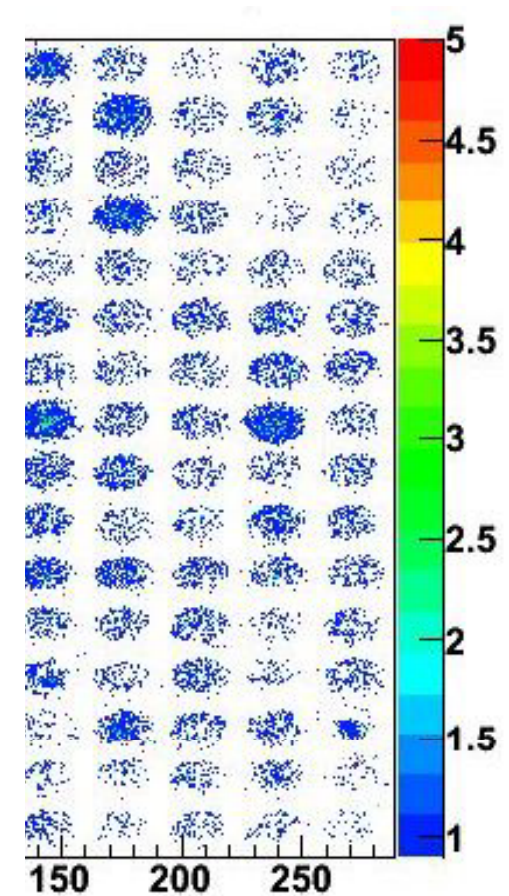
High Voltage was r  
in real time the HP



A red light emitting



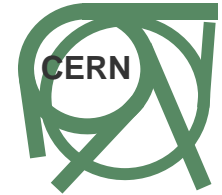
order to monitor



photons in the vessel

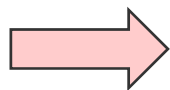


## RICH2 is routinely running



- 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

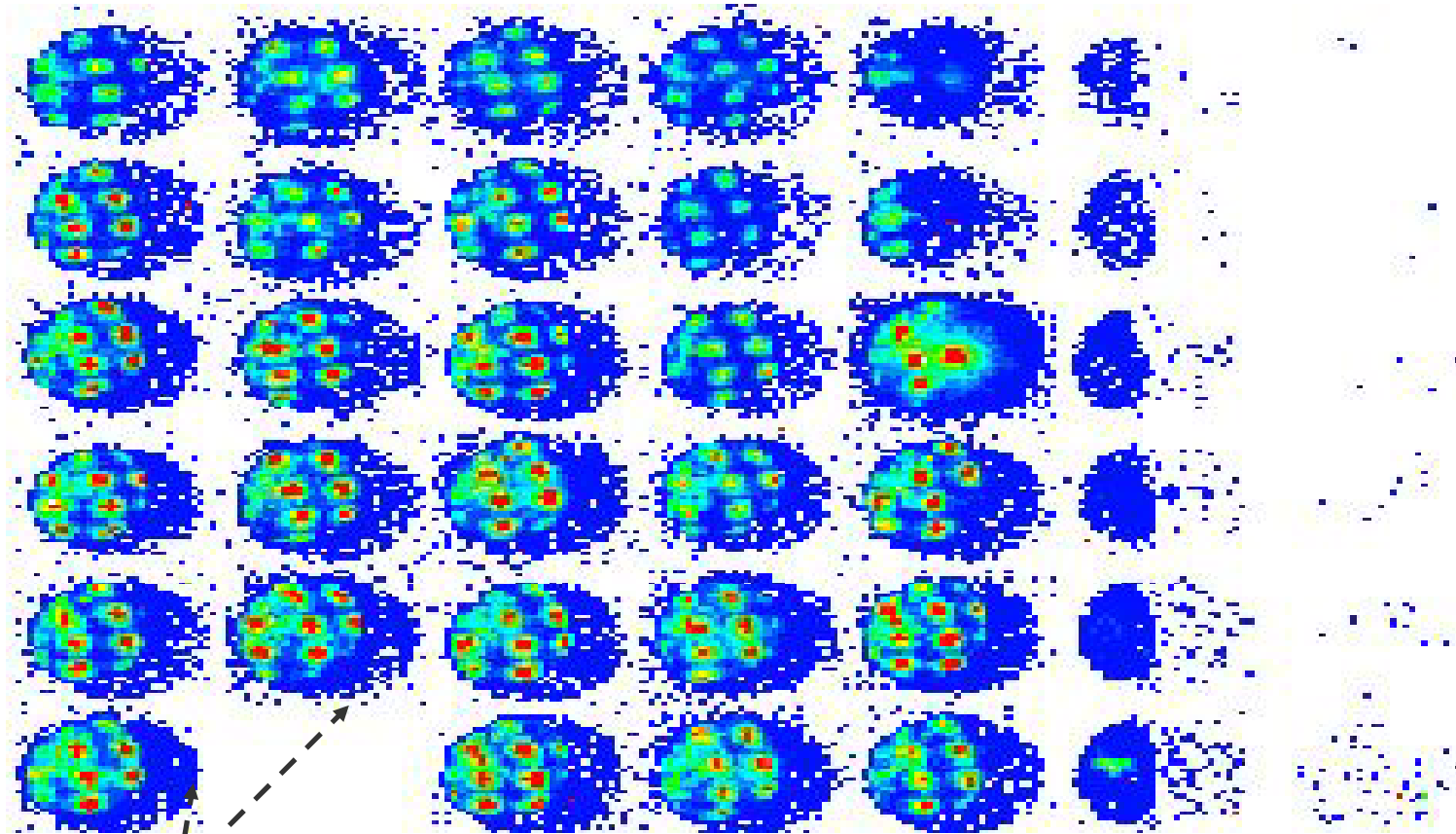


system to monitor and correct for the distortion



# First optical images from RICH2

We shine a defined pattern on the photodetector without and with magnetic field.



The shadow of the photon funnel

The shadows from the mumetal shields

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!



## 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.