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LOXAM  
RENTAL

P326 **NA62**  P326

# The NA62 Collaboration



National Institute for Physics and Nuclear Engineering  
IFIN-HH Bucharest-Magurele  
joint in 2014



# NA62 Physics Goal

NA62 aims to measure precisely  $BR(K^+ \rightarrow \pi^+ \nu \bar{\nu})$  exploiting a novel in-flight technique based on:

1. Calorimetry to veto extra particles
2. Very light trackers to reconstruct the  $K^+$  and the  $\pi^+$  momenta
3. Full particle identification

## State of the art:

Decay	Branching Ratio ( $\times 10^{10}$ )		References
	Theory (SM)	Experiment	
$K^+ \rightarrow \pi^+ \nu \bar{\nu} (\gamma)$	$0.85 \pm 0.07^{[1]}$	$1.73^{+1.15}_{-1.05}^{[2]}$	[1] J.Brod, M.Gorbahn, PRD78, arXiv:0805.4119 [2] AGS-E787/E949 PRL101, arXiv:0808.2459
$K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$	$0.27 \pm 0.04^{[3]}$	260 (90% CL) <sup>[4]</sup>	[3] M. Gorbahn, arXiv:0909.2221 [4] KEK-E391a, arXiv:0911.4789v1
$B_s^0 \rightarrow \mu^+ \mu^-$	$32.3 \pm 2.7^{[5]}$	$29 \pm 7^{[6]}$	[5] A.J. Buras et al., EPJ C72, arXiv:1208.0934 [6] CMS PAS BPH-13-007; LHCb-CONF-2013-012

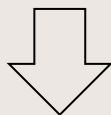


# 2014 Physics Goal

## ➤ Assumptions:

- 60 days of data taking
- 10% of the nominal Intensity x data taking efficiency

$$N_K = 0.06 \cdot 4.5 \times 10^{12} = 2.7 \times 10^{11}$$

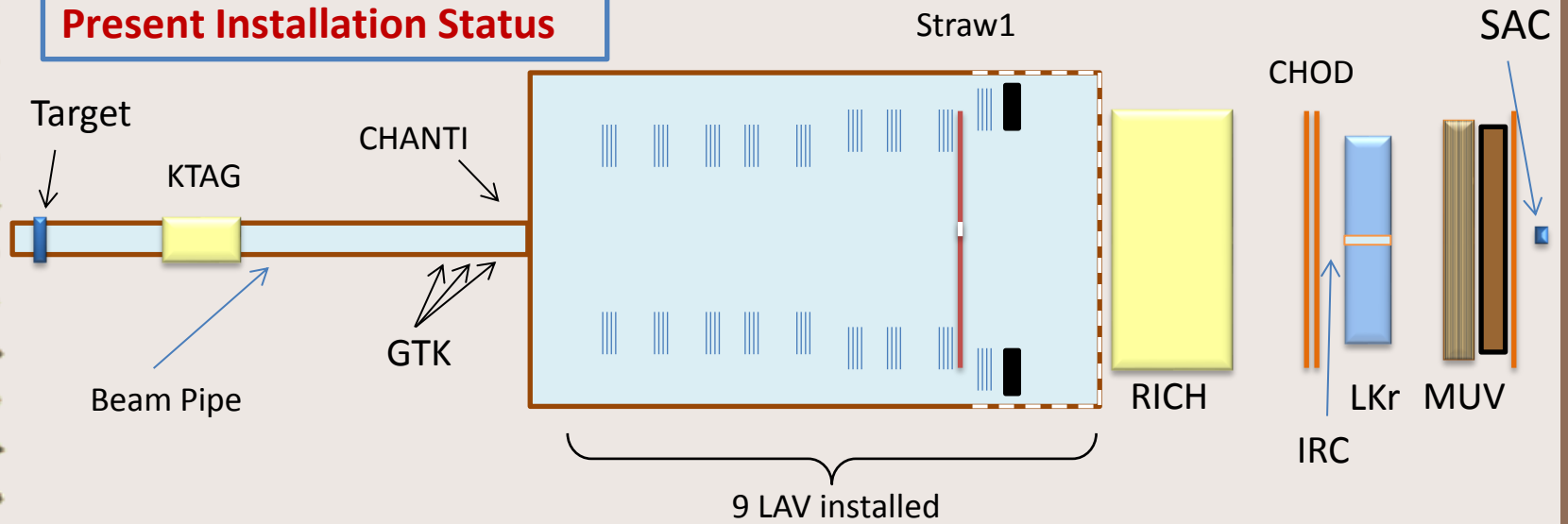


$$N_{\pi\nu\nu}^{\text{selected}} = N_K \cdot BR(\pi\nu\nu) \cdot \mathcal{A}_{\pi\nu\nu} = (2.7 \times 10^{11}) \cdot (0.8 \times 10^{-10}) \cdot 0.1$$

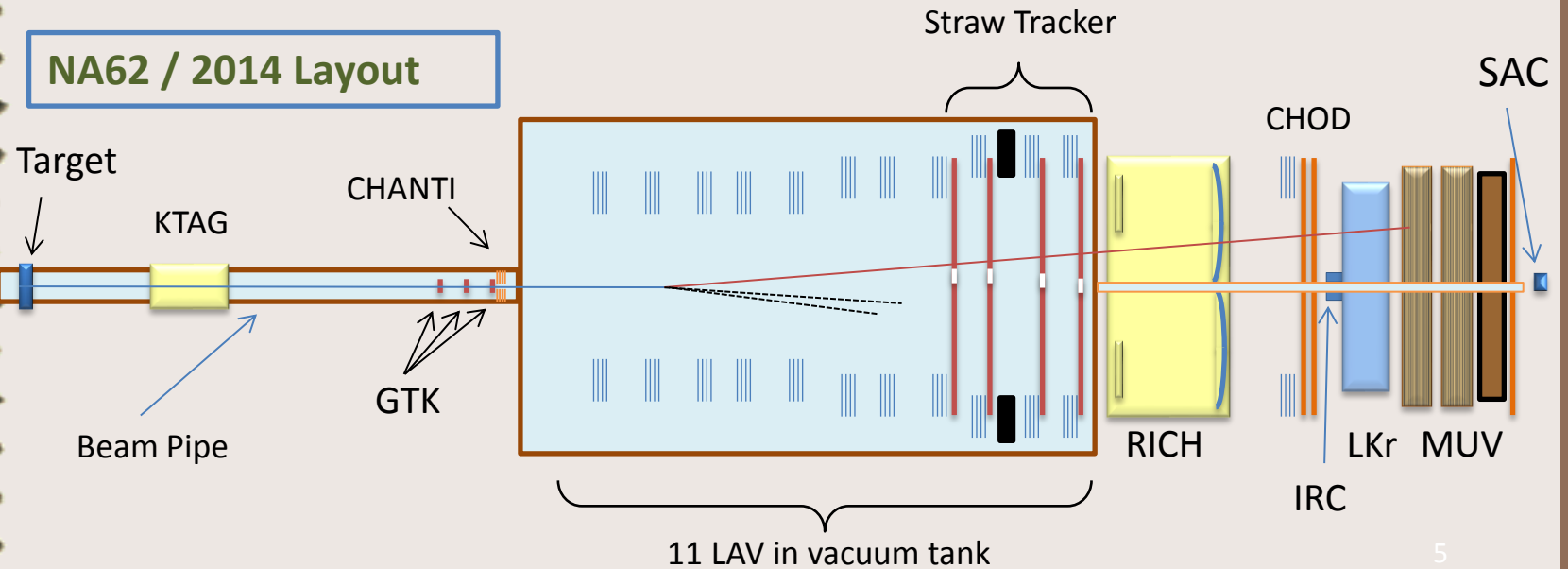
$$N_{\pi\nu\nu}^{\text{selected}} \approx 2.2 \text{ (SM)}$$

- ✗ Aiming to reach the required sensitivity:
  - ✗ To provide an observation of  $K^+ \rightarrow \pi^+ \nu \bar{\nu} \dots$
  - ✗ ...or find out what is still missing to do so...

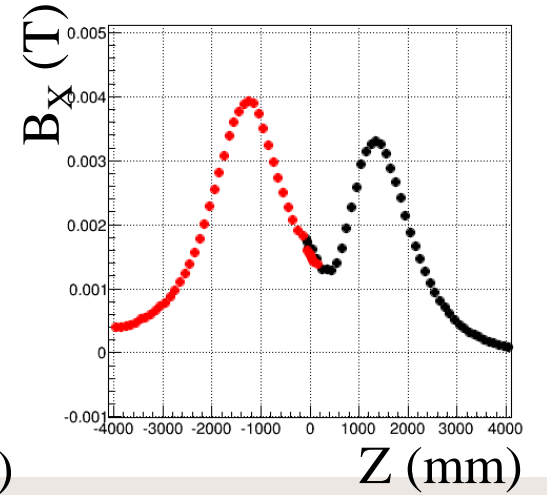
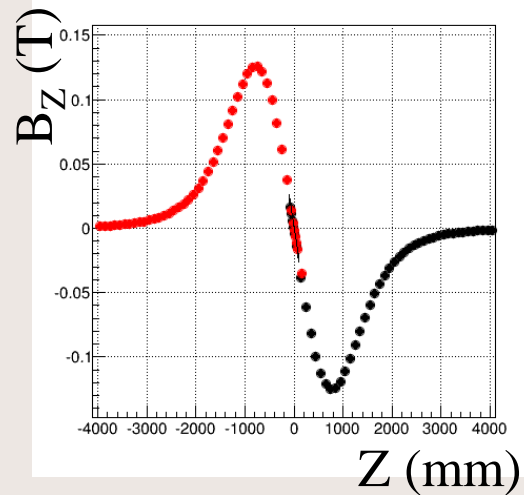
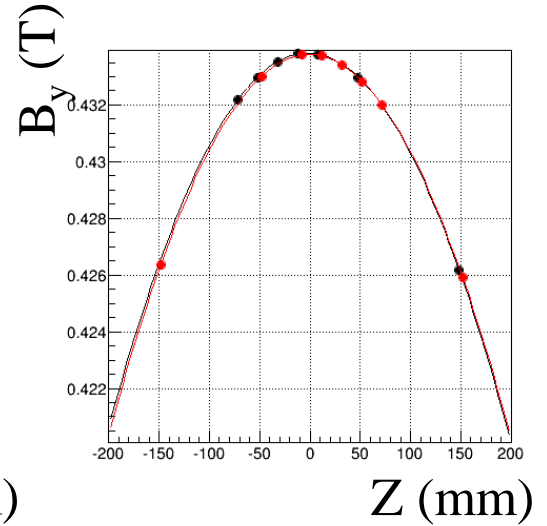
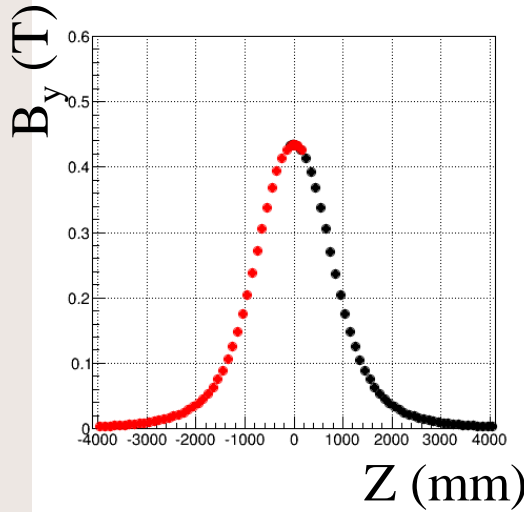
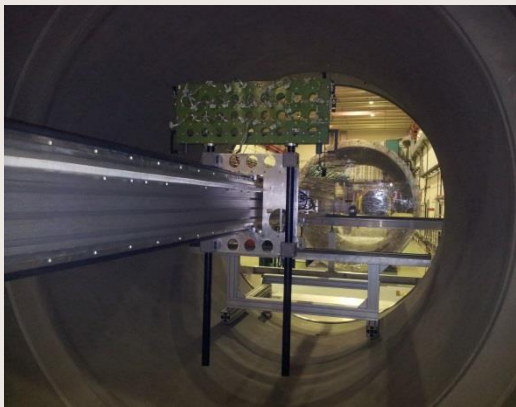
## Present Installation Status



## NA62 / 2014 Layout



# Magnetic Field Map



**F. Bergsma et al.**



# Residual B-Field in Decay Tank

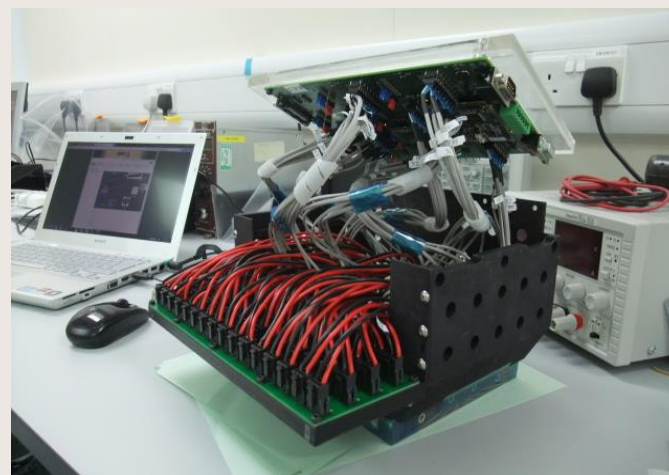
$\int B dl$  measured to a level of  $\pm 2 \times 10^{-4}$  TM





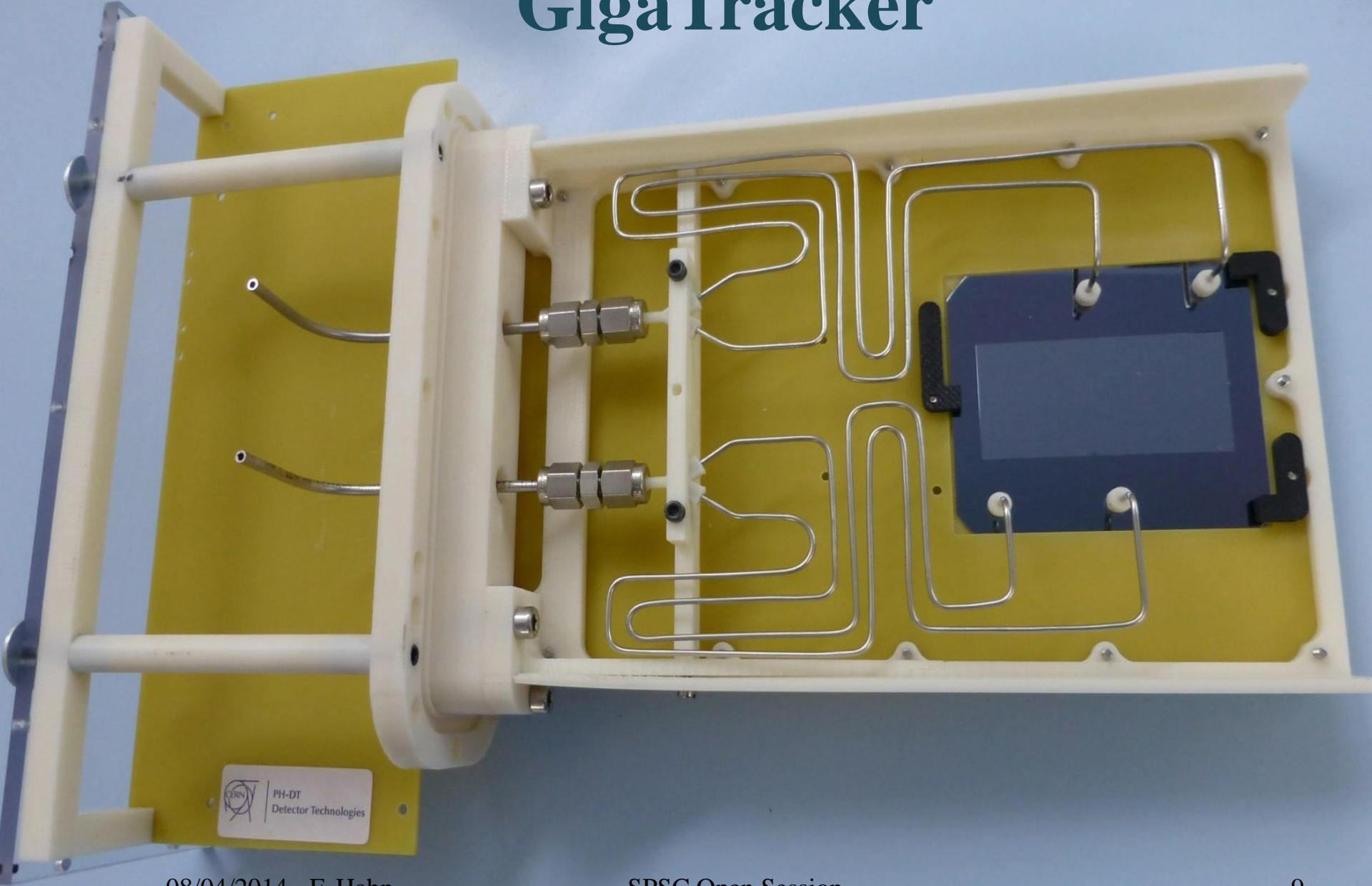
# KTAG - CEDAR

- PMTs: Hamamatsu replaced R7400 by R9980 (better in some respect higher gain and QE)
- Hybrid solution 16x R7400 and 32x R9980 per octant
- Use increased number of HPTDC boards to optimize rate capabilities.





# GigaTracker

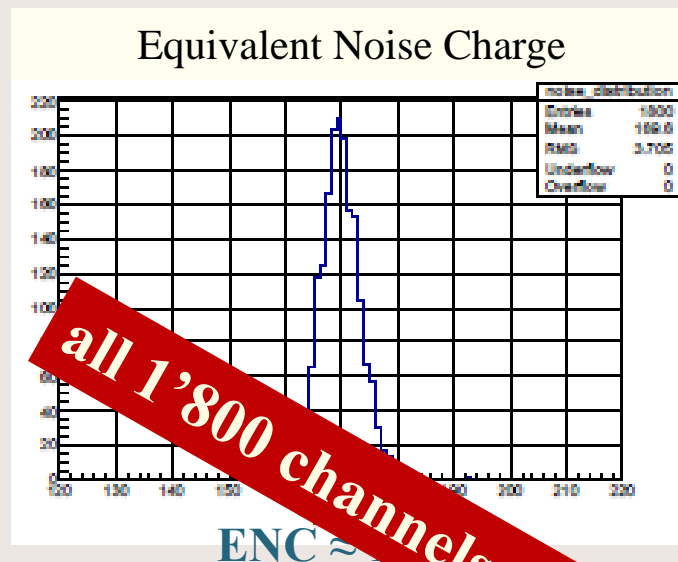




# GigaTracker / ASIC Tests

- The ASIC tests show that the chip is working as expected.
- GTK carrier board designed and ordered
- The chip thinning and bump bonding has been successfully tested on dummy chips.

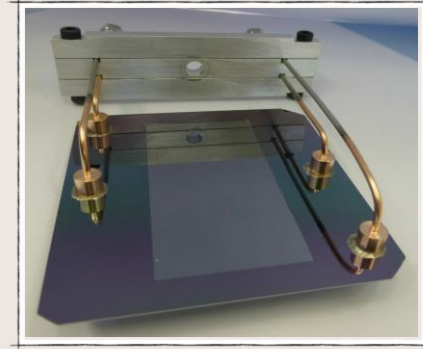
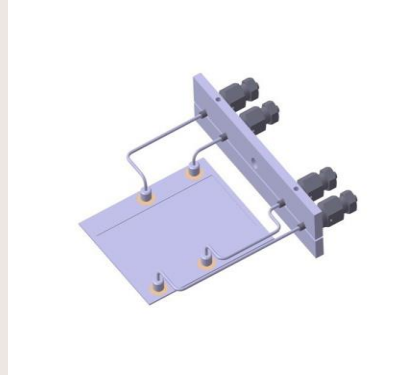
The remaining work is on a tight time plan, but the most difficult technical issues have been mastered



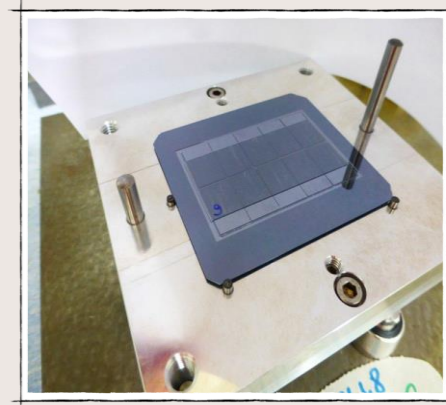
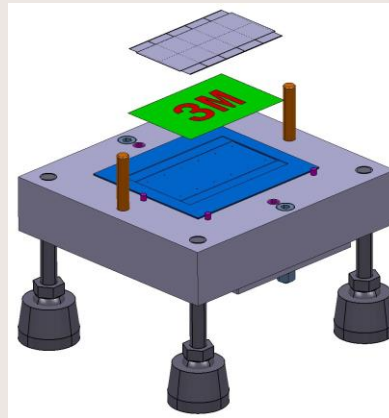
$\Rightarrow \sigma_t \approx 50$  ps RMS

# GTK Assembly Steps (1)

Soldered  
fluid  
connectors

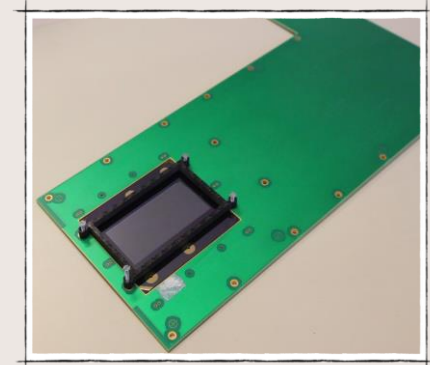
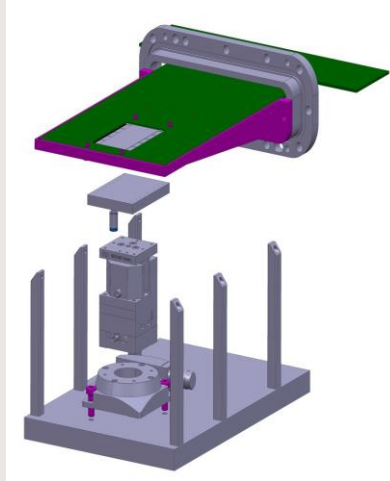


Thermal  
Interface

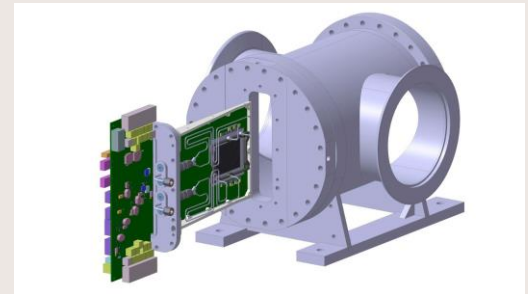
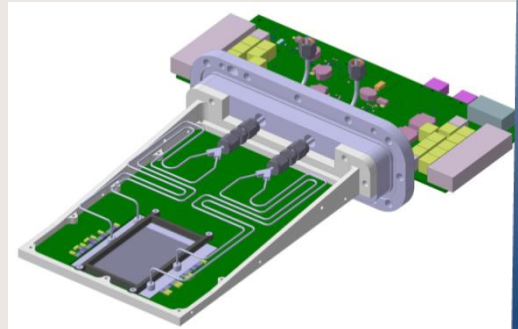


# GTK Assembly Steps (2)

Mounting to  
Carrier Board



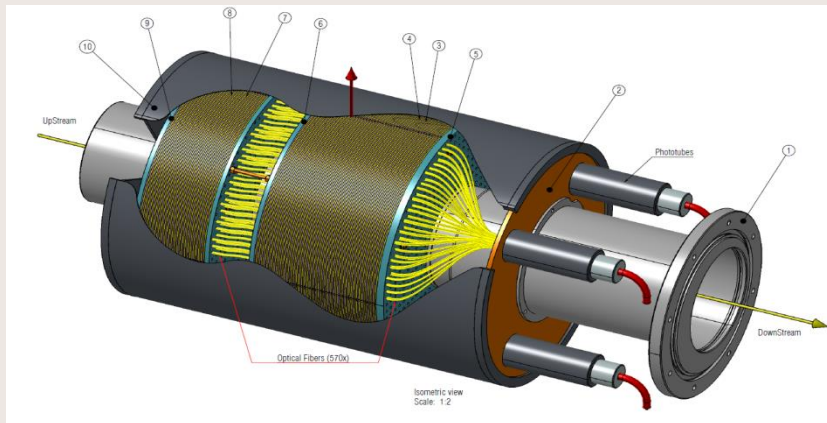
Installation



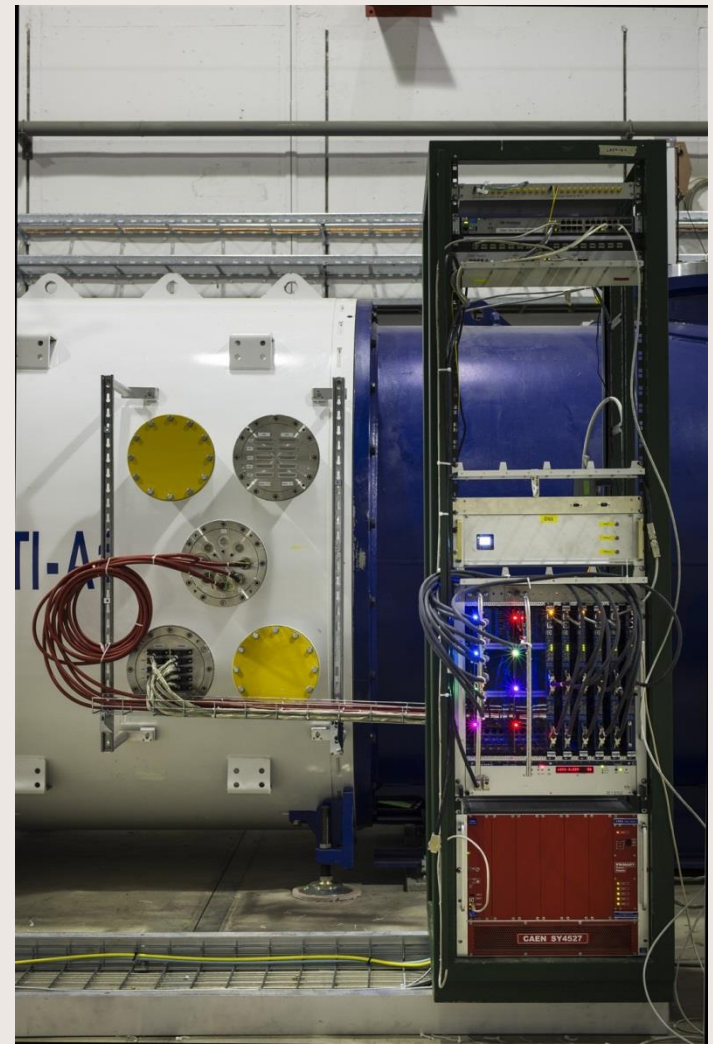
# Photon Vetos

- LAV 1 to 9 are installed
- LAV 10 + 11
- LAV 12 is in construction
- SAC is installed

## IRC

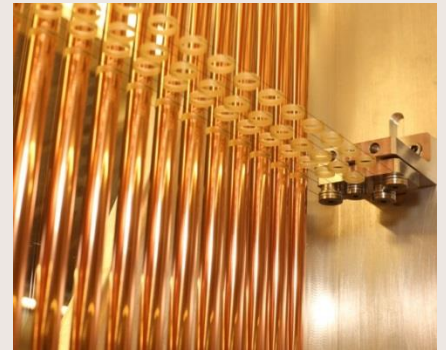


... in construction installation in July



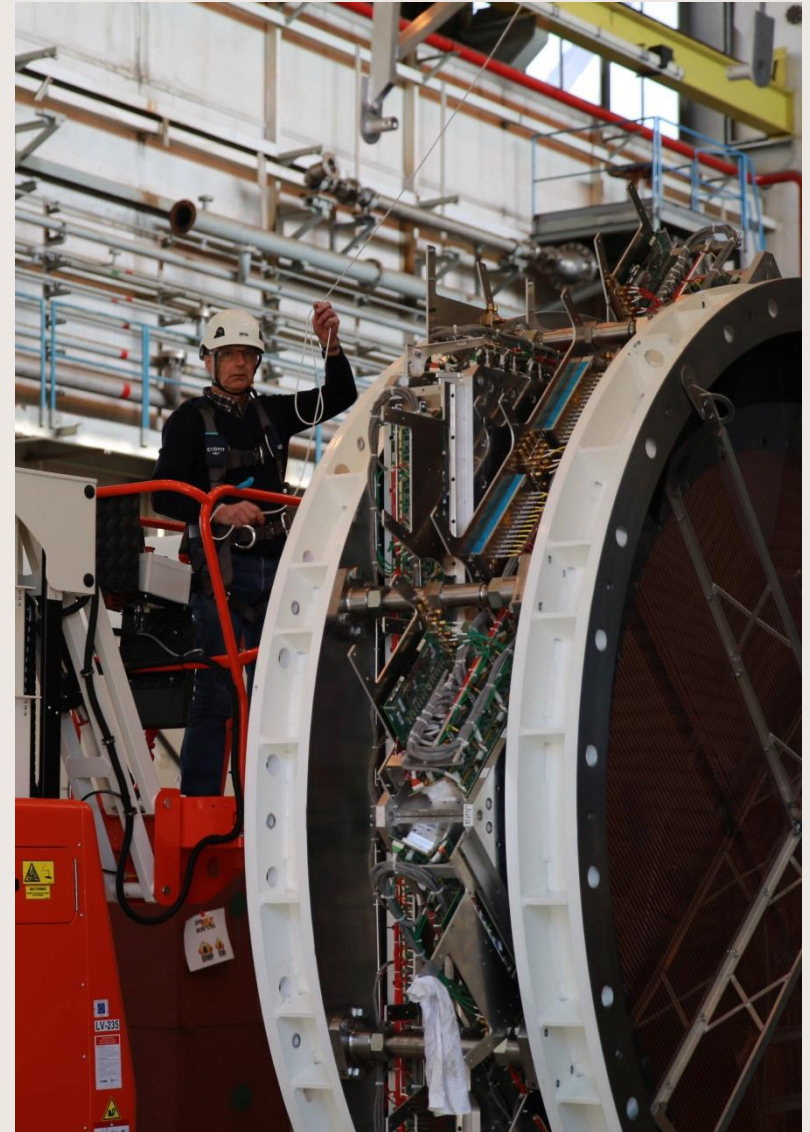
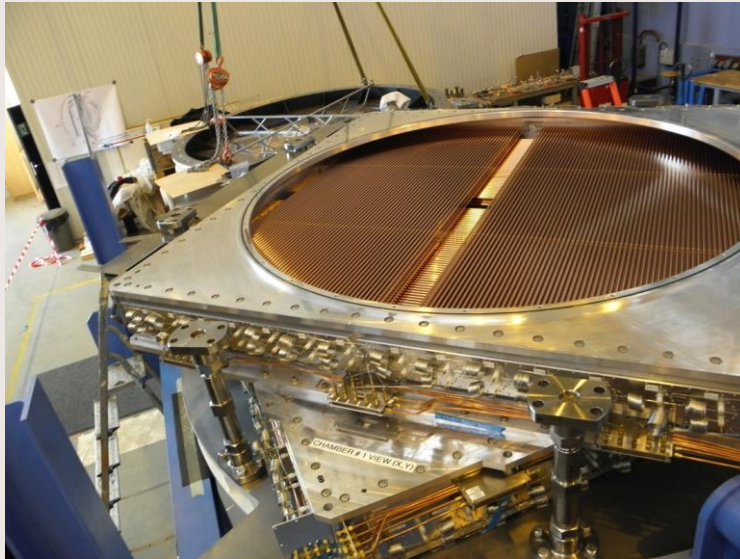
# Straw Chambers

- Straw Module Assembly:
  - At CERN: 4/4 modules are completed
  - AT JINR: 3/4 modules completed, the last module will be finished in June).
- Dressing and Stacking of Modules:
  - i.e. attaching all services (HV, LV and gas patch panels) to the chambers is in full swing.
- Electronics:
  - The frontend electronics were all produced and successfully tested.
  - The SRB (back-end electronics) development is coming to the end and the production of a pre-series is expected to be available in June 2014

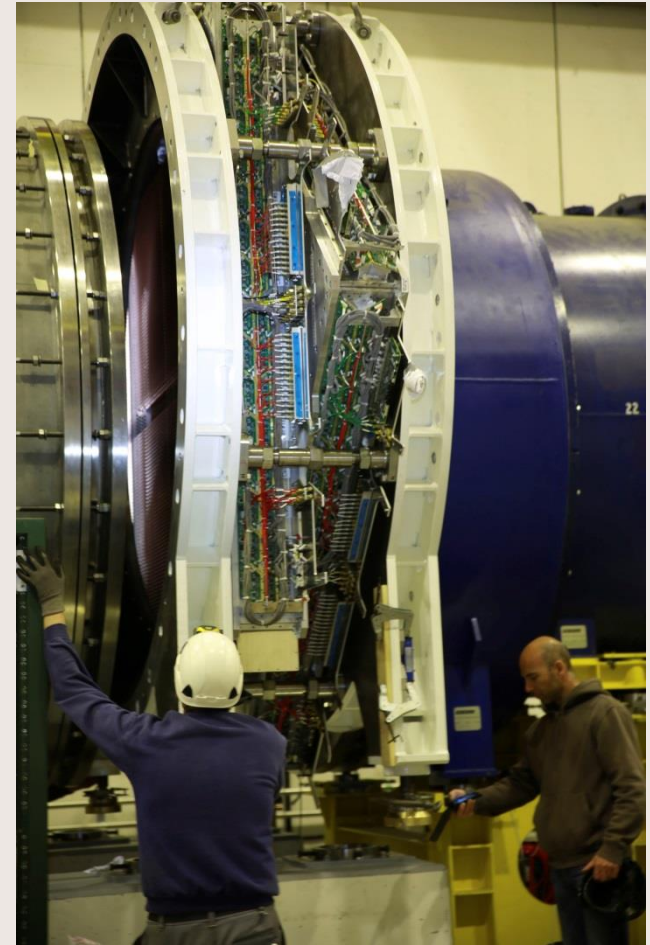




# STRAW1 / Stacking in B156

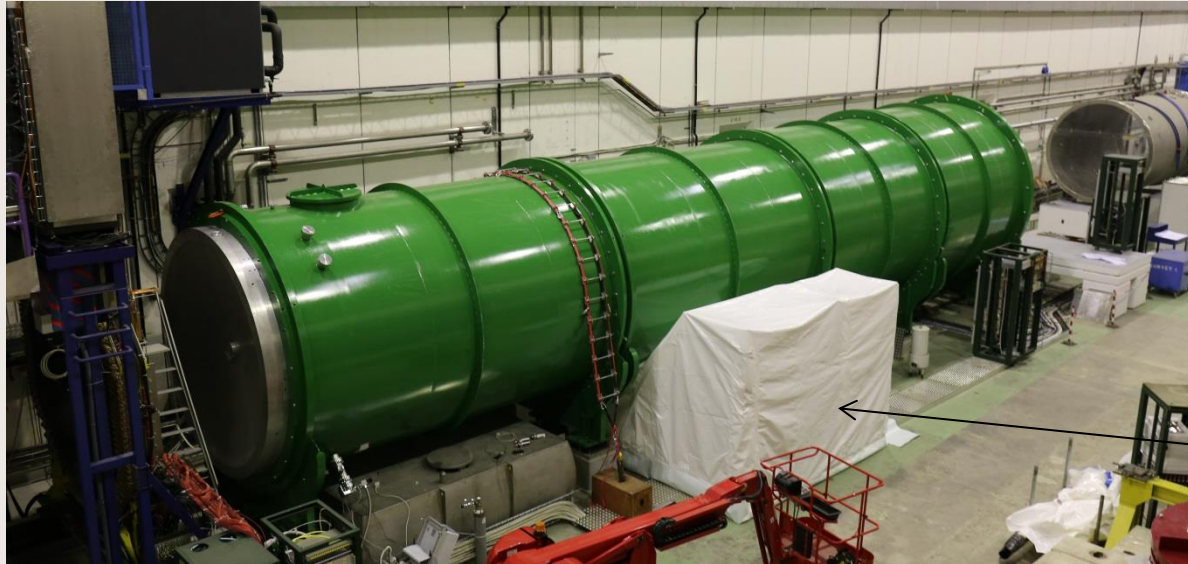
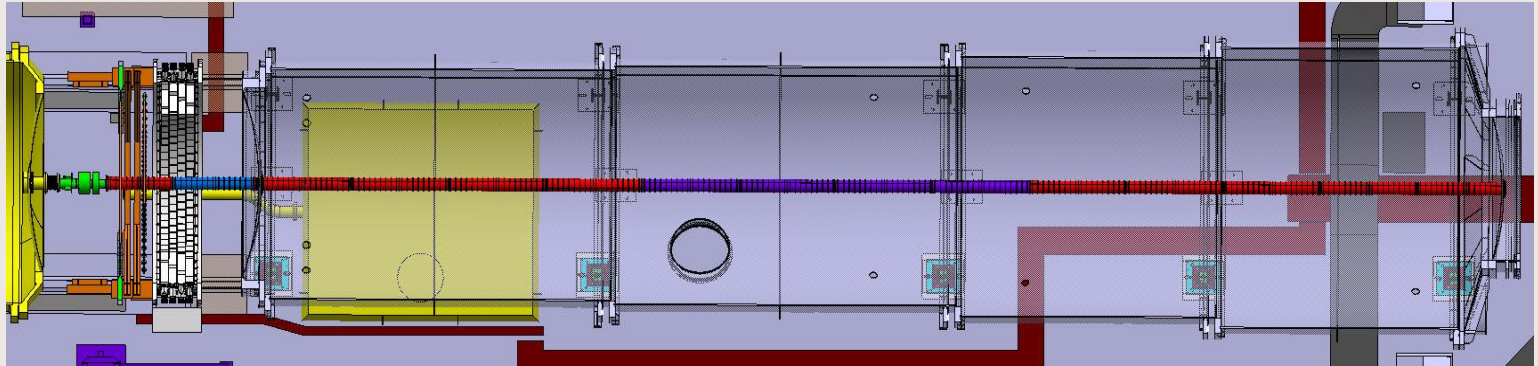


# STRAW 1 Installation



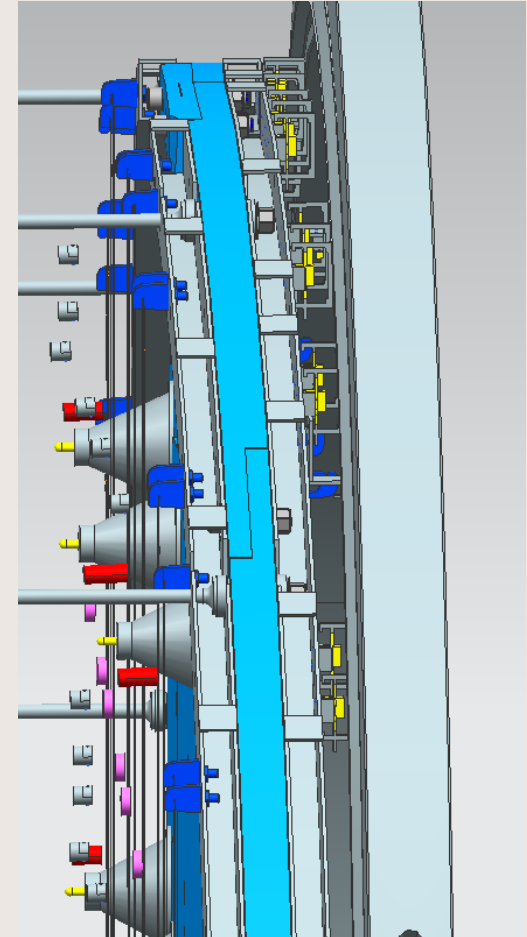
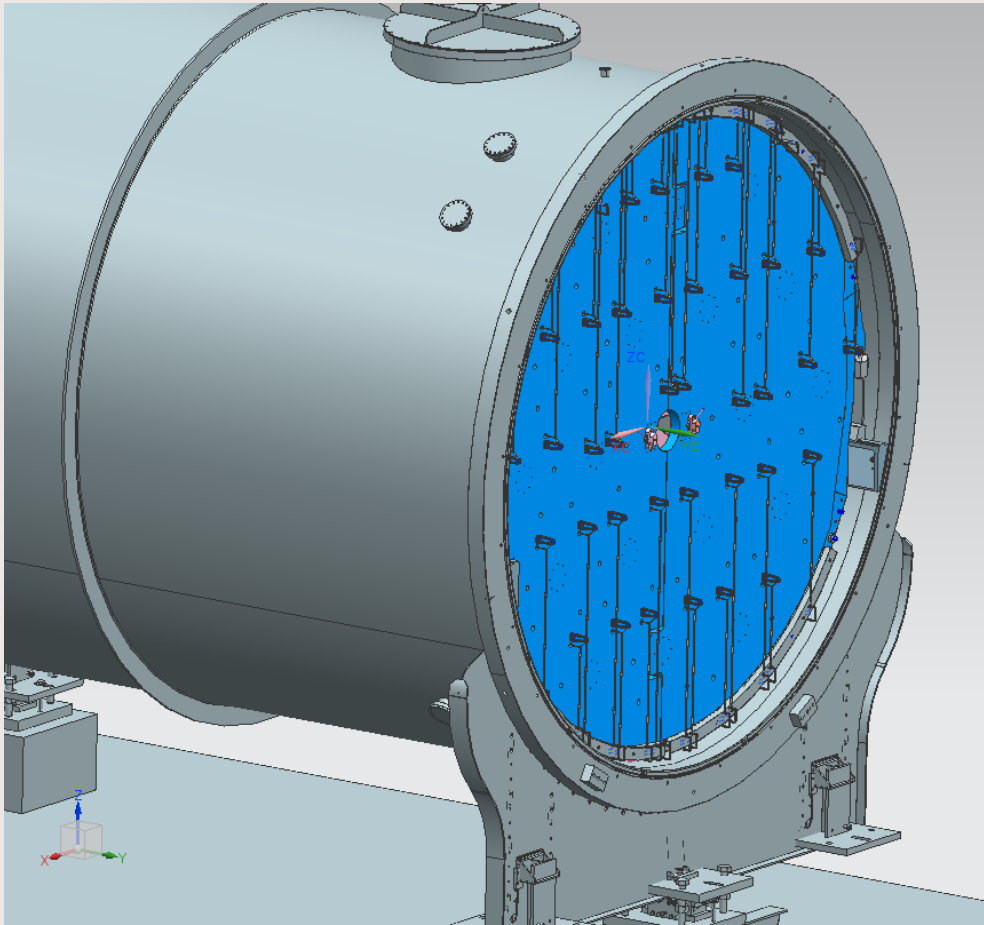


# RICH Vessel Installation

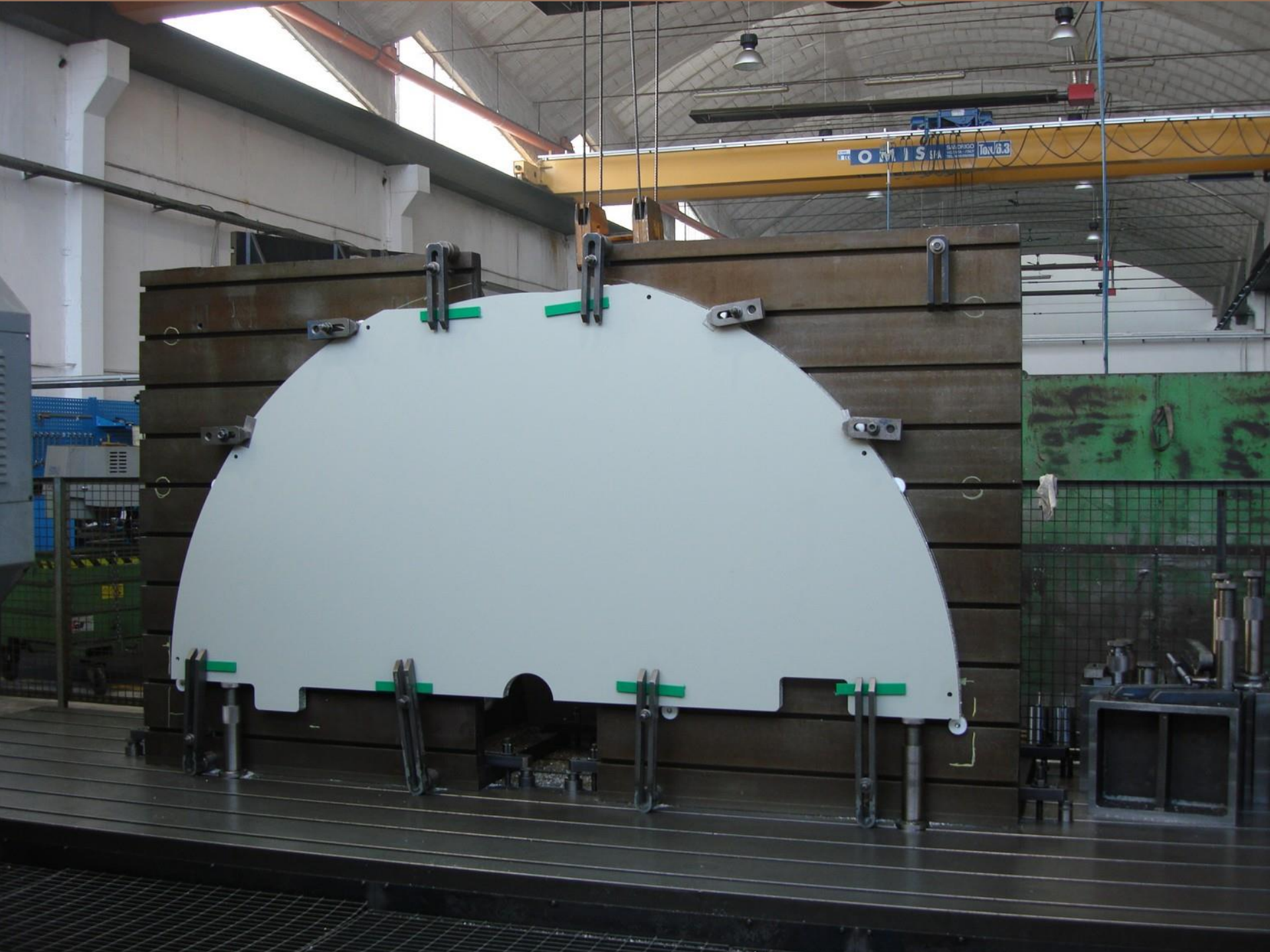


Air lock  
for access

# RICH Mirror Panel



**Rich Mirror Panel delivery expected end of April**



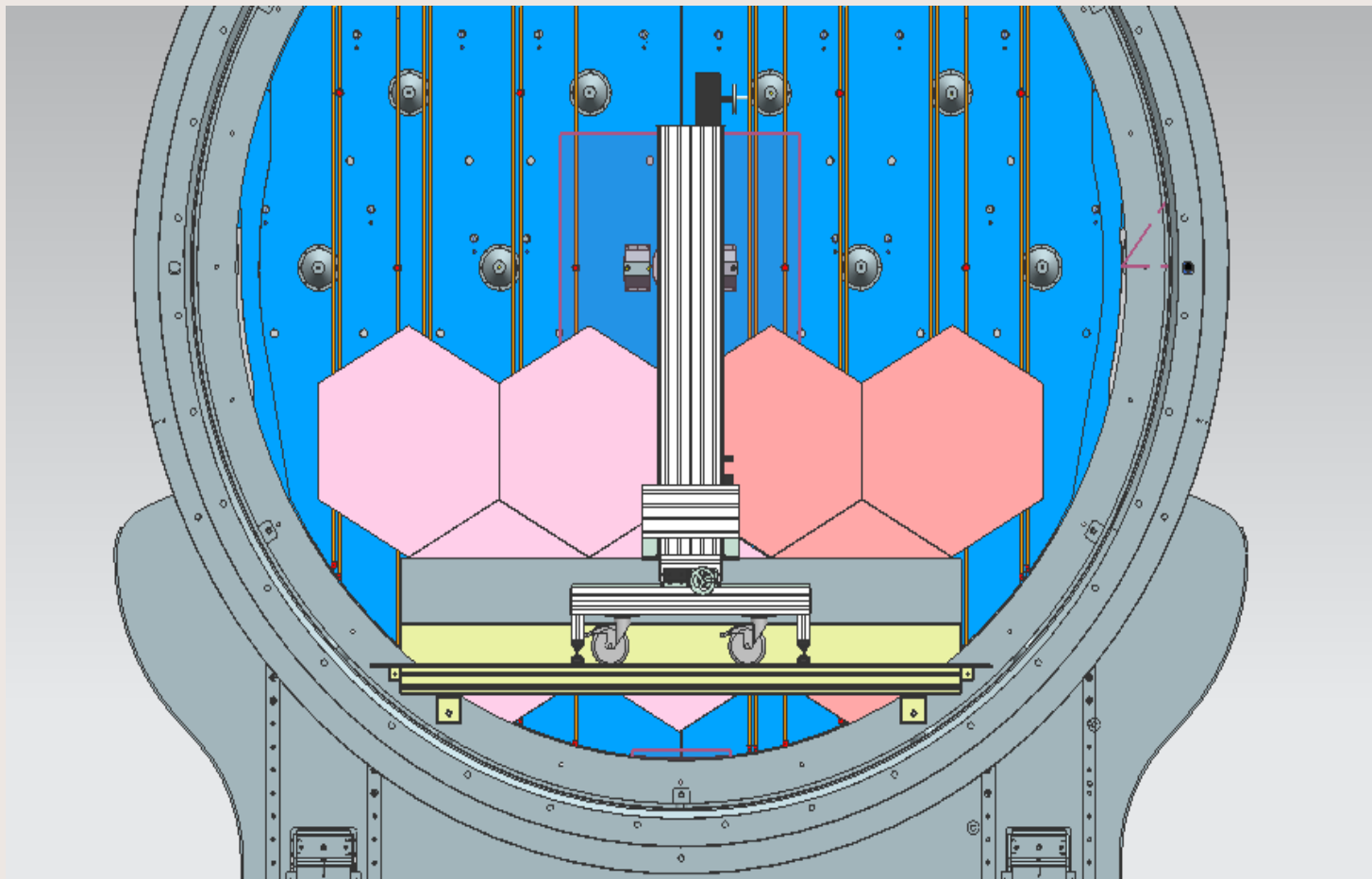
# PH-DT Thomas Schneider et al.



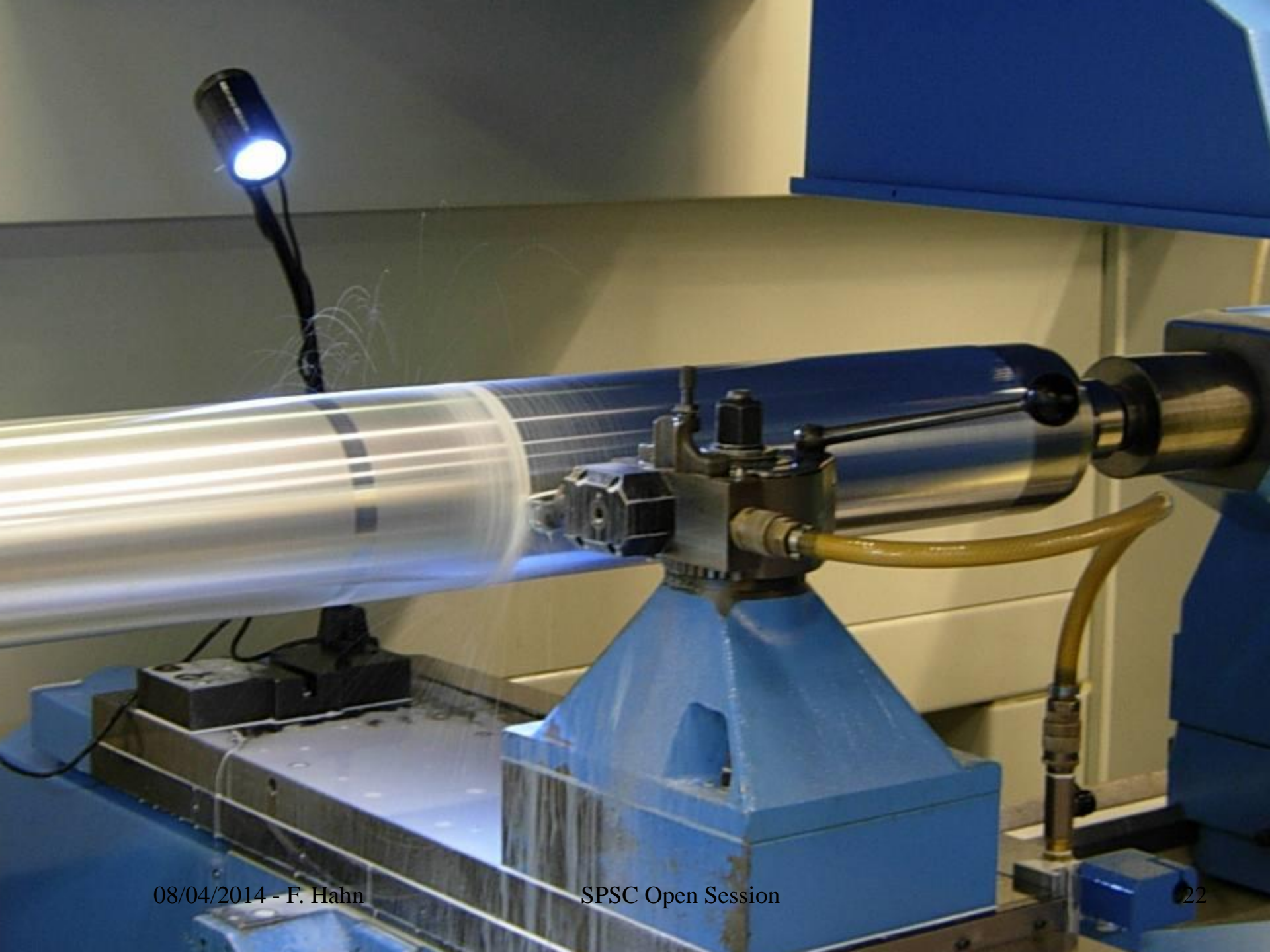
13/18 hexagonal mirrors are coated

# RICH Mirror Installation

Starting in May...



Installation sequence tested in Perugia on prototype

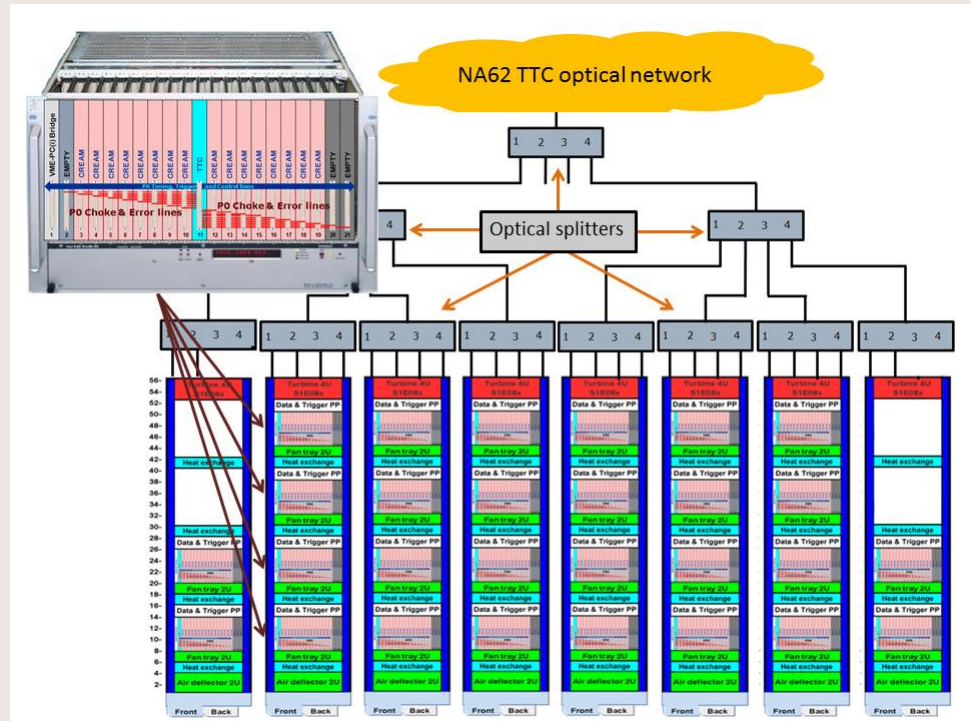




# Liquid Krypton Calorimeter

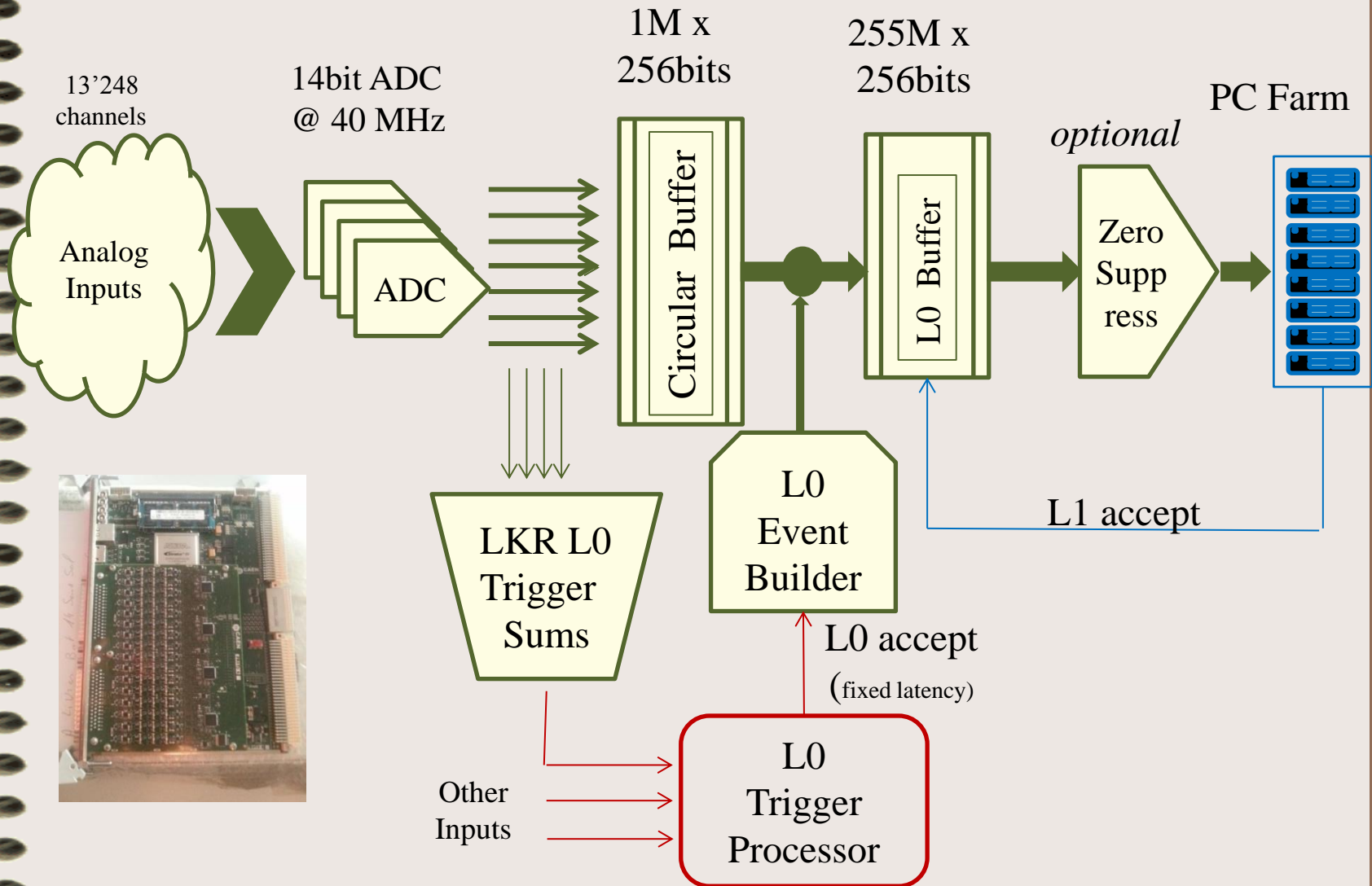


## CREAM





# LKR CREAM Read-Out







# CREAM Status

## CAEN Deliverables:

- Pre-series (16 modules) successfully tested
- serial production (11 modules received)
- Expect to receive all modules by mid-June



## Ongoing Tests at CERN:

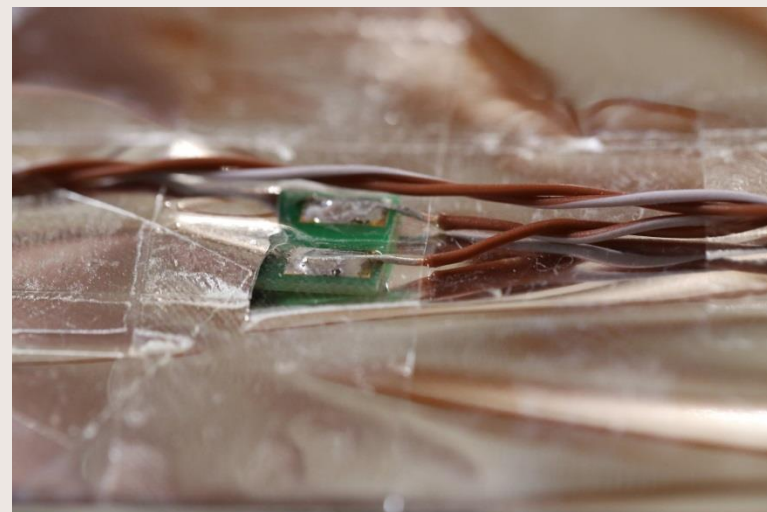
Tested CREAM read-out chain, .i.e

L0 trigger from TEL62 -> PC-Farm read L0 data from TEL62 -> L1 request to CREAM -> read CREAM data – event building -> write to disk



# Muon Vetos

- MUV2 + 3 are installed
- MUV1 is being assembled in Mainz
- Problems with scintillators and fibers caused delay in construction.
- MUV1 installation shifted to summer.



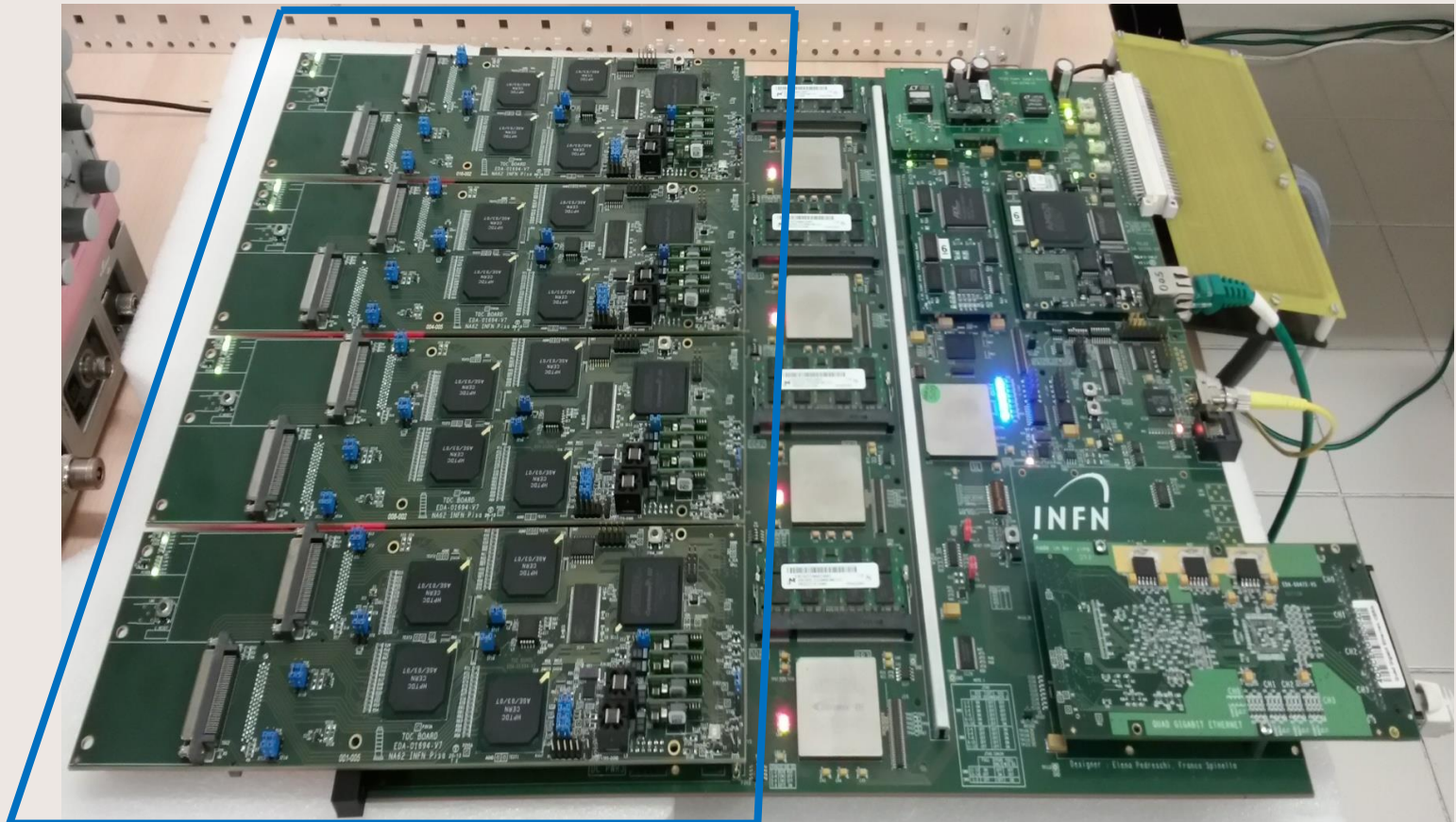


# TDAQ General Status

## Integration of sub-systems, i.e. phase of iterative and incremental testing

- two coordinated Dry-Runs in July and Nov. 2013
  - Lessons:
    - These tests are extremely useful for debugging
    - To increase efficiency further: Test sub-systems in more complex and realistic laboratory set-ups beforehand.
- In 2014:
  - Switch to continuous test mode for testing of individual sub-systems or individual functionalities for several sub-systems
  - In addition, special dry-runs, for example:
    - common L0 trigger primitive test is in June
    - Others will follow...

# TEL62 Board



**4 x TDCB Mezzanine**



# TDAQ Read-Out

## common components

- **TEL62 boards:**
  - TEL62 Firmware:
    - RO-firmware improvements: data storage handling far superior now; rate increase from 100kHz to 1 MHz (matching design value)
    - Trigger firmware: in progress for CHOD, LAV, MUV and RICH
  - TEL62 V3 Hardware:
    - upgrade of pin-compatible FPGA enhancing memory contingency for further developments.
    - hardware design final and frozen, some issues of assembly quality of prototype boards are being addressed
    - production has started; pre-series available this months
- **TDCB boards :**
  - Are under production; delivery soon



# TDAQ - Trigger Status

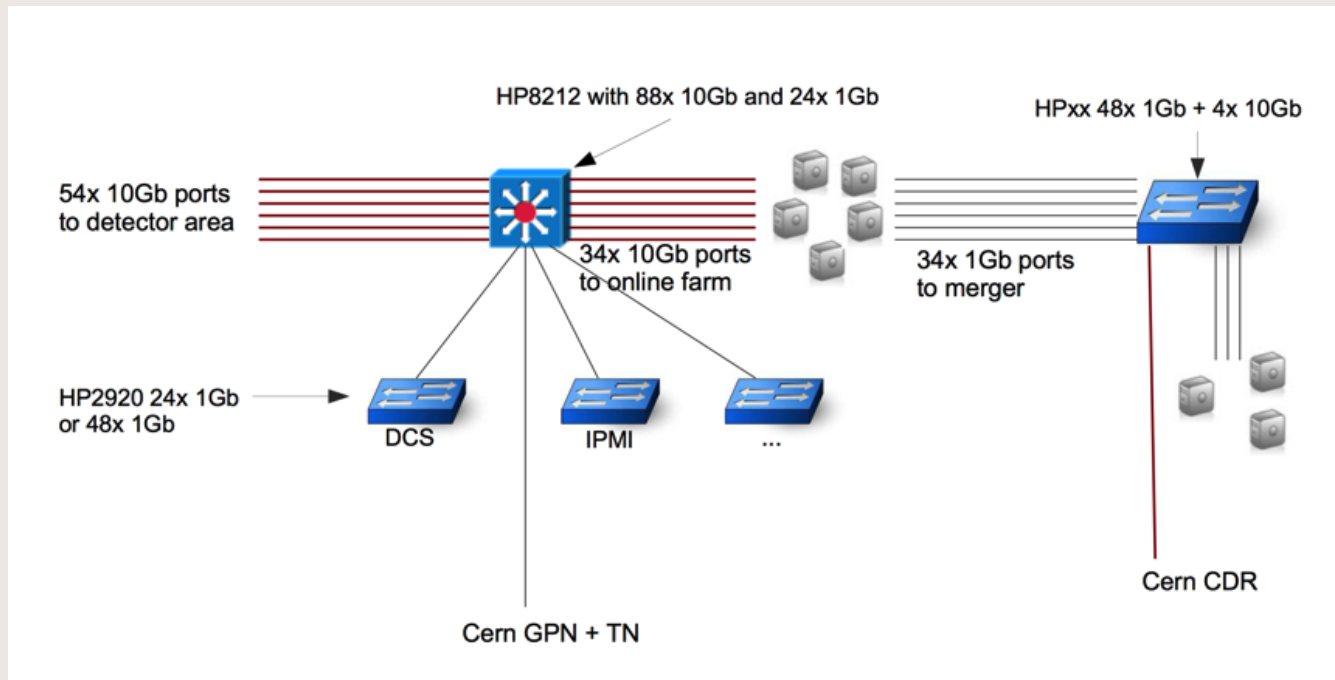
- L0 Trigger:
  - L0 Trigger Processor: two versions (one PC based the other FPGA based) under test;
    - most of the infrastructure is common.
    - Hardware for both versions exist; firmware writing and testing are ongoing
  - Dispatching of L0 primitives from sub-detectors is being tested
  - Intercommunication of TEL62 in preparation (RICH and LAV).
  - LKR-L0: new board (TELDES) interfacing TEL62's developed and tested.
  - NIM Trigger (as used in 2012) is kept up to date as back-up.
- L1/L2 Triggers:
  - L0 selected data is sent to PC-Farm, except LKR data are merged after L1.
  - L1 (software) trigger on sub-detector level
  - L2 software trigger on assembled and partially reconstructed events



# Data Handling / PC Farm

- PC-farm will include about 30 PC's
- 2-3 merger PC's (interface to CDR)

**installation  
in June**



# ECN3 Installation 07/2013

01/2014

Today

07/2014

Run

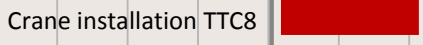
No demineralized water



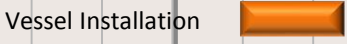
No chilled/iced water



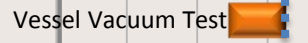
Crane installation TTC8



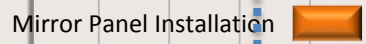
Vessel Installation



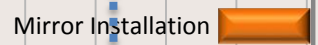
Vessel Vacuum Test



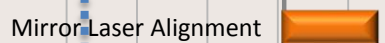
Mirror Panel Installation



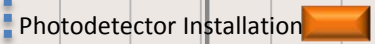
Mirror Installation



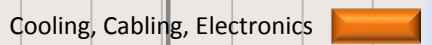
Mirror Laser Alignment



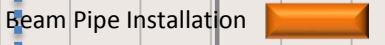
Photodetector Installation



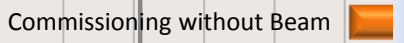
Cooling, Cabling, Electronics



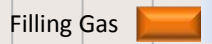
Beam Pipe Installation



Commissioning without Beam



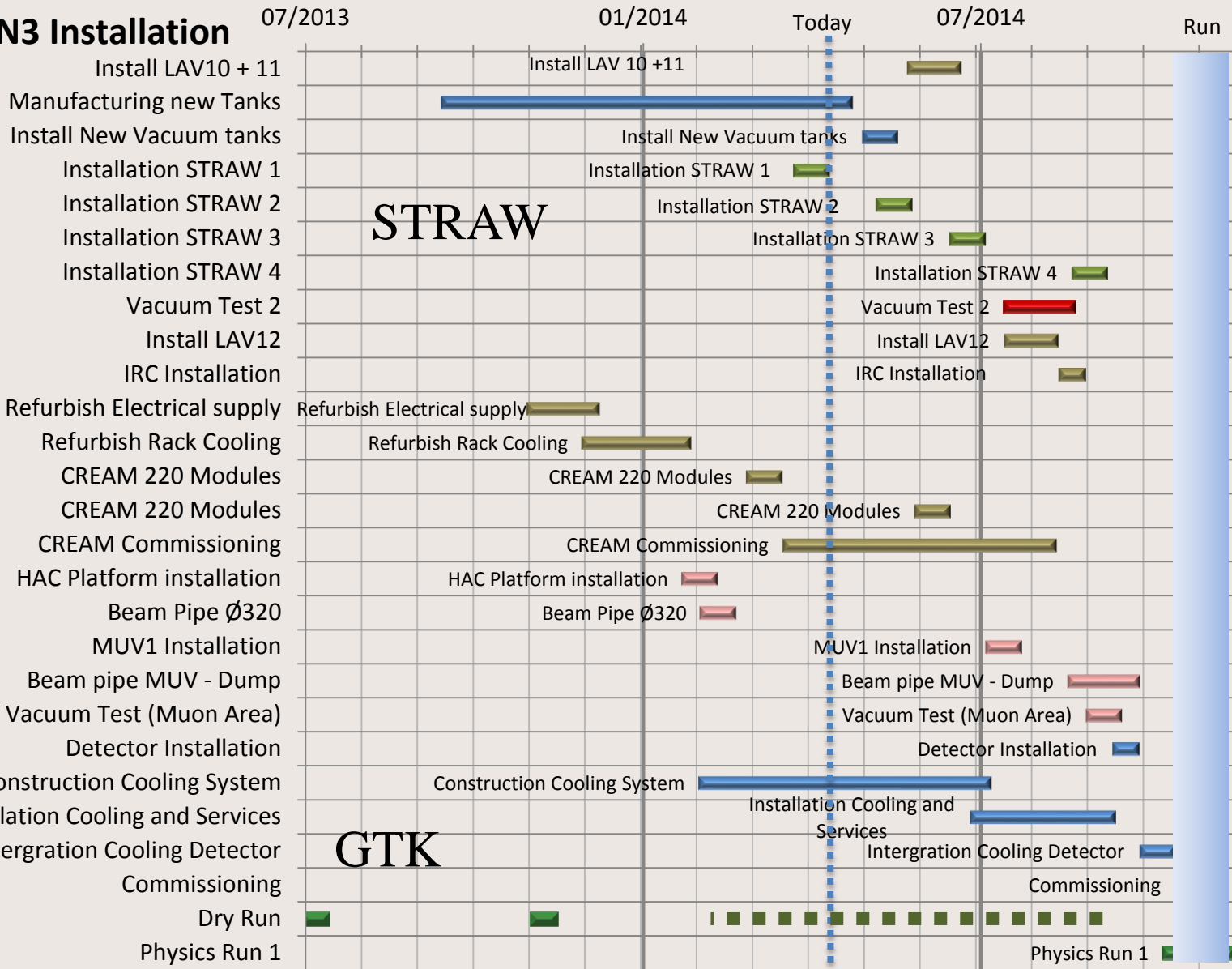
Filling Gas



# RICH



# ECN3 Installation



STRAW

GTK



# Summary

- Detailed report: **CERN-SPSC-2014-009 (SPSC-SR-134)**
- During the last 12 months we have made a lot of progress towards the completion of NA62, particular high-lights were the:
  - GTK ASIC
  - CREAM readout been successfully tested
  - Straw Chamber production
  - ...
- However, a lot remains to be done...

**We are confident that the successful work continues and that we will be ready to take data in October.**



# Thanks

- We warmly thank the referees and the SPS Committee for the time they spent analyzing our work and for their valuable feedback they give to us.
- We are grateful for the strong support of the Funding Agencies.
- The collaboration wishes to acknowledge the invaluable support provided by CERN and thanks in particular the Support, Technical and Administrative teams.