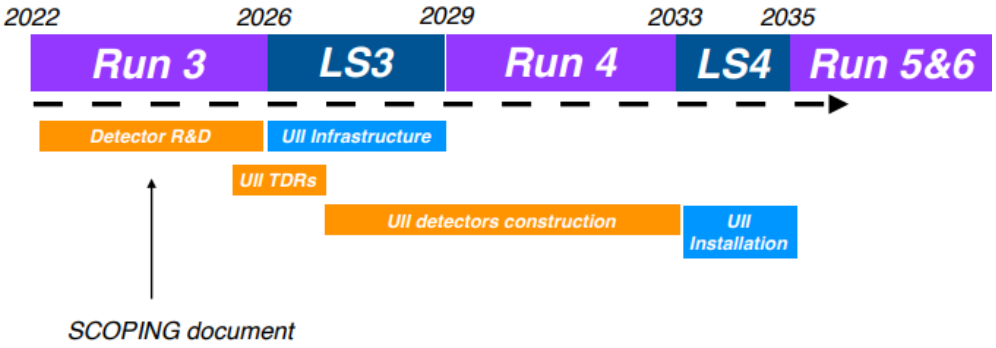
Attività, anagrafica e richieste servizi LHCb

LHCb upgrade phase II

- **Expression of Interest (LHCC 2017-003)**
- **Physics case (LHCC 2018-027)**
- **Strong support in European Strategy (2020)**
- **Framework TDR now published (LHCC-2021-012, https://cds.cern.ch/record/2776420/)**
  LHCC review started in September 2021, concluded in March 2022
  Detector options to achieve physics program, initial cost estimates



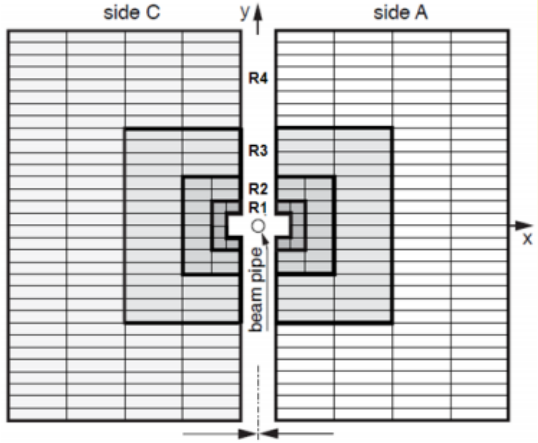
LHCb upgrade phase II

Muon detector baseline option (stations M2-M5):

- Inner regions (R1-R2): µRWell, 23 m^2, max rate: ~ 1 MHz/cm^2
- Outer regions (R3-R4): MWPCs (present + new higher granularity), 364m^2, max rate: ~ 5÷10kHz/cm^2
- New FE Electronics

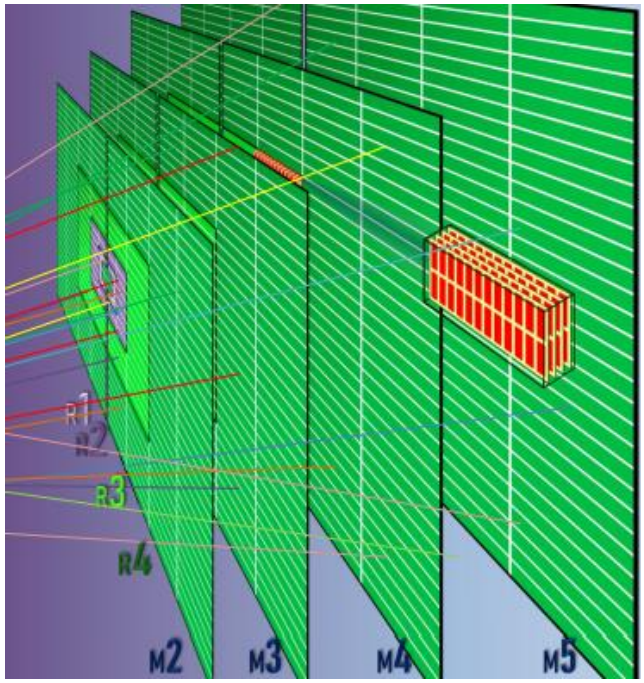
Other options for outer regions:

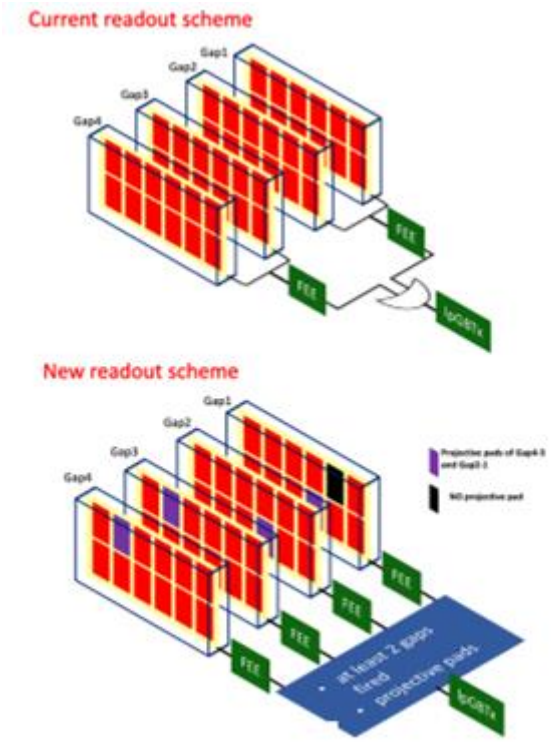
- RPCs and/or Scintillating Tiles



LHCb upgrade phase II @Bari

- **Simulation of the Muon detector**:
  evaluation of the expected rates
  optimization of the readout scheme and pad geometry
  requirements on improved time resolution





LHCb upgrade phase II @Bari

- **Development of new FE electronics**

G. De Robertis, F. Licciulli, F. Loddo

Requirements:
the new FEE should cope with a wide range of rates, pad density and capacitance (about a factor 100 between inner and outer regions), as well as be *back-compatible* (MWPCs in the outer regions)

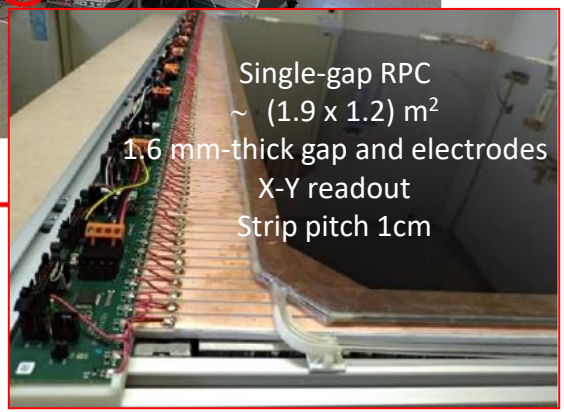
Upgraded version of FATIC2 ASIC (developed in Bari) as a possible option

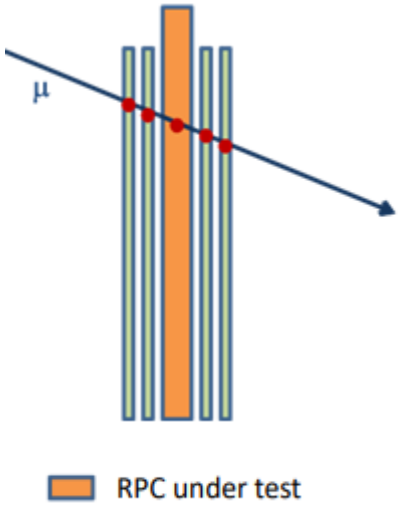
FATIC2 DAQ:
- FATIC2 FEB:
  - 4 FATIC2 dices bonded for a total of 128 channels
  - Fire-Fly connection HUB
- FATIC2 HUB:
  - 4 I/O ports to FATIC2 FEBs
- MOSAIC BOARD:
  - Control and Data Acquisition

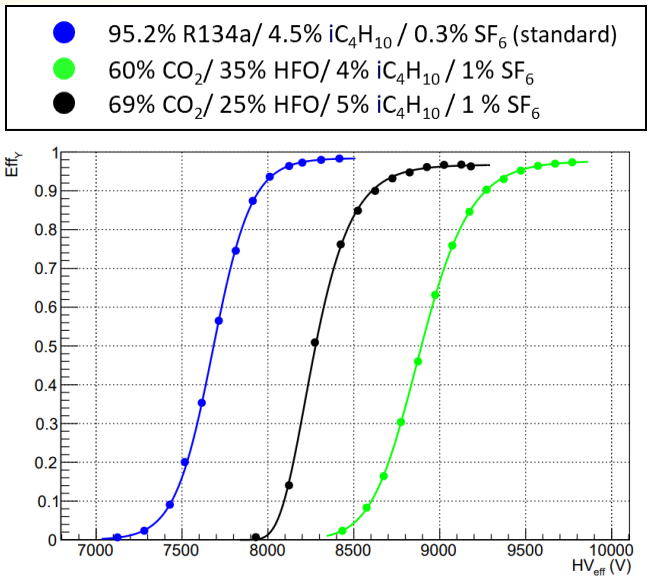
Design and production of FATIC2 FEBs for μRWELLs and for RPCs, first tests foreseen after summer

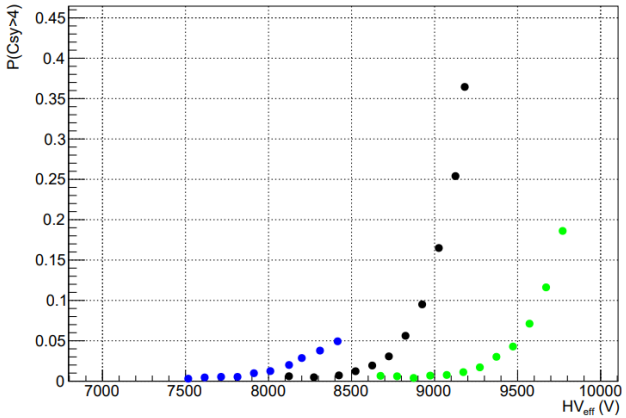
LHCb upgrade phase II @Bari

- **R&D on new-generation RPCs:**
  ongoing studies of eco-friendly gas mixtures (@Bari)





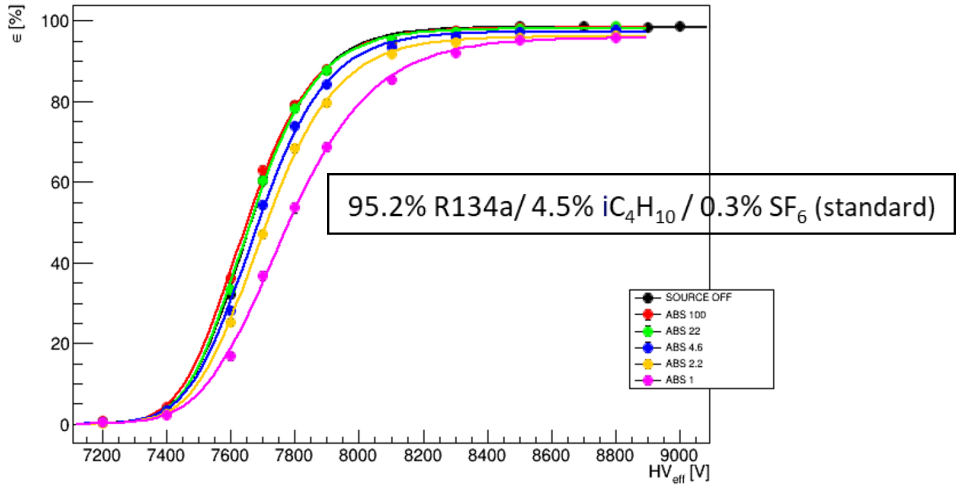


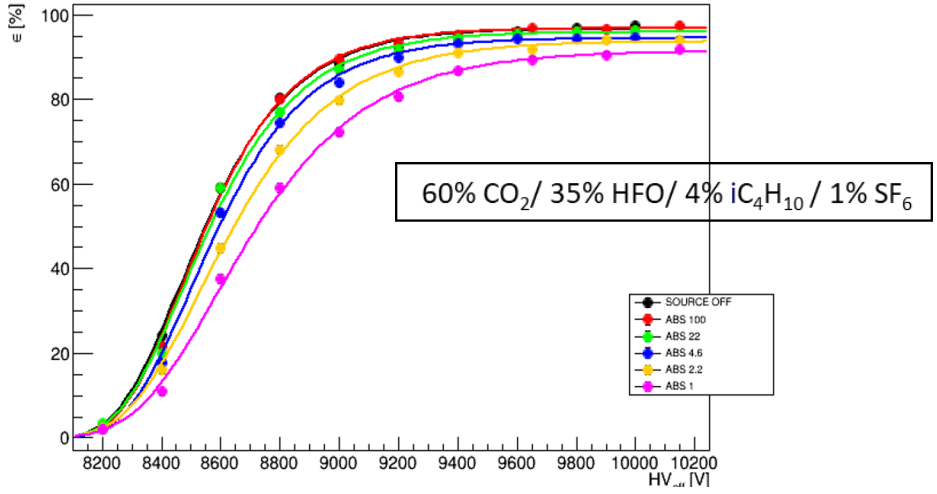


LHCb upgrade phase II @Bari

- **R&D on new-generation RPCs:**
  ongoing studies of eco-friendly gas mixtures (@GIF++)

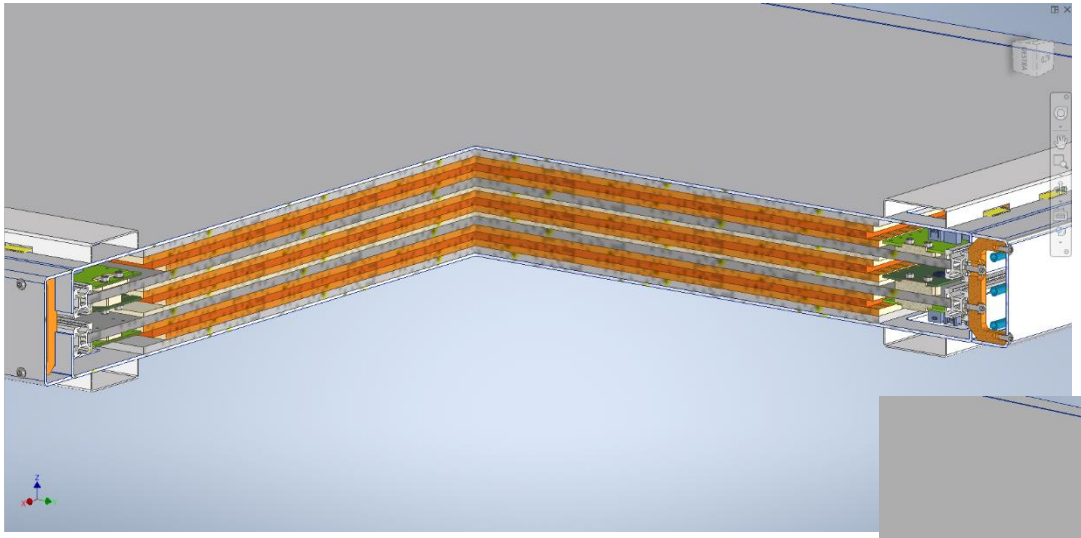
In collaboration with the RPC EcoGas@GIF++ group





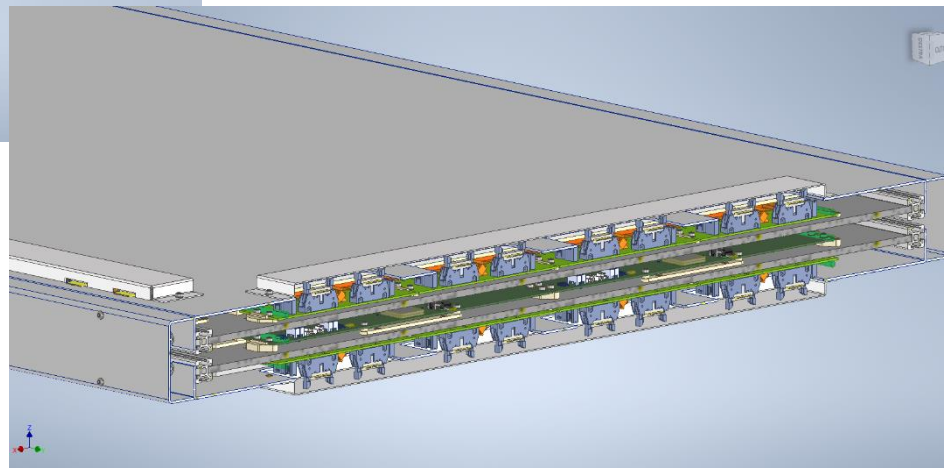
LHCb upgrade phase II @Bari

- **R&D on new-generation RPCs:**
  design of an RPC triplet prototype with *thin* gap / electrodes operated with eco-friendly gas mixtures



M. Mongelli, R. Triggiani, V. Valentino

External gaps: 1.6 mm, current electronics (FEERIC)
Internal gap with FATIC2 chip (synergy with CMS)

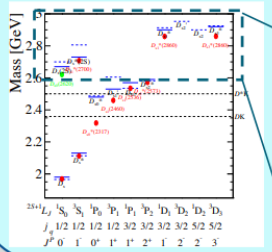


Physics analysis@Bari

A. Palano, M. De Serio, A. Pastore, M. Martinelli

STUDY OF $B_{(S)}^0 \to D^*(2010)^- K^0_S \pi^+$ DECAY CHANNEL

- The production of D_s^{**} in $B_{(s)}^0$ decays can help understanding the nature of these states
- Dalitz analyses involving DK final states have been also performed in B_s^0 decays:



Excited charm-strange states above the $D^*_{s2}(2573)$ seen in D(*)K spectra in collisions BaBar e^+e^- and LHCb

State	Mass	Width	Comment
	BaBar		
$D^*_{s1}(2700)^-$	$2710 \pm 2^{+12}_{-7}$	$149 \pm 7^{+39}_{-52}$	Seen in DK and D^*K
$D^*_{sJ}(2860)^-$	$2862 \pm 2^{+5}_{-2}$	$48 \pm 3 \pm 6$	Seen in DK and D^*K
$D_{sJ}(3040)^-$	$3044 \pm 8^{+30}_{-5}$	$239 \pm 35^{+46}_{-42}$	Seen in D^*K only
	LHCb		
$D^*_{s1}(2700)^-$	$2709.2 \pm 1.9 \pm 4.5$	$115.8 \pm 7.3 \pm 12.1$	Seen in DK and D^*K
$D^*_{sJ}(2860)^-$	$2866.1 \pm 1.0 \pm 6.3$	$69.9 \pm 3.2 \pm 6.6$	Seen in DK and D^*K
$D^*_{s1}(2860)^-$	2859 ± 12	159 ± 23	From $B^0_s \to \overline{D^0} K^- \pi^+$
$D^*_{s3}(2860)^-$	2860.5 ± 2.6	53 ± 7	From $B^0_s \to \overline{D^0} K^- \pi^+$

Now investigating D*K final states in $B_{(s)}^0$ decays …

F. Debernardis, A. Pastore, M. Pappagallo

SEARCH FOR $D_{S1} \to D_S \mu\mu$ DECAYS

- Absolute branching ratios of three decay modes
- Few decays modes might be still missing
- Large rate of radiative decays
- m = 2459.5 ± 0.6 MeV
- Γ < 3.5 MeV at 95% C.L.

$D_{s1}(2460)$

Decay Mode	BR (%)
$D_s^{*+}\pi^0$	48 ± 11
$D_s^+\gamma$	18 ± 4
$D_s^+\pi^+\pi^-$	4.3 ± 1.3
TOT	70 ± 12

Search for Dalitz decays of $D_{s1}(2460)$ by using the CF decay mode:
$D_s^+ \to K^+K^-\pi^+$ (5.45 ± 0.17)%

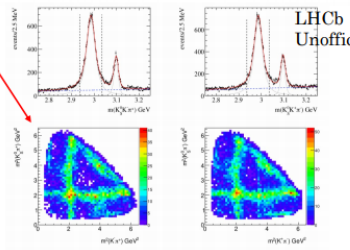
$$\underbrace{D_{s1}(2460)^+}_{J^P = 1^+} \to \underbrace{D_s^+}_{J^P = 0^-} \underbrace{\mu^-\mu^+}_{J^P = 1^-}$$

A. Palano, M. Martinelli

AMPLITUDE ANALYSIS OF $B^+ \to (K^0_S K\pi) K^+$

Now in review phase

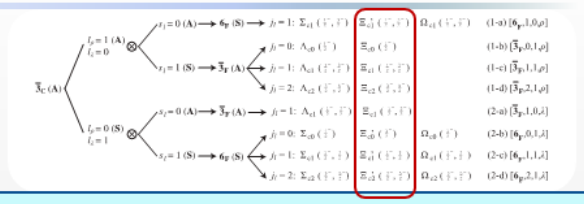
- Precise measurements of the charmonium resonances parameters.
- Measurement of the partial $B^+ \to (c\bar{c})K^+$ branching fractions.
- Dalitz plot analysis of the $\eta_c \to K^0_S K\pi$ decay.
- Amplitude analysis of the $K^0_S K\pi$ system in the threshold region.



A. Palano member of the Editorial Board until June 30th, 2022

Physics analysis@Bari

SPECTROSCOPY OF THE Ξ_c BARYONS



$\Xi_c^{**0} \rightarrow \Xi_c^0 \pi^+ \pi^-$

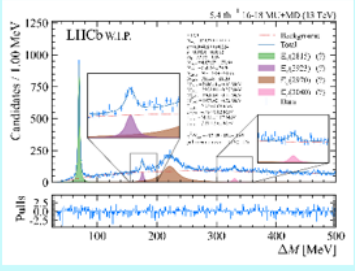
L. Lagrange, M. Pappagallo, F. Muheim

$\Xi_c^{**+} \rightarrow \Xi_c^+ \pi^+ \pi^-$

R. O'Neil, M. Pappagallo, M. Williams

$\Xi_c^{**+} \rightarrow \Lambda_c^+ \pi^+ K^-$

F. Oliva, M. Pappagallo, M. Williams

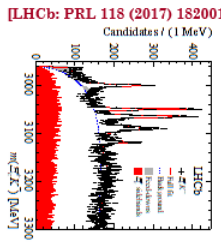


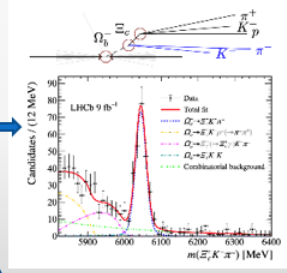
S. Mitchell, M. Pappagallo, M. Mikhasenko

FIRST EXCLUSIVE OBSERVATION OF Ω_c^{**0} IN $\Omega_b^- \rightarrow \Xi_c^+ K^- \pi^-$ DECAYS

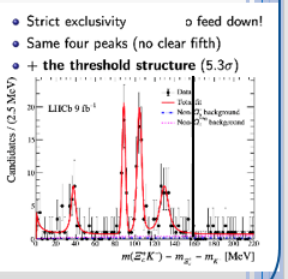
[LHCb: PRD 104 (2021) L091102]

[LHCb: PRL 118 (2017) 182001]





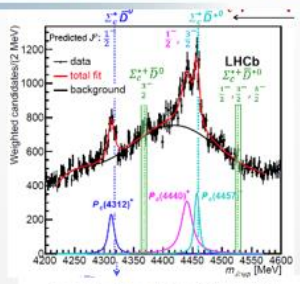
- Strict exclusivity — no feed down!
- Same four peaks (no clear fifth)
- + the threshold structure (5.3σ)

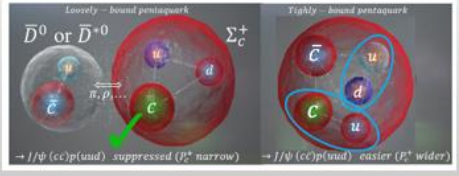


G. Robertons, M. Pappagallo, M. Needham

SEARCH FOR PENTAQUARKS IN $\Sigma_c D^{(*)}$ STATES

- The LHCb collaboration announced the discovery of the first pentaquark states, coming from a Λ_b baryon decaying to a $J/\psi p K^-$ final state. Two of the observed structures occurred very close to the $\Sigma_c D^{(*)}$ mass thresholds
- Due to the implications of isospin symmetry, it is expected that there will exist a multiplet corresponding to the pentaquarks shown, with differing total charge.





Particle 1	Particle 2	Corresponding Pentaquark
Σ_c^{++}	$\bar{D}^0$	P_c^{++}
Σ_c^{0}	$\bar{D}^0$	P_c^{0}
Σ_c^{++}	D^-	P_c^{+}
Σ_c^{0}	D^-	P_c^{-}
Σ_c^{++}	D^{*-}	P_c^{+}
Σ_c^{0}	D^{*-}	P_c^{-}

Table 1: *Different possible combinations of Σ_c baryons with D mesons to produce the isospin multiplet.*

M. Pappagallo Deputy Physics Coordinator until June 30th, 2022

Anagrafica LHCb-Bari 2023

M. De Serio (resp. loc.)	80%
R.A. Fini	80%
G. Galati	70%
A. Palano	*0%*
M. Pappagallo	90%
A. Pastore	80%
S. Simone	80%
P. D'Argent (Post doc)	100%
L. Congedo (PhD)	100%
F. Debernardis (PhD)	100%
G. De Robertis	10%
F. Licciulli	10%
F. Loddo	10%
TOT FTE	**7.0 → 8.1 (8.0)**

(nota: di cui 10% AIDAInnova)

Richiesta servizi

Servizio elettronico:

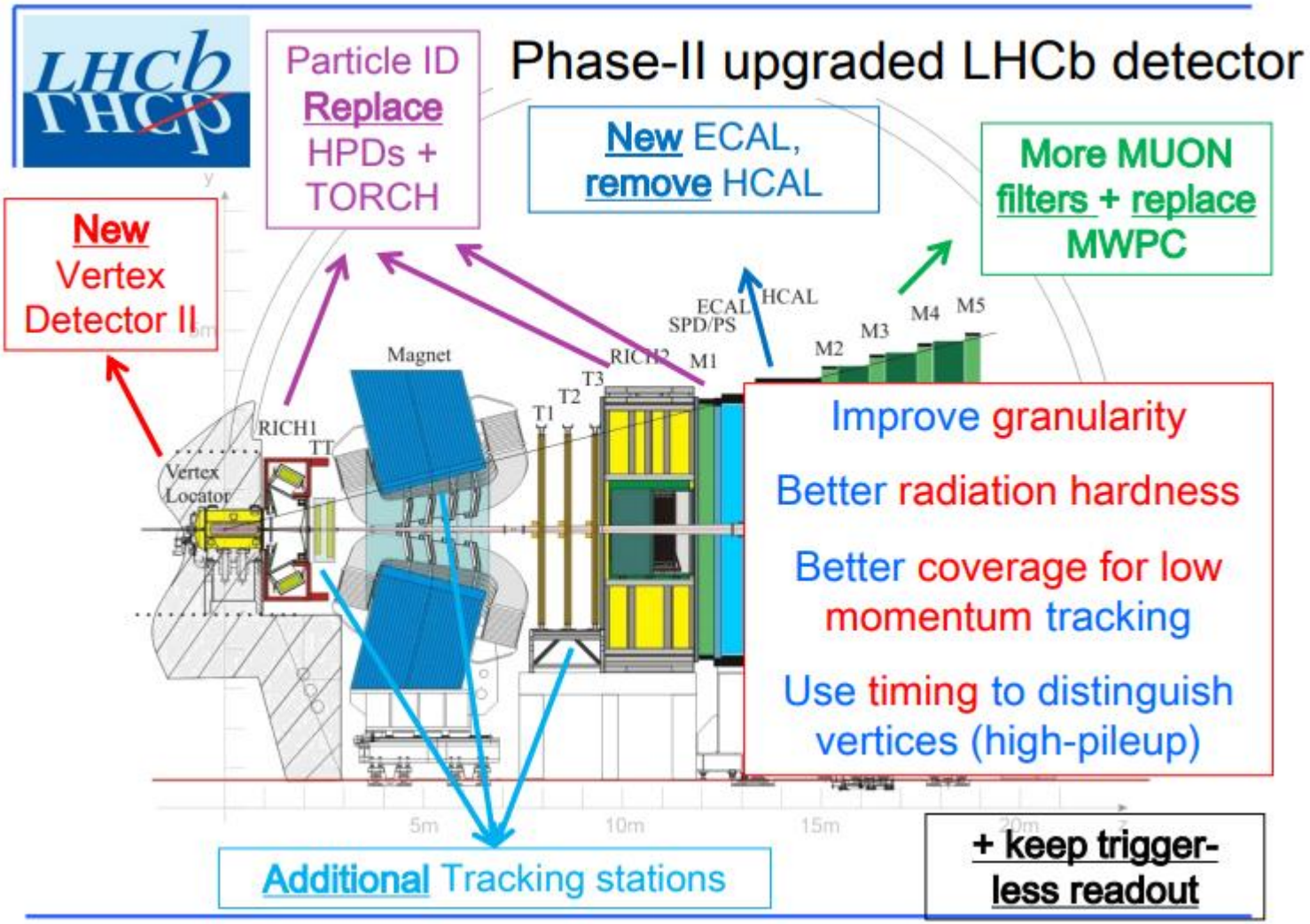
- Test FATIC2 + detector
- Progettazione FATIC3

Servizio meccanico:

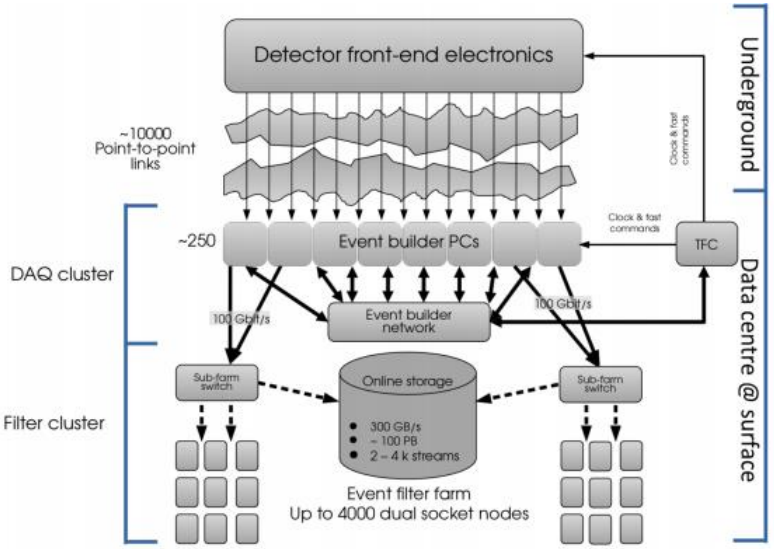
- Completamento e realizzazione del progetto di un prototipo di tripletto di camere RPC con gap sottili
- Realizzazione struttura meccanica di supporto per l'integrazione di RPC nel telescopio presso lab RPC Bari

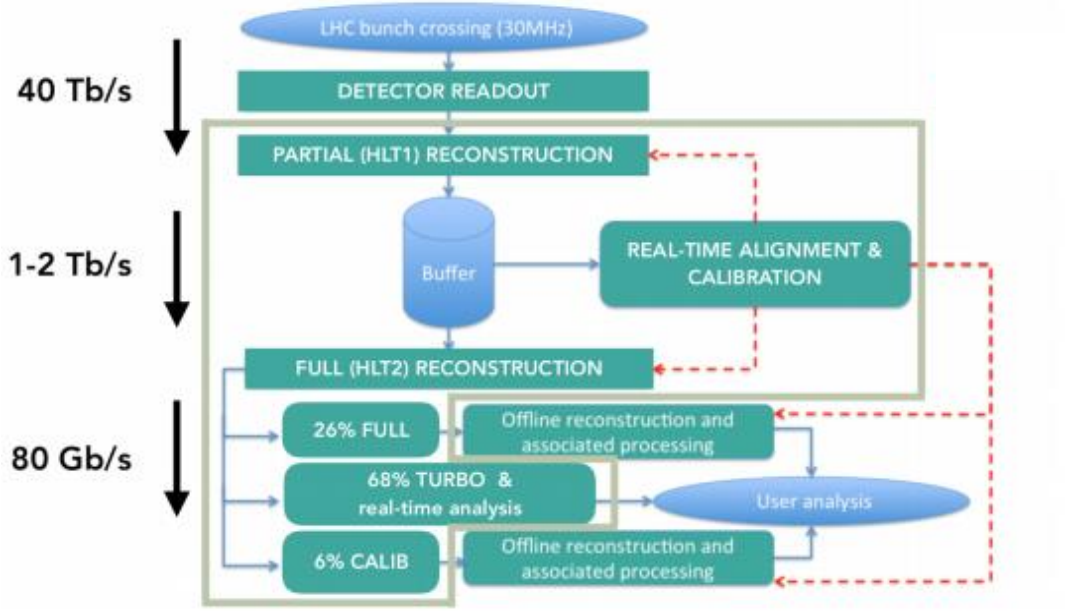
Backup slides

LHCb upgrade phase II



LHCb upgrade phase I



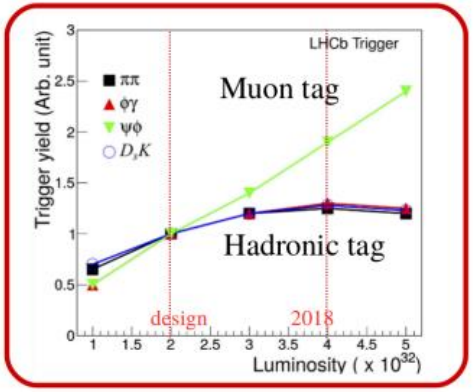


Remove the hardware trigger, detector readout at 30 MHz

Perform partial reconstruction and selection to reduce data flow from 40 Tb/s to 1-2 Tb/s: HLT1

Align and calibrate the detector in real time

Perform full reconstruction with offline quality in real time: HLT2



LHCb upgrade phase II @Bari

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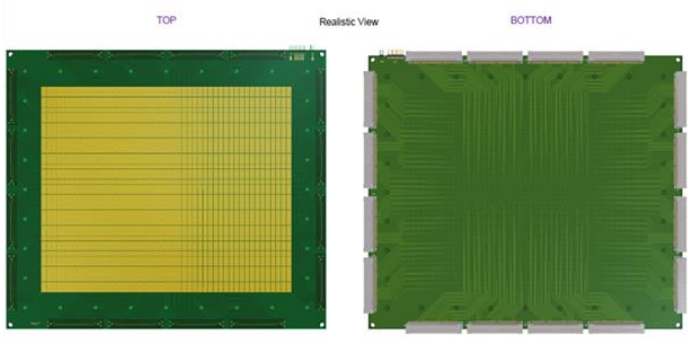
G. De Robertis, F. Licciulli, F. Loddo

Requirements:
the new FEE should cope with a wide range of rates, pad density and capacitance (about a factor 100 between inner and outer regions), as well as be *back-compatible* (MWPCs in the outer regions)

Upgraded version of FATIC2 ASIC (developed in Bari) as a possible option

TEST PROTOTIPO μRWELL M2R1 + FATIC



Layout prototipo M2R1:
- Dimensioni: 25x30 cm^2
- Numero di pads: 1920
- Numero di canali: 960
  (lettura coppie di pads)

LETTURA BiGap o QuadriGap

- Test catena DAQ
- Misure funzionali su banco (stabilità, S/N, soglie di lavoro)
- Presa dati con setup cosmici
- Presa dati con setup RX
- Test Beam (H8C beam area at CERN, Ott-Nov23)