CSN1- Preventivi 2026

Francesca Dordei INFN Istituto Nazionale di Fisica Nucleare

Consiglio di sezione, 10 Luglio 2025

Responsabilità in CSN1

Francesca Dordei
INFN Cagliari

LHC:

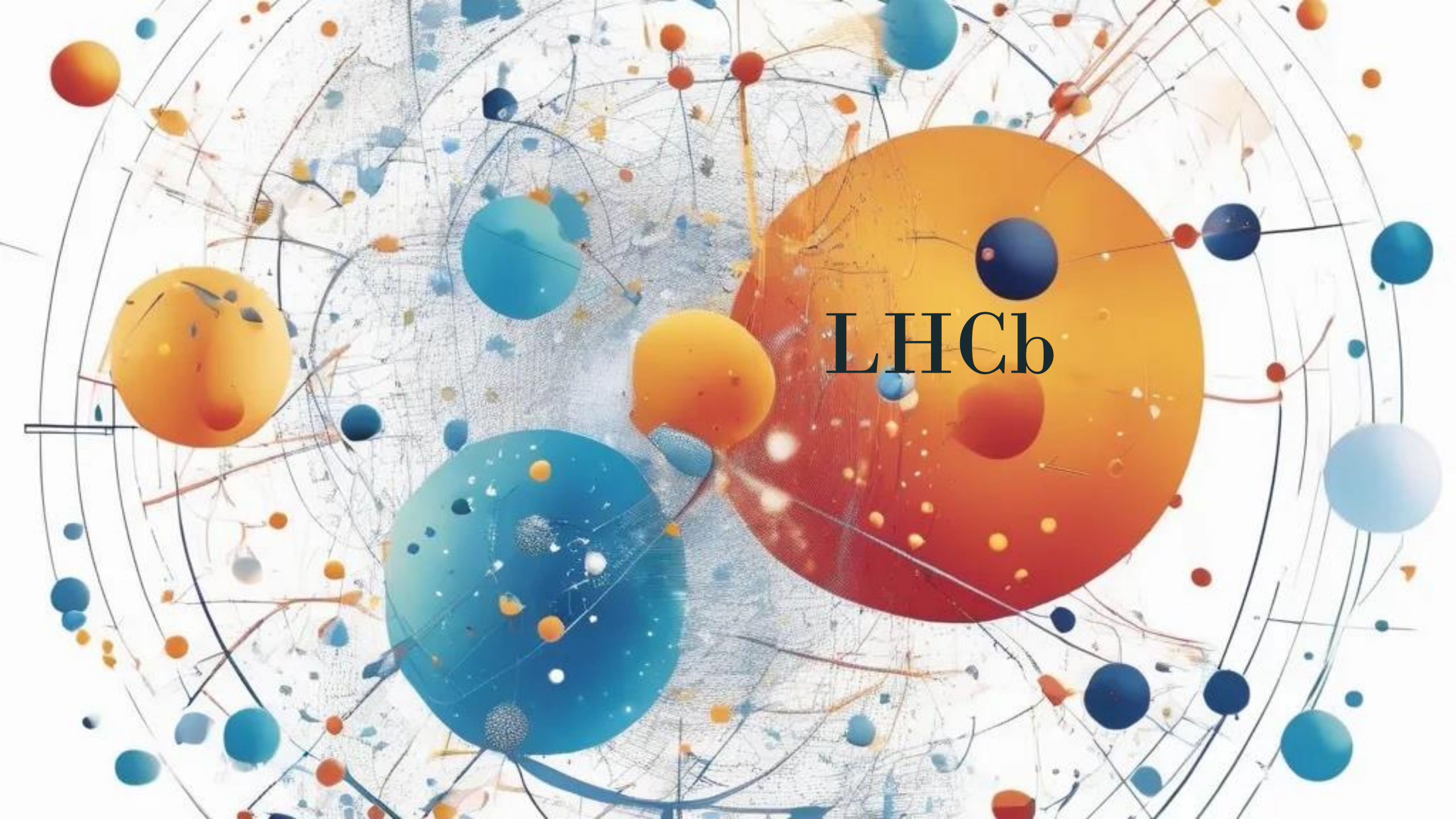
- **Membro P2UG (phase 2 upgrade group):** Alessandro Cardini (gettone)
- **Editorial Board Member:** Francesca Dordei
- **RTA institutional board member for Cagliari, Bologna, Ferrara:** Francesca Dordei
- **LHC Heavy-Ion convener:** Giulia Manca
- **Fixed-target subworking group convener**: Federica Fabiano
- **Liaisons**: Camilla De Angelis, Daniele Provenzano
- **Muon-monitoring**: Roman Litvinov

IGNITE:

- **Responsabile nazionale (e locale):** Adriano Lai

REFEREE:

- **Belle II:** Andrea Contu (gettone)


LHCb

LHCb: Overview

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✓ Cagliari è tra i gruppi piú grandi in Italia (20 autori)
✓ **Responsabile Locale:** Adriano Lai

Coinvolgimento

- **Rivelatori**: storicamente sui MUONI (commissioning, monitoring and maintenance), ora interesse spostato verso VELO (in particolare sull'Upgrade II) e Software (RTA)
- **Analisi**, 3 linee di ricerca principali:
  - **Metrologia CKM e violazione di CP**:
    - Misure di asimmetrie di CP e BF in decadimenti del B^- in 2 mesoni con charm
    - Misura della fase di violazione di CP φ_s e $\Delta\Gamma_d$
  - **Decadimenti rari e charm**:
    - Contributo principale all'osservazione e misura di BF di $\Sigma^+ \to p\mu^+\mu^-$
    - Ricerca del decadimento $B_s^0 \to \mu^+\mu^-\gamma$
    - Ricerca del decadimento $B_s^0 \to \tau^+\tau^-$
    - …
  - **Collisioni di ioni pesanti**: Cagliari è coinvolta in tutti i setup: p/Pb-GAS (SMOG), p-Pb, Pb-Pb. Inoltre profondamente coinvolta nel running, trigger, ricostruzione, data-quality e studi di selezione.

LHCb: CKM 2025

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- Cagliari è stata scelta per ospitare il workshop CKM nel 2025 (la conferenza di fisica del flavour piú importante, ~150 persone):

15-19 Settembre 2025,
Hotel Regina Margherita

https://ckm2025.ca.infn.it/

Local Organizing Committee

Francesco Dettori (Co-chair, Cagliari U.)

Francesca Dordei (Co-chair, INFN Cagliari)

Pierluigi Bortignon (Cagliari U.)

Giuseppe Bozzi (Cagliari U.)

Andrea Contu (INFN Cagliari)

Mirco Dorigo (INFN Trieste)

Giulia Manca (Cagliari U.)

Rolf Oldeman (Cagliari U.)

LHCb: CKM e Violazione di CP

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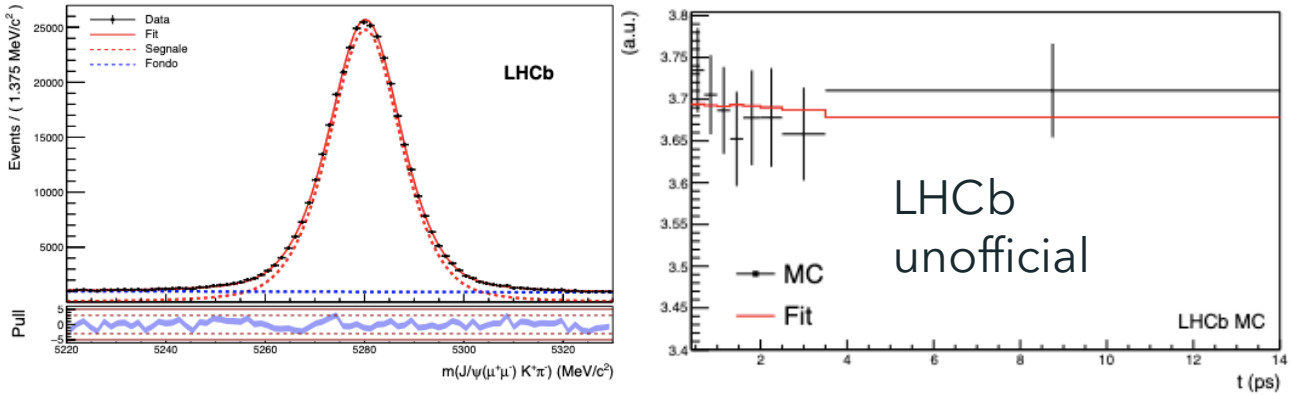
- **Misura di $\Delta\Gamma_d$** usando i canali $B_d^0 \to J/\Psi K_s$ e $B_d^0 \to J/\Psi K^*$
- Test molto stringente del Modello Standard



[F. Dordei, A. Kurzina]

Discussione tesi magistrale il 22 Luglio!

Altre analisi:

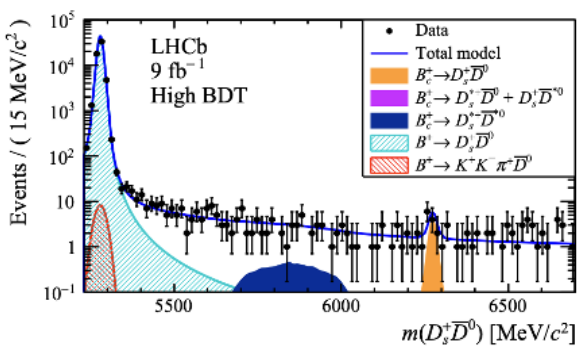
- Misura del parametro di violazione di CP φ_s con i dati di Run 3 [F. Dordei]

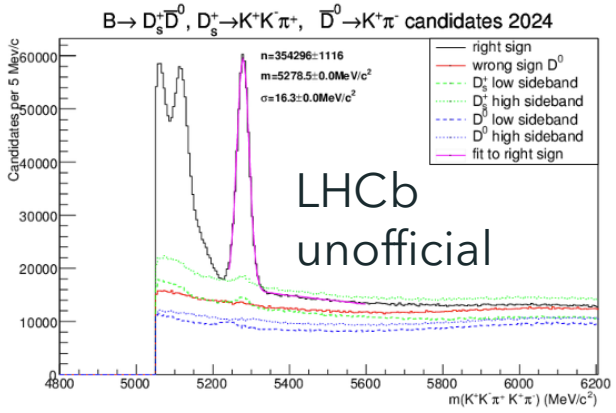
- Ricerca del decadimento $B_c^+ \to D_{(s)}^+ \bar{D}^0$: utile per misurare l'**angolo CKM γ**. *Run 1 : NPB 930 (2018) 563, Run 1+2 : JHEP 12 (2021) 117*
- Misura delle asimmetrie di CP in $B^+ \to D_{(s)}^+ \bar{D}^0$: ricercar di NP. *Run 1 : JHEP 05 (2018) 160, Run 1+2 : JHEP 09 (2023) 202*

- I dati di LHCb Run 3 data nettamente maggiori di Run1+Run2: *efficienza di trigger 2x maggiore*

Priorità: ricerca di $B_c^+ \to D_{(s)}^+ \bar{D}^0$. *Conferma o smentita dell'eccesso a* 3.4σ in Run1+2

[R. Oldeman]





LHCb: Decadimenti rari e charm

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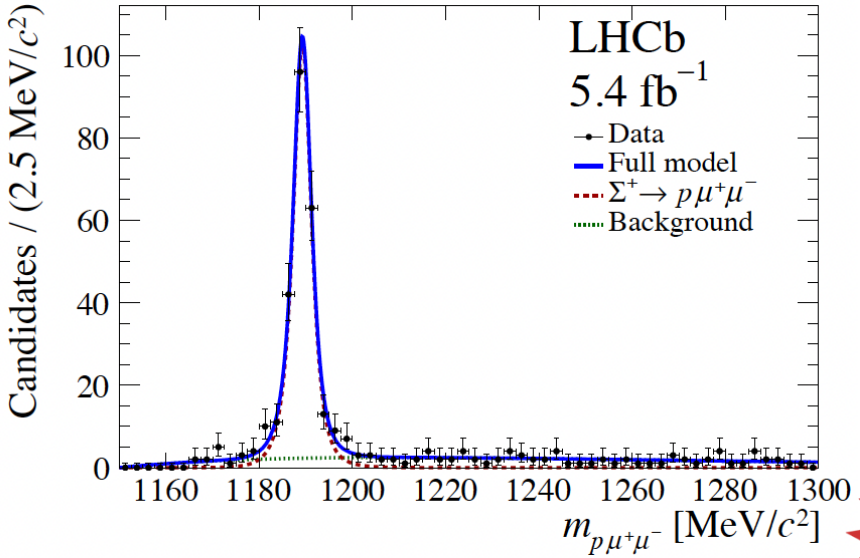
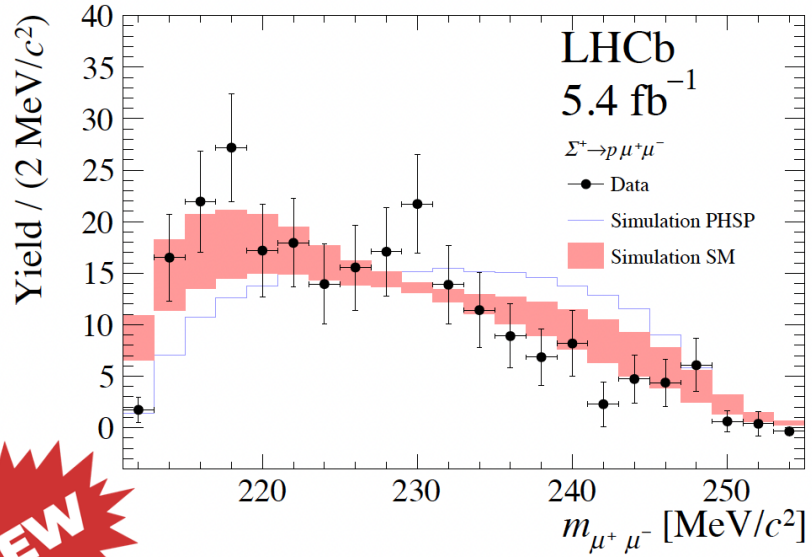
Osservazione del decadimento $\Sigma \to p\mu\mu$: il decadimento di un barione piú raro mai osservato





NEW

Accettato da PRL!

- FCNC rara $\mathcal{B}\sim10^{-8}$
- Evidenza di HyperCP di un possibile stato intermedio di NP
- Apre un nuovo filone di analisi

[F. Dettori, F. Dordei, D. Provenzano]

Altre analisi in corso:

- $B_s^0 \to \mu^+\mu^-$: Analisi dei dati di Run 3 in corso [F. Dettori, D. Provenzano]
- Misura del rapporto delle frazioni di adronizzazione $\frac{f_s}{f_d}$ con in dati di Run 3 [F. Dettori, D. Provenzano]
- Ricerca del decadimento $B_s^0 \to \mu^+\mu^-\gamma$ [F. Dettori, C. Normand]
- Ricerca del decadimento $B_s^0 \to \tau^+\tau^-$, sviluppo di nuovi metodi [A. Contu, F. Dettori, B. Saitta]
- Decadimenti rari del charm, $D^0 \to \mu\mu$ e $D^0 \to \mu\mu hh$ con i dati di Run 3 [A. Contu, F. Dettori]
- **PRIN2022** su analisi di ampiezza $D^0 \to K_S^0\pi\pi$ su GPU [Contu + Martinelli (MiB)], partenza Febbraio 2025, durata due anni

LHCb: Ioni pesanti

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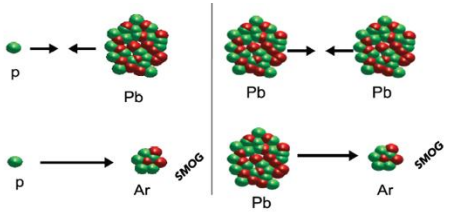
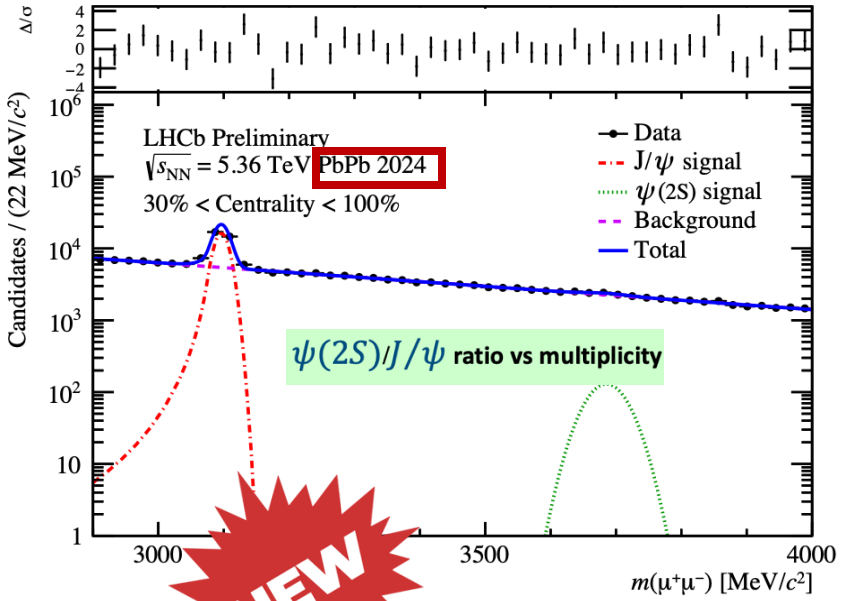
- LHCb started Heavy Ion activities in 2015; three setups on top of pp collisions:
  - p/Pb-GAS (SMOG) [NEW], p-Pb [new √s], Pb-Pb [NEW]
  - Cagliari deeply involved in running, trigger, reconstruction, data quality and selection studies.

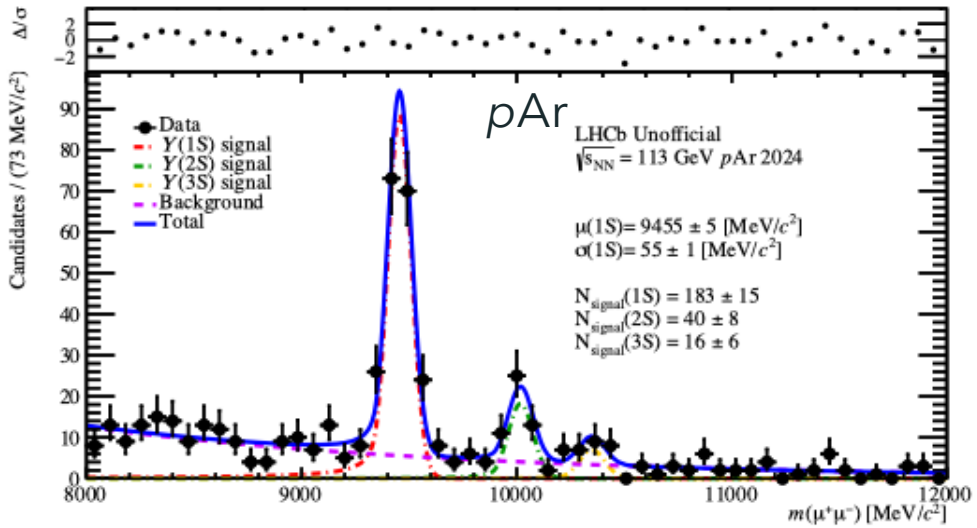
  => Cagliari is doing or has done analyses in <u>all setups</u>.

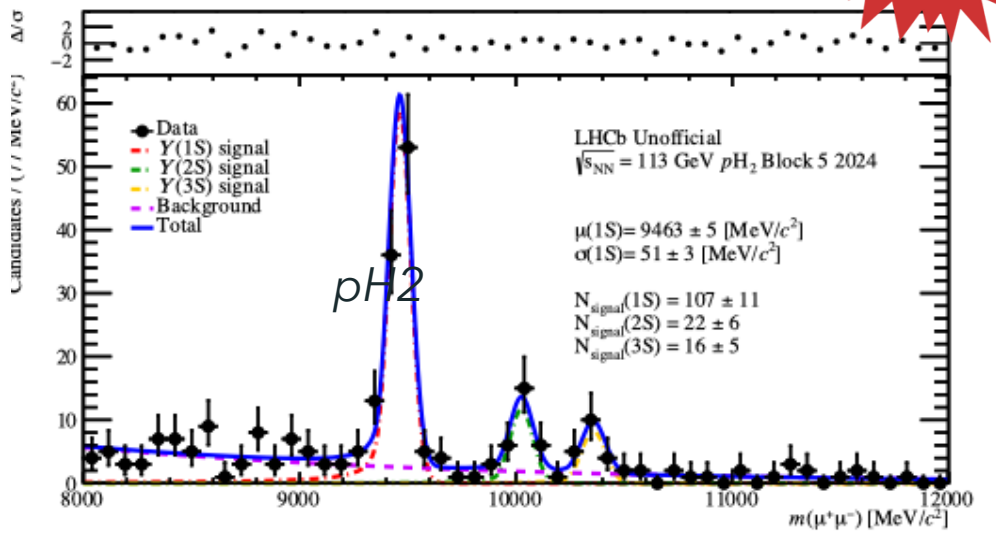


- Huge potential to study uniquely
  - Quark Gluon Plasma (QGP) in PbPb (χ_c,J/ψ from B) and SMOG (unique √s)
  - Cold Nuclear Matter Effects in pPb



Upsilon production in *p*Ar,pH collisions in Run3





[G. Manca, F. Fabiano, C. de Angelis, R. Litvinov]

- ψ(2S)/J/ψ ratio vs multiplicity in PbPb collisions 5.02 TeV, JHEP
- Λ transverse polarization in *p*Ne collisions at $\sqrt{s}$ 68.5 = GeV, JHEP
- Strangeness production in in *p*Ne collisions at $\sqrt{s}$ 68.5 = GeV, JHEP
- Total charm cross-section in 5.02 TeV *pp* collisions, EPJ+

LHCb: Rivelatore di Muoni

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INFN Cagliari

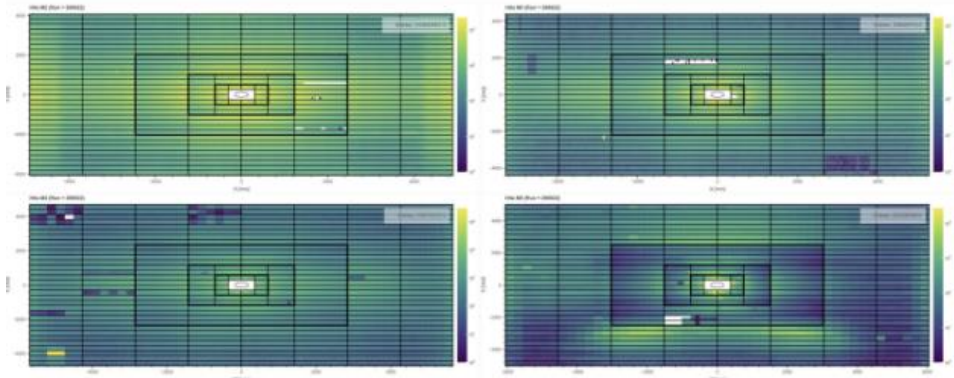
Attività 2024 e 2025:

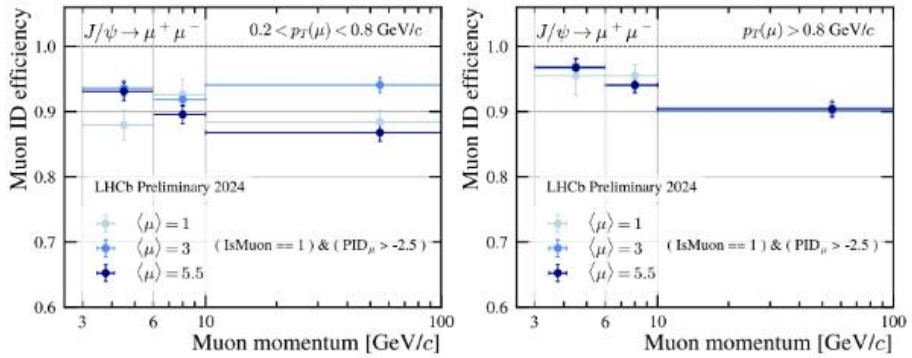
- ❑ Time alignment dei muoni,
- ❑ Muon monitoring,
- ❑ Data quality,
- ❑ Threshold scan and front-end maintenance.

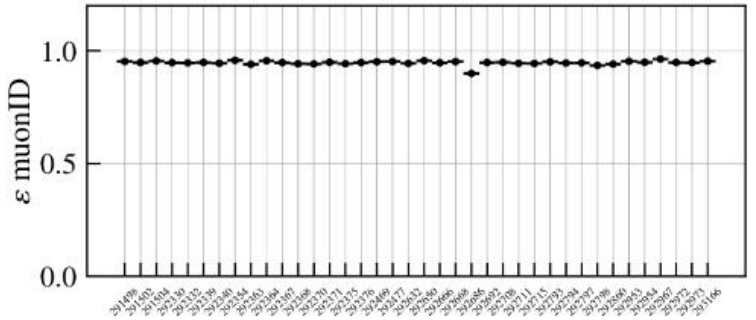
Novità 2026:

- ➢ Uscita da gruppo muoni (solo supporto in caso di emergenza)

[A. Contu, S. Kotriakhova, R. Litvinov]







LHCb : Attività di R&D per U2

Il 2026 sarà il primo anno in cui saranno chiesti finanziamenti per l'Upgrade 2.

Le prime scadenze dell'esperimento per l'U2 si riferiscono alla stesura dei **T**echnical **D**esign **R**eport (fine 2026), in cui devono essere chiarite le scelte tecnologiche in vista dell'Upgrade 2.

I lavori italiani relativi al VELO-U2 sono in parte sovrapposti e assorbiti nel progetto **IGNITE.**

- Inoltre, implementazione **Downstream Tracker su FPGA con algoritmo RETINA** per Run4 (Pre-U2).

Costi Core in fase di discussione

Sezione	FTE	Task	Average FTE in LS3			Average FTE in LS4			Cost
	current		Phys	Tech	Temp	Phys	Tech	Temp	kE
Cagliari	1	Simulation	0.5	0	0.5	0.5	0	0.5	0
	3.5	Sensors	3	2	2	3	1	2	715
	3.5	ASIC	1	3	1	1	2	1	2090
Firenze	2	Sensors	2	1	1	3	1	1	440
Milano	1	Simulation	0.5	0	0.5	0.5	0	0.5	0
	2	ASIC	0	2	2	0	1	1	0
	0.5	Modules	3	1	2	4	3	2	1210
TIFPA	2.5	Sensors	0	4	2	0	3	1	550
Total	16		10	13	11	12	11	9	5005

La componente Italiana nel VELO-U2 è ~25–30% del totale degli FTE interessati nel gruppo VELO

Gli interessi italiani si basano su forti competenze nello sviluppo di sensori, elettronica e sistemi di cooling, guadagnate negli ultimi 10-15 anni

Coordinamento gruppi italiani: Cagliari

LHCb

Preventivi finanziari 2026: richieste tabellari e R&D U2

Persone	FTE	Metabolismo consumi	Metabolismo missioni	R&D U2	Totale richieste 2026
20	14.5	22.0	137	50*	209

Cifre in k€

*Ibridizzazione dell'**Ignite-ER** con batch sensori 3D a colonna attualmente in produzione

Personale Tecnico (CTER):

GM. Cossu	40%
D. Marras	10%
L. La Delfa	30%
M. Arba	10%
M. Tuveri	20%

Ricercatori Tecnologi

LHCb IGNITE TOT LHCb IGNITE TOT

Barbaro	Massimo	1	0	0	0	0	80	80						staff	PO
Cadeddu	Sandro	0	1	1	1				20	80	100			tecn	Primo Tecn
Cardini	Alessandro	1	0	1	1	50	20	70						staff	Dir. Ric.
Contu	Andrea	1	0	1	1	50		50						staff	Primo Ric
De Angelis	Camilla	1	0	0	1	100		100						dott	Dott
Dettori	Francesco	1	0	1	1	80		80						staff	PA
Dordei	Francesca	1	0	1	1	70		70						staff	Prima Ric
Fabiano	Federica	1	0	0	1	100		100						pdoc	Post Doc
Lai	Adriano	0	1	1	1				50	50	100			tecn	Dir. Tec.
Lampis	Andrea	0	1	0	1					*				tecn	Tecn TD
Liang	Zhihua	1	0	0	1				*					pdoc	
Litvinov	Roman	1	0	1	1	100		100						pdoc	Ass. Ric.
Loi	Angelo	0	1	1	1					*				tecn	Tecn TD
Kotriakhova	Sofia	1	0	1	1	100		100						pdoc	
Manca	Giulia	1	0	1	1	100		100						staff	PA
Oldeman	Rudolf	1	0	1	1	70	30	100						staff	PA
Piccolo	Lorenzo	0	1	1	1				30	70	100			tecn	Tecn TD
Provenzano	Daniele	1	0	0	1	100		100						dott	Dott
Saitta	Biagio	1	0	0	1	0		0						pens	PO
Verdoglia	Michele	1	0	1	1	70	30	100						dott	Dott
		15	*5*	*13*	*19*	*9.9*	*1.6*	*11.5*	*1*	*2*	*3*	*20*	*0.68*		


IGNITE

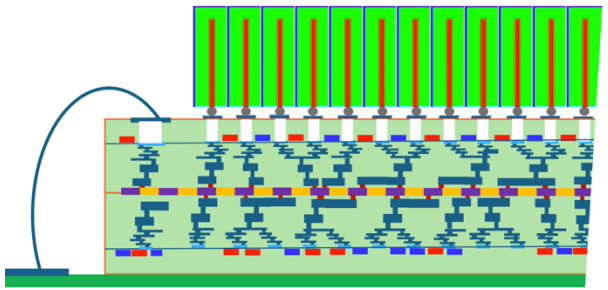
IGNITE

sviluppo di ASIC in tecnologia *CMOS 28-nm per 4D-tracking*

- Forte sinergia con LHCb. Nel 2026 l'attività di **IGNITE** si sovrappone largamente con le attività di LHCb-Upgrade2
- PI e Resp. Nazionale: Adriano Lai – Cagliari. 13 Sezioni INFN e 60 ricercatori/tecnologi coinvolti

- Attività in corso: sviluppo e test di ASIC secondo un approccio frattale (scalabilità)
  - ASIC con matrice 64x64 pixel sotto test
  - Progetto del prototipo finale 320x256 pixel

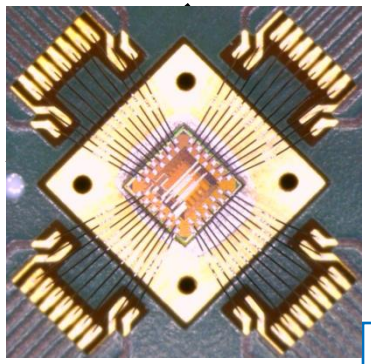
- **Attività previste nel 2026:**
  - Submission del prototipo finale con approccio 3D-HI (tri-dimensional heterogeneous integration)
  - Vertical stack 3D-HI e sensore
  - Test



FractalDesign®

*OK large area but **keep it local !!***

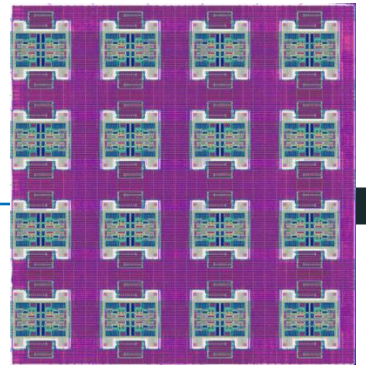
- Idea (**FractalDesign**) di realizzare ASIC di grande area (~2 cm²) come ripetizione di strutture elementari largamente indipendenti, tali da essere progettate, simulate, operate, testate e controllate **modularmente**
- Ciò può rendere possible la misura del tempo ad alta precisione (~30 ps rms) a livello del singolo pixel (~50 µm)



Ignite-0

2023

Test of pixel and other structures (1 mm²)



Mattonella

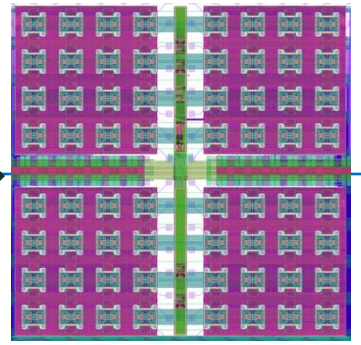
Repetition Element

8x8 pixels

45µm pitch

+ RDL to 55 µm pitch in sensor

x4

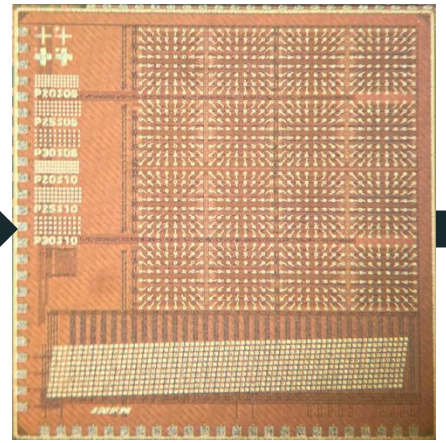


Block

16x16 pixels

x4

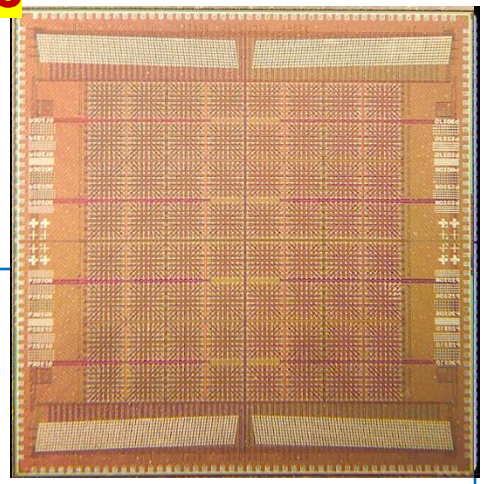
Sotto test in estate '25



Quadrant

32x32 pixels

x4



Ignite-64 core

2024

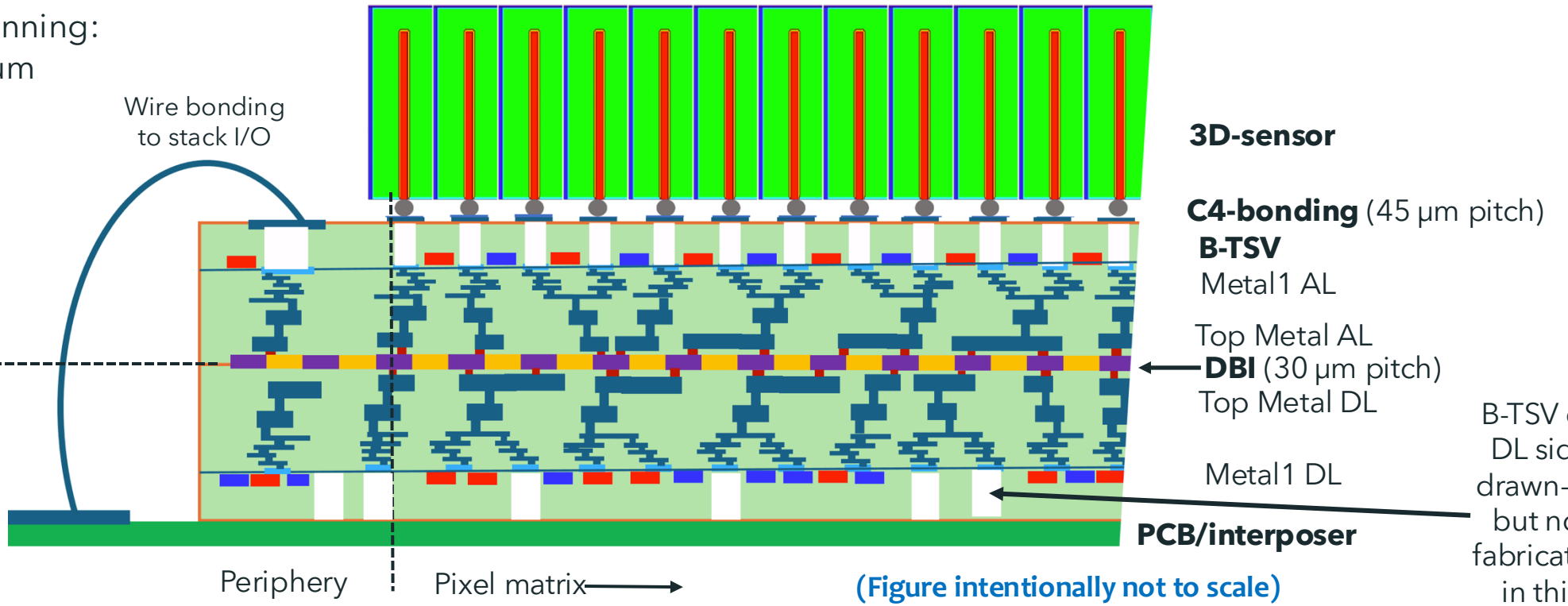
64x64 pixels ASIC

Fractal series

3D Heterogeneous Integration

- Il concetto del **FractalDesign** è strettamente legato all'integrazione verticale.
- L'ASIC consiste di due strati sovrapposti (vertical stack): Analog Layer e Digital Layer
- Questa tecnica non è mai stata realizzata in fisica delle alte energie (HEP).
- Realizzarla significa aprire una vasta area di applicazioni tecnologiche in HEP, specie per la misura ad alta risoluzione spazio-temporale ad altissimo rate di interazione ≈ 5-10 GHz/cm² (Hi-Lumi, nu-tagging, FCC)

Stack size after thinning:
- Sensor ≥ 150 µm
- AL ~10 µm
- DL ≥ 10 µm



IGNITE

Preventivi finanziari 2026 e anagrafica

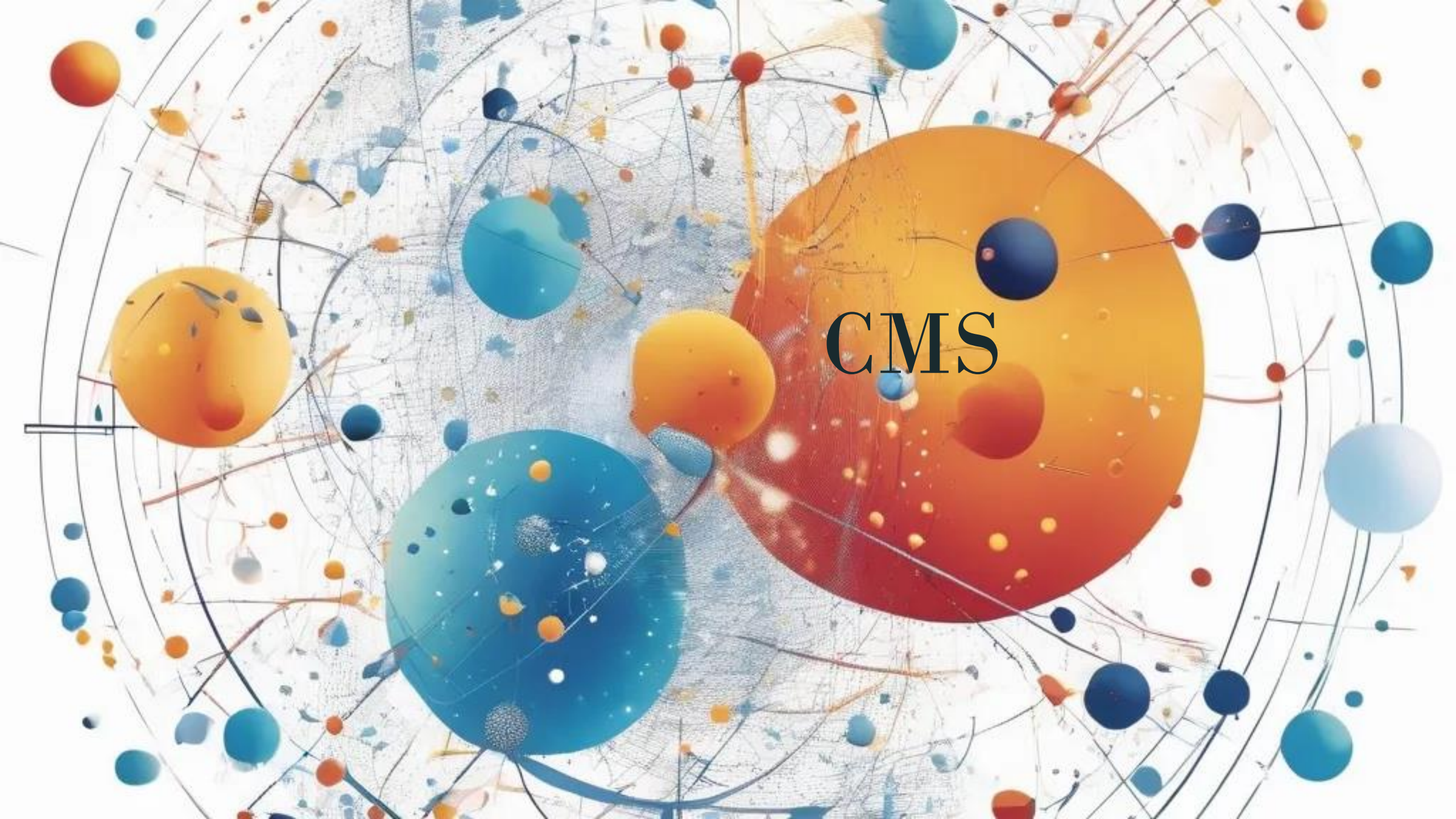
- Su Cagliari (sede RN) vengono concentrate le richieste maggiori e, se il caso, distribuite alle altre sezioni partecipanti in corso d'anno:

Richiesta [k€]	Sezione	Capitolo	Note
30	Cagliari	Missioni	Missioni per tutta la collaborazione (riunioni, test beam, test congiunti)
1200 SJ	Cagliari	Consumo	**Ignite-ER** (costo maschere Engineering Run) – da includere costo 14 wafer (100k€)
215	Cagliari	Consumo	Processo di integrazione verticale (3DHI) su 6 coppie di wafer. V. nota
15	Cagliari	Consumo	Consumi di laboratorio (test bench sensore/ASIC e probe station)
15 SJ	Cagliari	Consumo	Test sotto radiazione per caratterizzazione ASIC (schede e sistema)

Barbaro	Massimo	80	PO (DIE)	
Cadeddu	Sandro	80	1° tecn.	
Cardini	Alessandro	30	Dir. Ric.	
Cossu	Gian Matteo	60	CTER	
La Delfa	Luigi	30	CTER	
Lai	Adriano	50	Dir. Tec.	
Lampis	Andrea	0*	Tecn TD	100% PNRR-ETIC
Loi	Angelo	0*	Tecn TD	100% PNRR-ETIC
Oldeman	Rudolf	20	PA	
Piccolo	Lorenzo	70	Tecn TD	
Verdoglia	Michele	30	Dott	

Richiesta principale: **1.2 M€** per *submission* ASIC finale 320x256 pixel in CMOS 28nm e produzione wafer aggiuntivi (the **Ignite-ER**)

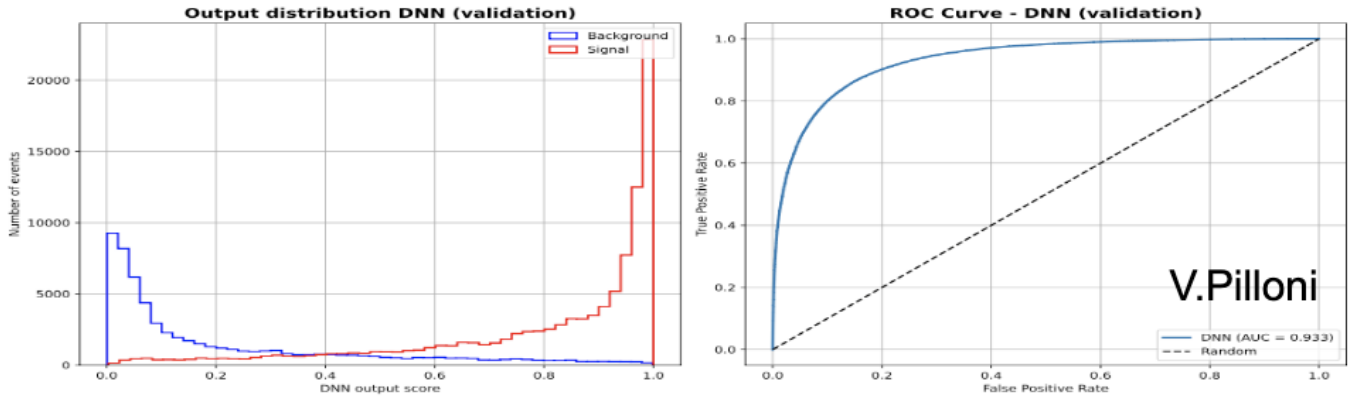
Come noto, secondo regole della CSN1, **le % IGNITE sono sinergiche a quelle di LHCb** (sono quindi sommate insieme per MOF esperimento, regolamento pubblicazioni, metabolismi di missioni e consumo).

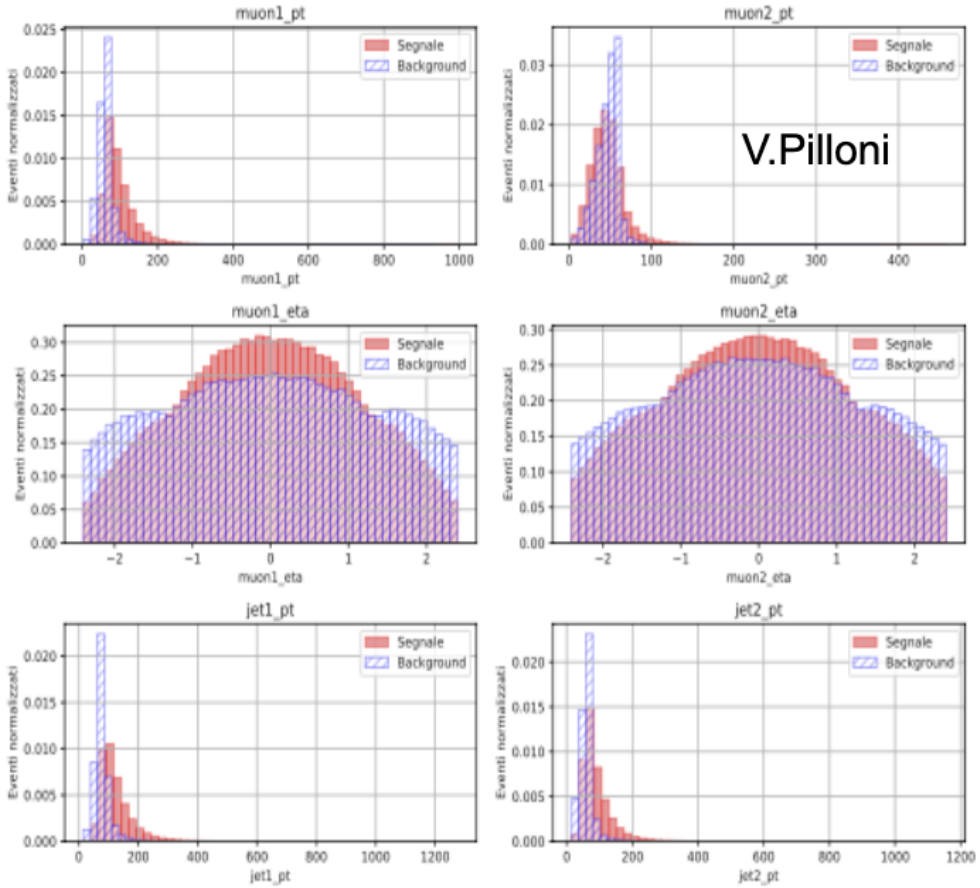

CMS

CMS: HIGGS - H→μμ (Run3)

Francesca Dordei
INFN Cagliari

- HMuMu working group coordination [Pierluigi Bortignon]
- Run3 MC validation of signals (ggF, VBF) and main backgrounds (DYJets, ttbar) using NanoAOD
- Bachelor theses:
  - Veronica Pilloni - Exp.07/2025 - UniCa
    - Development of DNN for ggF and VBF classification using Run3 MC
  - Nicola Lavarda - UniPD
  - Filippo Dorigo - UniPD
  - Tommaso Zamboni - UniPD





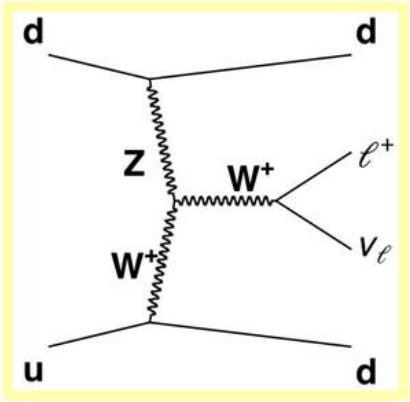
[A. C. M. Bulla, P. Bortignon, M. Tosi]

CMS: Vector Boson Fusion W (Run2)

Francesca Dordei
INFN Cagliari

Motivation:

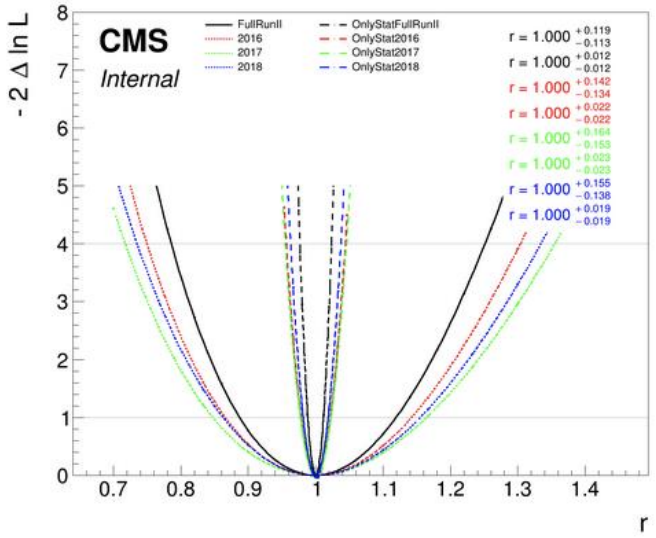
- Test of the SM gauge sector, **complementary** to Higgs Boson measurements
- Sensitive to new (BSM) physics: a**TGC, EFT**

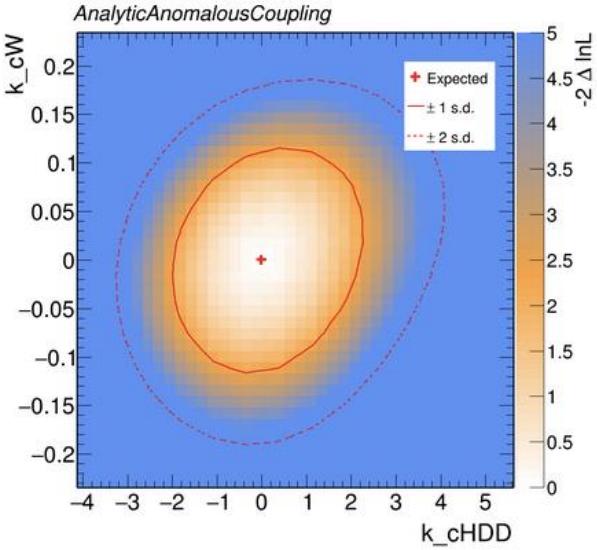


Signature:

- 2 highly energetic jets ("tagging" jets):
  - large gap in **η** (**|Δηjj|**)
  - high jet invariant mass (**mjj**)
- 1 charged lepton and neutrino pTmiss
  - central wrt the VBF jets

- **Statistical Method**: Combined binned maximum likelihood fit of the DNN output using signal and background templates.
- Expected 10% precision on the **signal cross section**
- **Direct** EFT injection and reinterpretation w/ high sensitivity to bosonic dimension-6 operators



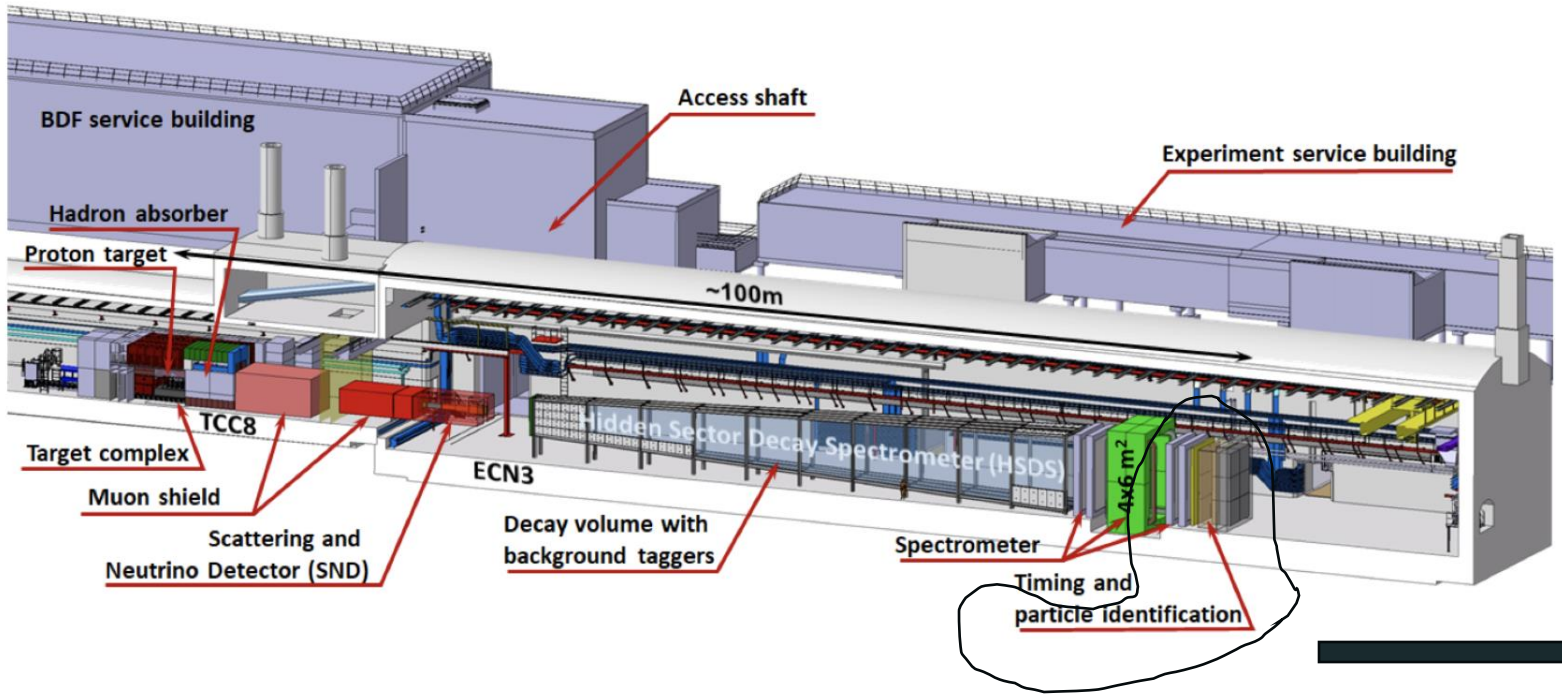


[A. C. M. Bulla, P. Bortignon, M. Tosi]


SHIP

1. Energy	2. Intensity (operators)	3. Intensity (particles)
New physics is heavy but may be produced by increasing $\sqrt{s}$	New physics is too heavy to be produced but induces detectable effective interactions	New physics is light and feebly-coupled but may be detected if increasing intensity

SHiP
Search for Hidden Particles



L'esperimento è **progettato per cercare qualsiasi tipo di particelle debolmente interagenti** e a vita media lunga, tra cui ad es. leptoni neutri pesanti, fotoni oscuri, scalari oscuri, ALPs e particelle supersimmetriche leggere.

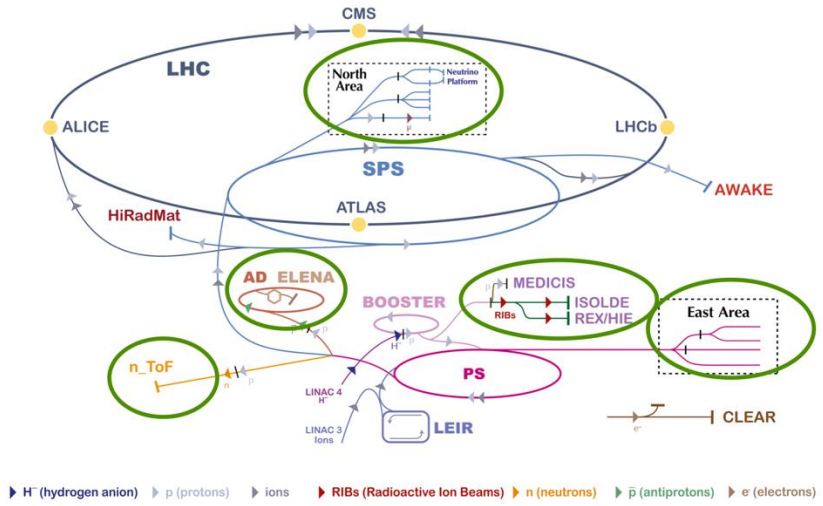
HI-ECN3 upgrade: finanziata dal CERN ~50 MCHF: **TDR nel 2026**

Rivelatori: verso una configurazione iniziale per il 2033 con un sotto-insieme dei sotto-rivelatori : **TDR nel 2027** → misura dei fondi

Responsabilitá a CA nella calorimetria/PID + editorial board/speaker's bureau chair
CA unici italiani tra i proponenti nel 2013 (poi NA)

[W. Bonivento, G. D'Appollonio]

Pursuing a compelling scientific programme complementary to high-energy colliders



Exploiting the unique capabilities of CERN accelerator complex
~ 20 projects, ~ 3 500 scientists

ISOLDE: radioactive nuclei facility
n-TOF: n-induced cross-sections
CLOUD: impact of cosmic rays on aeorosols and clouds
AD / ELENA: Antiproton Decelerator for antimatter studies
COMPASS → AMBER: hadron structure and spectroscopy
NA61/SHINE: ions and neutrino targets
NA62: rare kaon decays
NA64: search for dark photons
NA65: study of tau neutrino production
Neutrino Platform: ν detector R&D for experiments in the US and Japan
SHiP: future beam dump experiment with high-intensity beams
Etc. etc.

F. Gianotti, ESPP Update 2025, Venezia

Chiara priorità del CERN.

Pursuing a compelling scientific programme complementary to high-energy colliders

Physics Beyond Colliders Study Group

Neutrino physics
SHiP
SBN@CERN (ENUBET/NuTAG)
FASER, FPF, ***SND@LHC***

QCD related and other SM precision measurements:
AMBER, SMOG2, LHCspin, ALADDIN, ***TWOCRYST***
DICE/NA60+, ***NA61/SHINE***
(***FASER***, FPF, ***SHiP***, ***SND@LHC)***
MUonE, FAMU
EDMs (ALADDIN, cpEDM, @ISOLDE)
Strong-field QED (PAX, @AWAKE, @FCC-ee/LC)
Gravitational field of LHC beam

Hidden sector with "beam dump"
NA62, NA64, SHiP
BD@AWAKE
NA64@FCC-ee(injector), BD@LC
REDTOP

Bold: running or approved experiments

The Physics Beyond Colliders Study Group, established in 2016 and supported by the 2020 ESPP update, explores scientific opportunities offered by CERN accelerator complex that are complementary to LHC main programme.
Also wide support to similar efforts in other Member State laboratories.

New long-lived particles from LHC:
ANUBIS, CODEX-B, MAPP-2, MATHUSLA40, SHIFT
FASER, FPF, ***SND@LHC***

Non-accelerator projects:
Exploit CERN's technology (RF, vacuum, magnets, optics, cryogenics) for experiments at CERN or at other laboratories.
AION-100, axion heterodyne detection, ***BabyIAXO***, FLASH, RADES

Other facilities
cpEDM
γ-factory from partially stripped ions
SBN@CERN (ENUBET/NuTAG)

Courtesy G. Schnell


Richieste e
Anagrafica

Anagrafica 2026

cognome	nome	note	modulo	contratto	profilo	stato	aff	CMS	IGNITE	LHC_B	PRINS2022LA35SY	perc	tot	
Totale(FTE)								0	3,6	10,85	0,05		14,5	
Arba	Mauro		G3	Dip	Collaboratore	Attivo	1			10		LHC-B - 10%	10	Arba
Barbaro	Massimo	OPTIME e IGI	G1	Ass	Tecnologica F	Attivo	1		80			IGNITE - 80%	80	Barbaro
Bortignon	Pierluigi		G1	Ass	Incarico di Ric	Attivo	1	0				CMS - 0%	0	Bortignon
Bulla	Andrea Claudio Maria		G1	Ass	Scientifica Dot	Attivo	1	0				CMS - 0%	0	Bulla
Cadeddu	Sandro		G2	Dip	Primo Tecnolo	Attivo	5		80	20		IGNITE - 80% LHC-B - 20%	100	Cadeddu
Cardini	Alessandro	IGNITE Sinerg	G1	Dip	Dirigente di Ri	Attivo	1		20	50		IGNITE - 20% LHC-B - 50%	70	Cardini
Contu	Andrea	OPTIME e PN	G1	Dip	Primo Ricerca	Attivo	1			45	5	LHC-B - 45% PRINS2022LA	50	Contu
Cossu	Gian Matteo	OPTIME e IGI	G3	Dip	Collaboratore	Attivo	1		60	40		IGNITE - 60% LHC-B - 40%	100	Cossu
De Angelis	Camilla		G1	Ass	Scientifica Dot	Attivo	1			100		LHC-B - 100%	100	De Angelis
Dettori	Francesco		G1	Ass	Incarico di Ric	Attivo	1			80		LHC-B - 80%	80	Dettori
Dordei	Francesca	Referente per	G1	Dip	Primo Ricerca	Attivo	1			70		LHC-B - 70%	70	Dordei
Fabiano	Federica		G1	Ass	Scientifica Ass	Scaduto	1			100		LHC-B - 100%	100	Fabiano
La Delfa	Luigi		G3	Dip	Collaboratore	Attivo	2		30	30		IGNITE - 30% LHC-B - 30%	60	La Delfa
Lai	Adriano	OPTIME e IGI	G2	Dip	Dirigente Tecr	Attivo	1		50	50		IGNITE - 50% LHC-B - 50%	100	Lai
Lampis	Andrea		G2	Dip	Tecnologo	Scaduto	2		0	0		IGNITE - 0% LHC-B - 0%	0	Lampis
Liang	Zhihua		G1			Attivo	1			0		PNRR_ICSCS2 100%	0	Liang
Litvinov	Roman		G1	Ass	Scientifica Ass	Scaduto	1			100		LHC-B - 100%	100	Litvinov
Loi	Angelo		G2	Dip	Tecnologo	Scaduto	2		0	0		IGNITE - 0% LHC-B - 0%	0	Loi
Kotriakhova	Sofia									100		LHC-B - 100%	100	Kotriakhova
Manca	Giulia		G1	Ass	Incarico di Ric	Attivo	1			100		LHC-B - 100%	100	Manca
Marras	Davide		G3	Dip	Collaboratore	Attivo	3			10		LHC-B - 10%	10	Marras
Oldeman	Rudolf	OPTIME Sine	G1	Ass	Incarico di Ric	Attivo	1		30	70		IGNITE - 30% LHC-B - 70%	100	Oldeman
Piccolo	Lorenzo		G2	Dip	Tecnologo	Attivo	1		70	30		IGNITE - 70% LHC-B - 30%	100	Piccolo
Provenzano	Daniele		G1	Ass	Scientifica Dot	Attivo	1			100		LHC-B - 100%	100	Provenzano
Saitta	Biagio		G1	Ass	Associazione	Scaduto	1			0		LHC-B - 0%	0	Saitta
Tuveri	Marcellino		G3	Dip	Collaboratore	Attivo	5			20		LHC-B - 20%	20	Tuveri
Verdoglia	Michele		G1	Ass	Scientifica Dot	Attivo	1		30	70		IGNITE - 30% LHC-B - 70%	100	Verdoglia

Regole Metabolismi CSN1

Francesca Dordei
INFN Cagliari

- Missioni: (FTE + 0,7) × 0,6 + DIST
- Gettoni per responsabilità:
  - 1.5 k€ per ciascun referee non coordinatore
  - 2 k€ per ciascun Osservatore nelle altre CSN
  - 30 k€ per Presidente CSN1
  - Per membri di nomina/rappresentanza INFN riconosciuta in comitati:
    ECFA 4 k€, PDG 4 k€, ECFA panels 2 k€, ACCU 2 k€, LHCC 4 k€, SPSC 3 k€, GLV 1.5 k€, RRB 8k€, …
  - M. Maggiora direttore I2JL: spese non più incluse in finanziamento BES ⟹ 42 k€ da Dot1 TO
- Consumi: (FTE + 6.0) × 0.36
- Inventariabile: 5.2 × ln(FTE) + FTE/3.8 – 3

Sede	DIST (k€)
CA, CT, LE, TS	+3
BA	+2
RM1/2/3, LNF	–2
Altre sedi	0

n. FTE	Pubblicazioni (k€	Seminari (k€)
< 15	1	2
15 – 45	2	2
> 45	3	2

Anagrafica e richieste 2026

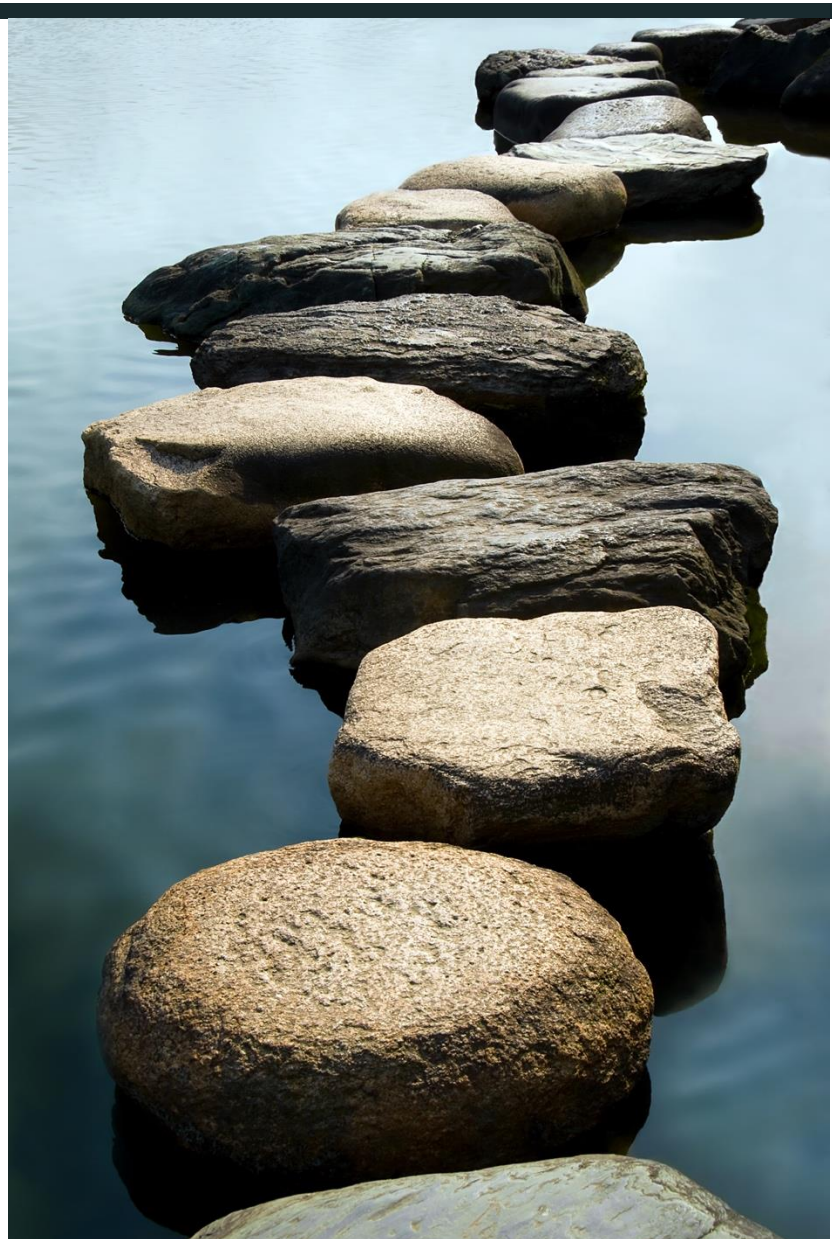
Francesca Dordei
INFN Cagliari

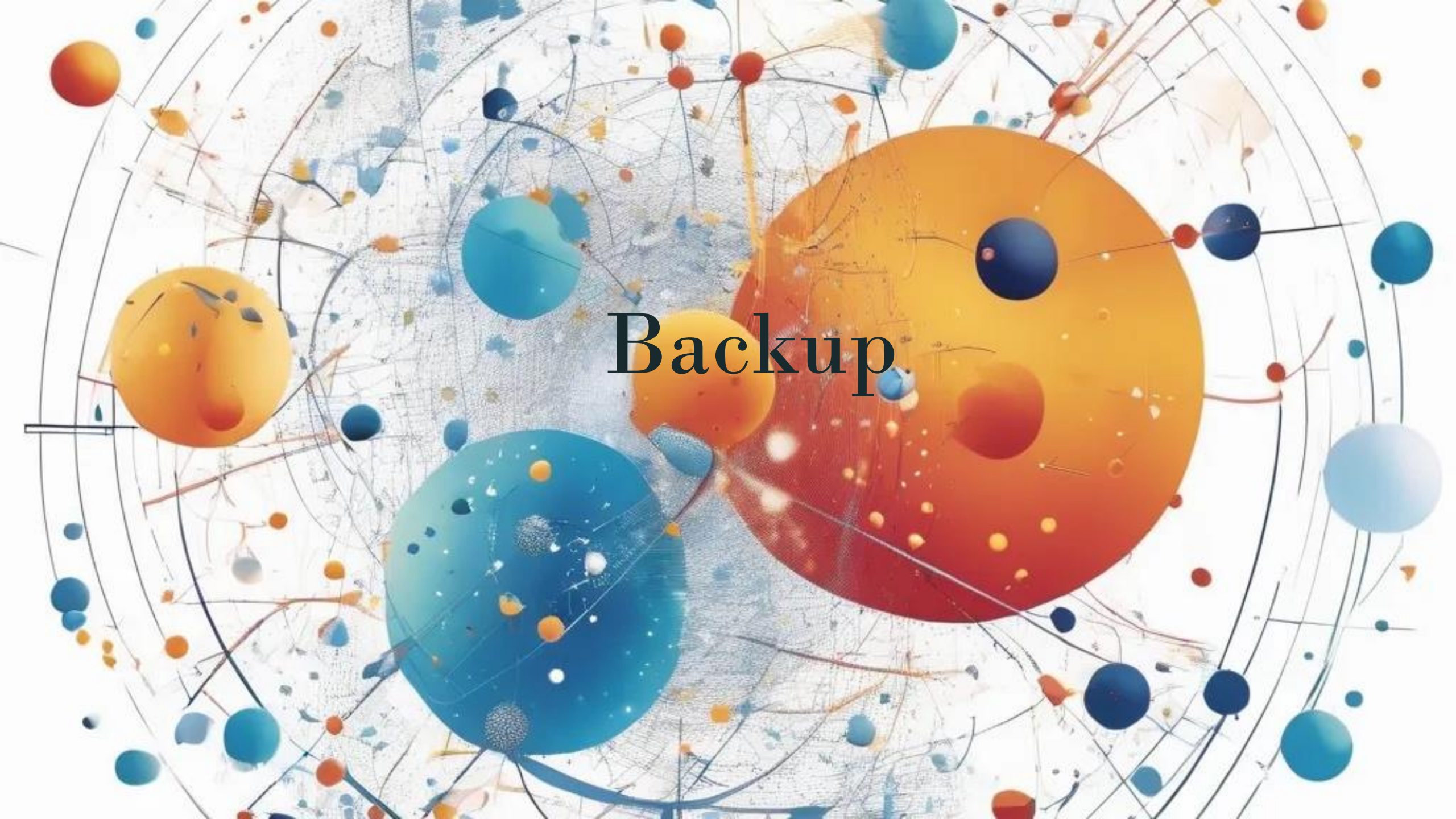
- **Ricercatori + Tecnologi: 17.5 (10.85 LHCb + 2 CMS + 3.6 IGNITE + 0.05 PRINS2022LA35SY + 1 PNRR_ICSCS2)**
- **Collaboratori Tecnici: 2 (1.1 LHCb + 0.9 IGNITE da sinergia)**
- Richieste tabellari + gettoni Dotazioni:
  - Missioni (tabellari + gettoni): 17.5K€
  - Consumo: 8.5K€
  - Inventariabile: 16.5K€
  - Seminari: 2K€
  - Pubblicazioni: 2K€

Conclusioni

Francesca Dordei
INFN Cagliari

- Gruppo sostanzialmente stabile (+0.2 FTE)
- LHCb Cagliari, includendo le attività di IGNITE, si conferma uno dei piu` grandi gruppi di LHCb in Italia con un coinvolgimento importante su tutti i fronti che si rispecchia nei ruoli di responsabilità ricoperti sia ora che in passato.




Backup

Assegnazioni 2025

•Ricercatori + Tecnologi: 17.3 (11.4 LHCb + 2 CMS + 2.6 IGNITE + 0.2 Spoke2 + 1.1 Optime da sinergia)

•Collaboratori Tecnici: 1.7 (1.1 LHCb + 0.5 IGNITE + 0.1 Optime da sinergia)

•Richieste tabellari + gettoni:

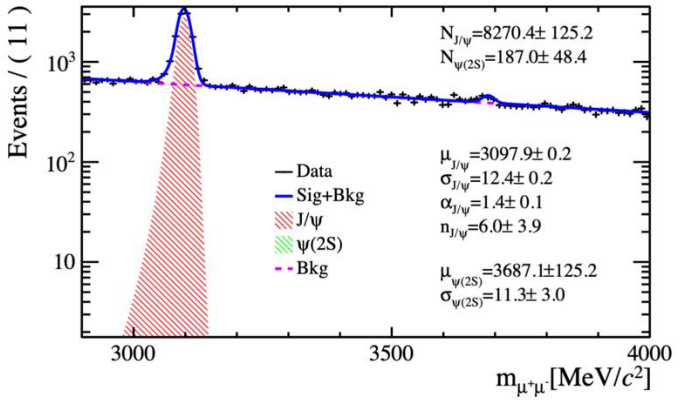
- Missioni (tabellari + gettoni): 18K€
- Consumo: 8.5K€
- Inventariabile: 16.5K€
- Seminari: 2K€
- Pubblicazioni: 2K€

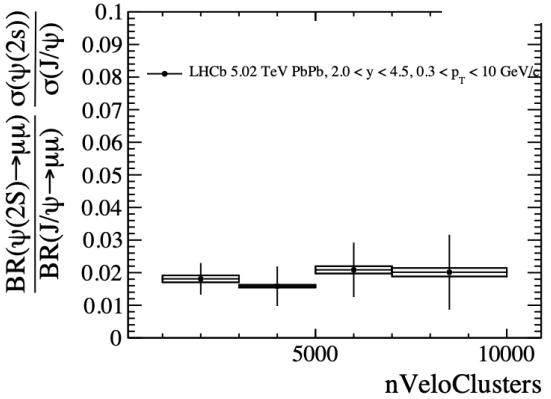
Selected Results: PbPb (CdA,GM)

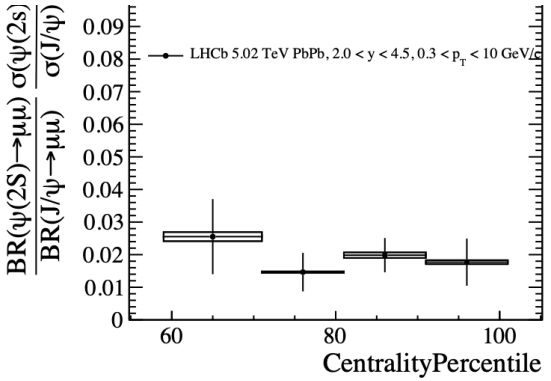
$\psi(2S)/J/\psi$ ratio vs multiplicity in PbPb collisions 5.02 TeV

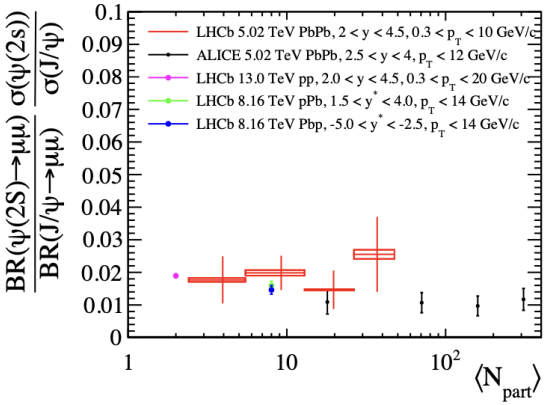
- Quarkonia suppression is a good probe to study QGP formation:
  - **Stronger dissociation expected for** $\psi(2S)$ **wrt** J/ψ since lower binding energy
  - Relative **quarkonia yield** expected to **change** with different temperatures achieved **in different centrality regions**

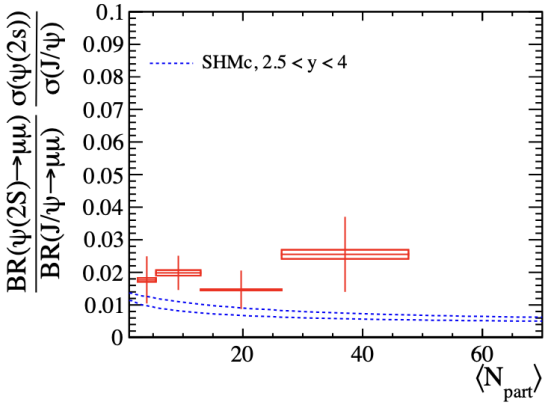
In collaboration with Frascati, LosAlamos and Tsinghua









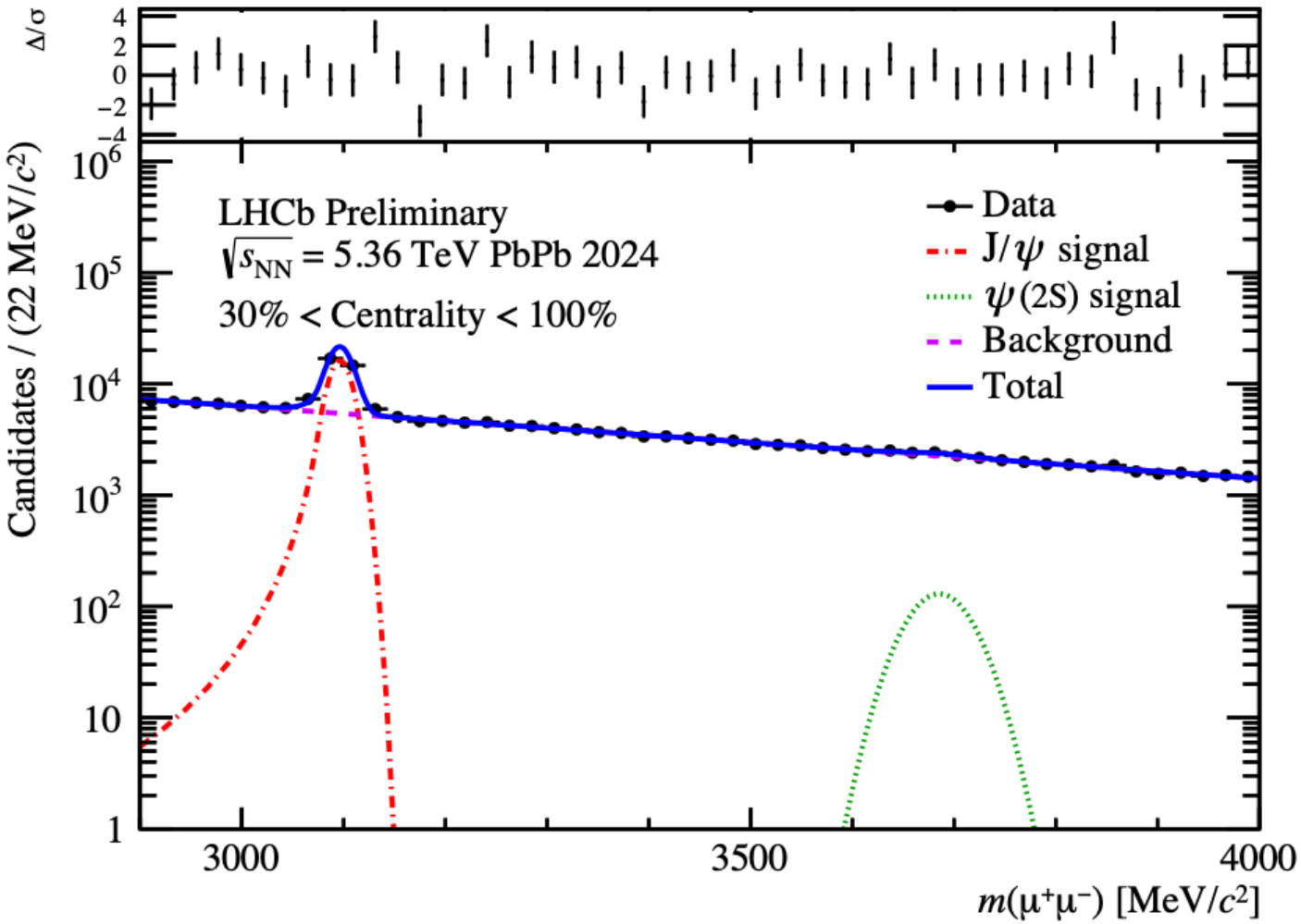


- **Reasonable agreement with ALICE and LHCb *pp* and *p*Pb results and theory**

Published by JHEP !

- **New results with 2024 data on the way**

PbPb in 2024 (CdA, GM)



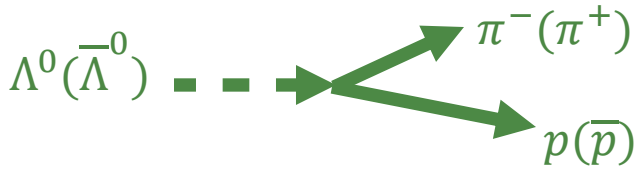
- Work in progress

Selected Results: SMOG (CdA,FF,GM)

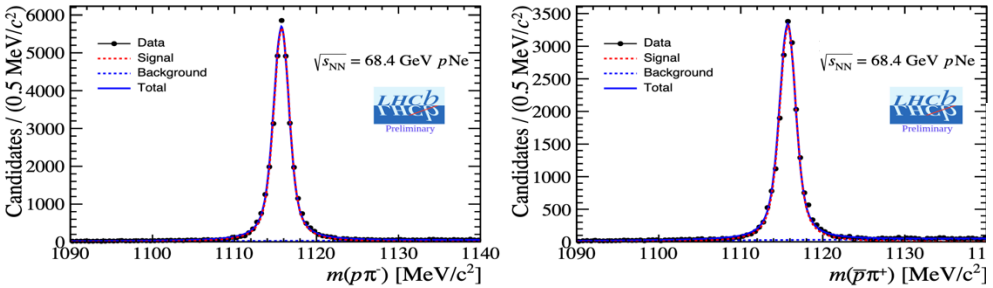
Λ transverse polarization in pNe collisions at $\sqrt{s}$ 5.68 = GeV (CdA,GM)

In collaboration with Frascati

- **We measured the polarization in the 2017 SMOG pNe sample:**

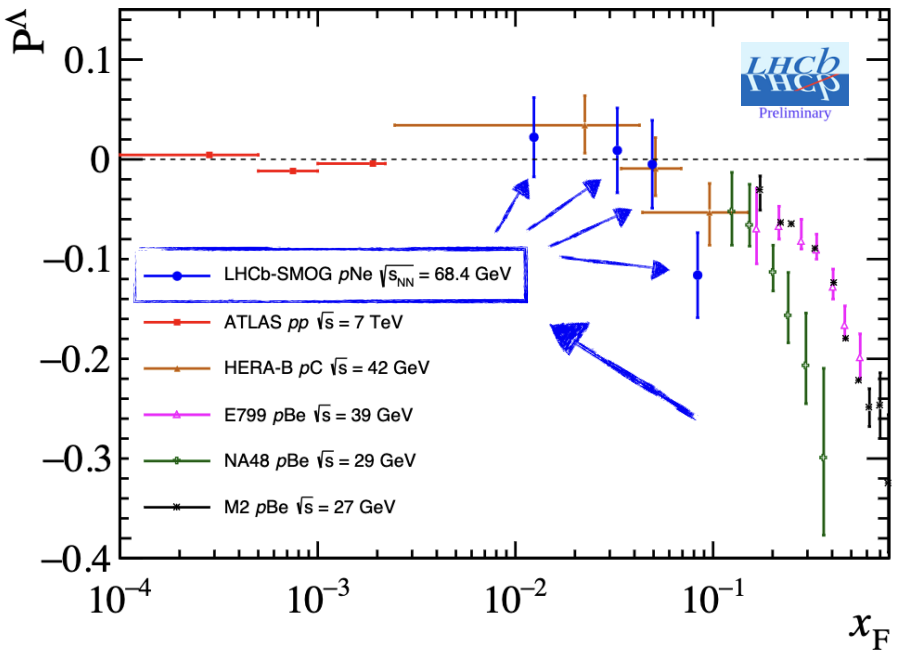


Both Λ and $\overline{\Lambda}$ states analyzed



- **Decay protons** are preferentially emitted along the spin direction of the Λ
- Polarization accessible measuring the **asymmetry in the proton's angular distribution:**

$$\frac{dN}{d\Omega} = \frac{dN_0}{d\Omega}(1 + \alpha P_n^{\Lambda} \cos\theta)$$



- **Published in JHEP**

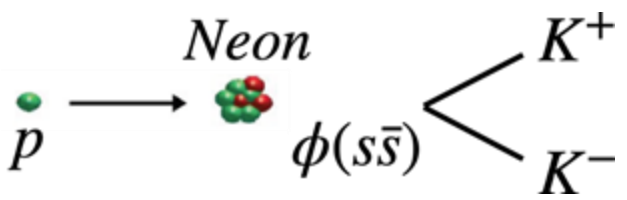
Selected Results: SMOG (CdA,FF,GM)

Strangeness production in in *p*Ne collisions at $\sqrt{s}$ 68.5 = GeV (FF,GM) *In collaboration with Frascati*

First *measurement of the cross-section in pT, y in pNe collisions at 68.5 GeV*

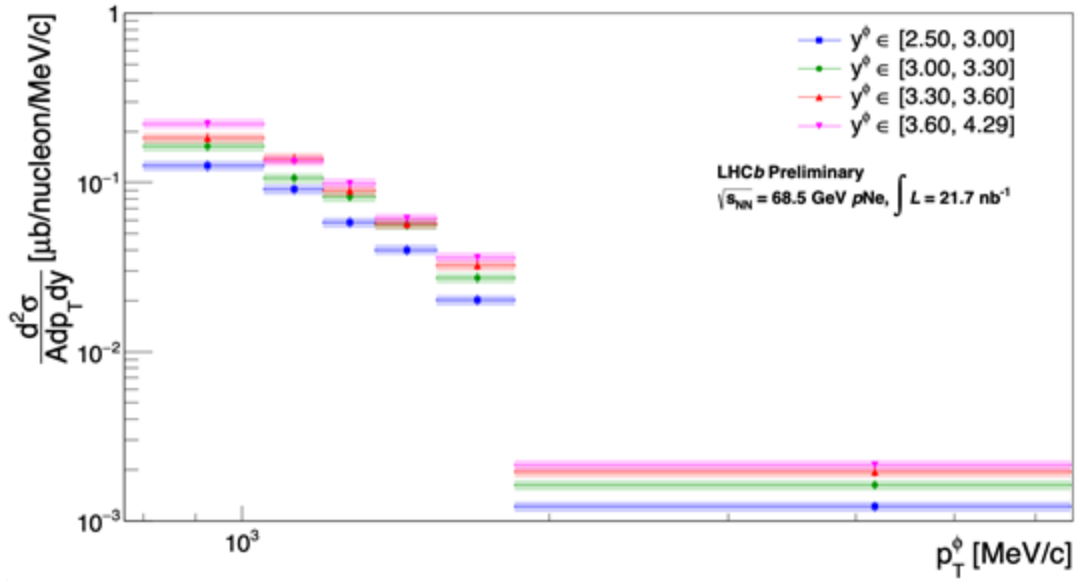
- ***Observable***

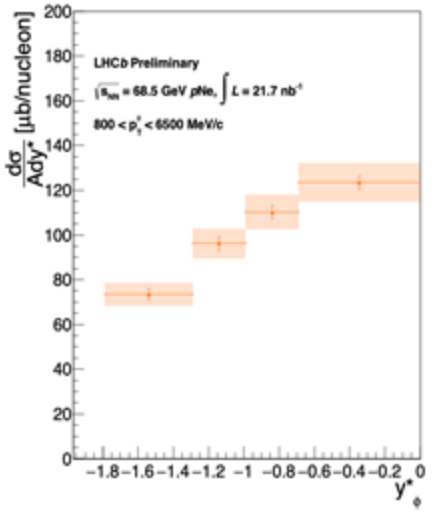
$$\frac{d^2\sigma(p_T, y)}{dp_T\, dy} = \frac{N^{\phi}(p_T, y)}{\mathscr{L}\, \mathrm{BR}\, \epsilon_{tot}(p_T, y)\, \Delta p_T\, \Delta y A_{Ne}}$$

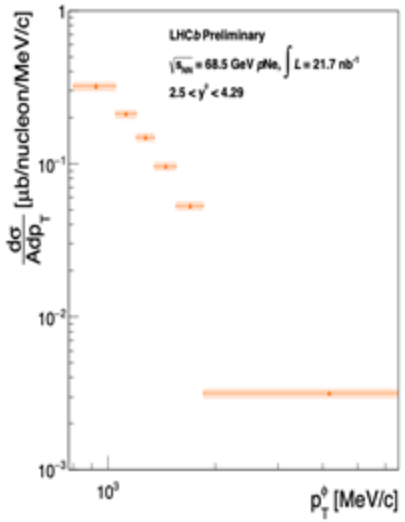


BR = (48.9 ± 0.5)%

Results: ***Double differential cross-section per nucleon in pT,y***







- Published in JHEP

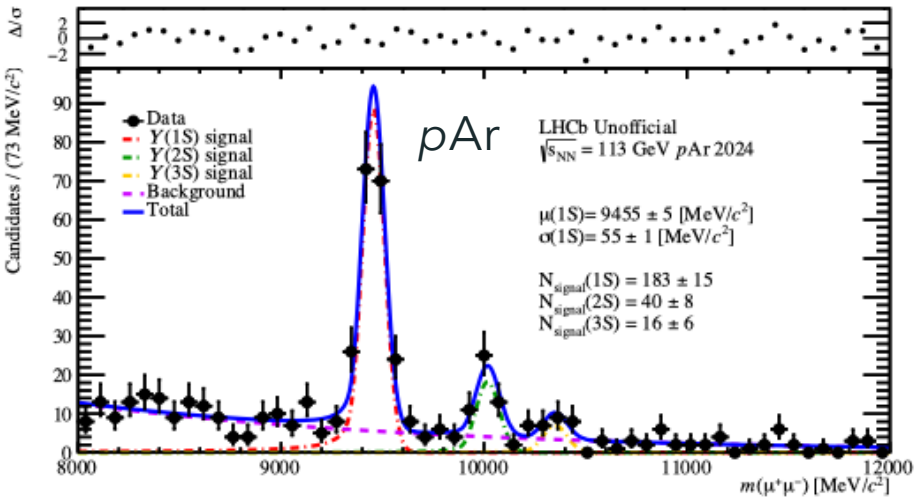
Selected Results: SMOG (CdA,FF,GM)

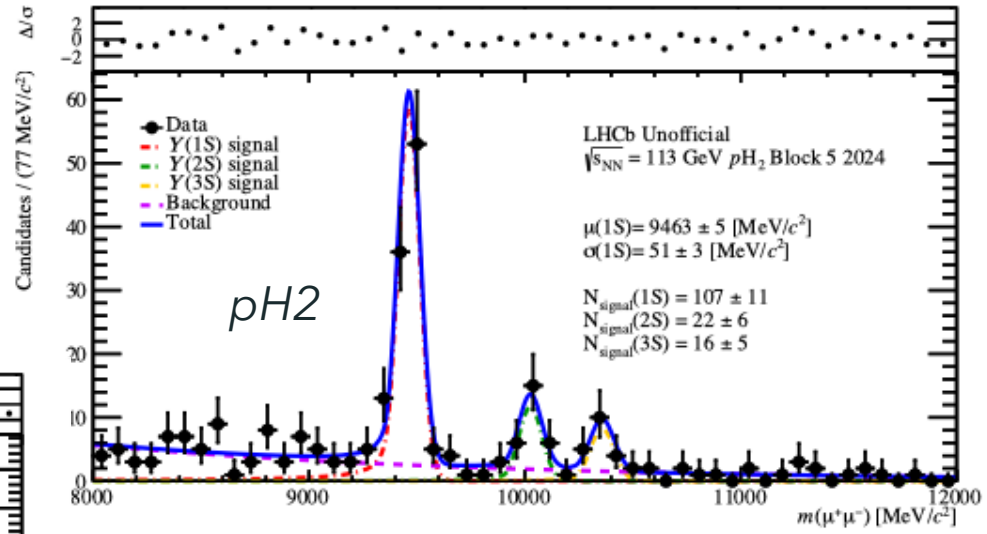
Upsilon production in *p*Ar,pH collisions in Run3(FF,GM)

In collaboration with Frascati

Aiming to *measurement of the cross-section or ratio of*

Results: ***single differential cross-section per nucleon in pT,y if Lumi available***



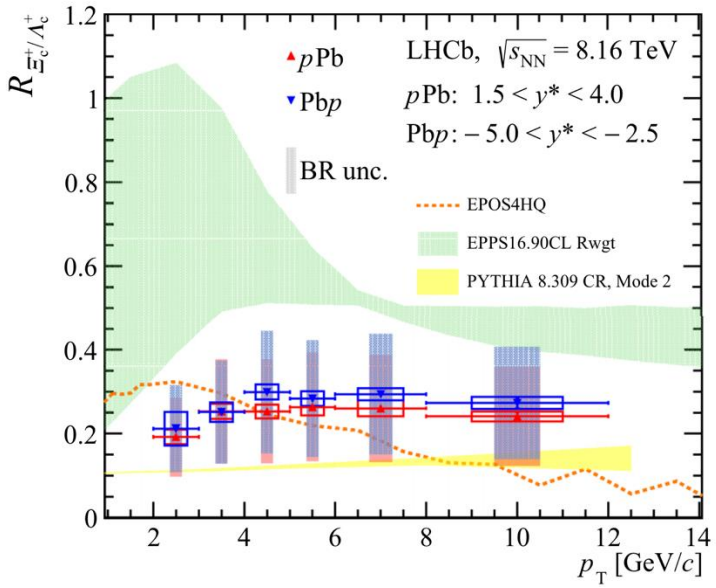


Selected Results: pp (RL,JS,GM)

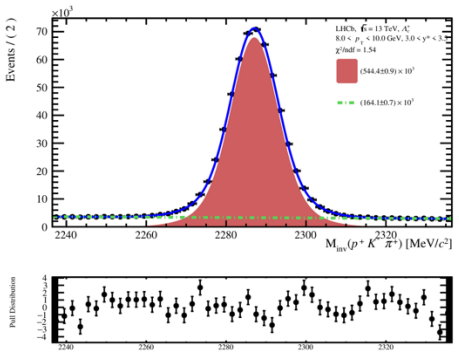
Prompt Ξ_c^+ production in pPb and *pp* collisions

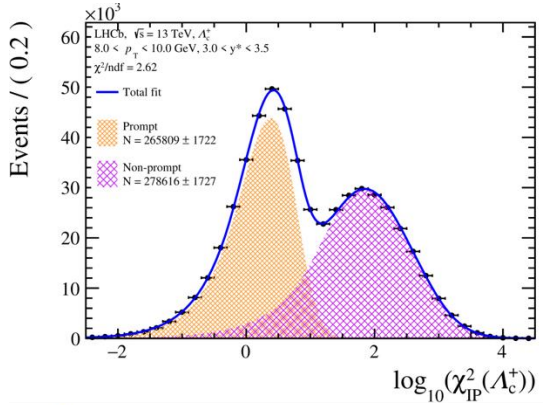
Powerful probe of hadronization:

- charmed baryon formation is not universal and depends on collision system (ref).



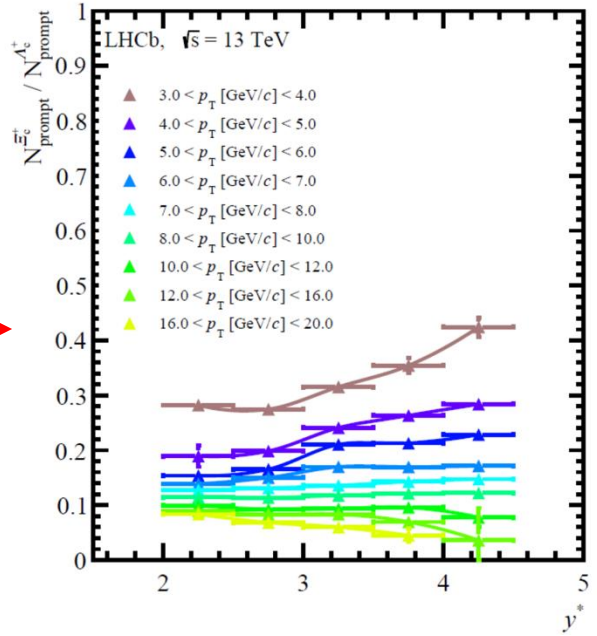
Phys. Rev. C 109, 044901





Analysis in *pp* collisions at 13 TeV is ongoing:

- LHCb provides extensive studies of charm hadronisation;
- Prompt signal selection is done;



In collaboration with Maastricht
WORK IN PROGRESS

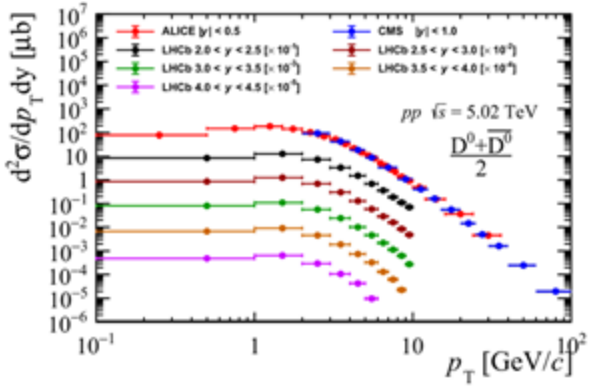
Total charm cross-section in 5.02 TeV *pp* collisions (JS, GM)

- Combination of extensive open charm hadron cross-sections by ALICE, CMS & LHCb
  - Charm baryon data used for the first time
- Pythia8 tuned to match *D*-meson data → extrapolation to full phase space
- Precise result on the upper limit of NLO calculations

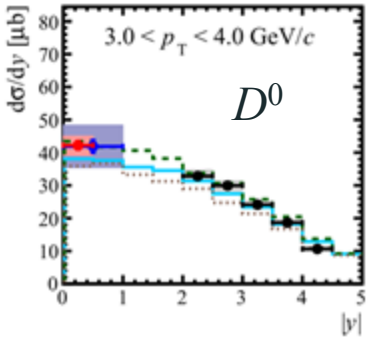
In collaboration with Krakow, Heidelberg, LLR, , C.Bierlich @Lund

Experiment	ALICE	CMS	LHCb
Luminosity (pb^{-1})	$(19.3\pm0.4)\times10^{-3}$	27.4 ± 0.6	8.60 ± 0.33
Hadrons	D^0, D^+, D^{*+}, D_s^+, Λ_c^+, Ξ_c^0	D^0, Λ_c^+	D^0, D^+, D^{*+}, D_s^+
p_T coverage (GeV/c)	0–36	2–100	0–10
y coverage	$\lvert y\rvert$ <0.5	$\lvert y\rvert$ <1.0	2.0< y <4.5

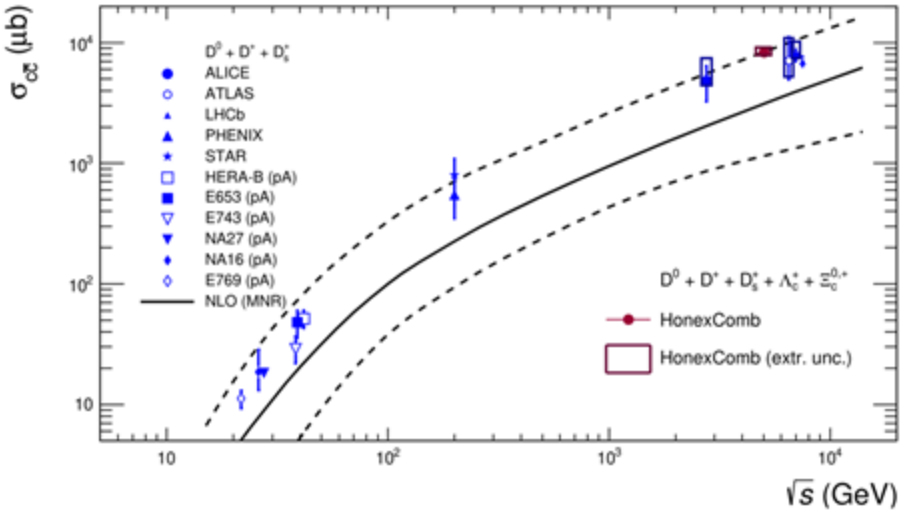
Combined D^0 measurements



Pythia vs. data



Published by EPJ Plus!



arXiv:2311.11426

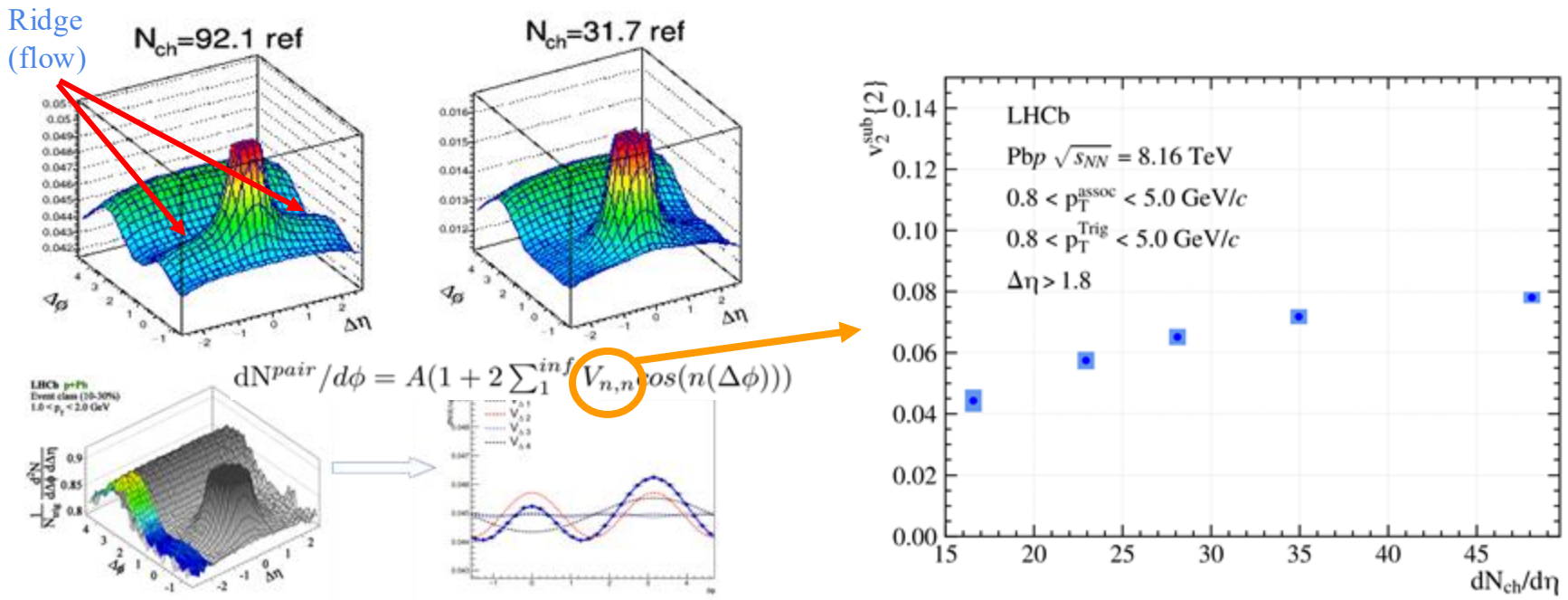
Selected Results: pPb (JS,GM)

Charged hadron flow harmonics in 8.16 TeV *p*Pb collisions

twiki

In collaboration with Santiago

- Angular correlation functions constructed from pairs of charged hadrons
- Visible near-side ridge (flow) in high activity events
- Fourier function fit to the ridge region → derive flow harmonics v_n

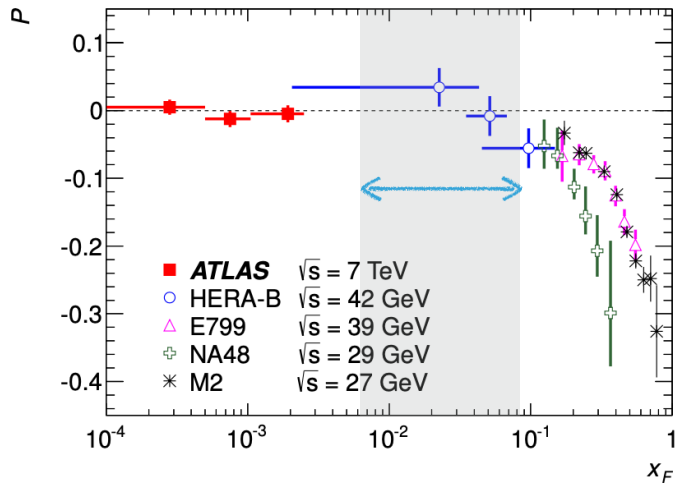


Published by JHEP !

Λ transverse polarization in *p*Ne collisions at $\sqrt{s}$ = 68.5 GeV

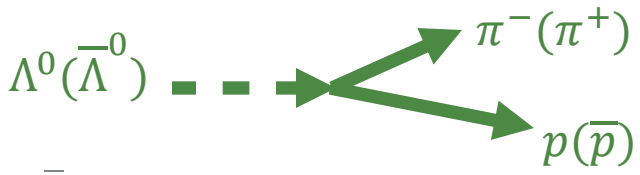
- **Transverse $_{\Lambda}$ polarization:** discovered in 1976 in *p*Be collisions using 300 GeV unpolarised beam
- **Polarization effects not expected** in particle production from unpolarised beam at **high energy**
- Polarization observed also for other hyperons (Ξ^0, $\Xi^{\pm}$, $\Sigma^{\pm}$)

- Most recent measurements in collider and fixed target experiments →
  LHCb reach in the grey zone
- Despite many theories and experiments performed, **still not a clear explanation**

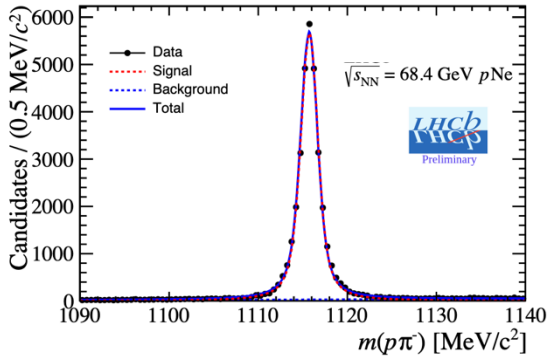


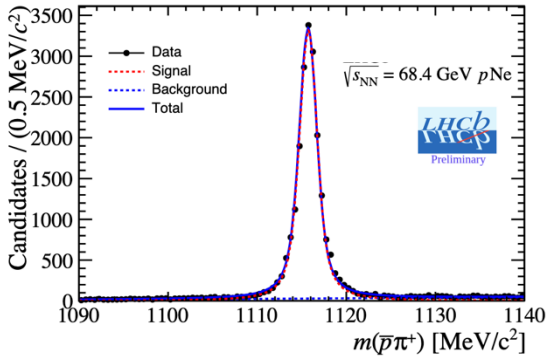
Λ transverse polarization in *p*Ne collisions at $\sqrt{s}$ = 68.5 GeV

- **We measure the polarization in the 2017 SMOG *p*Ne sample:**
  - **It is studied exploiting the Λ decay**



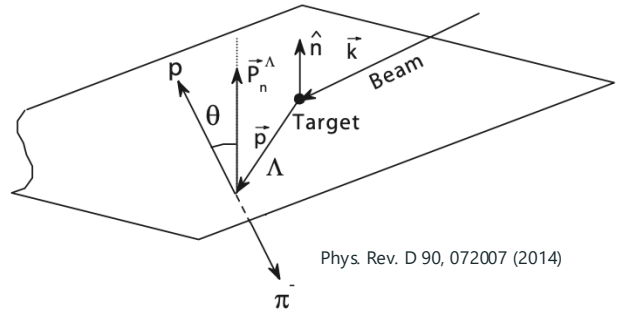
Both Λ and $\bar{\Lambda}$ states analyzed





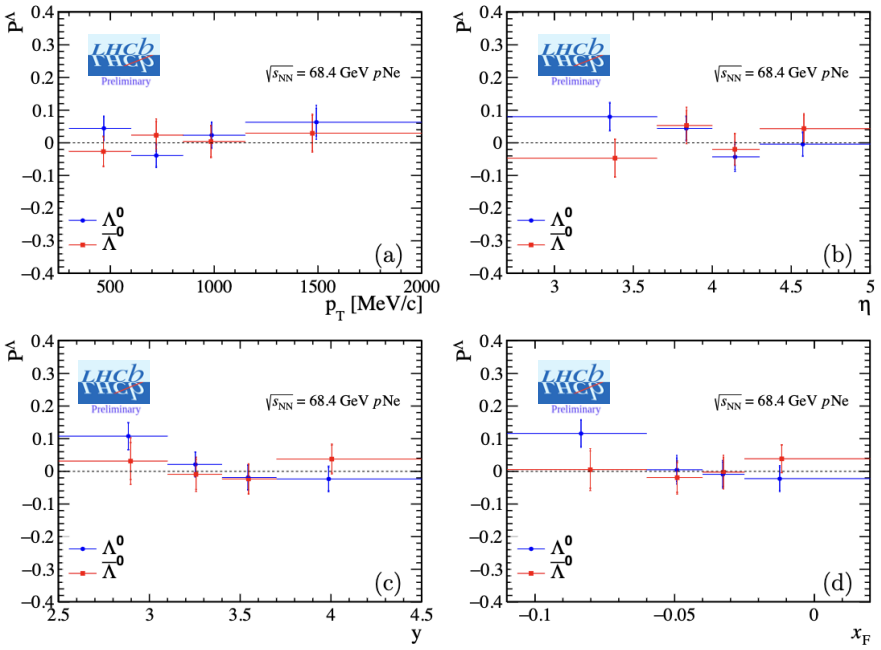
- **Decay protons** are preferentially emitted along the spin direction of the Λ
- Polarization accessible measuring the **asymmetry in the proton's angular distribution:**

$$\frac{dN}{d\Omega} = \frac{dN_0}{d\Omega}(1 + \alpha P_n^{\Lambda} \cos\theta)$$

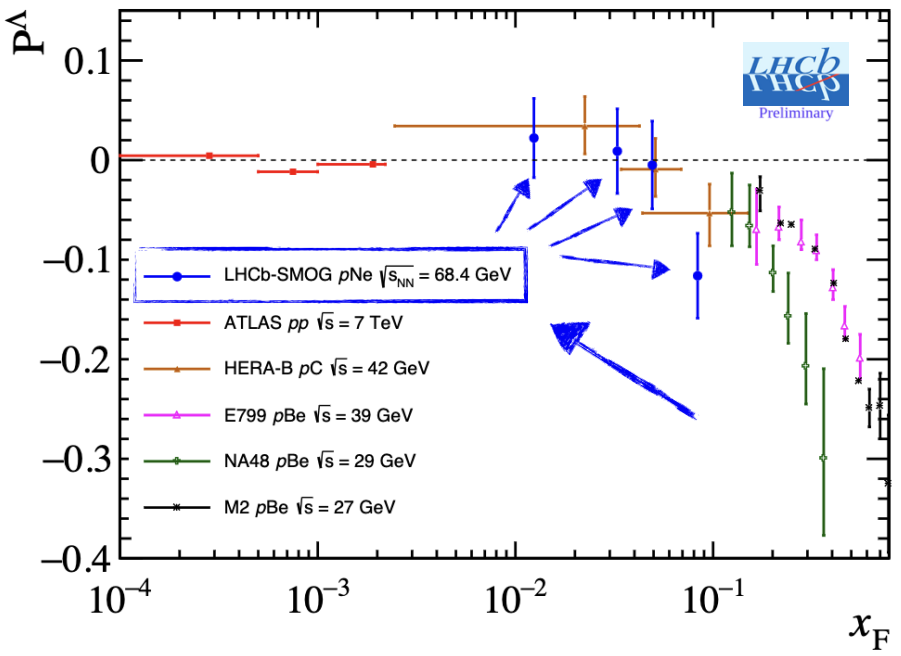


Phys. Rev. D 90, 072007 (2014)

Λ transverse polarization in *p*Ne collisions at $\sqrt{s}$ = 68.5 GeV



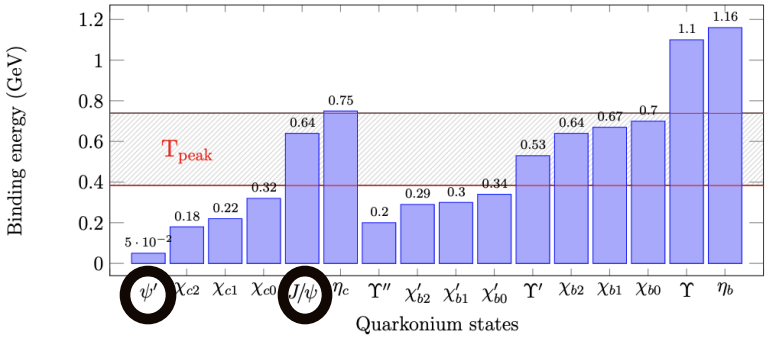
- **Comparison with results** from other experiments performed **in different kinematical regions and collision system**
- **Very good agreement!**



- LHCb-PAPER-2024-009, arxiv:2405.11324 submitted to JHEP, first minor comments received on 02/07/24!

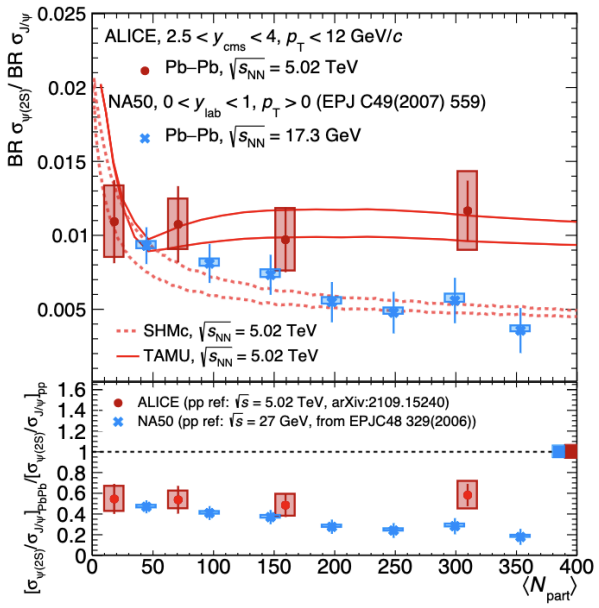
$\psi(2S)/J/\psi$ ratio vs multiplicity in PbPb collisions at $\sqrt{s}$ = 5.02 TeV

- Quarkonia suppression is a good probe to study QGP formation:
  - **Stronger dissociation expected for $\psi(2S)$ wrt J/ψ** since lower binding energy



  - Relative **quarkonia yield** expected to **change** with different temperatures achieved **in different centrality regions**

- Flat centrality dependence observed from ALICE



https://doi.org/10.1103/PhysRevLett.132.042301

$\psi(2S)/J/\psi$ ratio vs multiplicity in PbPb collisions at $\sqrt{s}$ = 5.02 TeV

- J/ψ and ψ(2S) reconstructed in the **dimuon channel**
- **The ratio is obtained as:**
  - $\frac{\mathcal{B}(\psi(2S)\to\mu\mu)\cdot\sigma_{\psi(2S)}}{\mathcal{B}(J/\psi\to\mu\mu)\cdot\sigma_{J/\psi}} = \frac{N_{\psi(2S)}}{N_{J/\psi}} \times \frac{\varepsilon_{tot}(J/\psi)}{\varepsilon_{tot}(\psi(2S))}$
    - The measurement is performed in **multiplicity bins:**

$$\mathcal{B}(J/\psi \to \mu^+\mu^-) = (5.961 \pm 0.033)\%$$
$$\mathcal{B}(\psi(2S) \to \mu^+\mu^-) = (8.0 \pm 0.6) \times 10^{-3}$$

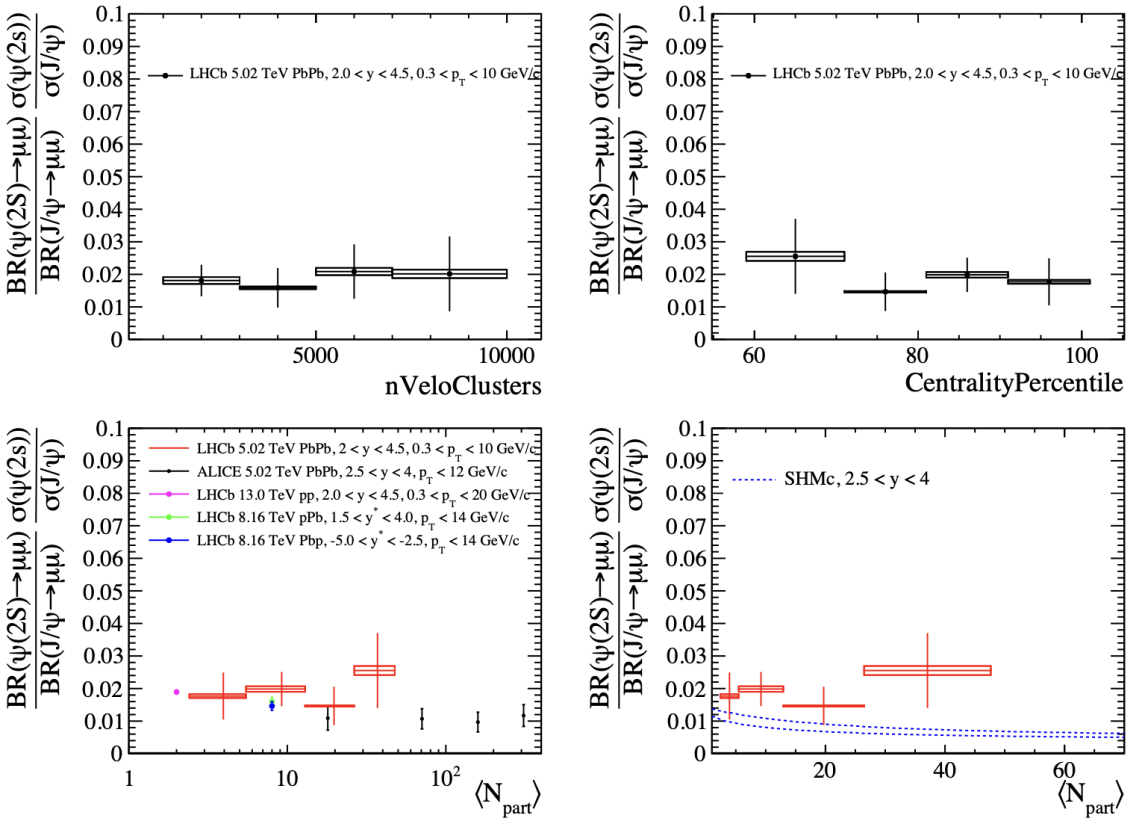
http://pdg.lbl.gov

- If conditions allow it, we would like to combine the results obtained in 2018 PbPb collisions with the 2023 ones

nVeloClusters	1000-3000	3000-5000	5000-7000	7000-10000
Centrality (%)	95	85	75	65

$\psi(2S)/J/\psi$ ratio vs multiplicity in PbPb collisions at $\sqrt{s}$ = 5.02 TeV

- **Flat multiplicity dependence,** first centrality bin dominated by statistical uncertainties

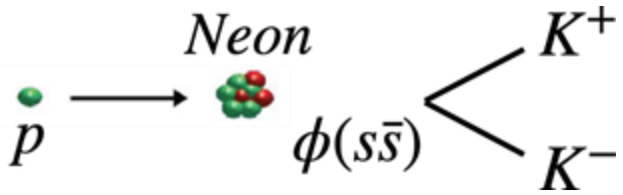


- **Reasonable agreement with ALICE and LHCb *pp* and *p*Pb results!**
- **Reasonable agreement with the Standard Hadronisation Model Theory prediction!**

https://www.nature.com/articles/s41586-018-0491-6

- **LHCb-ANA-2024-037 signed-off from the WG on 26/06/2024, RC kick-off meeting foreseen soon.**
- **Targeting Hard Probes in September 2024!**

Strangeness Production in *p*Ne and PbNe fixed-target collisions at 68.5 GeV

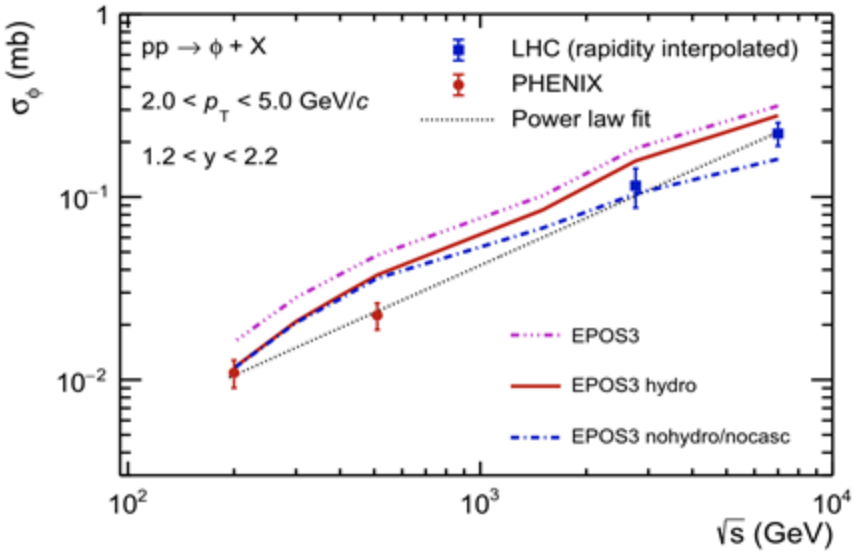


BR = (48.9 ± 0.5)%

First *measurement of the cross-section in pT, y in pNe collisions at 68.5 GeV*

- ***Observable***: $\frac{d^2\sigma(p_T, y)}{dp_T\, dy} = \frac{N^{\phi}(p_T, y)}{\mathscr{L}\, \mathrm{BR}\, \epsilon_{tot}(p_T, y)\, \Delta p_T\, \Delta y A_{Ne}}$

Previous measurements: arXiv:1402.6162v1, arXiv:1710.01656v2



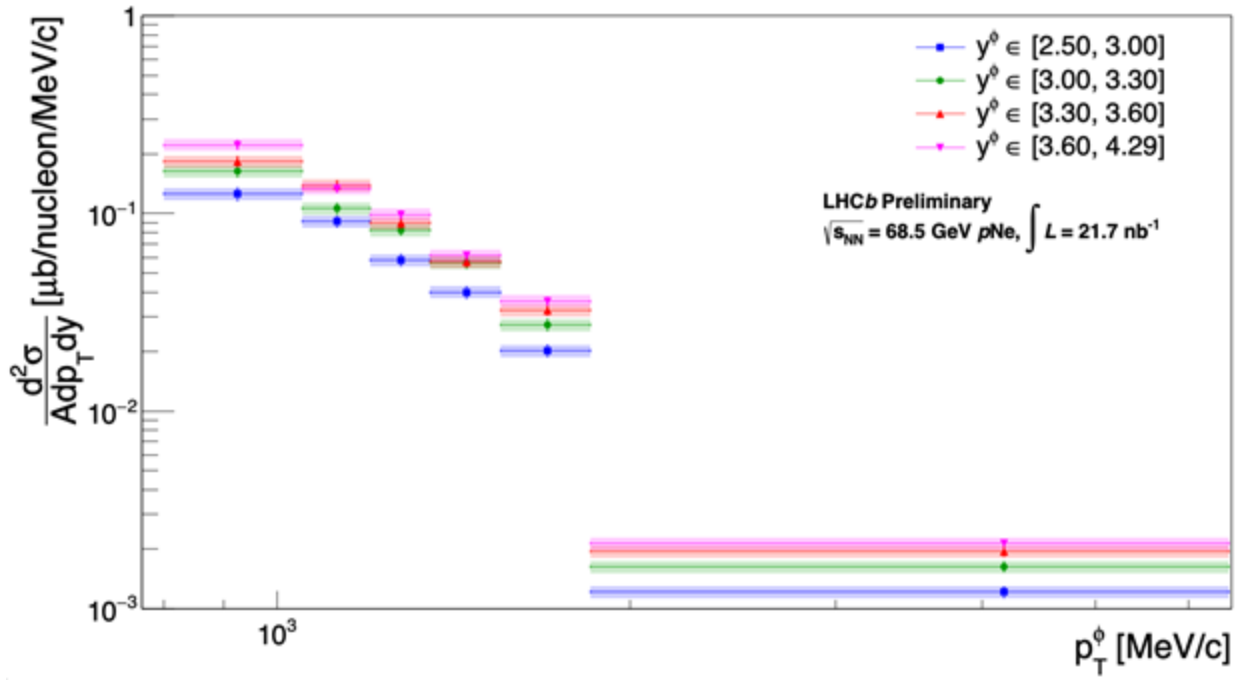
Outlook

Strangeness enhancement as a test for QGP formation

Observable: $\frac{\left(\frac{N_\phi}{N_{p,\pi}}\right)_{PbNe}}{\left(\frac{N_\phi}{N_{p,\pi}}\right)_{pNe}}$

Strangeness Production in pNe and PbNe fixed-target collisions at 68.5 GeV

Results: ***Double differential cross-section per nucleon in pT,y***

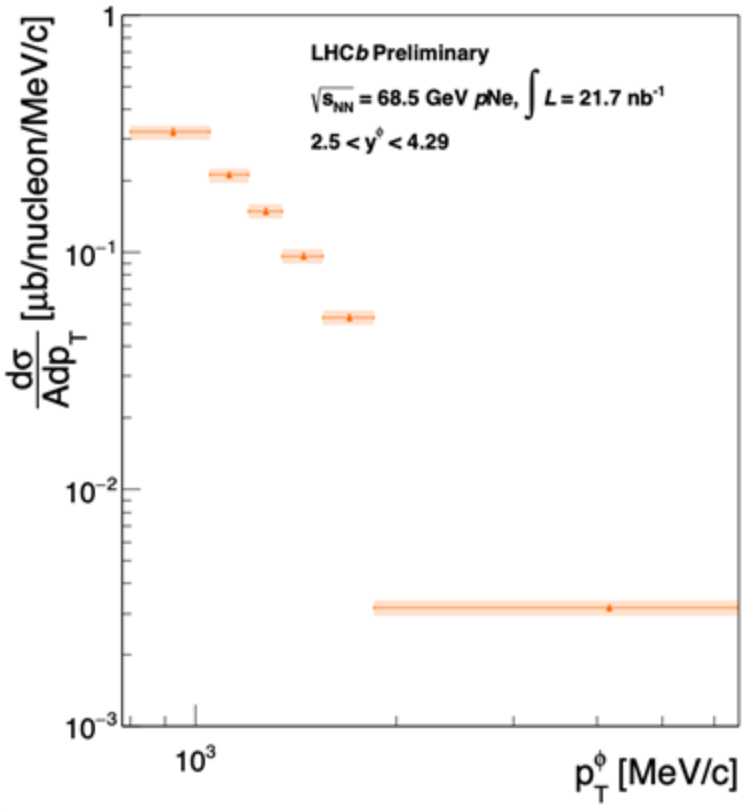


$$\frac{d^2\sigma(p_T, y)}{dp_T\, dy} = \frac{N^\phi(p_T, y)}{\mathscr{L}\,\mathrm{BR}\,\epsilon_{tot}(p_T, y)\,\Delta p_T\,\Delta y A_{Ne}}$$

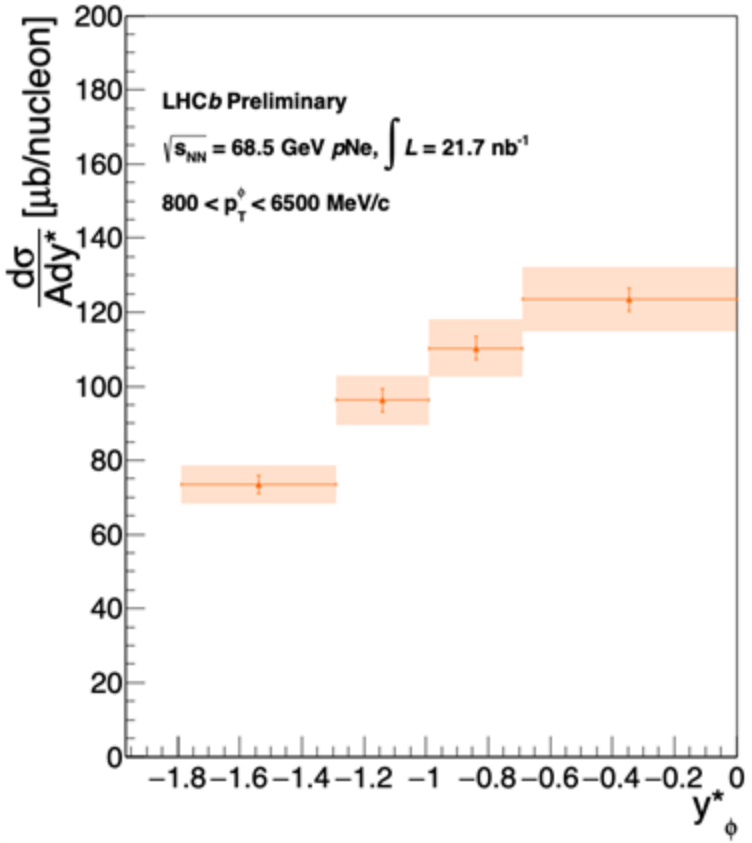
- Bars: statistical+uncorrelated uncertainties
- Filled areas: correlated uncertainties

Strangeness Production in pNe and PbNe fixed-target collisions at 68.5 GeV

Results: ***Single differential cross-section per nucleon in pT and yCM***



- Bars: statistical+ uncorrelated uncertainties
- Filled areas: correlated uncertainties



Strangeness Production in pNe and PbNe fixed-target collisions at 68.5 GeV

Results: ***Single differential cross-section per nucleon in pT compared to other experiments at RHIC and LHC***