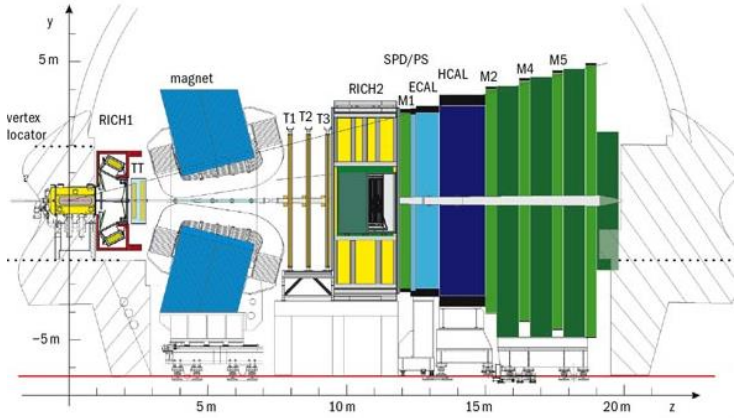


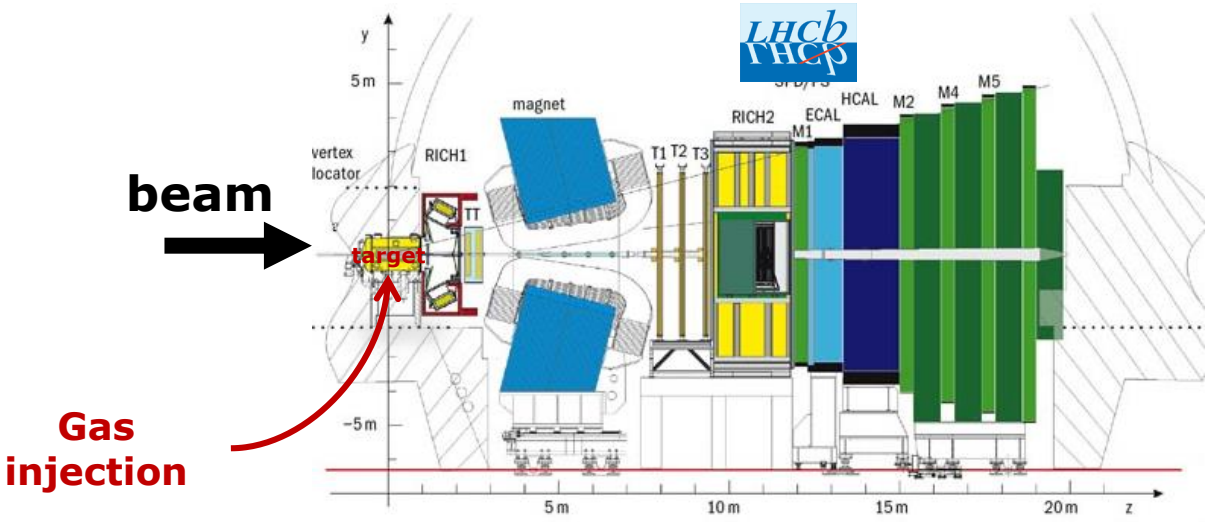
LHCb @ LLR

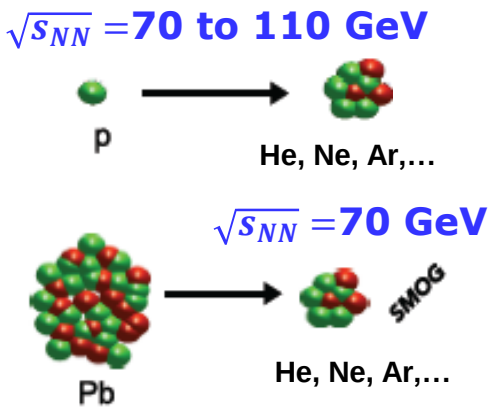
Hadronic physics at LHC

tourniquet – 2024

Objectifs scientifiques

- **LLR-LHCb team focusses on heavy flavour studies with special effort on the LHCb Fixed-Target program (initiated by LLR together with LAL in 2015)**
  - 1st physics case: Probing **colour screening in a QGP** (AA collisions)
  - 2nd physics case: Understanding ($c\bar{c}$ bound states) **quarkonia production/suppression** in *p*A (no QGP)
  - 3rd physics case: Exploring **hadronization mechanism at large Bjorken-x** (valence region of the target)





- **LLR-LHCb has also a strong contribution in LHCb luminosity measurement**
  - Driven by V. Balagura (LHCb representative at LHC Luminosity and Calibration WG)

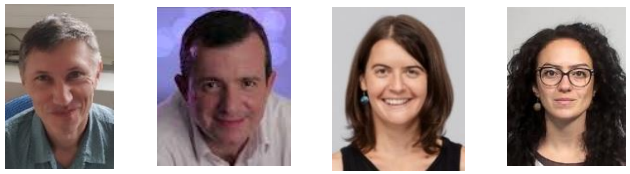
Composition actuelle de l'équipe

Responsable scientifique local: **F. Fleuret -> E. Maurice (depuis le 15/10/2024)**

Liste des chercheurs participants:

- **3+1 permanents**
  - ***Vladislav Balagura (VB),*** *DR2*, 100%
  - ***Frédéric Fleuret (FF),*** *DR1*, 100%
  - ***Émilie Maurice (EM),*** *PAX (polytechnique)*, 100%
  - ***Élisabeth Niel (EN),*** *CRCN*, 100% (février 2025)

VB FF EM EN



- **3 post-doctorants :**
  - ***Oscar Boente (OB),*** 100% (depuis mars 2022)
    - 3 mois ANR-EM + 2 mois LLR + 12 mois poly. + 24 mois ANR-EM
  - ***Kara Mattioli (KM),*** 100% (depuis mai 2022)
    - 28 mois ANR-EM
    - Poste ATER-X (2 ans à partir de septembre 2024)
  - ***Chenxi Gu (CG),*** 100% (depuis fév. 2023)
    - 24 mois Eurotech

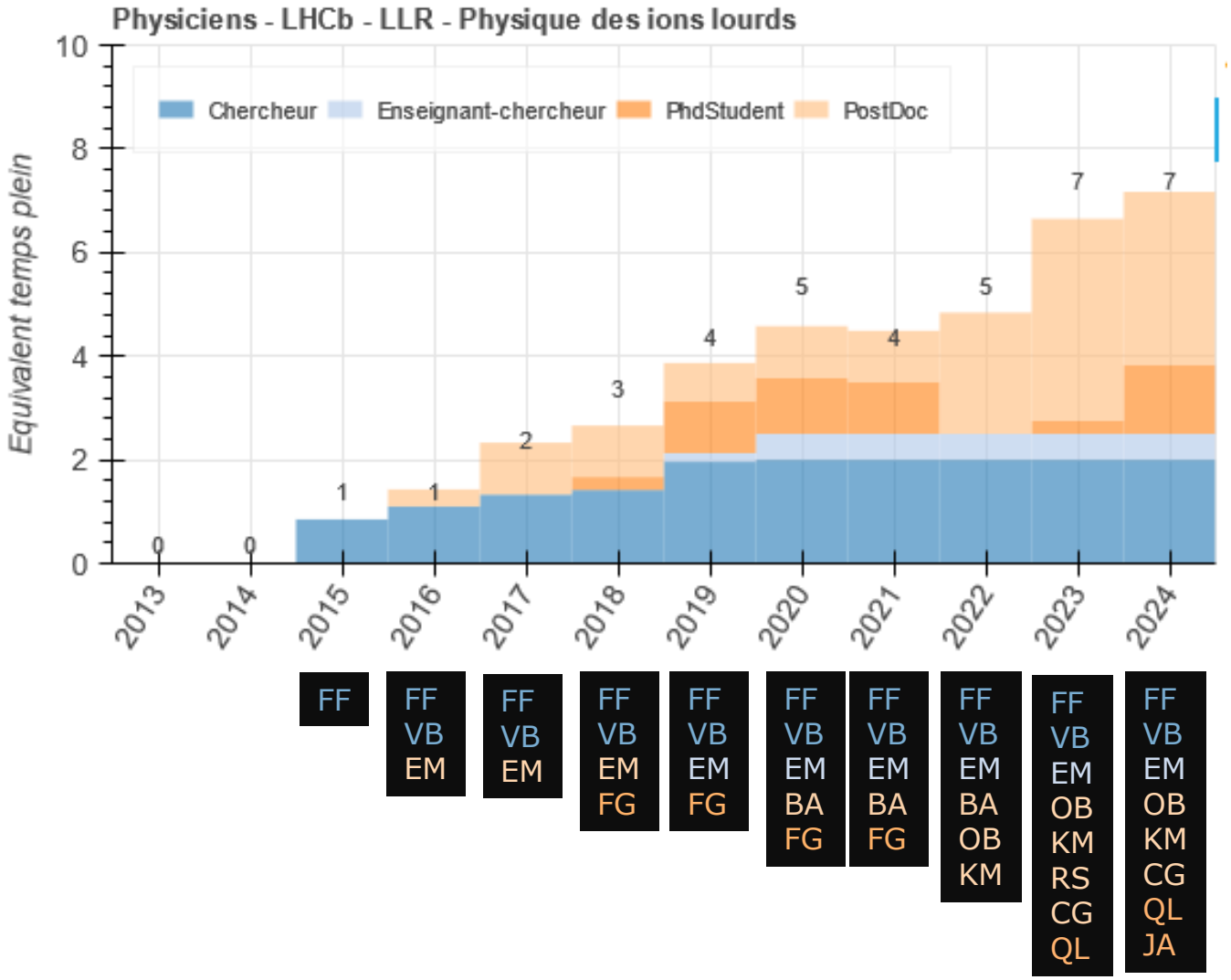
OB KM CG

- **2 doctorantes :**
  - ***Qiuchan Lu (QL),*** 100% (depuis décembre 2023)
    - Financement polytechnique
  - ***Juliette Authier (JA),*** 100% (depuis septembre 2024)
    - Financement IN2P3

QL JA

Évolutions récentes

Statut LLR : **LHCb member associated to LAL** → **LHCb full member**




Frédéric Fleuret


Vladislav Balagura


Emilie Maurice


Felipe Garcia


Benjamin Audurier


Oscar Boente


Kara Mattioli


Rita Sadek


Chenxi Gu

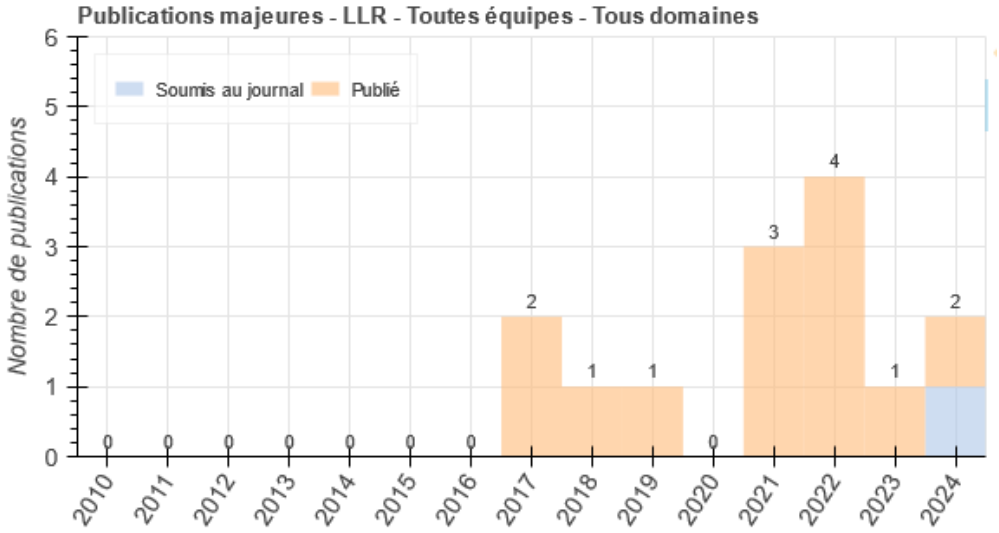

Qiuchan Lu


Juliette Authier

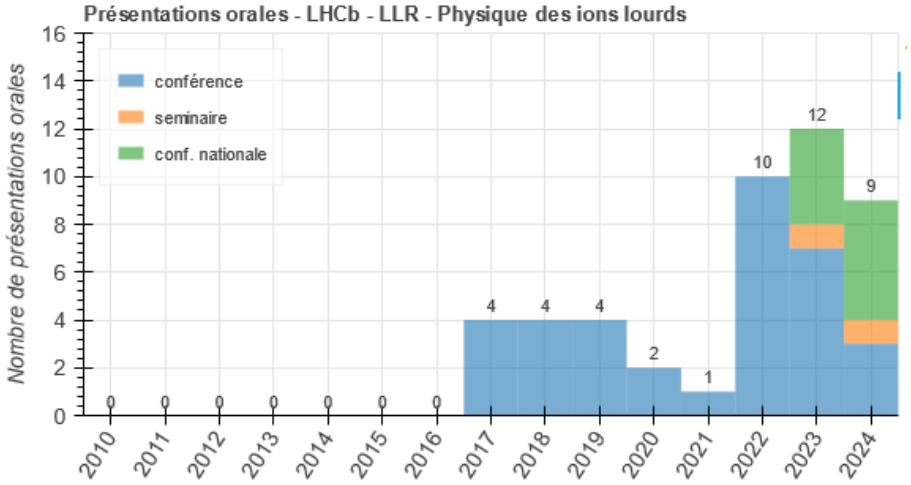
Publications

Contribution of LLR members / full analysis done at LLR

- Prompt and nonprompt J/ψ production and nuclear modification in *p*Pb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV - ***Phys.Lett.B*** **774 (2017) 159-178**
- Study of prompt D^0 meson production in *p*Pb collisions at $\sqrt{s_{NN}}$=5 TeV - ***JHEP*** **10 (2017) 090**
- First Measurement of Charm Production in its Fixed-Target Configuration at the LHC - ***Phys.Rev.Lett.*** **122 (2019) 13, 132002**
- Measurement of B^+, B^0 and Λ_b^0 production in *p*Pb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV - ***Phys.Rev.D*** **99 (2019) 5, 052011**
- J/ψ photoproduction in Pb-Pb peripheral collisions at $\sqrt{s_{NN}}$ = 5 TeV - ***Phys.Rev.C*** **105 (2022) 3, L032201**
- Study of coherent J/ψ production in lead-lead collisions at $\sqrt{s_{NN}}$ = 5 TeV - ***JHEP*** **07 (2022) 117**
- Measurement of the Λ_c^+ to D^0 production ratio in periphera PbPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV - ***JHEP*** **06 (2023) 132**
- Centrality determination in heavy-ion collisions with the LHCb detector - ***JINST*** **17 (2022) 05, P05009**
- J/ψ and D^0 production in $\sqrt{s_{NN}}$ = 68.5 GeV PbNe collisions - ***Eur.Phys.J.C*** **83 (2023) 7, 658**
- Charmonium production in *p*Ne collisions at $\sqrt{s_{NN}}$ = 68.5 GeV - ***Eur.Phys.J.C*** **83 (2023) 7, 625**
- Open charm production and asymmetry in *p*Ne collisions at $\sqrt{s_{NN}}$ = 68.5 GeV - ***Eur.Phys.J.C*** **83 (2023) 6, 541**
- Prompt and nonprompt ψ(2S) production in *p*Pb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV - ***JHEP*** **04 (2024) 111**
- Strangeness enhancement with charmed mesons in high-multiplicity *p*Pb collisions at $\sqrt{s_{NN}}$ = 8.16 TeV - ***Phys.Rev.D*** **110 (2024) 3, L031105**
- A high-density gas target at the LHCb experiment - **Phys. Rev. Accel. Beams 27, 111001**



Conférences



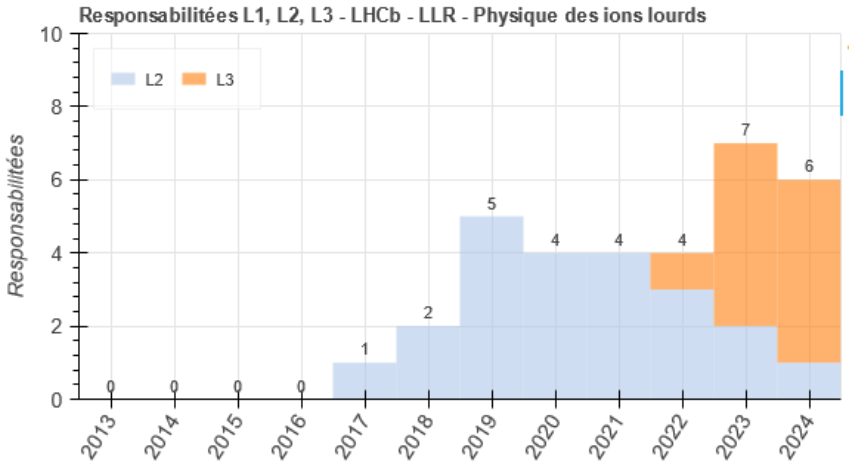
+ Frédéric Fleuret = convener session HI, LHCp 2018
+ Emilie Maurice = convener session HI, ICHEP 2024 et ACHEP 2023
+ Kara Mattioli = convener session HI, LHCp 2024
+ Frédéric Fleuret = organisation of yearly QGP-France Nat. Conf.

In red: Hard Probes & Quark Matter
In bold: plenary

AUDURIER Benjamin	Heavy-flavour production at LHCb, XXIXth International Conference on Ultra-relativistic Nucleus-Nucleus Collisions, Krakow, Pl, 4 - 10 Apr 2022
AUDURIER Benjamin	LHCb prospectives, Rencontres QGP France 2022, Tours, France, 2 – 5 May 2022
AUDURIER Benjamin	Latest results of open and hidden heavy-flavour production in heavy- ion collisions from LHCb, Quark-Gluon Plasma Characterisation with Heavy Flavour Probes, Virtual and Villazzano, Italy, 15-18 Nov 2021
AUDURIER Benjamin	Recent results on heavy flavour in small and large systems from LHCb, 8th Conference of Large Hadron Collider Physics (LHCP), Online, 25 - 30 May 2020
AUDURIER Benjamin	Heavy Flavour production in pp and heavy-ion collisions at LHCb, Heavy-flavour hadronization in pp and heavy ion collisions at the LHC, Meyrin, Switzerland, 02-03 Mar 2020
BALAGURA Vladislav	Overview of the LHCb luminosity determination methodology in Run 2, LHC Lumi Days 2019, Cern, Switzerland, 4 - 5 Jun 2019
BALAGURA Vladislav	Non factorization at LHCb : Two-dimensional vdM scans, LHC Lumi Days 2019, Cern, Switzerland, 4 - 5 Jun 2019
BALAGURA Vladislav	Luminosity at LHCb, Instrumentation for Colliding Beam Physics, Novosibirsk, Russia, 27 Feb - 3 Mar 2017
BOENTE GARCIA Oscar	Studies of low-x phenomena with the LHCb detector, XXIXth International Conference on Ultra-relativistic Nucleus-Nucleus Collisions, Krakow, Pl, 4 - 10 Apr 2022
BOENTE GARCIA Oscar	LHCb overview, Rencontres QGP France 2022, Tours, France, 2 – 5 May 2022
BOENTE GARCIA Oscar	Studies of the cold nuclear matter (nPDFs), QCD@LHC2022, Orsay, France, 28 Nov - 2 Dec 2022
BOENTE GARCIA Oscar	Heavy-flavour production in fixed-target mode , 11th Large Hadron Collider Physics Conference 2023, Belgrade, Serbia, 22 - 26 May 2023
BOENTE GARCIA Oscar	**New results from the expanding heavy-ion program at LHCb, LHC Seminar, CERN, 19 September 2023**
BOENTE GARCIA Oscar	Charm production in LHCb fixed-target mode, 12th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions (Hard Probes 2024, HP2024), 22-27 sept. 2024
BOENTE GARCIA Oscar	LHCb performances for Run 3, QGP-France 2024, Bagnoles de l'Orne, 21-24 may 2024
BOENTE GARCIA Oscar	LHCb Overview, QGP-France 2023, Bagnoles de l'Orne, 26-29 juin 2023
FLEURET Frédéric	Charm production in Pb-Ne collisions at LHCb, Fixed target experiments at LHC, STRONG-2020, CERN, 23 – 24 June 2022
FLEURET Frédéric	Charm production in fixed-target mode at LHCb, Hard Probes 2018: International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions, Aix-les-bains, France, 1 - 5 Oct 2018
FLEURET Frédéric	New results on hard probes in heavy-ion collisions with LHCb , Sixth Annual Conference on Large Hadron Collider Physics, Bologna, Italy, 4 - 9 Jun 2018
FLEURET Frédéric	Hard probes with p-Pb and Pb-Pb collisions and fixed target results at LHCb, 53rd Rencontres de Moriond on QCD and High Energy Interactions, La Thuile, Italy, 17 - 24 Mar 2018
GARCIA Felipe	Heavy-Flavour production in fixed-target mode with LHCb, European Physical Society Conference on High Energy Physics (EPS-HEP) 2019, Ghent, Belgium, 10 - 17 Jul 2019
GU Chenxi	Modification of heavy-quark hadronisation as a function of multiplicity, 11th Large Hadron Collider Physics Conference 2023, Belgrade, Serbia, 22 - 26 May 2023
GU Chenxi	Modification of heavy quark hadronization in high-multiplicity collisions at LHCb, 11th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions (HP2023), Aschaffenburg, Germany, 26 - 31 Mar 2023
GU Chenxi	Modification of heavy quark hadronization in high-multiplicity collisions at LHCb, 30th Conference on Ultra-Relativistic Nucleus-Nucleus Collisions (Quark Matter 2023), Houston, Texas, United States of America, 3 - 9 Sep 2023
GU Chenxi	Recent results on open heavy flavor production (pp, pPb, PbPb) from LHCb , 31st International Workshop on Deep Inelastic Scattering, Grenoble, Fr, 8 - 12 Apr 2024
GU Chenxi	Hadronization of heavy quarks at LHCb, GDR QCD2024, Tours, 27-29 May 2024
GU Chenxi	Recent results on open heavy flavor production (pp, pPb, PbPb) from LHCb, QGP-France 2024, Bagnoles de l'Orne, 21-24 may 2024
GU Chenxi	Heavy Quark ahdronzation in high-multiplicity events with LHCb, QGP-France 2023, Bagnoles de l'Orne, 26-29 juin 2023
LU Qiuchan	Heavy-ion physics at LHCb, 42nd International Conference on High Energy Physics (ICHEP 2024), Prague, Czech Republic, 18 - 24 Jul 2024
LU Qiuchan	MC infrastructure and preparation for chi_c measurement in SMOG2, QGP-France 2024, Bagnoles de l'Orne, 21-24 may 2024
MATTIOLI Kara	Recent measurements of heavy flavor jet production at the LHC, 51st International Symposium on Multiparticle Dynamics, Pitlochry, Gb, 31 Jul - 5 Aug 2022
MATTIOLI Kara	Heavy flavor in fixed-target experiments at the LHC: Recent results and future prospects, QCD@LHC2022, Orsay, France, 28 Nov - 2 Dec 2022
MATTIOLI Kara	New measurements in fixed-target collisions at LHCb, 11th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions (HP2023), Aschaffenburg, Germany, 26 - 31 Mar 2023
MATTIOLI Kara	Recent results from fixed target collisions at LHCb, 30th Conference on Ultra-Relativistic Nucleus-Nucleus Collisions (Quark Matter 2023), Houston, Texas, United States of America, 3 - 9 Sep 2023
MATTIOLI Kara	Fixed-target and astroparticle physics at LHCb, Implications of LHCb measurements and future prospects, Cern, Ch, 25 - 27 Oct 2023
MATTIOLI Kara	LHCb Overview, QGP-France 2024, Bagnoles de l'Orne, 21-24 may 2024
MATTIOLI Kara	LHCb SMOG: a Fixed Target program at the CERN Large Hadron Collider
MATTIOLI Kara	Charm production with LHCb Fixed-target, QGP-France 2023, Bagnoles de l'Orne, 26-29 juin 2023
MAURICE Emilie	**Highlights from the LHCb experiment, XXIXth International Conference on Ultra-relativistic Nucleus-Nucleus Collisions, Krakow, Pl, 4 - 10 Apr 2022**
MAURICE Emilie	Charm production in p-Ne collisions at LHCb, Fixed target experiments at LHC, STRONG-2020, CERN, 23 – 24 June 2022
MAURICE Emilie	**LHCb Status Report, 137th LHCC Meeting, CERN, Geneva, Switzerland, 27 - 28 Feb 2019**
MAURICE Emilie	**Results on heavy ion and fixed target collisions at LHCb, Hard Probes 2018: International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions, Aix-les-bains, France, 1 - 5 Oct 2018**
MAURICE Emilie	Heavy ion physics at LHCb, 6th International Conference on New Frontiers in Physics, Kolymbari, Krete, Greece, 17 - 29 Aug 2017
MAURICE Emilie	Fixed-target physics at LHCb, 5th Conference on Large Hadron Collider Physics 2017, Shanghai, China, 15 - 20 May 2017
MAURICE Emilie	New high resolution measurements of open and hidden charm production in proton-nucleus collisions at $\sqrt s = 110$ GeV with LHCb, The XXVI international conference on ultrarelativistic heavy-ion collisions, Chicago, United States Of America, 6 - 11 Feb 2017
SADEK Rita	Luminosity Measurement at LHCb, QGP-France 2023, Bagnoles de l'Orne, 26-29 juin 2023

Responsabilités

Niveau	Nom	Fonction	Titre	Début	Fin
L2	MAURICE Emilie	Convener	Convener du Performance Working Group « Luminosity »	01 Apr 2017	31 Mar 2019
L2	FLEURET Frédéric	Convener	Convener du Physics Working Group « Ion and fixed target »	01 Jan 2018	31 Mar 2020
L2	BALAGURA Vladislav	Convener	Convener Physics Performance WG "luminosity"	01 Jan 2019	31 Mar 2024
L2	AUDURIER Benjamin	Convener	Convener du Physics Working Group « Ion and fixed target »	01 Apr 2019	31 Mar 2021
L2	AUDURIER Benjamin	Convener	Convener du Physics Working Group « LPCC Heavy Ion »	01 Apr 2021	31 Mar 2023
Autres	FLEURET Frédéric	Member	Membre du « Speakers Bureau »	05 Dec 2021	06 Dec 2023
L3	MATTIOLI Kara	Convener	DPA liaison for sprucing, IFT WG	01 May 2022	01 Sep 2026
L3	GU Chenxi	Convener	Liaison MC, IFT WG	01 Feb 2023	31 Jan 2025
L3	BOENTE GARCIA Oscar	Coordinator	Centrality in Heavy ion collisions	01 Sep 2023	01 Sep 2025
L3	BOENTE GARCIA Oscar	Coordinator	performance contact for SMOG	01 Sep 2023	01 Sep 2025
Autres	MAURICE Emilie	Member	Membre du « Speakers Bureau »	01 Oct 2023	30 Sep 2025
L3	LU Qiuchan	Convener	Liaison MC, IFT WG	01 Dec 2023	01 Dec 2026



Faits marquants

- **2017 : prix fondation L'Oréal – UNESCO jeunes talents : Émilie Maurice**

- **2021 : ANR ThermoFixed : Émilie Maurice**

- **2021: soutenance thèse Felipe Garcia (J/ψ et D^0 PbNe)**

- **2024 : HDR Émilie Maurice**

- **2024 : médaille de bronze du CNRS : Émilie Maurice**

- **2024: LHCb Early Career Scientist award : Oscar Boente and Kara Mattioli**

Futur

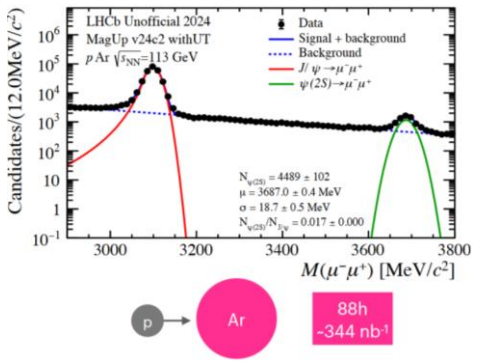
- **2015 – 2022 : nous avons démontré la faisabilité du programme cible-fixe de LHCb**

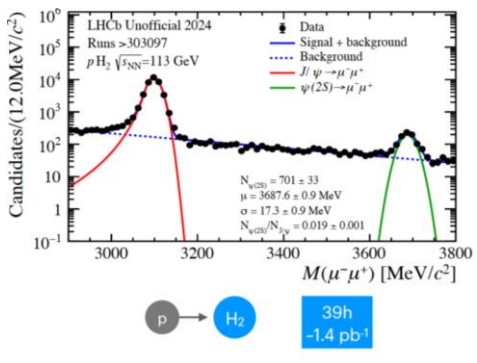
• J/ψ and D^0 in *p*Ar, *p*He:	PRL 122 (2019) 132002
• J/ψ and ψ' in *p*Ne:	Eur. Phys. J. C83 (2023) 625
• D^0 asymmetry in *p*Ne :	Eur. Phys. J. C83 (2023) 541
• J/ψ and D^0 in PbNe :	Eur. Phys. J. C83 (2023) 658
• Centrality determination in PbNe:	JINST 17 (2022) P05009

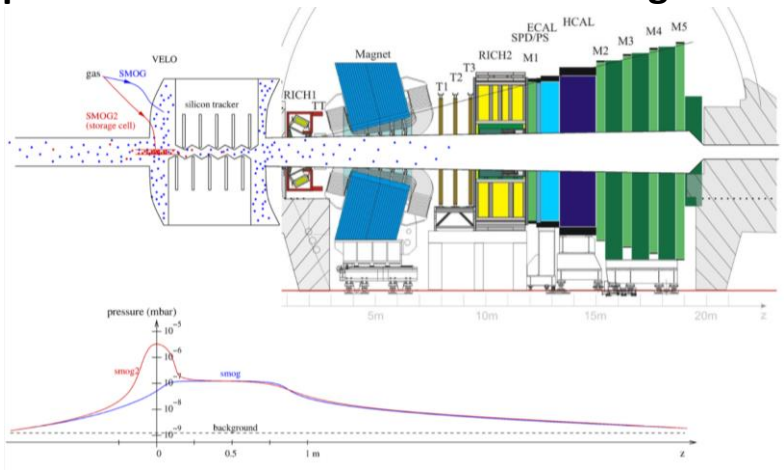
LHCb SMOG: *NEED MORE DATA*

- **Depuis 2024 : nous nous engageons dans des études de physique à haute luminosité**

LHCb Upgrade I + SMOG2: precision measurements in Fixed-Target mode







L'équipe possède le leadership dans les triggers, sprucings, MonteCarlo, analysis production pour SMOG2 (+ forte contribution aux operations).

Espère un soutien IN2P3 (financement postdoc) pour maintenir le leadership et exploiter les données actuellement en cours d'acquisition.