Relatório LHCb
2022-2024

Murilo Rangel
CBPF, PUC-Rio e UFRJ

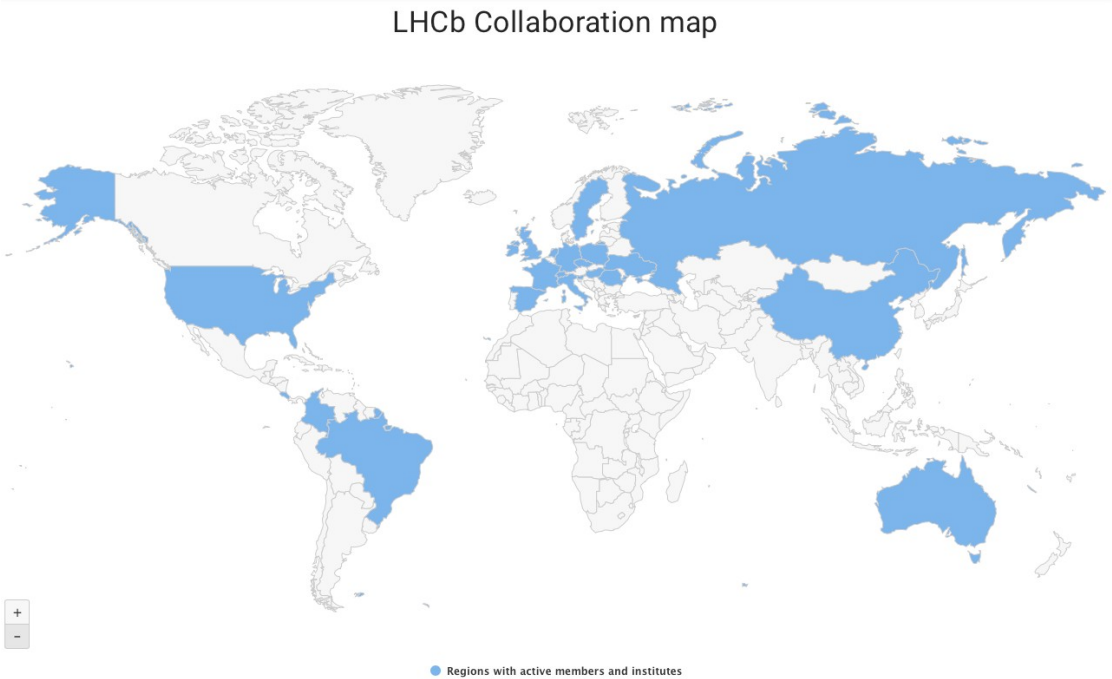
II Workshop INCT CERN-Brasil

Jul 2 – 3, 2024
Instituto de Física da USP
America/Sao_Paulo timezone

Instituto Nacional de Ciência e Tecnologia CERN-Brasil

Colaboração LHCb em números (april 2024)

→22 países
→99 Instituições
→1686 membros
→1113 autores
→639 doutores



Participação brasileira
- 3 Instituições
- 45 membros
- 27 autores (2,4%)
- 20 doutores (3,1%)

Grupo atual

Doutores	
Ignacio Bediaga	CBPF
Patricia Camargo Magalhaes	CBPF/UNICAMP
Melissa Maria Cruz Torres	CBPF/UNAH
Jussara de Miranda	CBPF
Alberto dos Reis	CBPF
Andre Massafferri	CBPF
Daniel Sundfeld Lima	CBPF/UnB
Carla gobel Burlamaqui	PUC-Rio
Adlène Hicheur	UFRJ
Bruno Souza de Paula	UFRJ
Érica Ribeiro Polycarpo Macedo	UFRJ
Fernando Ferreira Rodrigues	UFRJ
Irina Nasteva	UFRJ
José Helder Lopes	UFRJ
Juan Martin Otalora Goicochea	UFRJ
Murilo Santana Rangel	UFRJ
Leandro Salazar de Paula	UFRJ
Miriam Mendes Gandelman	UFRJ
Sandra Filippa Amato	UFRJ
Vinícius Franco Lima	UFRJ

Estudantes de doutorado	
Ulisses De Freitas Carneiro Da Graca	CBPF
Lucas Falcão	CBPF
Leonardo Santoro	CBPF
Gustavo Alejandro Loachamin Ordonez	PUC-Rio
Ivanildo Rui Barbosa	PUC-Rio
Victoria Ramos De Oliveira	PUC-Rio
Beatriz Moraes Vivacqua	UFRJ
Gabriella Machado Darze	UFRJ
Pedro Henrique Hein Nogarolli Vilela Pereira	UFRJ

Estudantes de mestrado	
Diogo Ayres Rocha	CBPF
Carina Silva Lyra	CBPF
Stalin Peter Do Nascimento Pedro	CBPF
Vania Martins Dos Santos	CBPF
Marcos Fontes Vaz	PUC-Rio
Renata Ferreira Leite Considera	PUC-Rio
Jeferson dos Santos Oliveira	UFRJ
Jessica Martina Mafra do Vale	UFRJ
Dennis Justino de Souza	UFRJ
Alexandre Cardoso Campos	UFRJ

Infelizmente, em Junho de 2023, o professor Alvaro Gomes (UnB) nos deixou ...

Alvaro Gomes 1980-2023

Alvaro was a long term member of the collaboration having obtained his PhD from CBPF in 2010, worked as a postdoc in the UFRJ group, and then obtained a permanent position at the University of Brasília, where he was in discussion for forming a new LHCb group. Throughout his career he was dedicated to studying B to three hadron decays, and was currently serving as a BnoC/B2CC amplitude analysis convenor.

Alvaro was much loved, a gentle considerate colleague with many friends in the collaboration. He was taken from us far too early by a thrombosis.

Our deepest condolences to all the Brazilian colleagues and his many friends across the experiment.

Slide do Chris Parkes https://indico.cern.ch/event/1278802/contributions/5372140/attachments/2674208/4636714/TM_270623.pdf

Defesas & Post-docs

Mestrado		
Lucas Cordeiro Romão,	2022	PUC-Rio
Leonardo Santoro de Oliveira	2022	PUC-Rio
Victoria Ramos de Oliveira	2023	PUC-Rio
Gustavo Alejandro Loachamin Ordoñez	2023	PUC-Rio
Salazar Travancas Neto	2024	UFRJ
Beatriz Moraes Vivacqua	2024	UFRJ
Gabriel dos Santos Rodrigues	2024	UFRJ

Doutorado		
Juan Baptista de Souza Leite	2023	CBPF
Lucas Meyer Garcia	2023	UFRJ
Felipe Luan Souza de Almeida	2023	UFRJ

Pós-doutores		
Lucas Meyer Garcia	2023-2024	UFRJ
Diego Torres Machado	2019-2024	CBPF

Caveat

-

Fiz escolhas do que relatar – não foram incluídos:
- Detalhes das contribuições
- Participação em conferências
- Notas internas
- Resposabilidades nos projetos
- ...

Responsabilidades (estrutura permanente)

Deputy Physics Coordinator:

Carla Göbel Burlamaqui de Mello – 2022-2024

Convener:

Melissa Cruz Torres - Charmless b-hadron decays – 2022-2025

Melissa Cruz Torres - B decays to Charmonia – 2024-2025

Speaker's Bureau:

Érica Ribeiro Polycarpo Macedo – 2021-2023

Bruno Souza de Paula – 2024-2026

Editorial Board:

Miriam Mendes Gandelman – 2020-2022

Irina Naskova Nasteva – 2024-2026

LHCb Early Career, Gender and Diversity Office:

Irina Naskova Nasteva – 2021-2023

Prêmios

A colaboração LHCb concede 4 prêmios anualmente
- Technical awards (desde 2023)
- Moritz Karbach summer student prize (desde 2015)
- Thesis awards (desde 2016)
- Early Career Scientist awards (desde 2016)

Prêmios

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- **Moritz Karbach summer student prize (desde 2015)**
- Thesis awards (desde 2016)
- Early Career Scientist awards (desde 2016)

- Giovanna Rezende, UFRJ Rio de Janeiro, "Safety System for the Vertex Locator (VELO) subdetector of the LHCb"

- Vemund Elias Lundheim, Norwegian University of Science and Technology, Trondheim, "Craver presentation"

- Simon Thor, KTH Royal Institute of Technology, Stockholm,"Improving LbMCSubmit"

Prêmio Technical awards

2024

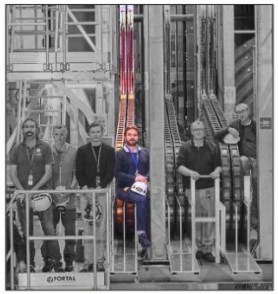
Ulisses de Freitas Carneiro da Graça (CBPF)

For his outstanding contribution to the installation and operation of the SciFi detector

SciFi

Ulisses de Freitas Carneiro da Graça

- **2015:** Joined LHCb Experiment
  - SciFi Tracker Electronics R&D for Upgrade I
- **2019:** SciFi FEE-Tester Delivery
  - 280^{+} Front-End Boxes Tested 2019≈2022
- **2021≈2023:** SciFi Installation, Test & Commissioning
  - 2022: SciFi integrated to LHCb Control & DAQ
    - ✓ Extensive debugging of SciFi Systems
    - ✓ Optimization of Calibration Tools
    - ✓ Validation of Clustering Algorithm and Data Encoding
- **2023≈2024:** Det. Electronics Commissioning Task Force
  - Debugging unknown data loss in SciFi since early 2022
  - Associated with TFC de-synchronization ≈Nov/2022
  - Correlated with Control Link FEC's ≈Apr/2023
  - Conclusive cause-effect evidences ≈Sep/2023
  - Effective Mitigation of (relevant) Data Loss before 2024

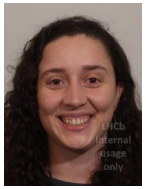


cds.cern.ch/record/2805358 (edited)

CBPF Centro Brasileiro de Pesquisas Físicas

LHCb Technical Award 2024 – 11 June 2024

Menções honrosas



Menção honrosa 2024: “VeLo DCS summary panel”

Autor: **Victoria Ramos**

SOCIEDADE BRASILEIRA DE FÍSICA

Menção honrosa 2024: “Direct production of J/ψϕ vector mesons at the LHCb experiment without additional activity”, orientada pelo Prof. Murilo Rangel.

Autor: **Lucas Meyer Garcia**

Instituto Nacional de Ciência e Tecnologia CERN-Brasil

PDJ de 09/2023 a 02/2024

Lembrando: LHCb Upgrade I (CERN-LHCC-2012-007 DP-2023-002)

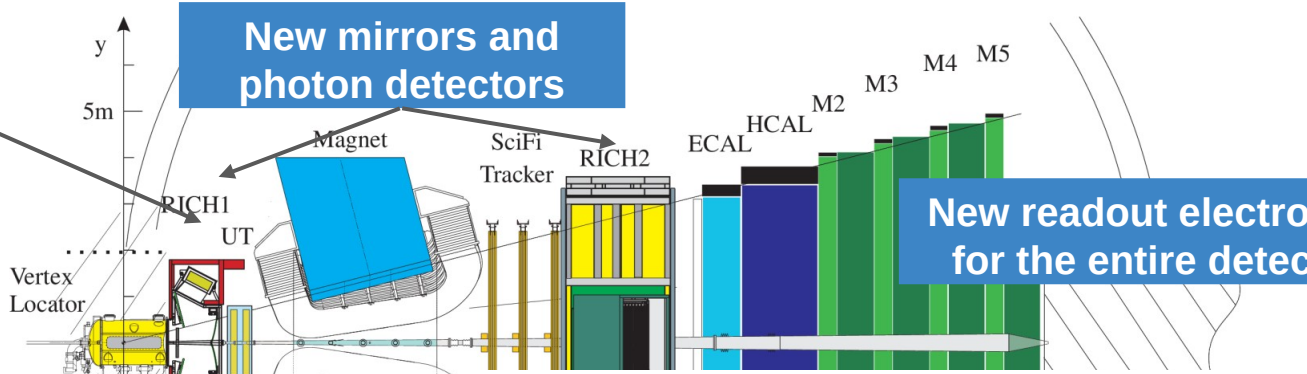
UT
(new silicon tracker)

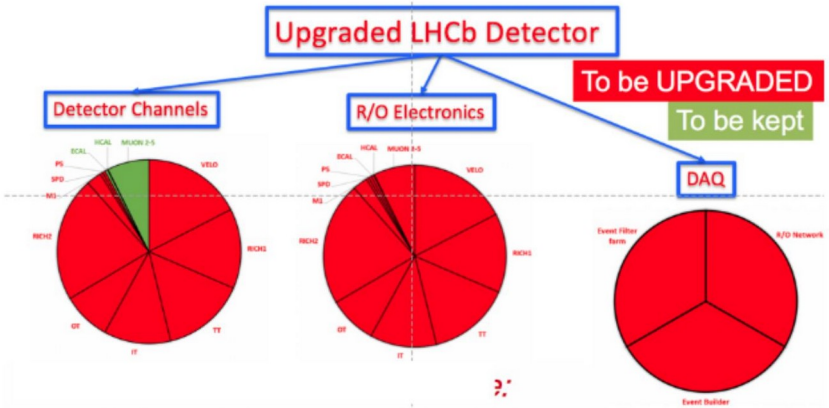
New mirrors and photon detectors

New readout electronics for the entire detector

New VELO
(Pixel Detector)

SciFi
(new scintillating fibre tracker)



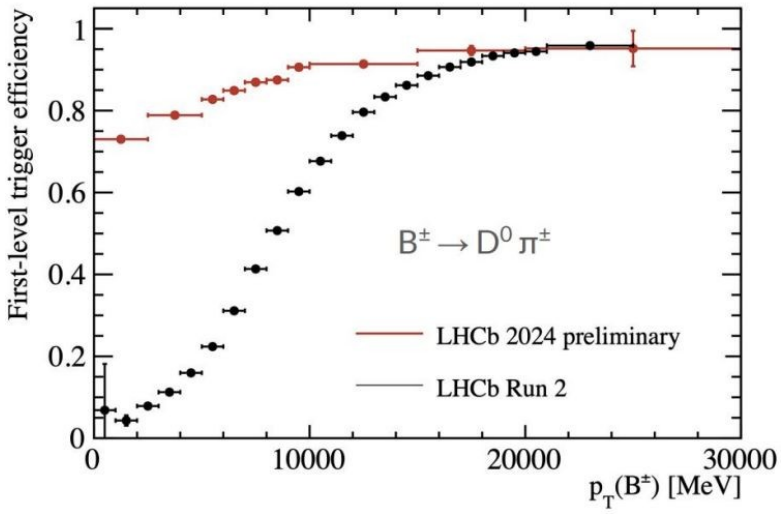


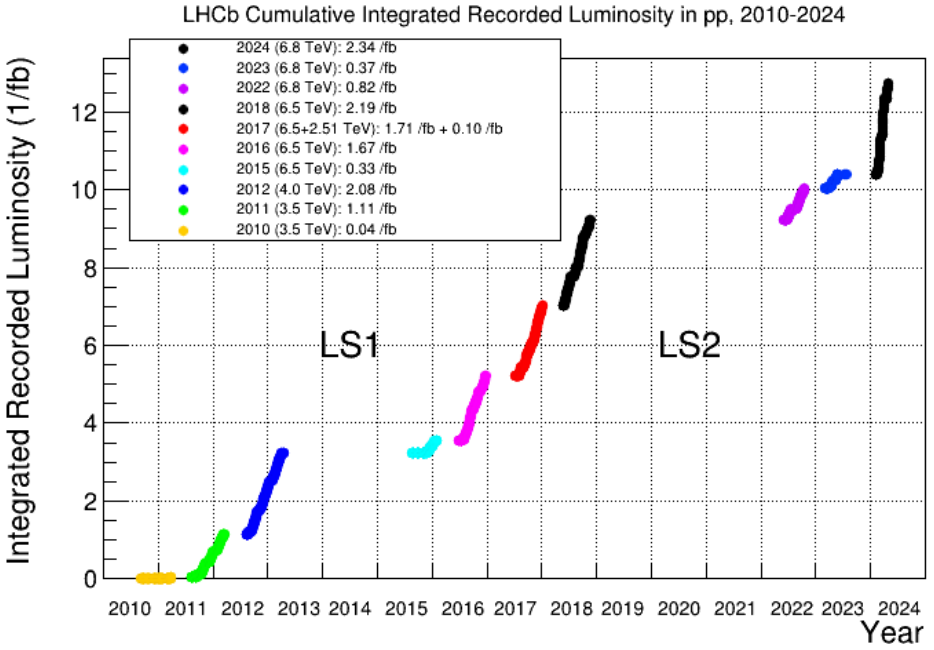
LHCb Atual

Detector em operação e coletando dados

calibração – alinhamento – monitoramento

validação de todo processamento de dados e trigger em software certificado



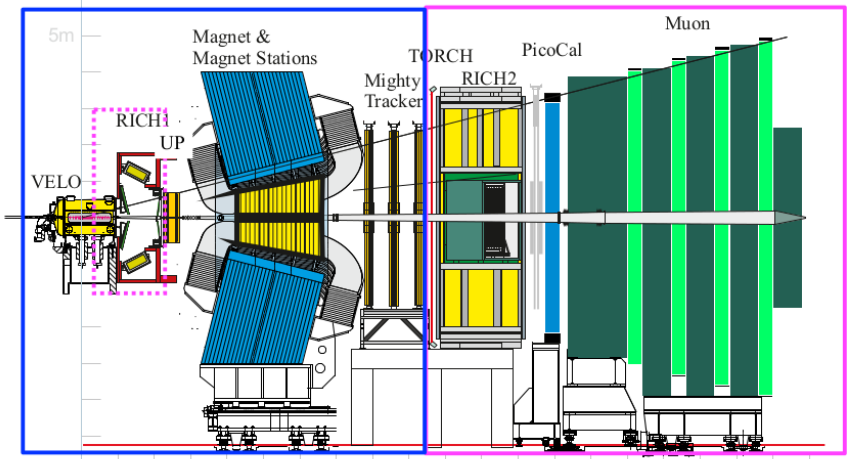


LHCb Upgrade II

Sub-detectores TDR até 2026 e prontos até 2032

- Contribuições BR
- Mighty Tracker
- Real Time Analysis
- Vertex Locator

Baseline design: *targeting same (or better in certain domains) performance as in Run 3, but running at 1.5x10^{34}cm^{-2}s^{-1} with pile-up ×7 wrt Run 3!*



Tracking system

VELO: *pixel 3D silicon, hit time resolution 50ps, ASIC 28nm*

UP (upstream tracker) and Mighty Tracker (downstream): *MAPS pixel for UP and inner region of Mighty Tracker, scintillating fibres for outer region of Mighty Tracker*

Magnet Stations: *scintillating slabs covering side walls of magnet, for low momentum* **NEW SYSTEM**

PID system

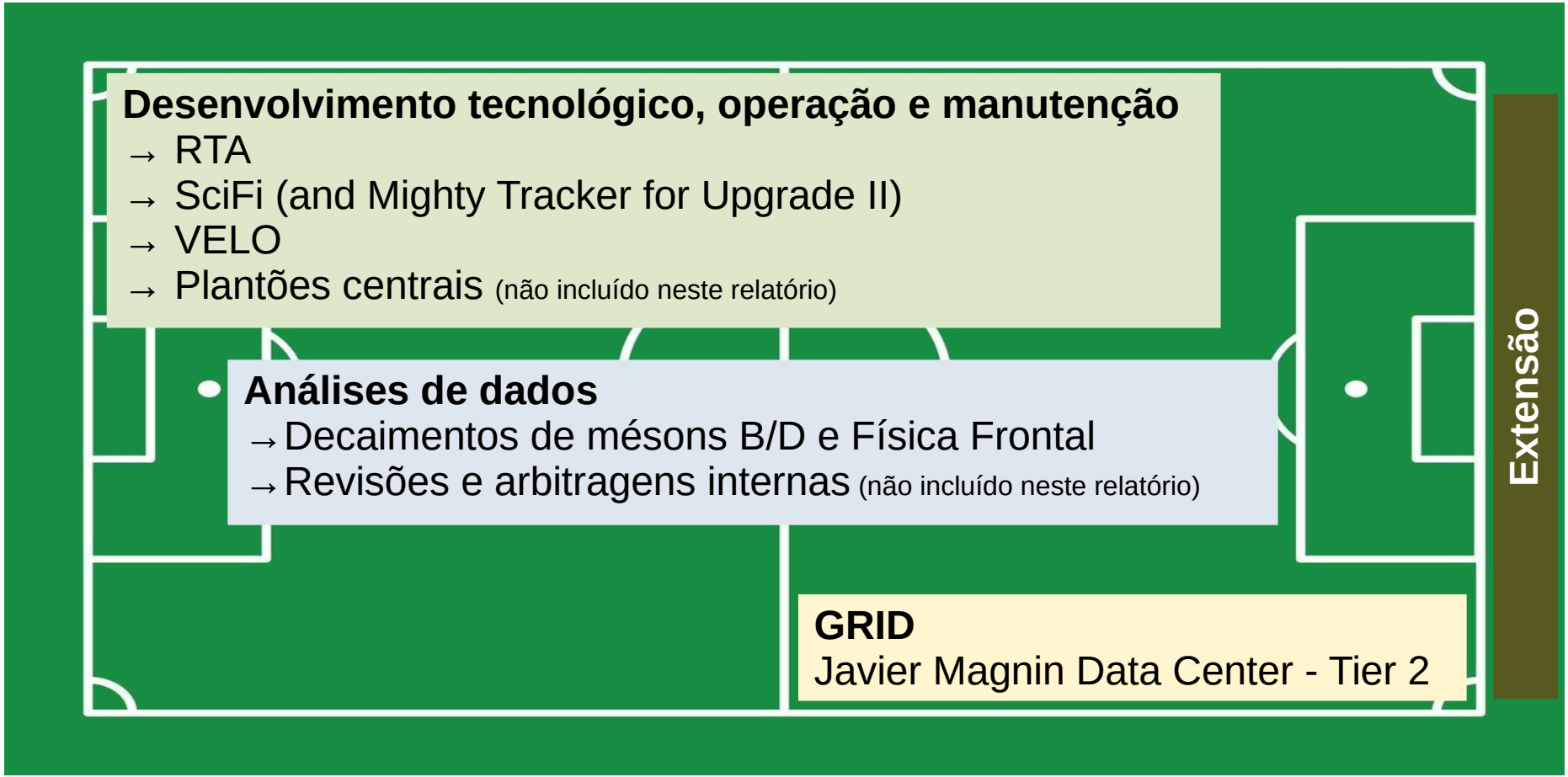
RICH: *reduced pixel with SiPM/MCP, timing info added*

TORCH: *new time-of-flight for low momentum, quartz and SiPM/MCP* **NEW SYSTEM**

PicoCal: *timing and longitudinal segmentation, SPACAL with radiation hard crystals inner region, old Shashlik outer region*

Muon: *muRWELL technology inner region, keep old MWPCs outer region*

Atividades realizadas

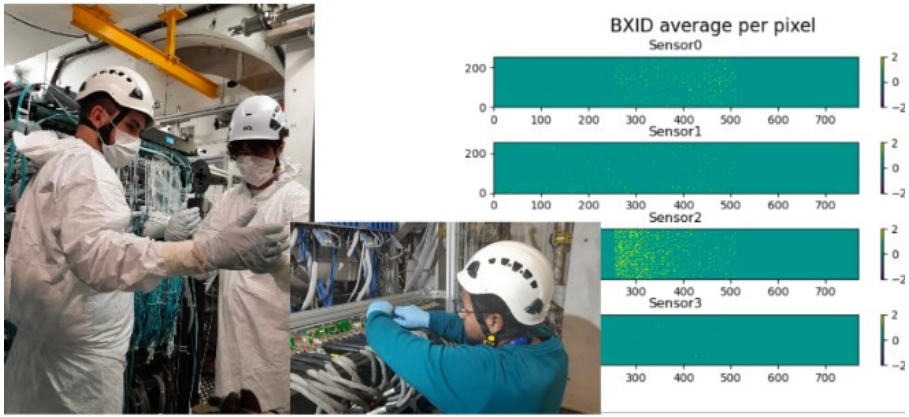


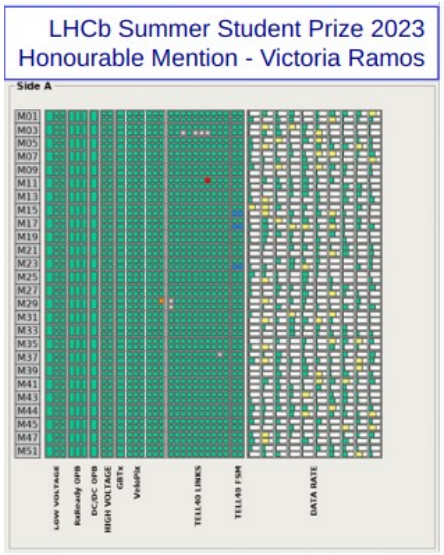
VeLo

Alice Dominguez, Erica Polycarpo, Gabriel Rodrigues, Irina Nasteva, Pedro Nogarolli, Stalin Pedro, Victoria Ramos, Vinicius Franco Lima

Atividades nos últimos dois anos:

- Instalação e comissionamento
- Monitoramento em tempo real – painéis e alarmes implementados.
- Alinhamento temporal por pixel implementado.
- Plantões de VELO Piquet nas operações do detector.



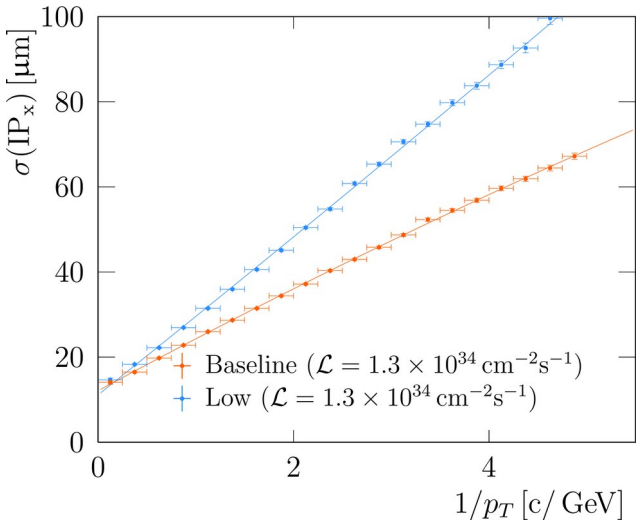


VeLo – Upgrade II

Alice Dominguez, Erica Polycarpo, Gabriel Rodrigues, Irina Nasteva, Pedro Nogarolli, Stalin Pedro, Victoria Ramos, Vinicius Franco Lima

Projetos (ver GT-2):

- R&D dos sensores e ASICs até 2026, instalação em 2032
- Planos de caracterização do Timepix-4 e participação dos test beams
- Integração da eletrônica e desenvolvimento de simulações



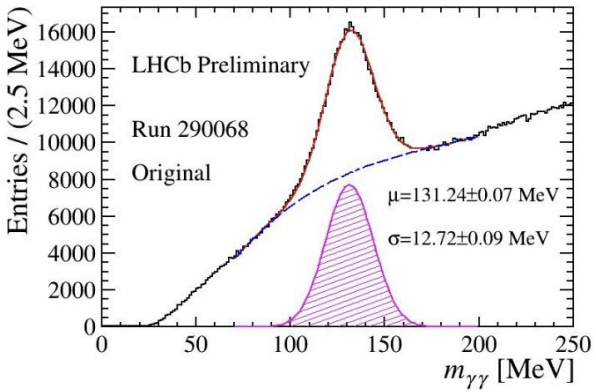
RTA

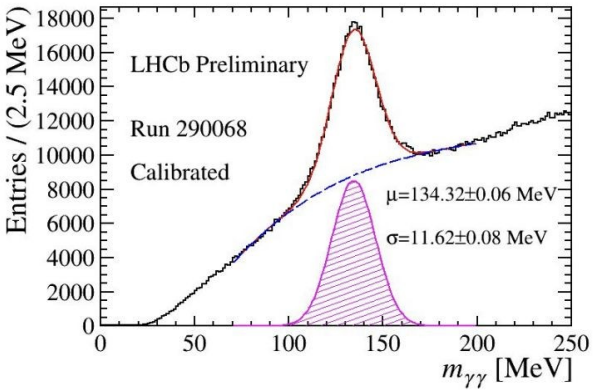
Bruno de Paula, Beatriz Vivacqua, Daniel Sundfeld, Fernando Rodrigues, Jessica do Vale, José Lopes, Juan Otalera, Leonardo Santoro, Murilo Rangel

LHCb Real Time Analysis Project

Projeto iniciou oficialmente em 2019

- → Integração no sistema online
- → Reconstrução de jatos e seleção de mésons D no HLT2
- → Reconstrução de fótons no HLT1 (GPU)
- → Calibração de fótons usando pi0s
- → Plantões de monitoramento e RTA piquet



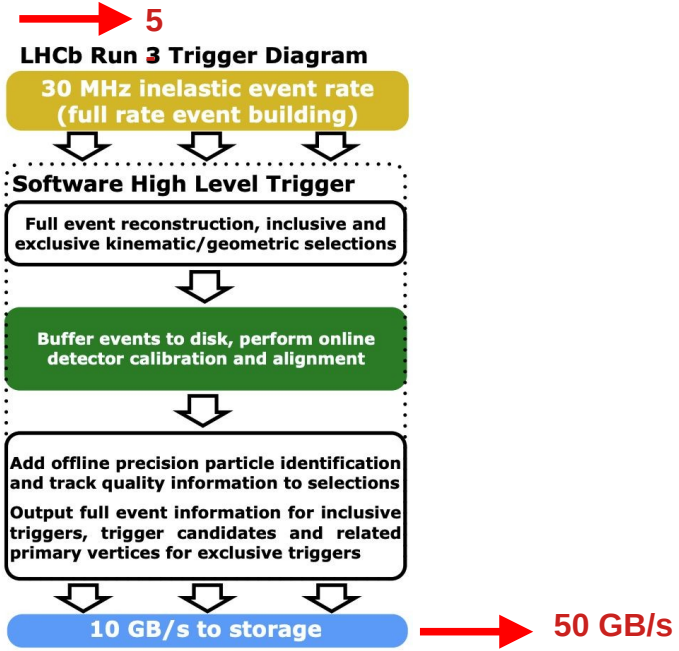


RTA – Upgrade II

Bruno de Paula, Beatriz Vivacqua, Daniel Sundfeld, Fernando Rodrigues, Jessica do Vale, José Lopes, Juan Otalera, Leonardo Santoro, Murilo Rangel

Proposta:

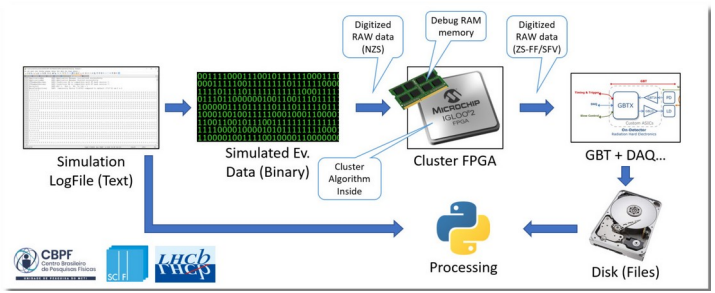
+ implementar HLT2 em GPUs – processar 7x mais dados que Run 3-4.
+ estudos de escala para a multiplicidade de seleções em GPUs e persistência dos dados

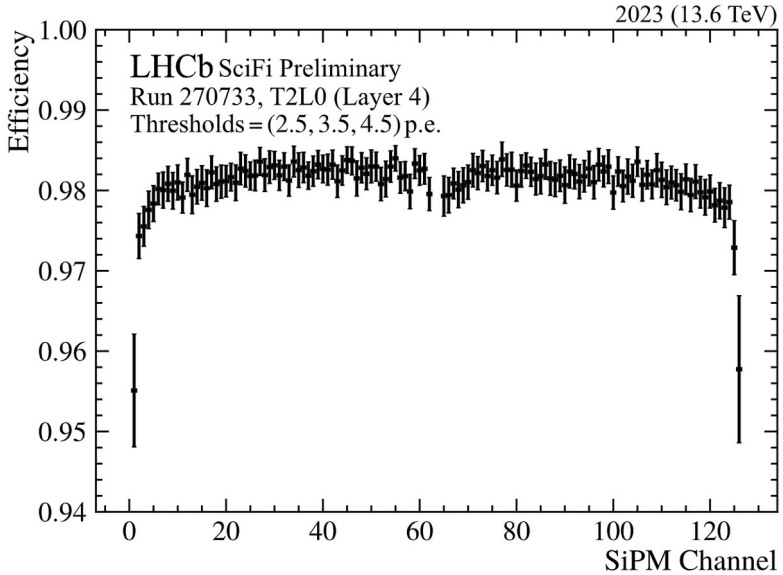


SciFi

Andre Massafferri, Ulisses De Freitas Carneiro Da Graca, Lucas Falcão e Diogo Ayres

Projeto conceitual: 2014 → Validação e calibração SciFi Concluída: 2023





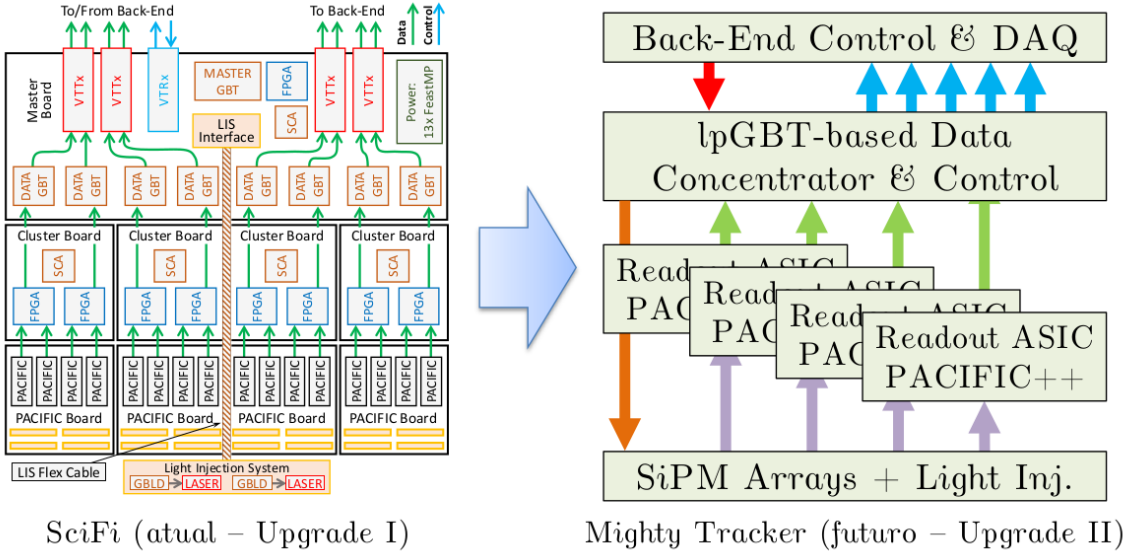
Eficência média de detecção de hits para uma camada

https://cds.cern.ch/record/2869773/files/LHCb-FIGURE-2023-021.pdf

Mighty Tracker – Upgrade II

Andre Massafferri e Ulisses De Freitas Carneiro Da Graca

Meta: Desenvolver os Módulos de Leitura (FEBs / ROBs), sistemas de Controle e Monitoramento

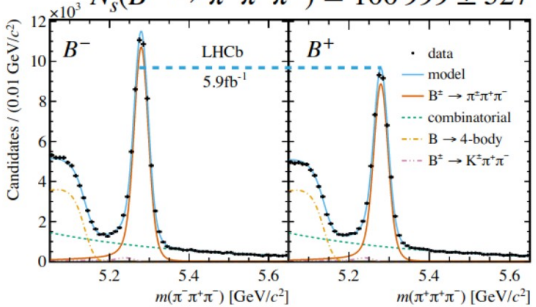


Ver detalhes no relatório GT-3

Decaimentos de mésons B

Phys. Rev. D108 (2023) 012013	I. Bediaga , M. Cruz , A. Gomes , G. Gomes , J. Helder Lopes, L. S. Lavra, A. Massafferri, J. M. de Miranda, I. Nasteva, J. Otalora, A. C. dos Reis, F. Rodrigues, D. Torres Machado	Search for direct CP violation in charged charmless B→PV decays
Phys. Rev. D108 (2023) 012008		Direct CP violation in charmless three-body decays of B± mesons
On-going	Lucas Falcão, Jussara Miranda, André Massaferri, Melissa Cruz, Ignacio Bediaga	Amplitude Analysis of B2piKK decays
On-going	Jussara Miranda, Patricia Magalhães, Fernando Rodrigues, Ignacio Bediaga, Juan Otalora	Amplitude Analysis of B2pipipi decays
On-going	Ignacio Bediaga, Diego Torres, Irina Nasteva, Melissa Cruz, Fernando Rodrigues, Helder Lopes, Juan Otalora	CP violation measurement B2pph decays
On-going	Juan Leite, Alberto Reis	Amplitude Analisis of the B+ -> K+K-K+ decays
On-going	Jessica Mafra do Vale, Leandro de Paula, Miriam Gandelman	Search for Bc->KKpi

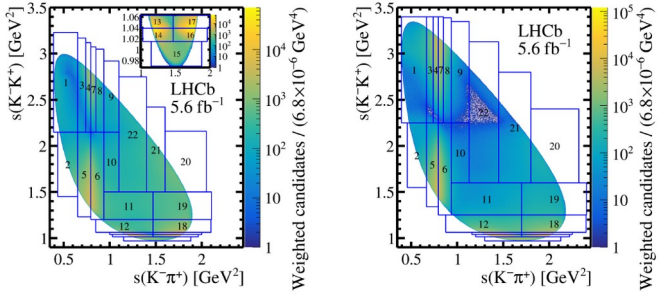
$N_s(B^\pm \to \pi^\pm\pi^+\pi^-) = 100\,999 \pm 527$



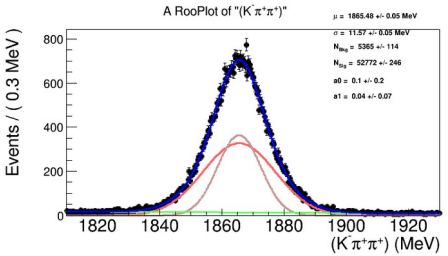
$A_{CP} = +0.080 \pm 0.004 \pm 0.003 \pm 0.003\ (14.1\sigma)$

Decaimentos de mésons D

JHEP 07 (2023) 067	Sandra Amato, Carolina Bolognani, Carla Göbel, Erica Polycarpo, Alberto C. dos Reis	Search for CPV in the Dalitz Plots of the decays D+(s)→ K- K+ K+
JHEP 06 (2023) 044	Fernanda Abrantes, Sandra Amato, Carla Göbel, Juan Leite, Erica Polycarpo, Alberto C. dos Reis	Amplitude analysis of the D+→π−π+π+ decay and measurement of the π−π+ S-wave amplitude
JHEP 07 (2023) 204		Amplitude analysis of the D+s→π−π+π+ decay
to be submitted	Felipe Luan Souza de Almeida, Sandra Amato, Alexandre Campos, Lucas Falcão, Carla Göbel, Erica Polycarpo, Alberto C. dos Reis	Measurement of CP violation observables in D2KKpi
on-going	Leonardo Santoro, Sandra Amato, Erica Polycarpo, Carla Göbel, Alberto C. dos Reis	Search for CPV in Ds2piKK
on-going	Sandra Amato, Gustavo Castro, Felipe de Almeida, Carla Göbel, Erica Polycarpo, Alberto dos Reis, Beatriz Vivacqua	Search for CPV in Ds2pipipi
on-going	Alexandre Campos, Sandra Amato, Erica Polycarpo, Alberto Reis, Carla Gobel	Studies of CPV models for Dp2KKpi
on-going	Ivanildo Barbosa, Sandra Amato, Erica Polycarpo, Carla Göbel, Alberto dos Reis, Gustavo Ordonez	BR measurement of D2KKK
on-going	Dennis de Souza, Gabriella Darze, Erica Polycarpo, Sandra Amato, Albertos dos Reis, Carla Göbel	Amplitude Analysis of D2KKpi

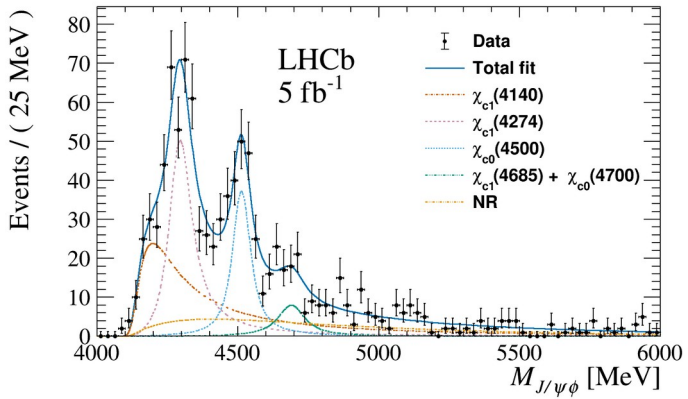


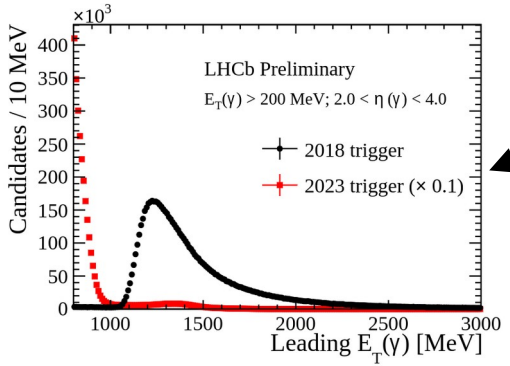
… validação 2024



Física frontal

JHEP 07 (2022) 117	B. Audurier, A. Bursche, V. Dobishuk, P. Gandini, D. Johnson, H. Li, G. Manca, M.S. Rangel, B. Schmidt, R. Kopecna, Q. Lu	J/ψ production in ultraperipheral collsions at 2015
JHEP 06 (2023) 146	Benjamin Audurier, Albert Bursche, Vasyl Dobishuk, Weisong Duan, Hengne Li, Qiuchan Lu, Giulia Manca, Murilo Santana Rangel, Burkhard Schmidt, Xiaolin Wang, Yanxi Zhang	charmonium production in ultraperipheral collsions at 2018
to be submitted	Lucas Meyer Garcia, Naomi Raab, Ronan McNulty, Murilo Santana Rangel and Bruno Souza de Paula	Observation of exotic J/ψϕ resonances in diffractive processes in proton-proton collisions
on-going	Jeferson dos Santos Oliveira, Murilo Rangel, Lucas Meyer Garcia, Bruno de Paula	Associated production of dimuons and dikaons in diffractive events
on-going	Pedro Nogarolli, Renata Ferreira, Carla Göbel, Erica Polycarpo, Murilo Rangel	Search for ALP in ultraperipheral collisions





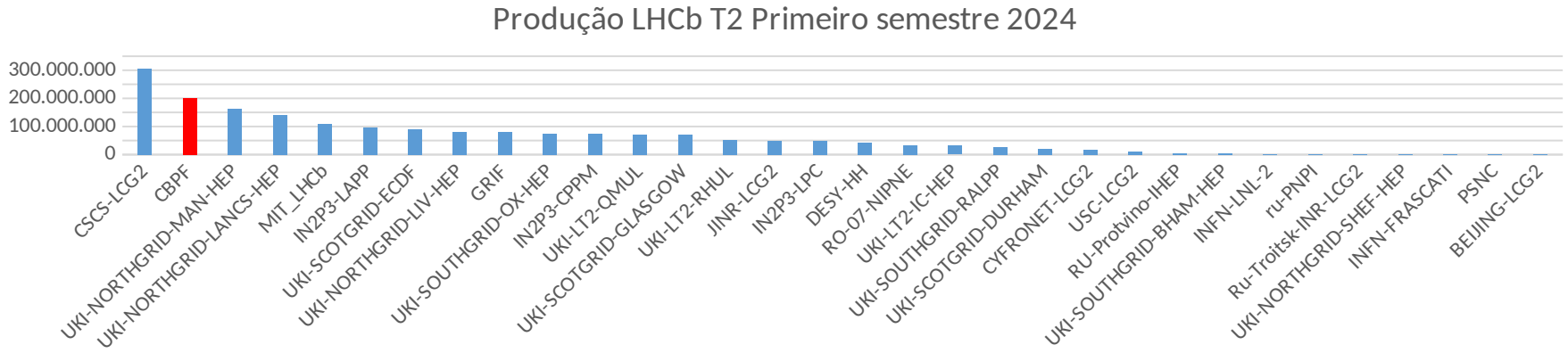
https://cds.cern.ch/record/2898822/files/LHCb-FIGURE-2024-012.pdf

GRID

O CBPF tem um Tier 2 com 80 worker nodes e 5.540 cores
https://accounting.egi.eu/egi/site/CBPF/

* Novembro/2022 - 15 novas maquinas com um total de 1.920 cores.
* Janeiro/2024 - 20 novas maquinas com um total de 2.560 cores.

Em janeiro e fevereiro de 2024:
- entre os 50 sites mais produtivos no mundo
- primeiro da América Latina em todo LHC
- segundo site Tier 2 no LHCb em tempo de CPU



Extensão

Grupo da UFRJ (@lapeufrj) → disciplina de extensão

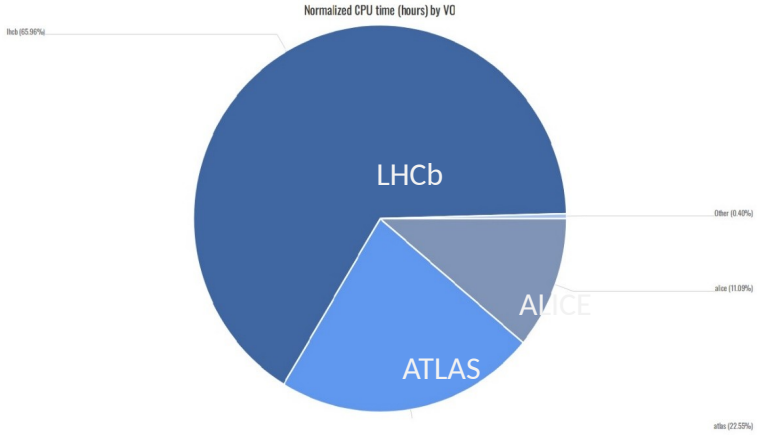
- Palestras em escolas
- Organização do Masterclass Internacional
- Realização de eventos locais
- Publicação em redes sociais (instagram, facebook, youtube e wikipedia)
- Criação de material de divulgação científica (vídeos, jogo da memória, ...)

-

Obrigado!!

BACKUP

GRID/CBPF

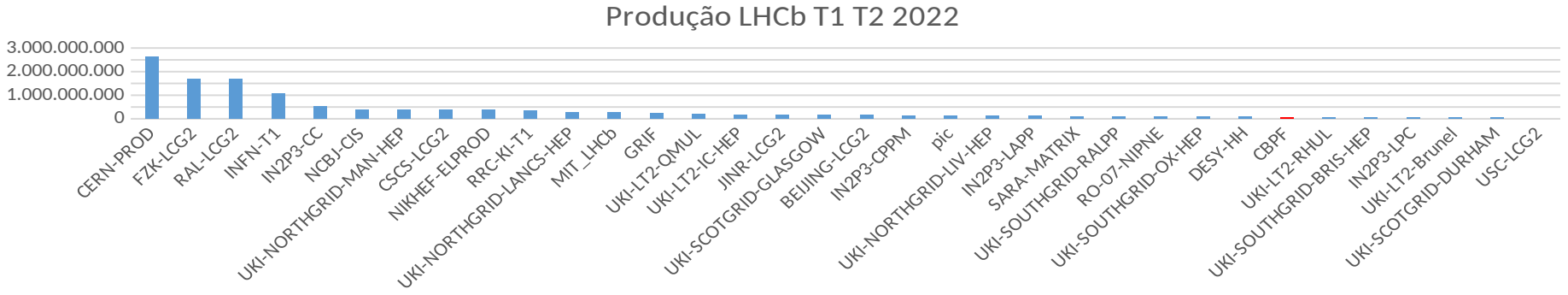


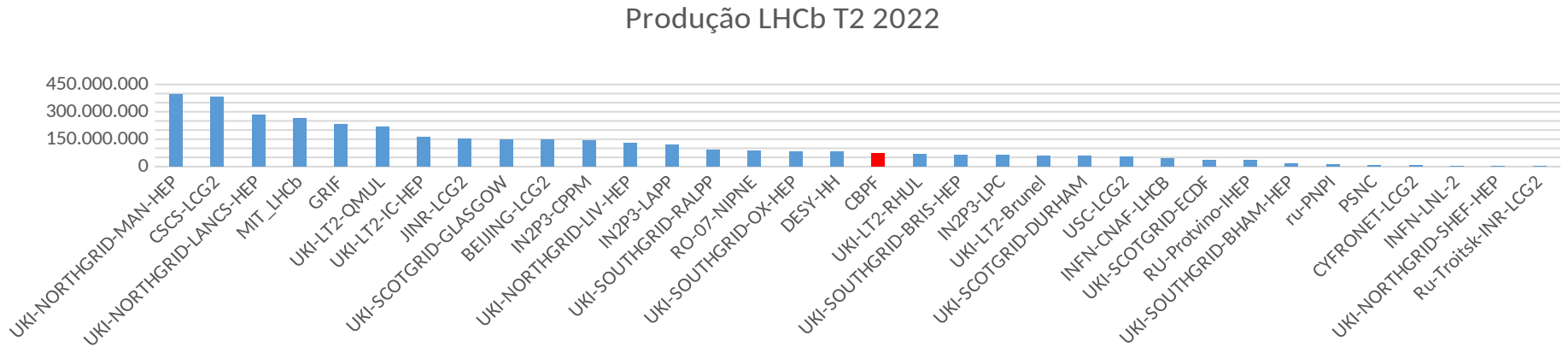
04/23 – 04/24 EGI

Jaime - CBPF
Eraldo - CBPF


JAVIER MAGNIN
DATAGRID CENTER

GRID/CBPF


Produção LHCb T1 T2 2022
3.000.000.000
2.000.000.000
1.000.000.000
0
CERN-PROD
FZK-LCG2
RAL-LCG2
INFN-T1
IN2P3-CC
NCBJ-CIS
UKI-NORTHGRID-MAN-HEP
CSCS-LCG2
NIKHEF-ELPROD
RRC-KI-T1
UKI-NORTHGRID-LANCS-HEP
MIT_LHCb
GRIF
UKI-LT2-QMUL
UKI-LT2-IC-HEP
JINR-LCG2
UKI-SCOTGRID-GLASGOW
BEIJING-LCG2
IN2P3-CPPM
pic
UKI-NORTHGRID-LIV-HEP
IN2P3-LAPP
SARA-MATRIX
UKI-SOUTHGRID-RALPP
RO-07-NIPNE
UKI-SOUTHGRID-OX-HEP
DESY-HH
CBPF
UKI-LT2-RHUL
UKI-SOUTHGRID-BRIS-HEP
IN2P3-LPC
UKI-LT2-Brunel
UKI-SCOTGRID-DURHAM
USC-LCG2


Produção LHCb T2 2022
450.000.000
300.000.000
150.000.000
0
UKI-NORTHGRID-MAN-HEP
CSCS-LCG2
UKI-NORTHGRID-LANCS-HEP
MIT_LHCb
GRIF
UKI-LT2-QMUL
UKI-LT2-IC-HEP
JINR-LCG2
UKI-SCOTGRID-GLASGOW
BEIJING-LCG2
IN2P3-CPPM
UKI-NORTHGRID-LIV-HEP
IN2P3-LAPP
UKI-SOUTHGRID-RALPP
RO-07-NIPNE
UKI-SOUTHGRID-OX-HEP
DESY-HH
CBPF
UKI-LT2-RHUL
UKI-SOUTHGRID-BRIS-HEP
IN2P3-LPC
UKI-LT2-Brunel
UKI-SCOTGRID-DURHAM
USC-LCG2
INFN-CNAF-LHCB
UKI-SCOTGRID-ECDF
RU-Protvino-IHEP
UKI-SOUTHGRID-BHAM-HEP
ru-PNPI
PSNC
CYFRONET-LCG2
INFN-LNL-2
UKI-NORTHGRID-SHEF-HEP
Ru-Troitsk-INR-LCG2


JAVIER MAGNIN
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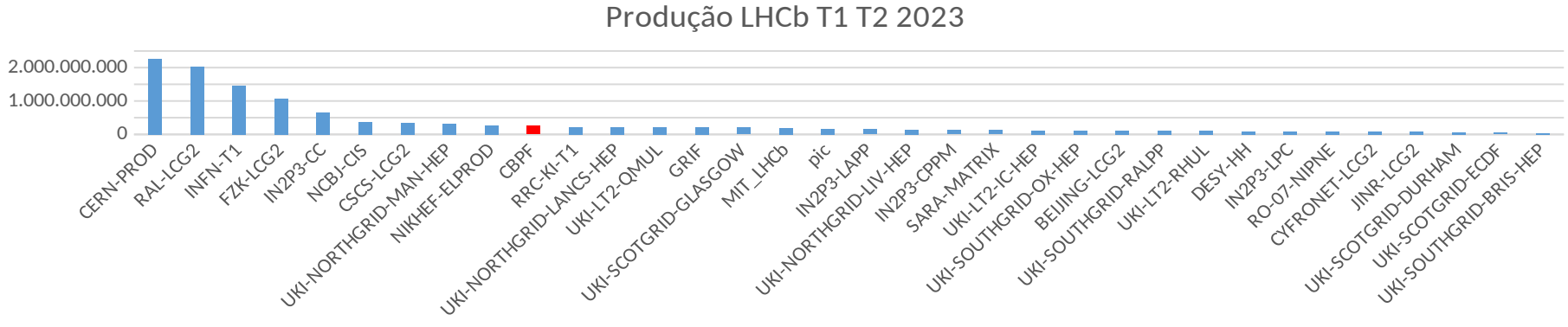
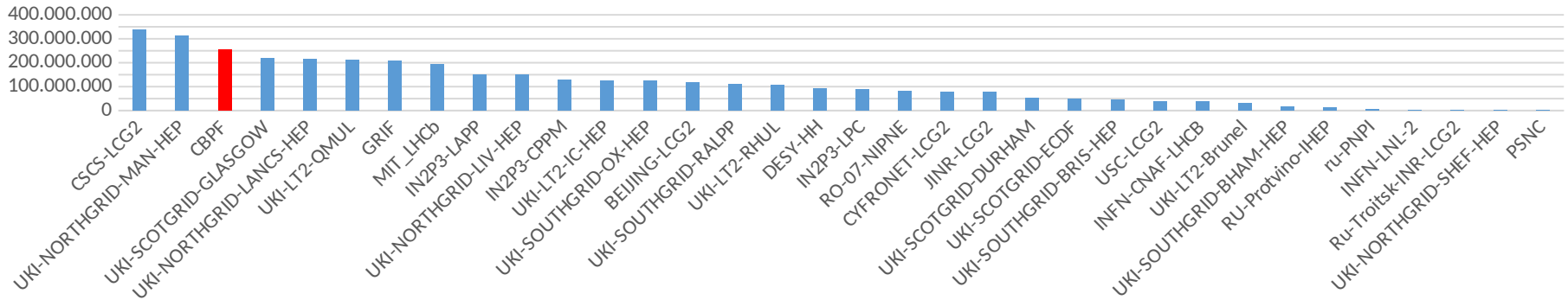
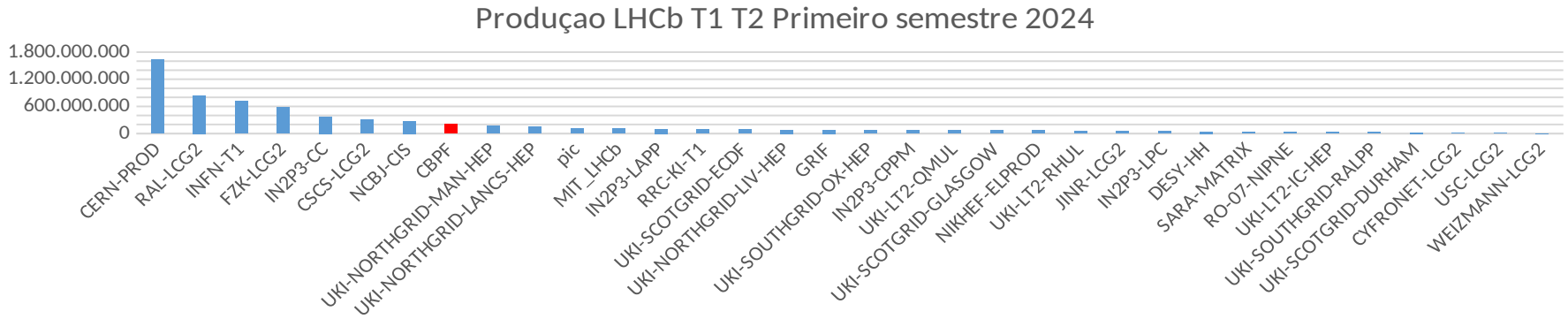
GRID/CBPF

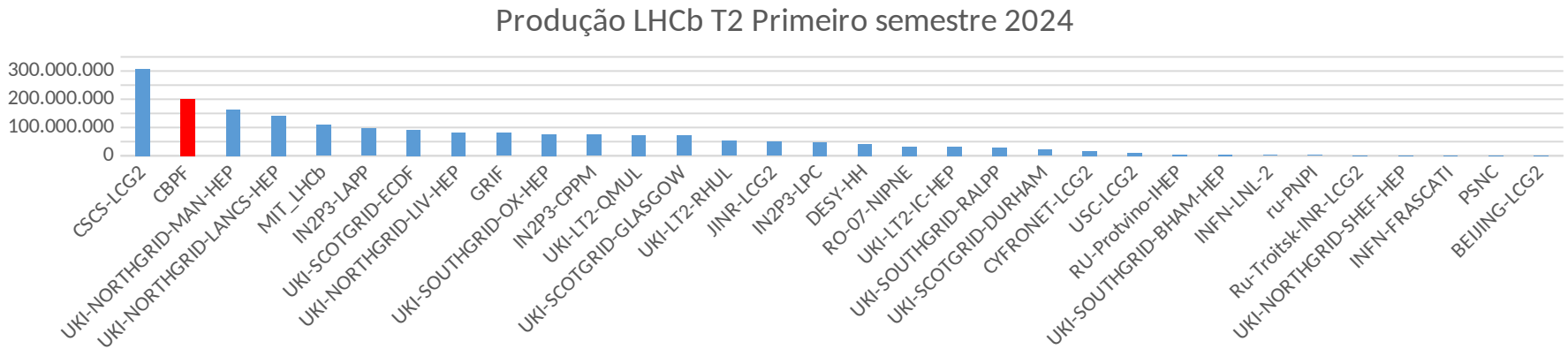

Produção LHCb T1 T2 2023
2.000.000.000
1.000.000.000
0
CERN-PROD
RAL-LCG2
INFN-T1
FZK-LCG2
IN2P3-CC
NCBJ-CIS
CSCS-LCG2
UKI-NORTHGRID-MAN-HEP
NIKHEF-ELPROD
CBPF
RRC-KI-T1
UKI-NORTHGRID-LANCS-HEP
UKI-LT2-QMUL
GRIF
UKI-SCOTGRID-GLASGOW
MIT_LHCb
pic
IN2P3-LAPP
UKI-NORTHGRID-LIV-HEP
IN2P3-CPPM
SARA-MATRIX
UKI-LT2-IC-HEP
UKI-SOUTHGRID-OX-HEP
BEIJING-LCG2
UKI-SOUTHGRID-RALPP
UKI-LT2-RHUL
DESY-HH
IN2P3-LPC
RO-07-NIPNE
CYFRONET-LCG2
JINR-LCG2
UKI-SCOTGRID-DURHAM
UKI-SCOTGRID-ECDF
UKI-SOUTHGRID-BRIS-HEP


Produção LHCb T2 2023
400.000.000
300.000.000
200.000.000
100.000.000
0
CSCS-LCG2
UKI-NORTHGRID-MAN-HEP
CBPF
UKI-SCOTGRID-GLASGOW
UKI-NORTHGRID-LANCS-HEP
UKI-LT2-QMUL
GRIF
MIT_LHCb
IN2P3-LAPP
UKI-NORTHGRID-LIV-HEP
IN2P3-CPPM
UKI-LT2-IC-HEP
UKI-SOUTHGRID-OX-HEP
BEIJING-LCG2
UKI-SOUTHGRID-RALPP
UKI-LT2-RHUL
DESY-HH
IN2P3-LPC
RO-07-NIPNE
CYFRONET-LCG2
JINR-LCG2
UKI-SCOTGRID-DURHAM
UKI-SCOTGRID-ECDF
UKI-SOUTHGRID-BRIS-HEP
USC-LCG2
INFN-CNAF-LHCB
UKI-LT2-Brunel
UKI-SOUTHGRID-BHAM-HEP
RU-Protvino-IHEP
ru-PNPI
INFN-LNL-2
Ru-Troitsk-INR-LCG2
UKI-NORTHGRID-SHEF-HEP
PSNC


JAVIER MAGNIN
DATAGRID CENTER

GRID/CBPF

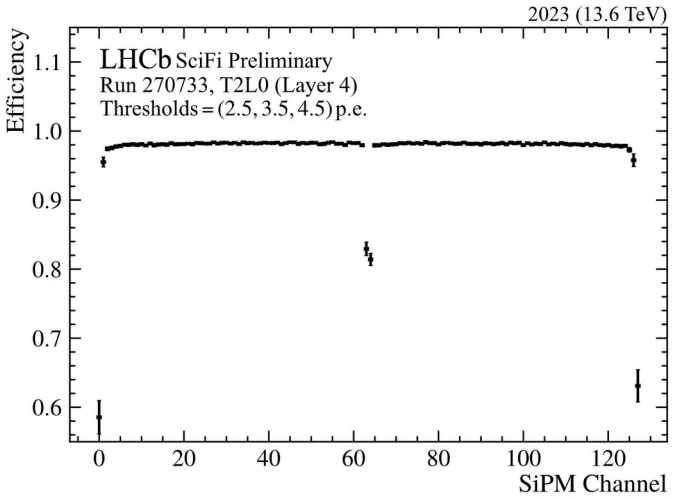

Produçao LHCb T1 T2 Primeiro semestre 2024
1.800.000.000
1.200.000.000
600.000.000
0
CERN-PROD
RAL-LCG2
INFN-T1
FZK-LCG2
IN2P3-CC
CSCS-LCG2
NCBJ-CIS
CBPF
UKI-NORTHGRID-MAN-HEP
UKI-NORTHGRID-LANCS-HEP
pic
MIT_LHCb
IN2P3-LAPP
RRC-KI-T1
UKI-SCOTGRID-ECDF
UKI-NORTHGRID-LIV-HEP
GRIF
UKI-SOUTHGRID-OX-HEP
IN2P3-CPPM
UKI-LT2-QMUL
UKI-SCOTGRID-GLASGOW
NIKHEF-ELPROD
UKI-LT2-RHUL
JINR-LCG2
IN2P3-LPC
DESY-HH
SARA-MATRIX
RO-07-NIPNE
UKI-LT2-IC-HEP
UKI-SOUTHGRID-RALPP
UKI-SCOTGRID-DURHAM
CYFRONET-LCG2
USC-LCG2
WEIZMANN-LCG2


Produção LHCb T2 Primeiro semestre 2024
300.000.000
200.000.000
100.000.000
0
CSCS-LCG2
CBPF
UKI-NORTHGRID-MAN-HEP
UKI-NORTHGRID-LANCS-HEP
MIT_LHCb
IN2P3-LAPP
UKI-SCOTGRID-ECDF
UKI-NORTHGRID-LIV-HEP
GRIF
UKI-SOUTHGRID-OX-HEP
IN2P3-CPPM
UKI-LT2-QMUL
UKI-SCOTGRID-GLASGOW
UKI-LT2-RHUL
JINR-LCG2
IN2P3-LPC
DESY-HH
RO-07-NIPNE
UKI-LT2-IC-HEP
UKI-SOUTHGRID-RALPP
UKI-SCOTGRID-DURHAM
CYFRONET-LCG2
USC-LCG2
RU-Protvino-IHEP
UKI-SOUTHGRID-BHAM-HEP
INFN-LNL-2
ru-PNPI
Ru-Troitsk-INR-LCG2
UKI-NORTHGRID-SHEF-HEP
INFN-FRASCATI
PSNC
BEIJING-LCG2

SciFi

Andre Massafferri e Ulisses De Freitas Carneiro Da Graca

Projeto conceitual: 2014 → Calibração SciFi Concluída: 2023



Eficência média de detecção de hits para uma camada
https://cds.cern.ch/record/2869773/files/LHCb-FIGURE-2023-021.pdf

The efficiency is expected to drop at the edges of the SiPMs due to gaps between the detector elements and damaged fibres at the edges from cutting of the fibre mats.

The drop in the center of the SiPMs is due to the devices being assembled from two dies of 64 channels with a small gap between them.

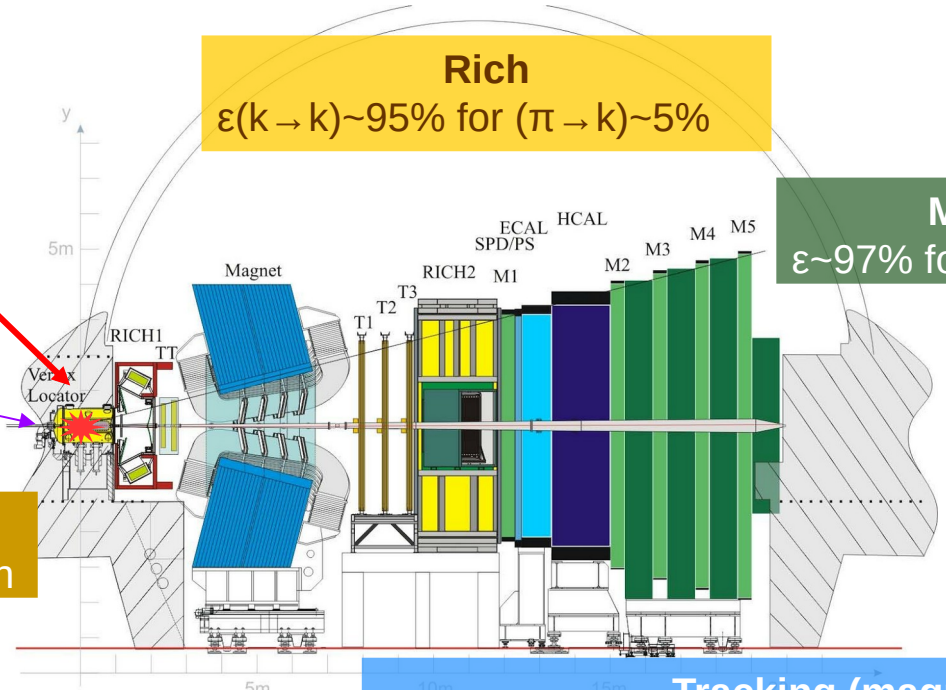
LHCb is a single arm spectrometer fully instrumented in the forward region (2.0<η<5.0)
Designed for heavy flavour physics and also exploited for general purpose physics
[Int. J. Mod. Phys. A 30, 1530022 (2015)]

Rich
ε(k→k)~95% for (π→k)~5%

Collision

Muon
ε~97% for misID~2%

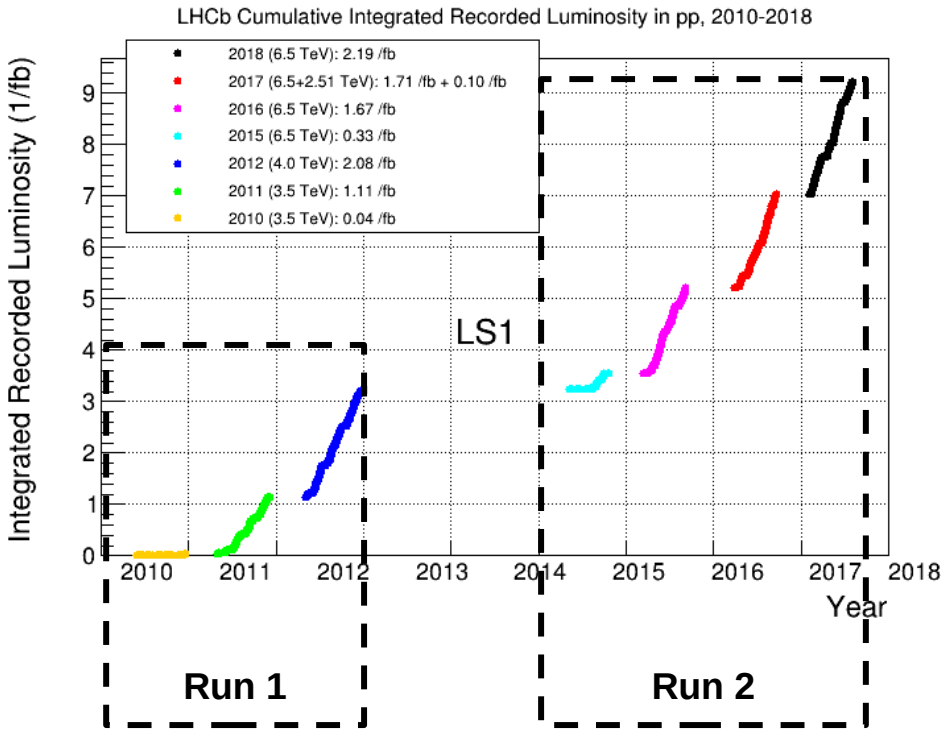
SMOG

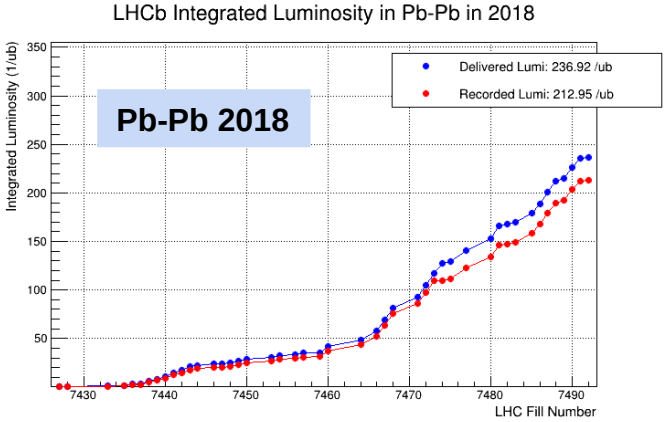


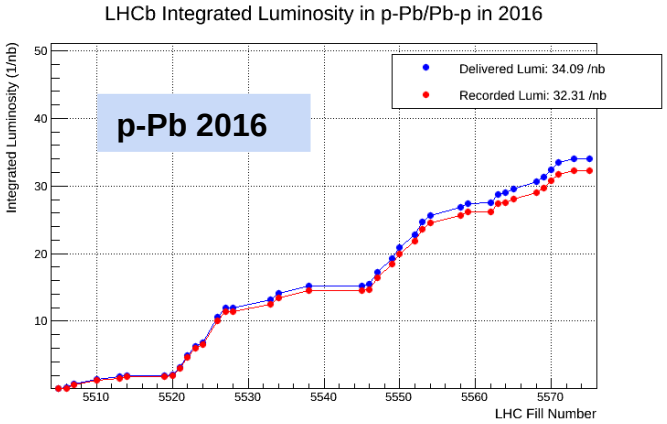
VELO
~20μm IP resolution

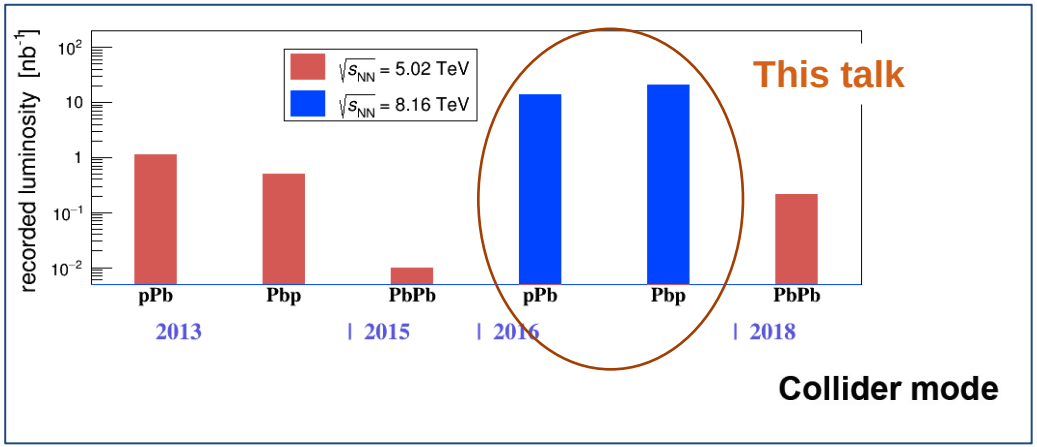
Herschel
Forward counters

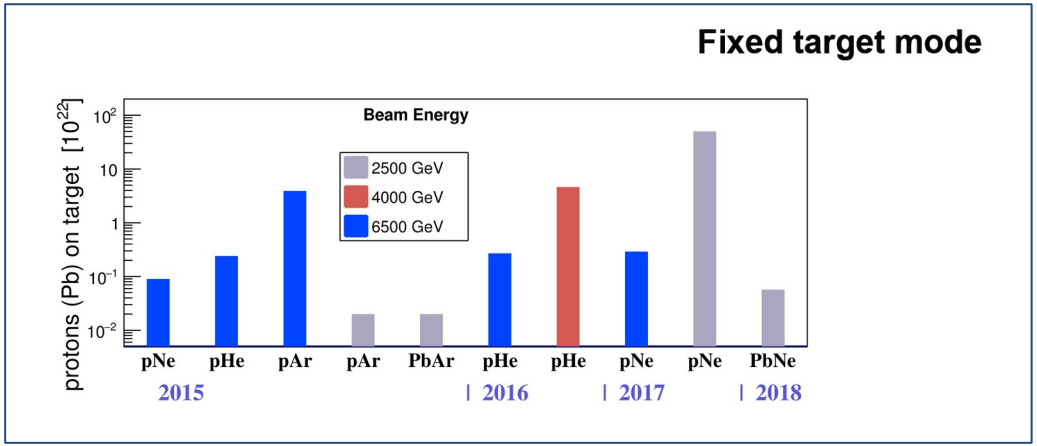
Tracking (magnet)
0.4%-0.6% momentum resolution (0.2-100 GeV)

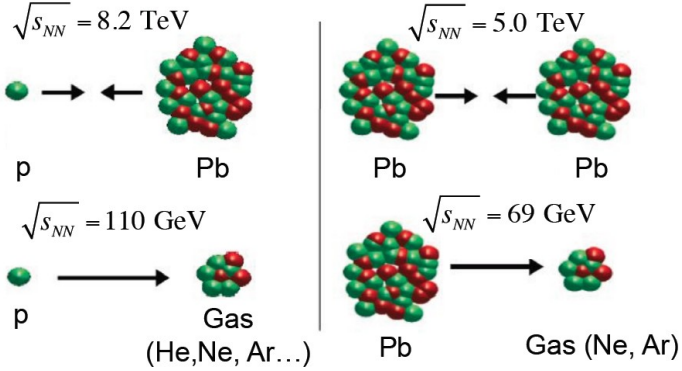

LHCb Cumulative Integrated Recorded Luminosity in pp, 2010-2018
2018 (6.5 TeV): 2.19 /fb
2017 (6.5+2.51 TeV): 1.71 /fb + 0.10 /fb
2016 (6.5 TeV): 1.67 /fb
2015 (6.5 TeV): 0.33 /fb
2012 (4.0 TeV): 2.08 /fb
2011 (3.5 TeV): 1.11 /fb
2010 (3.5 TeV): 0.04 /fb
Integrated Recorded Luminosity (1/fb)
LS1
Year
Run 1
Run 2


LHCb Integrated Luminosity in Pb-Pb in 2018
Pb-Pb 2018
Delivered Lumi: 236.92 /ub
Recorded Lumi: 212.95 /ub
Integrated Luminosity (1/ub)
LHC Fill Number


LHCb Integrated Luminosity in p-Pb/Pb-p in 2016
p-Pb 2016
Delivered Lumi: 34.09 /nb
Recorded Lumi: 32.31 /nb
Integrated Luminosity (1/nb)
LHC Fill Number


recorded luminosity [nb^{-1}]
10^2
10
1
10^{-1}
10^{-2}
$\sqrt{s_{NN}}$ = 5.02 TeV
$\sqrt{s_{NN}}$ = 8.16 TeV
This talk
pPb
Pbp
PbPb
pPb
Pbp
PbPb
2013
2015
2016
2018
Collider mode


Fixed target mode
protons (Pb) on target [10^{22}]
10^2
10
1
10^{-1}
10^{-2}
Beam Energy
2500 GeV
4000 GeV
6500 GeV
pNe
pHe
pAr
pAr
PbAr
pHe
pHe
pNe
pNe
PbNe
2015
2016
2017
2018


$\sqrt{s_{NN}}$ = 8.2 TeV
p
Pb
$\sqrt{s_{NN}}$ = 5.0 TeV
Pb
Pb
$\sqrt{s_{NN}}$ = 110 GeV
p
Gas
(He,Ne, Ar…)
$\sqrt{s_{NN}}$ = 69 GeV
Pb
Gas (Ne, Ar)

LHCb Upgrade I

CERN-LHCC-2012-007

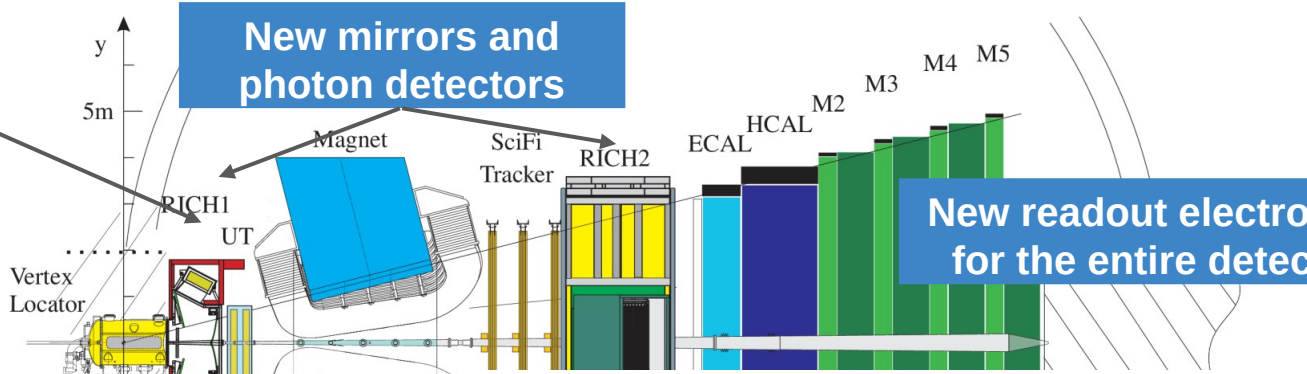
UT
(new silicon tracker)

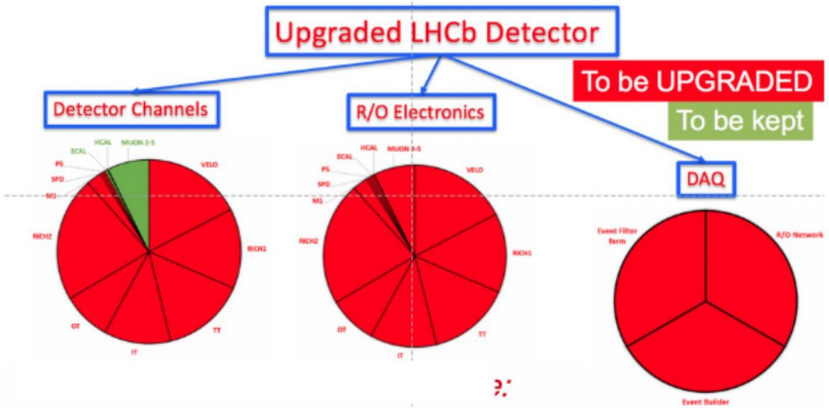
New mirrors and photon detectors

New readout electronics for the entire detector

New VELO
(Pixel Detector)

SciFi
(new scintillating fibre tracker)





LHCb Upgrade I

CERN-LHCC-2012-007

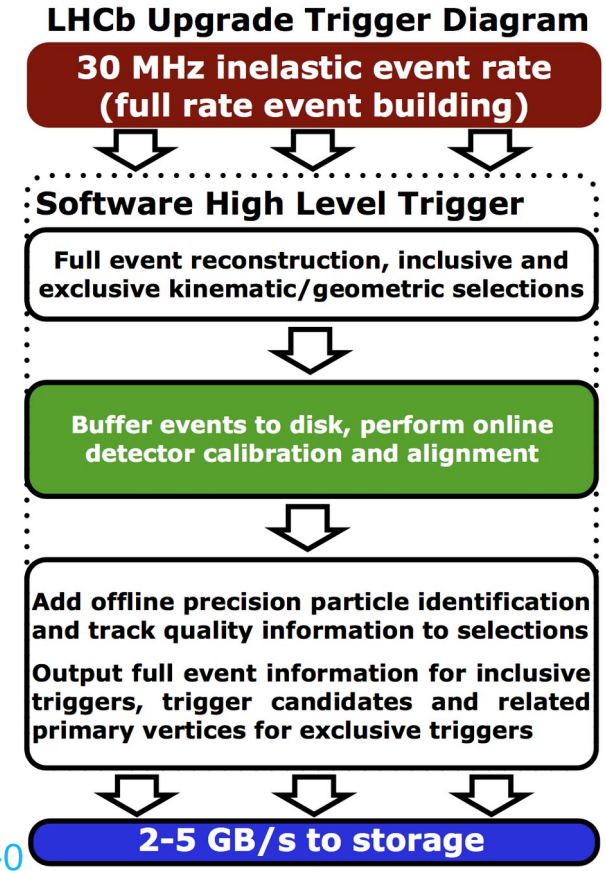
❋ Increase instantaneous luminosity:
$4 \times 10^{32} \rightarrow 2 \times 10^{33}$ cm^{-2} s^{-1}

❋ Replacement of tracking detectors
♯ finer granularity to cope with higher particle density
♯ new front-end electronics compatible with 30 MHz readout

❋ Remove hardware trigger stage and operate software trigger at 30 MHz input rate with 5 x more pileup than Run 2.

❋ Prospects for integrated luminosity for heavy-ion

PbPb	**0.5/nb**
pPb	**150/nb**



LHCB-PUB-2014-0

Refletindo …

High Energy Physics has a large investment in software

--- Critical part of the physics production pipeline: real-time and offline analysis software

--- LHC experiments use about 1M CPU cores every hour of every day
++ 1000 PB of data with 100 PB of data transfers per year (10-100 Gb links)

--- Estimated to be around 50M lines of C++ which would cost more than 500M to develop commercially

--- There are vast challenges ahead of us to support our ongoing physics programme

https://hepsoftwarefoundation.org