Commissioning of the ALICE MFT detector and measurement of the polarisation of the J/ψ in 5.02 TeV ultra-peripheral Pb-Pb collisions

Lucrezia Camilla MIGLIORIN - IP2I Lyon

PhD Day - IP2I 22/10/2021

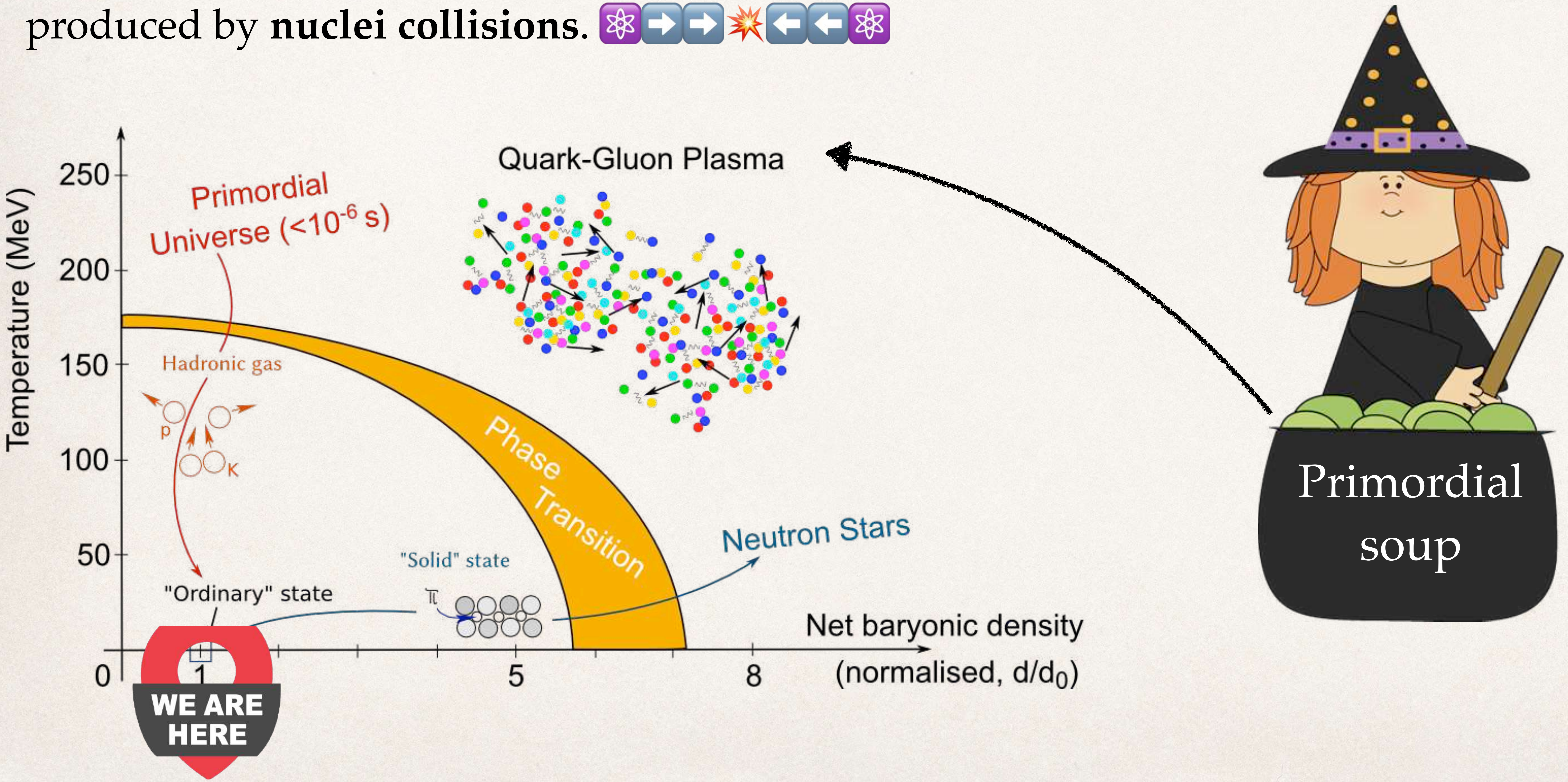
Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️

L.C.Migliorin (l.migliorin@cern.ch)

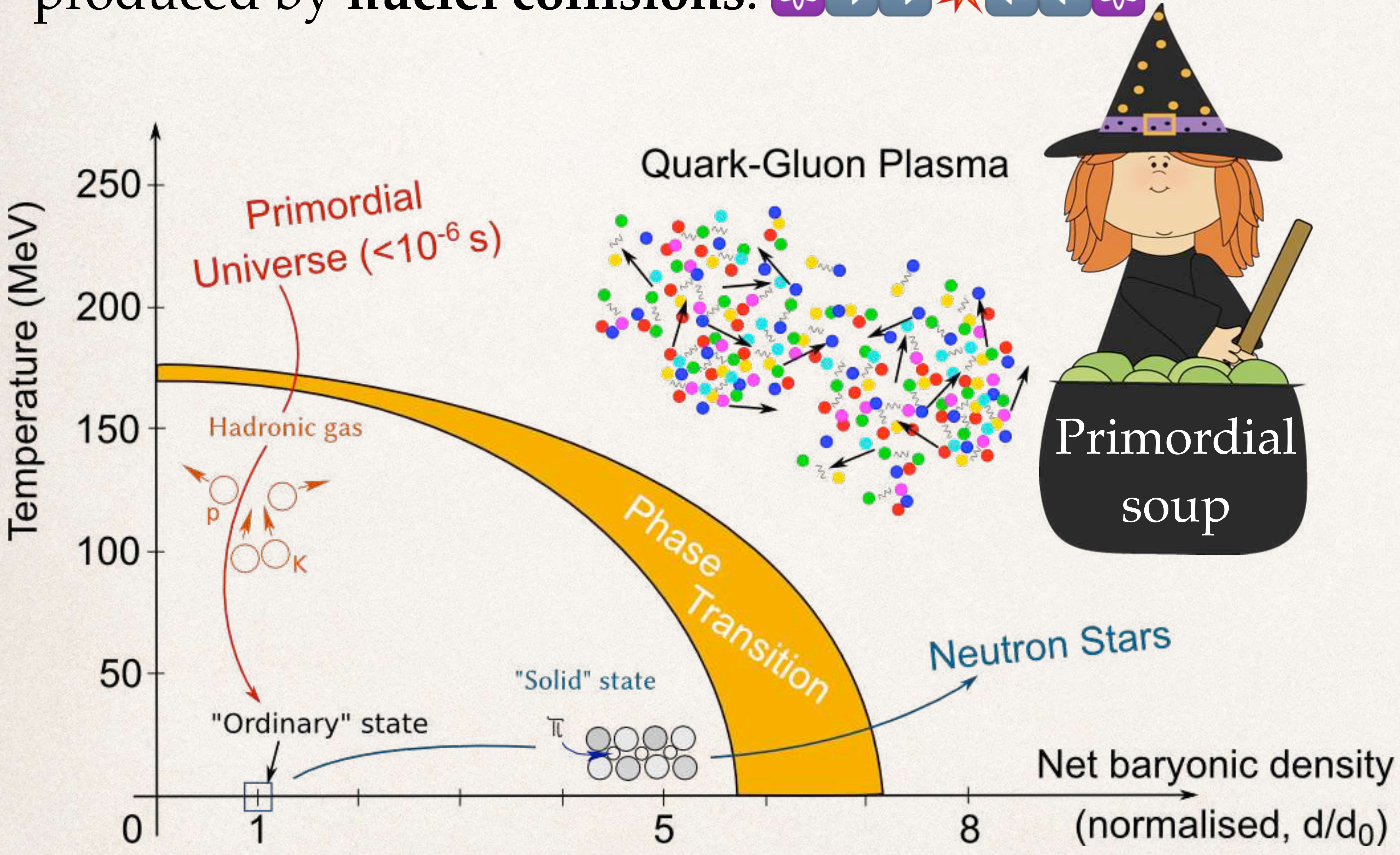
Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



Ultra-peripherical collisions in heavy-ion collisions (1)

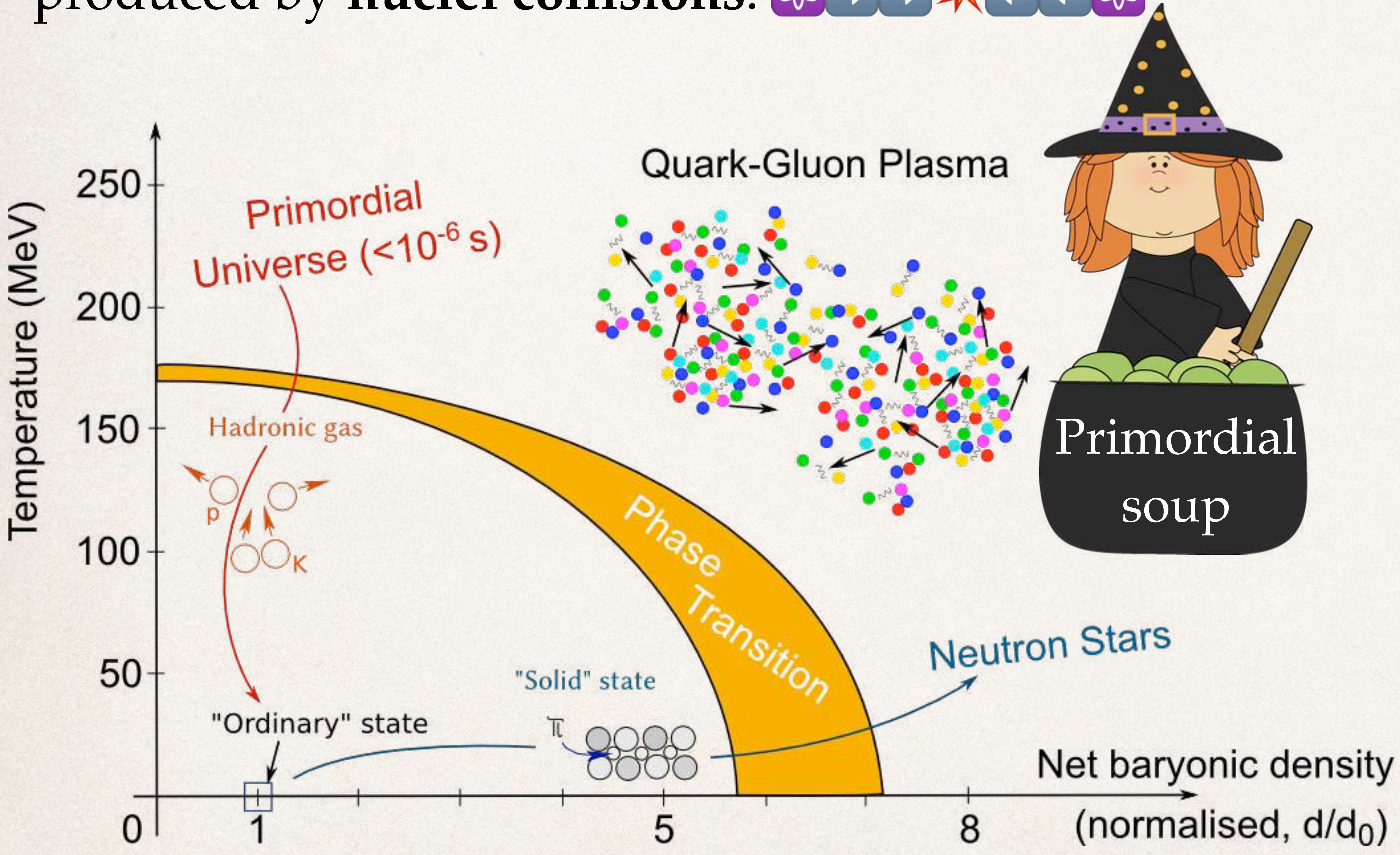
Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍲.

Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️

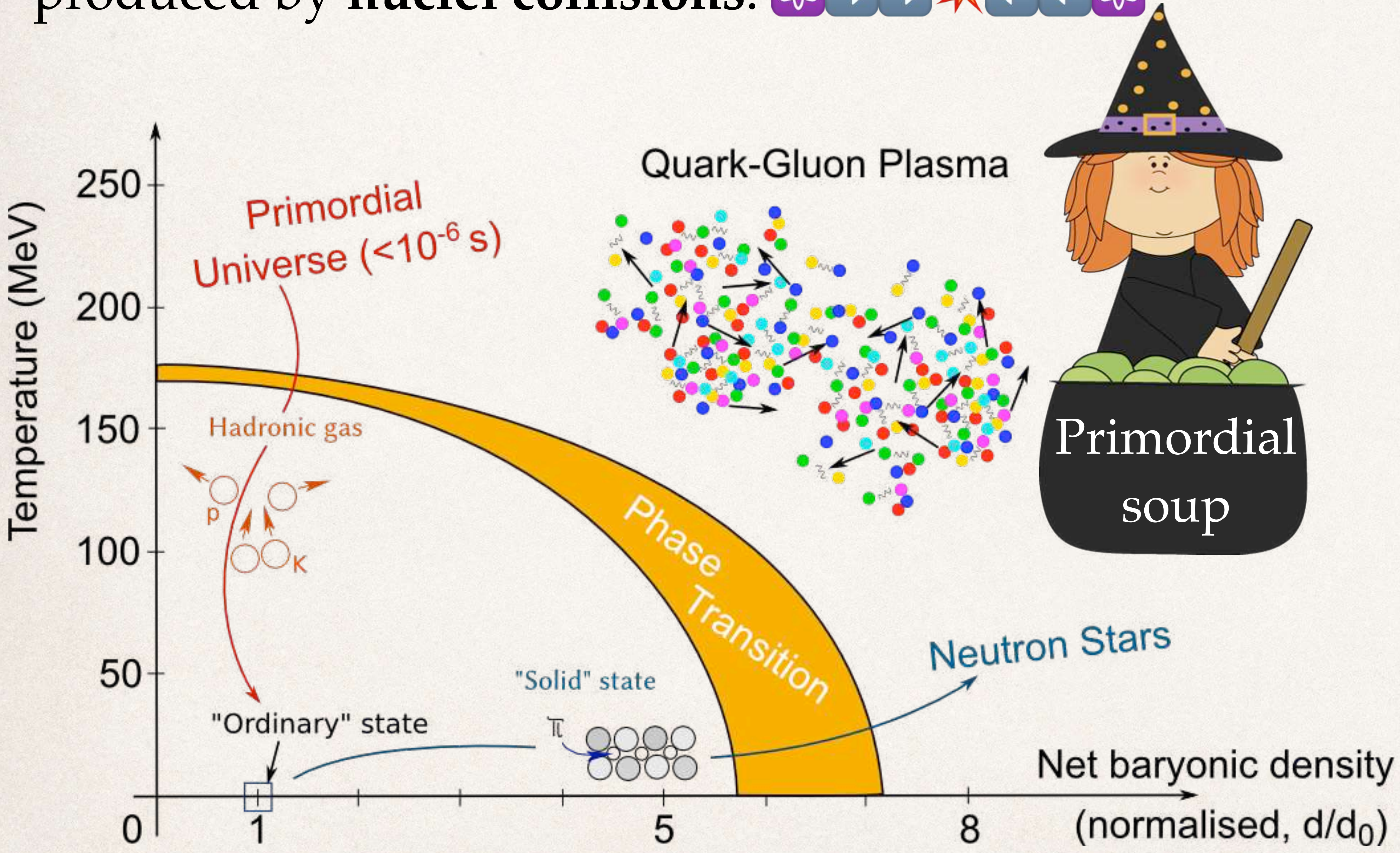


Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍜.

One important characteristic still **unknown** : parton distribution functions (PDFs) show **gluon distributions** are still poorly known.

Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



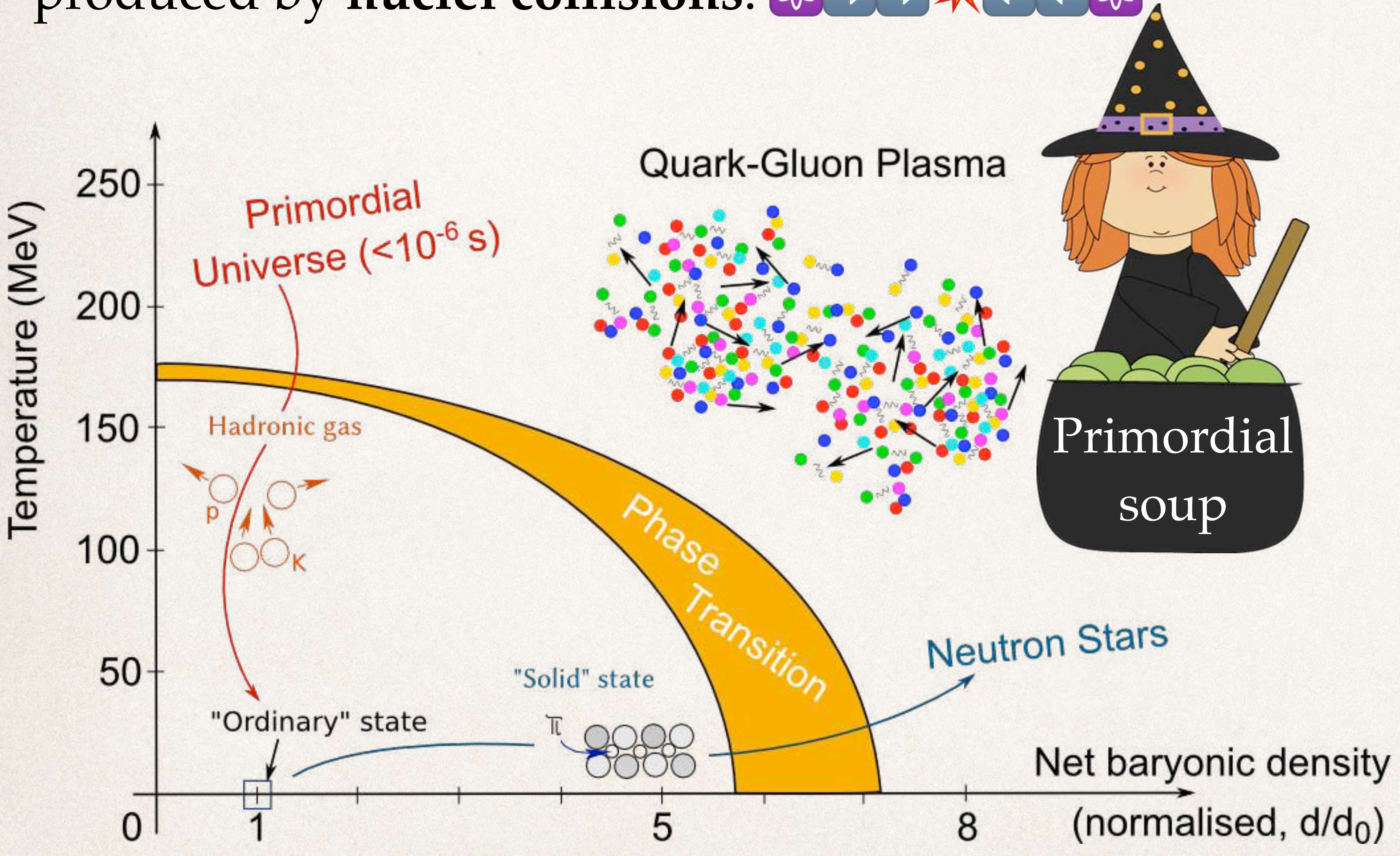
Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍜.

One important characteristic still **unknown** : parton distribution functions (PDFs) show **gluon distributions** are still poorly known.

Parton?!

Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍲.

One important characteristic still **unknown** : parton distribution functions (PDFs) show **gluon distributions** are still poorly known.

Dolly Parton

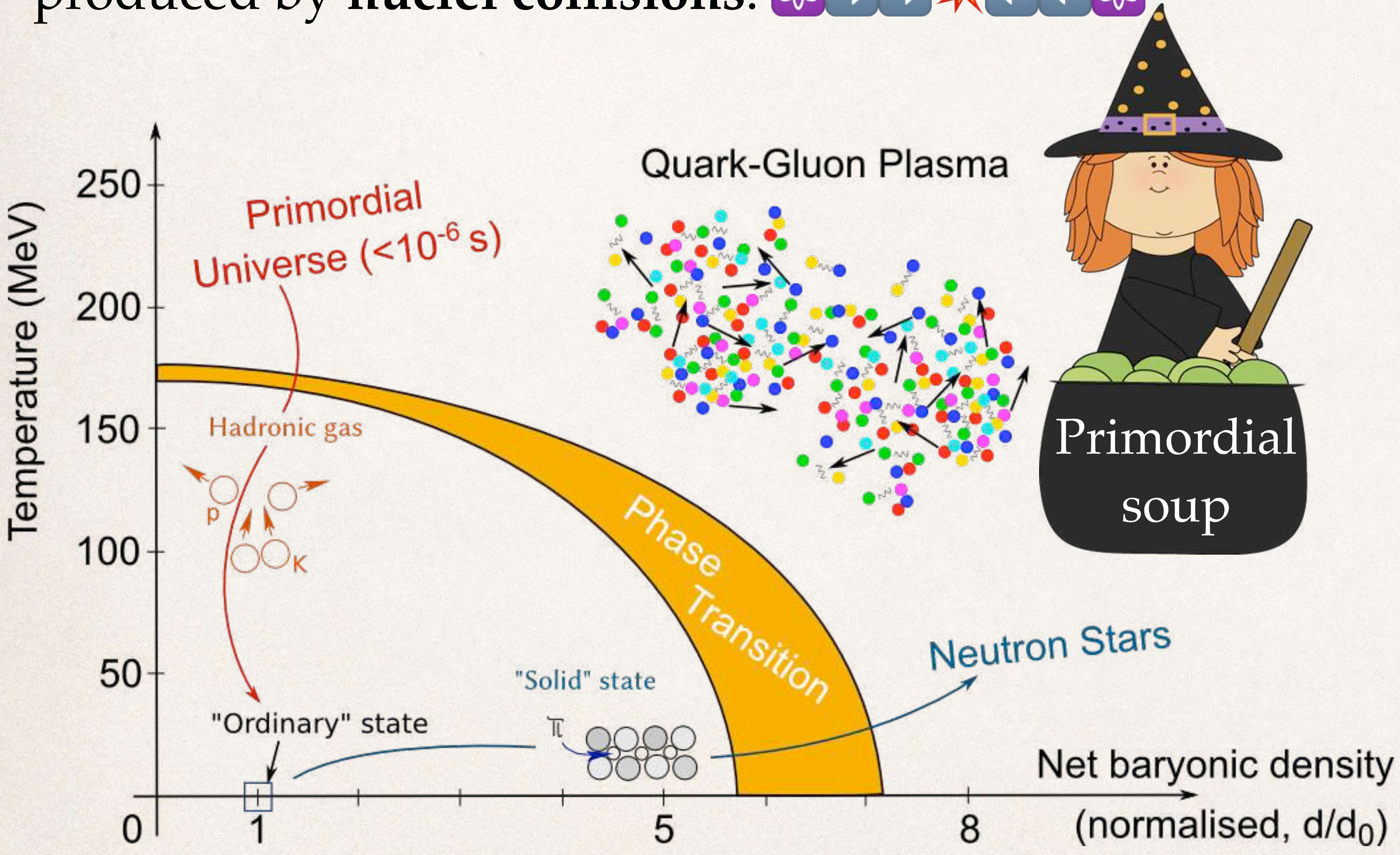
Parton?!

or

L.C.Migliorin (l.migliorin@cern.ch)

Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍜.

One important characteristic still **unknown** : parton distribution functions (PDFs) show **gluon distributions** are still poorly known.

Parton?!

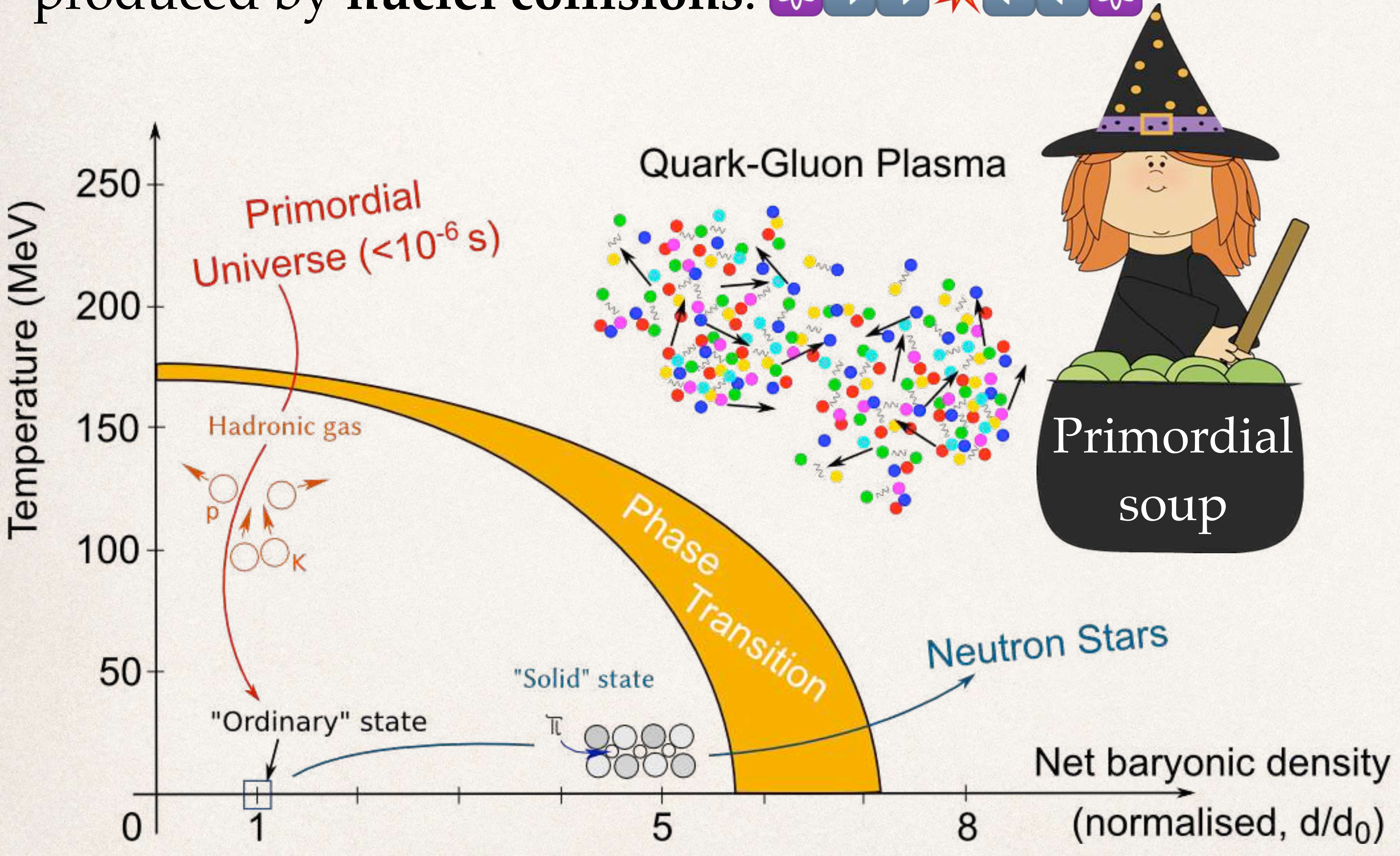
Dolly Parton

or

Proposed by R. Feynman, a hadron is composed of a number of point-like constituents, termed "partons".

Ultra-peripherical collisions in heavy-ion collisions (1)

Purpose of ultra-relativistic heavy-ion collisions : study of **Quark-Gluon Plasma** (QGP) characteristics produced by **nuclei collisions**. ⚛️➡️➡️💥⬅️⬅️⚛️



Important for heavy-ion collision : **distinguish** between **final-state particles** produced **directly** by the nuclei themselves ☄️🥇 from those **originating from the QGP** 🍜.

One important characteristic still **unknown** : parton distribution functions (PDFs) show **gluon distributions** are still poorly known.

Dolly Parton

Parton?!

or

Proposed by R. Feynman, a hadron is composed of a number of point-like constituents, termed "partons".

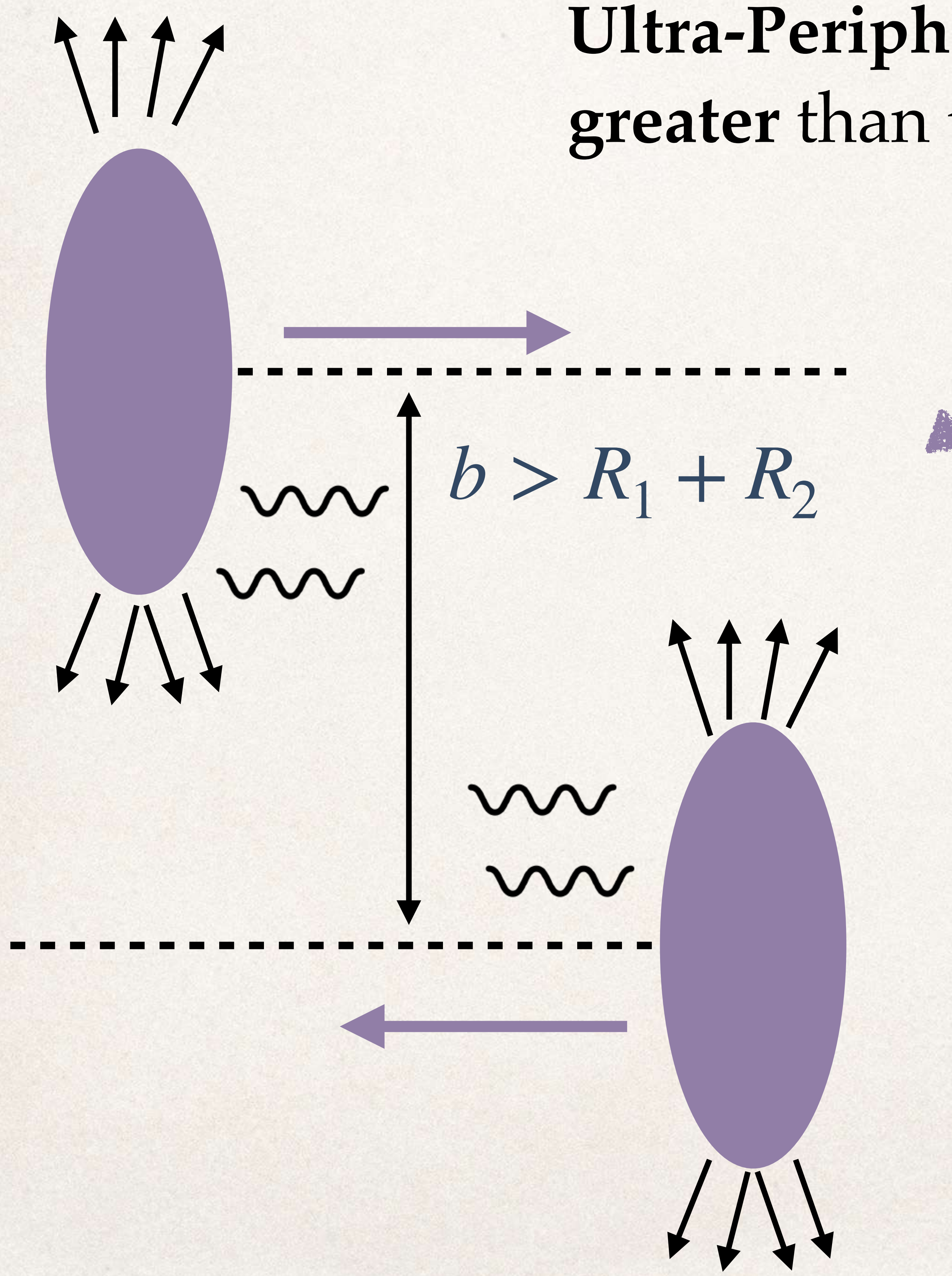
Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A,$ a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

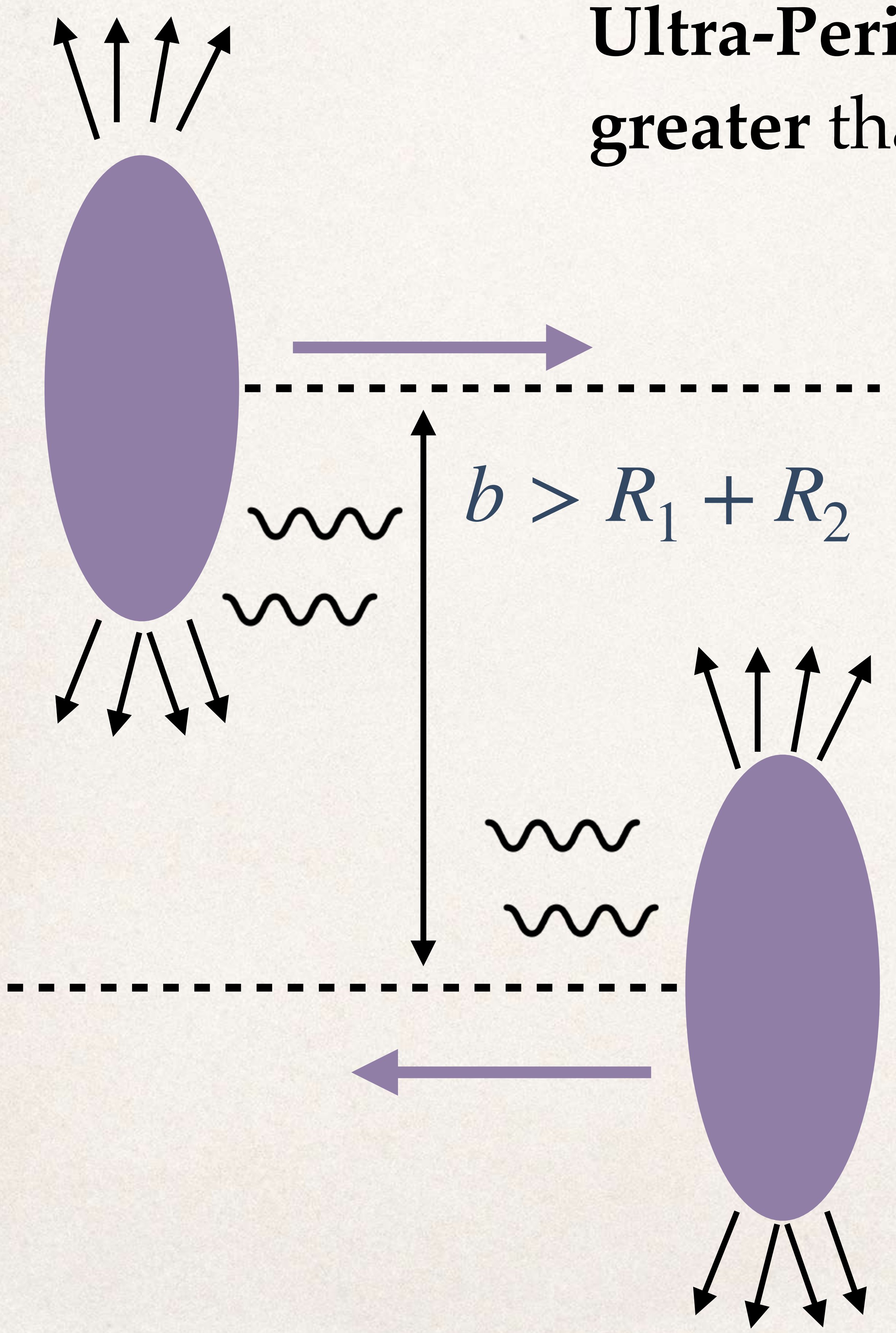
Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*)** **greater** than the **sum** of their **radii.**



Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

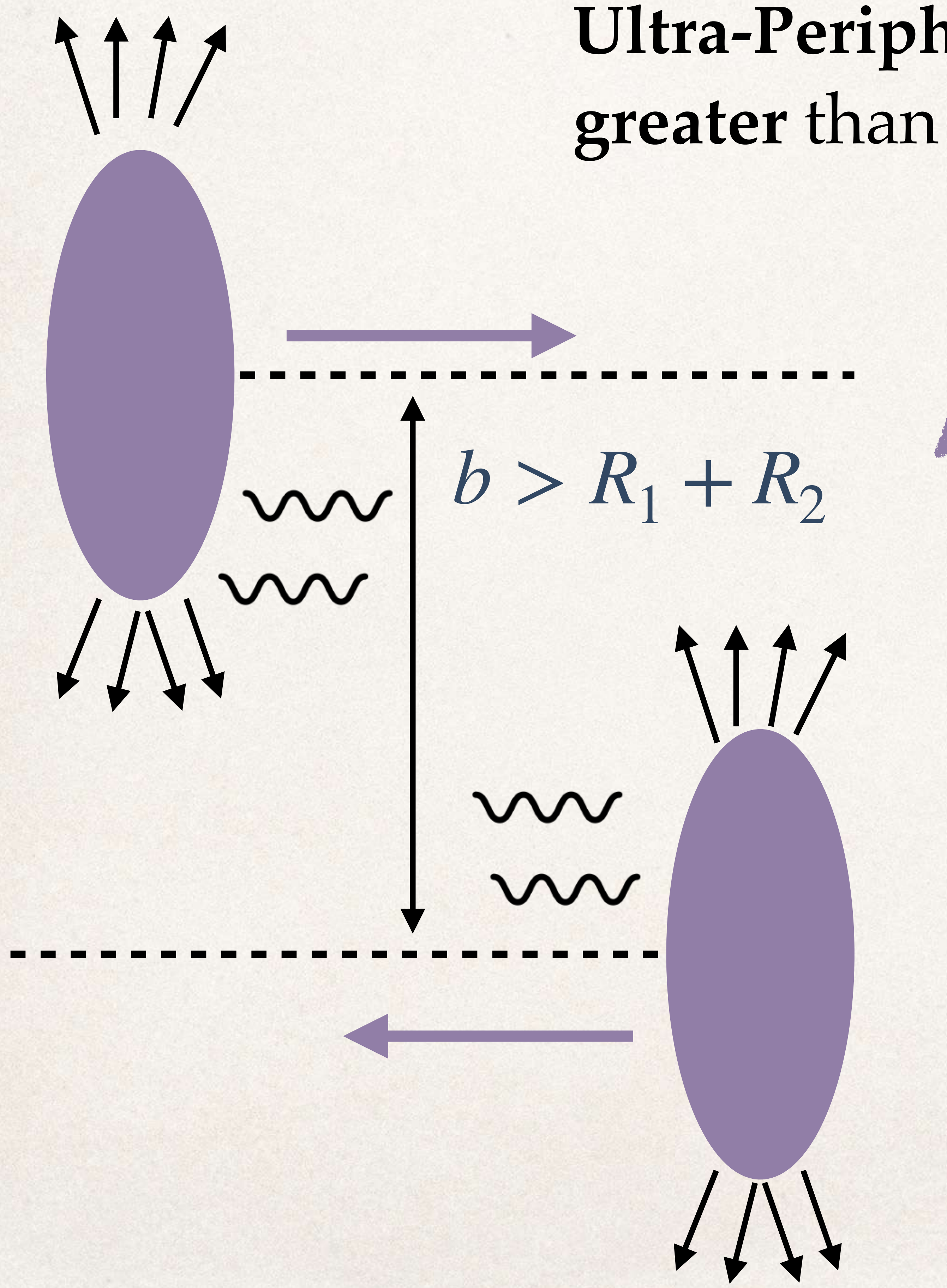
Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*)** **greater** than the **sum** of their **radii.**



L.C.Migliorin (l.migliorin@cern.ch)

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

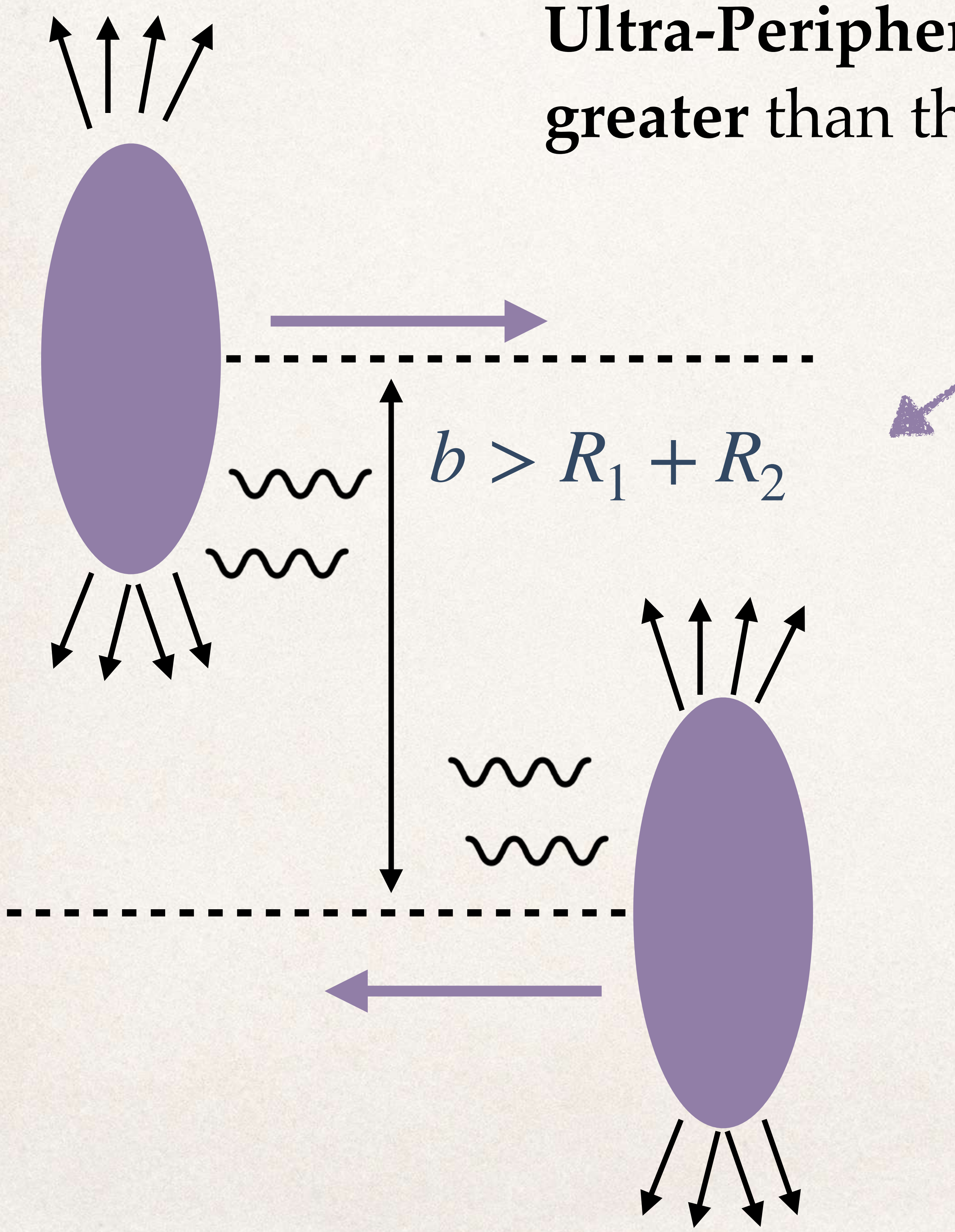


Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*)** **greater** than the **sum** of their **radii.**

UPC are collisions that do not collide!🤯🤯🤯

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬



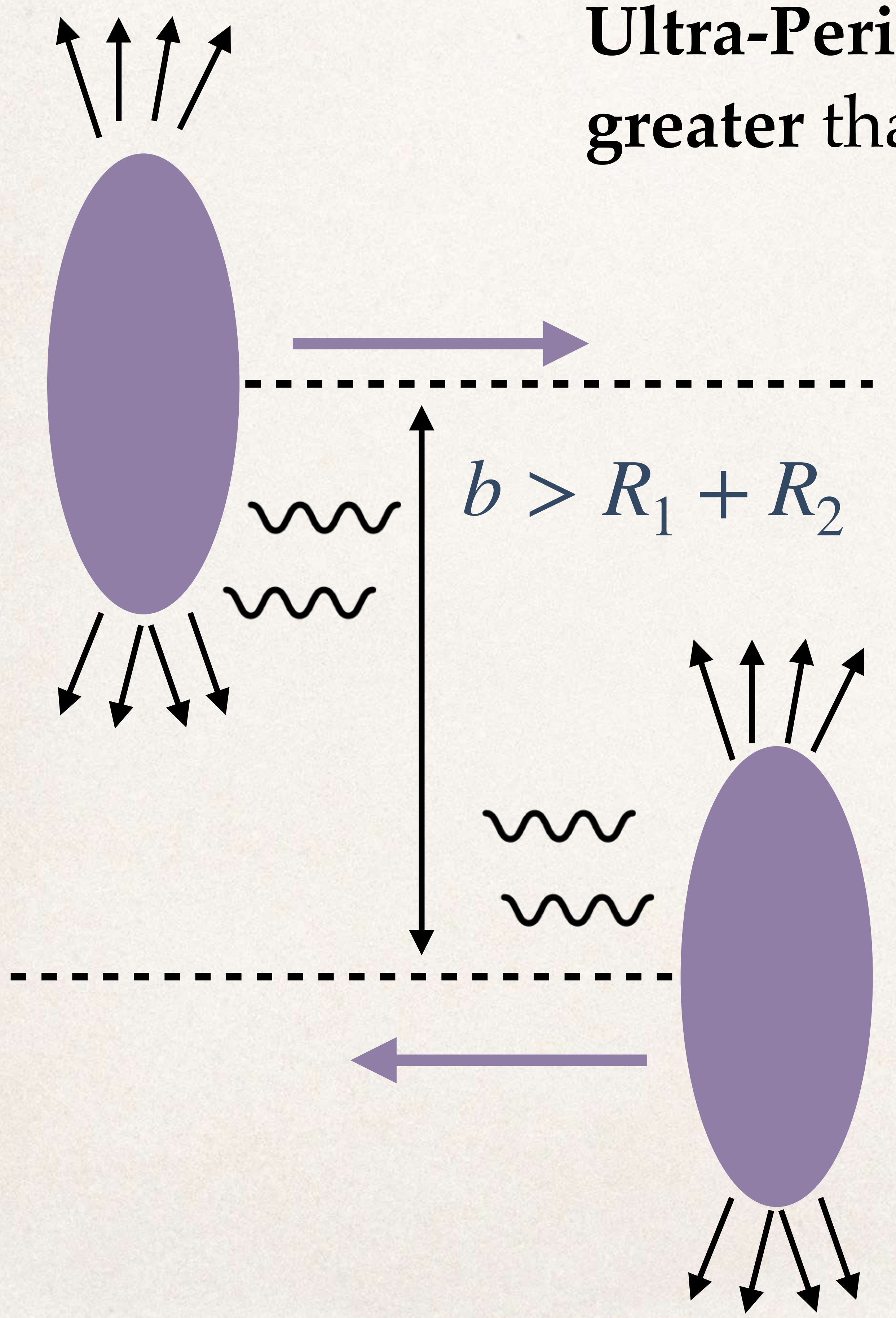
Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*) greater** than the **sum** of their **radii.**

UPC are collisions that do not collide!🤯🤯🤯

Due to their electric field, they exchange a **very energetic photon** ⚡💪🏼.

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬



Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*) greater** than the **sum** of their **radii.**

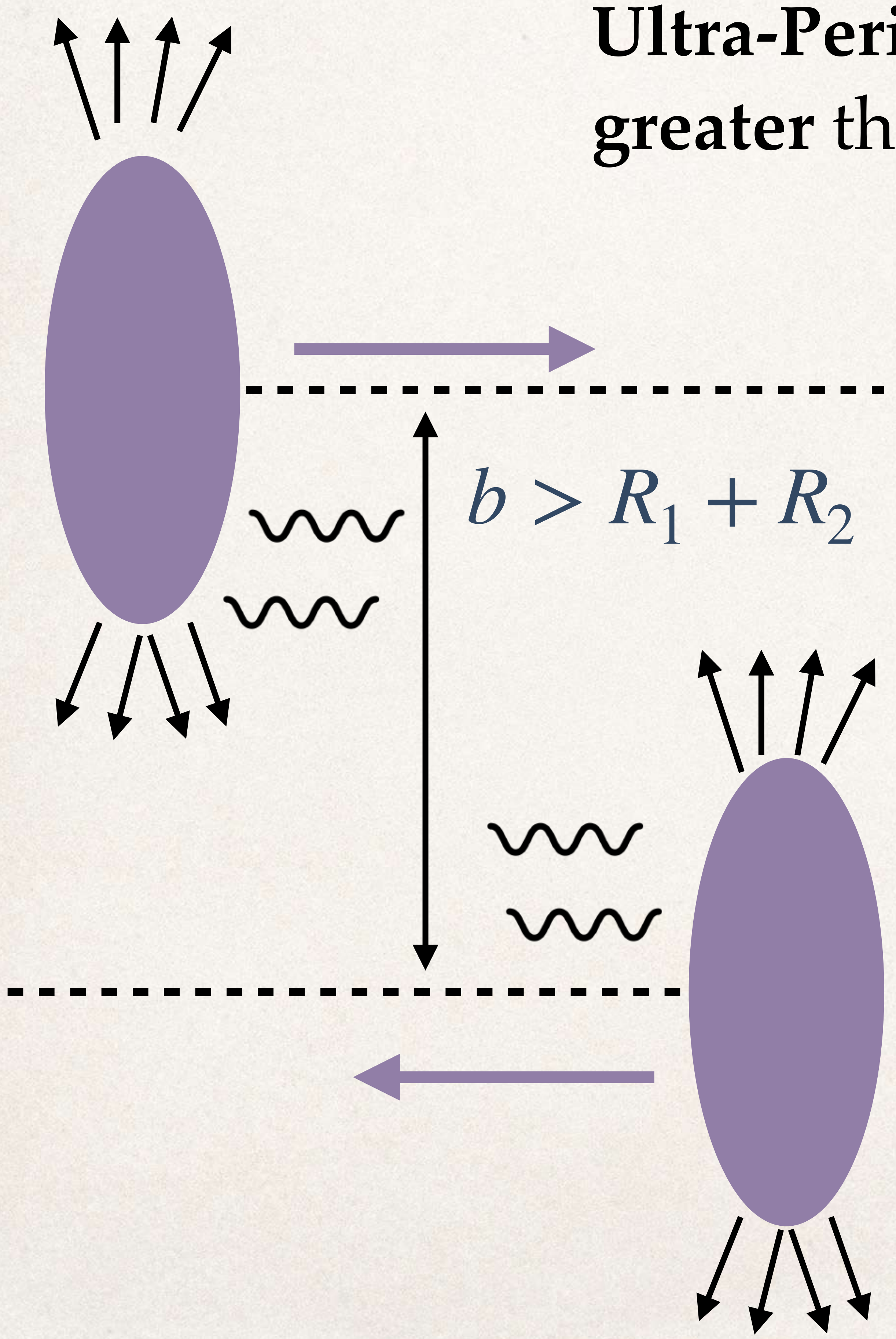
UPC are collisions that do not collide!🤯🤯🤯

Due to their electric field, they exchange a **very energetic photon** ⚡💪🏼.

A photonuclear interaction that has attracted a lot of interest is **exclusive vector meson production** as J/ψ mesons!

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

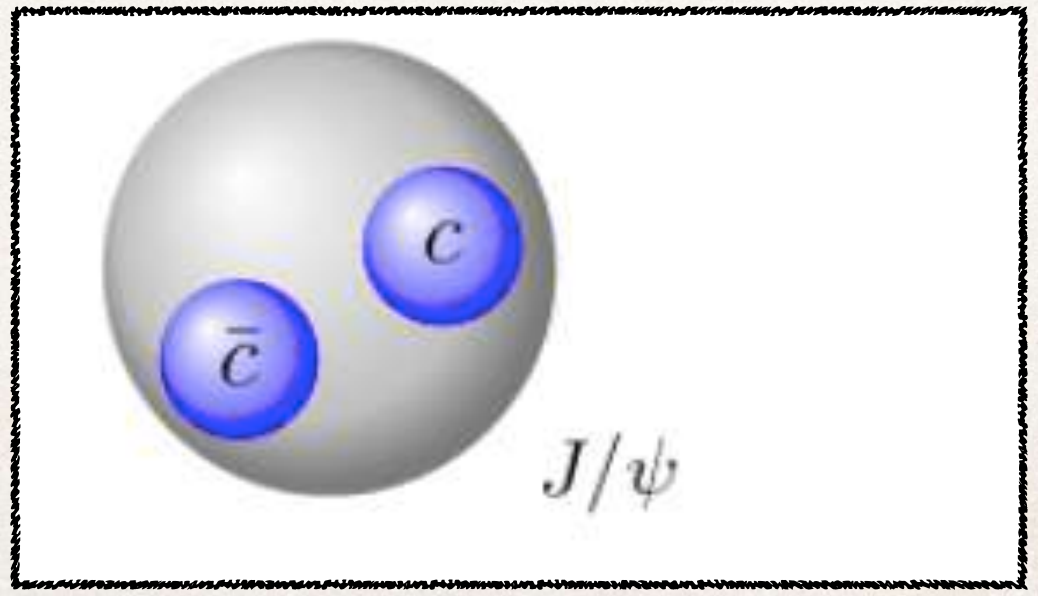


Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*)** **greater** than the **sum** of their **radii.**

UPC are collisions that do not collide!🤯🤯🤯

Due to their electric field, they exchange a **very energetic photon** ⚡💪.

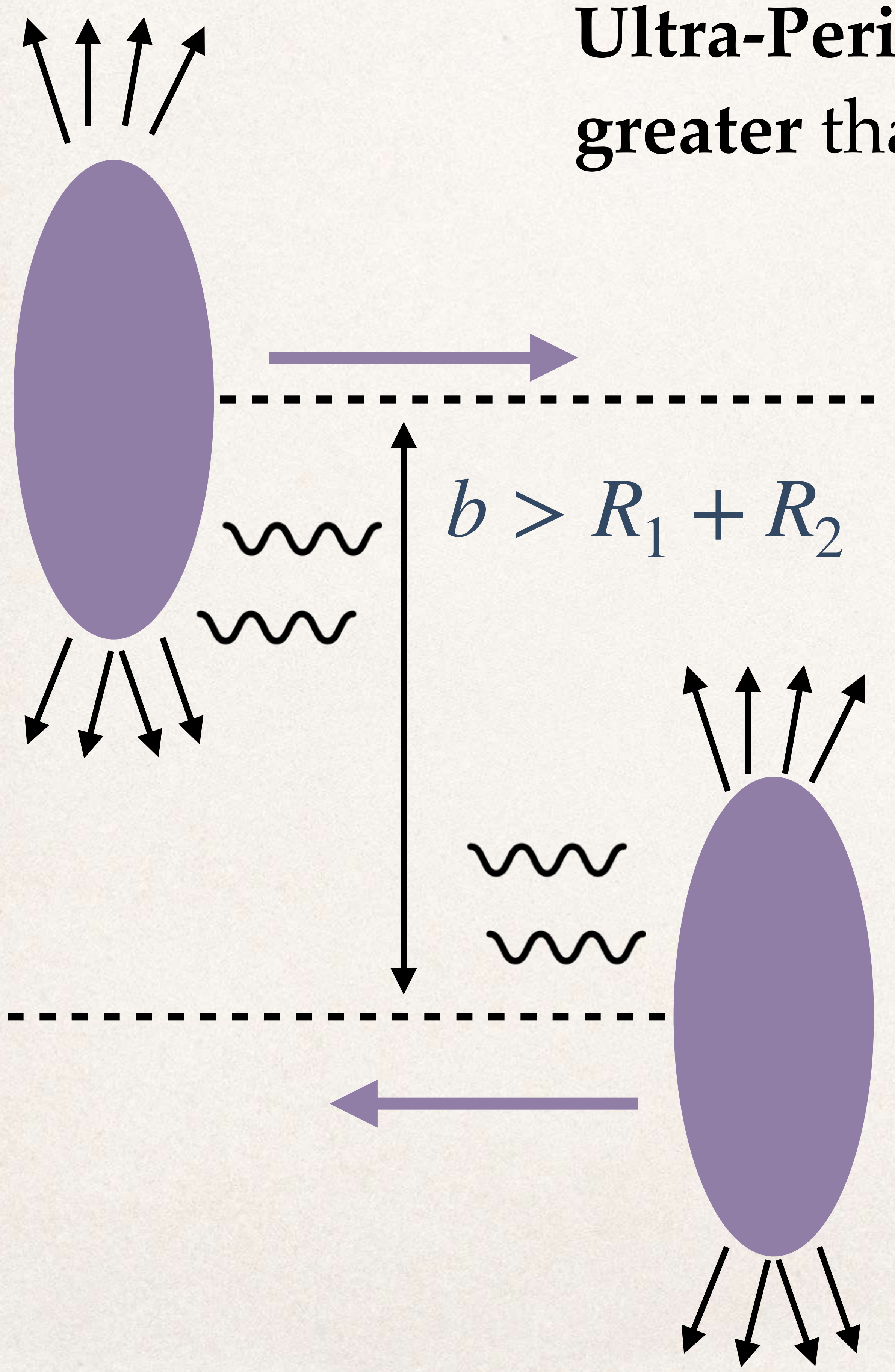
A photonuclear interaction that has attracted a lot of interest is **exclusive vector meson production** as J/ψ mesons!



L.C.Migliorin (l.migliorin@cern.ch)

Ultra-peripherical collisions in heavy-ion collisions (2)

One of interaction types : $\gamma - A$, a **photon** generated by one of the passing nuclei can interact with a **parton** inside a second one producing a wide variety of particles → ***photoproduction***.📸🎬

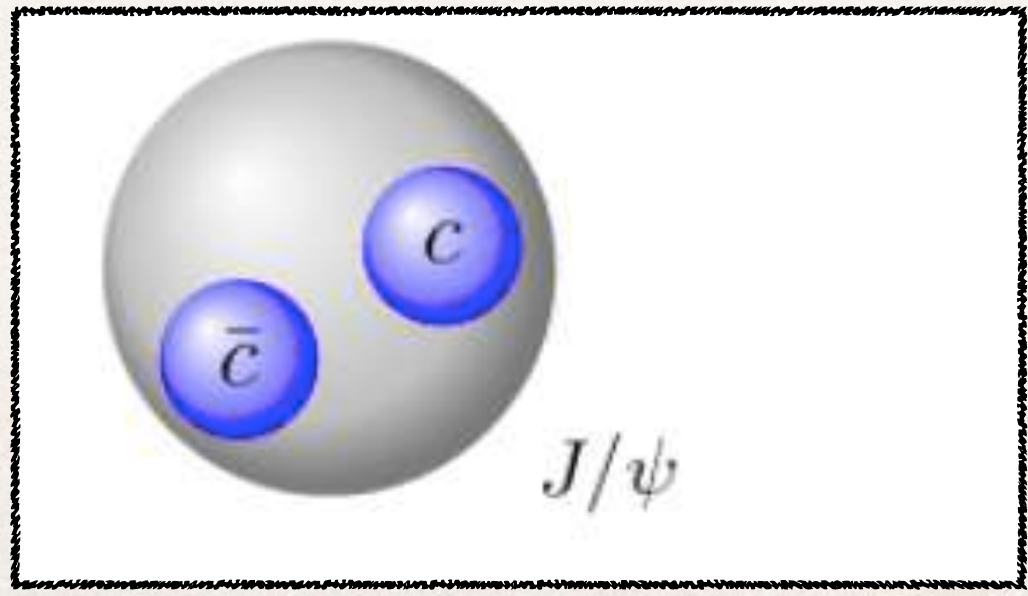


Ultra-Peripheral Collisions (UPC) : two **nuclei** intersect with an **impact parameter (*b*) greater** than the **sum** of their **radii.**

UPC are collisions that do not collide!🤯🤯🤯

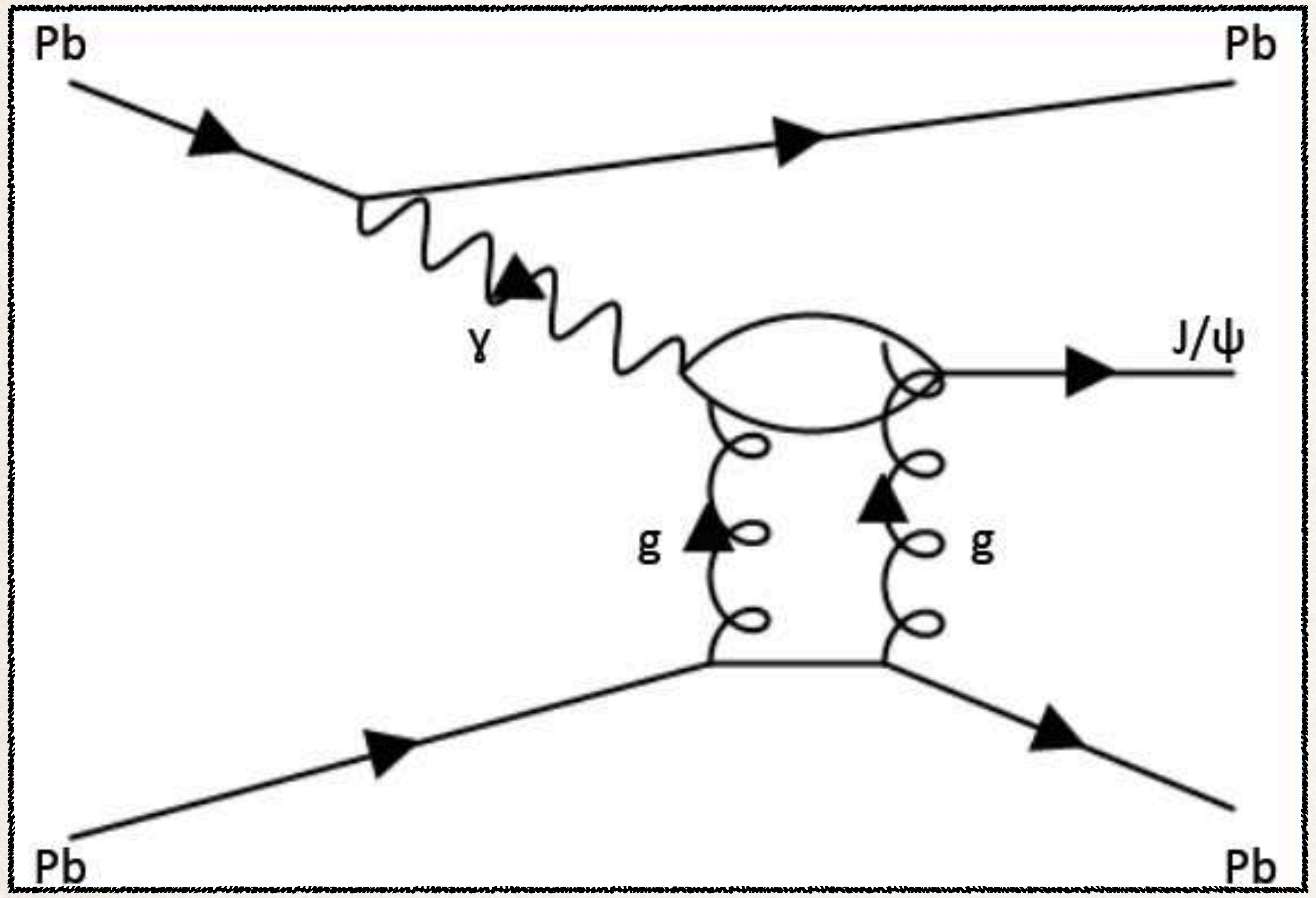
Due to their electric field, they exchange a **very energetic photon** ⚡💪🏼.

A photonuclear interaction that has attracted a lot of interest is **exclusive vector meson production** as J/ψ mesons!



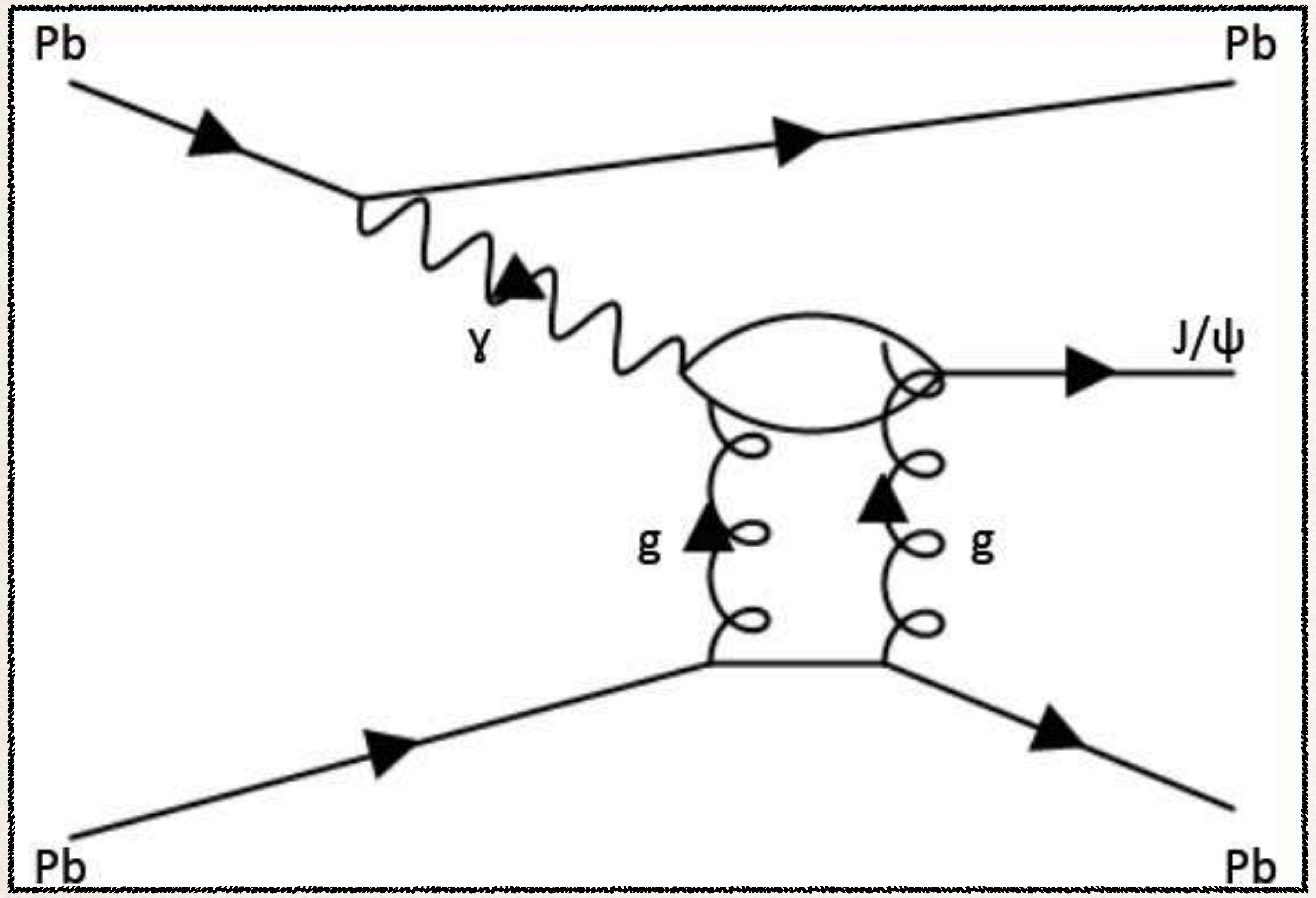
Charm quark

Ultra-peripherical collisions in heavy-ion collisions (3)



I'm working on this hadronic reaction described by this Feynman diagram!

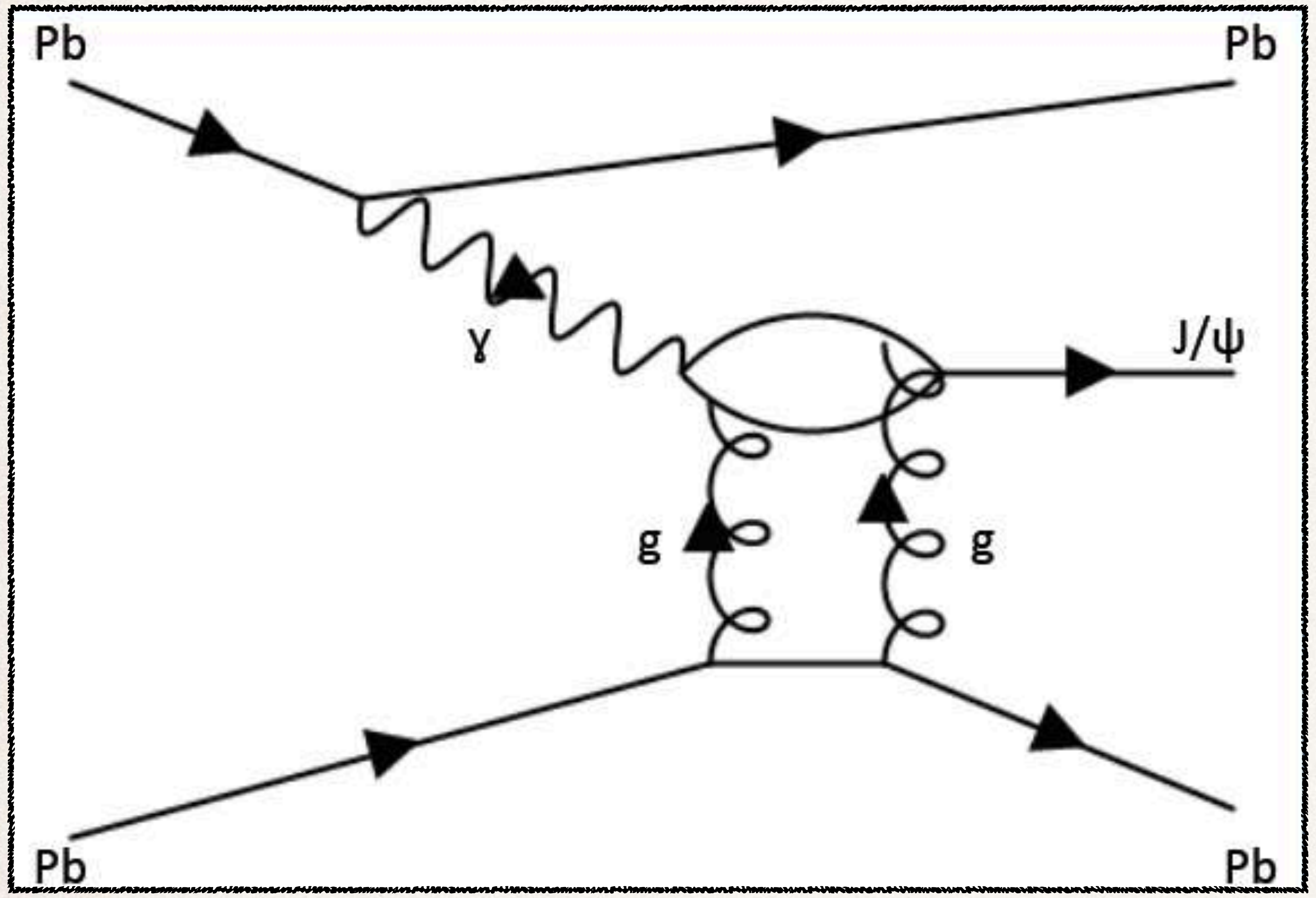
Ultra-peripherical collisions in heavy-ion collisions (3)



I'm working on this hadronic reaction described by this Feynman diagram!

Several different physics processes in UPC events :

Ultra-peripherical collisions in heavy-ion collisions (3)

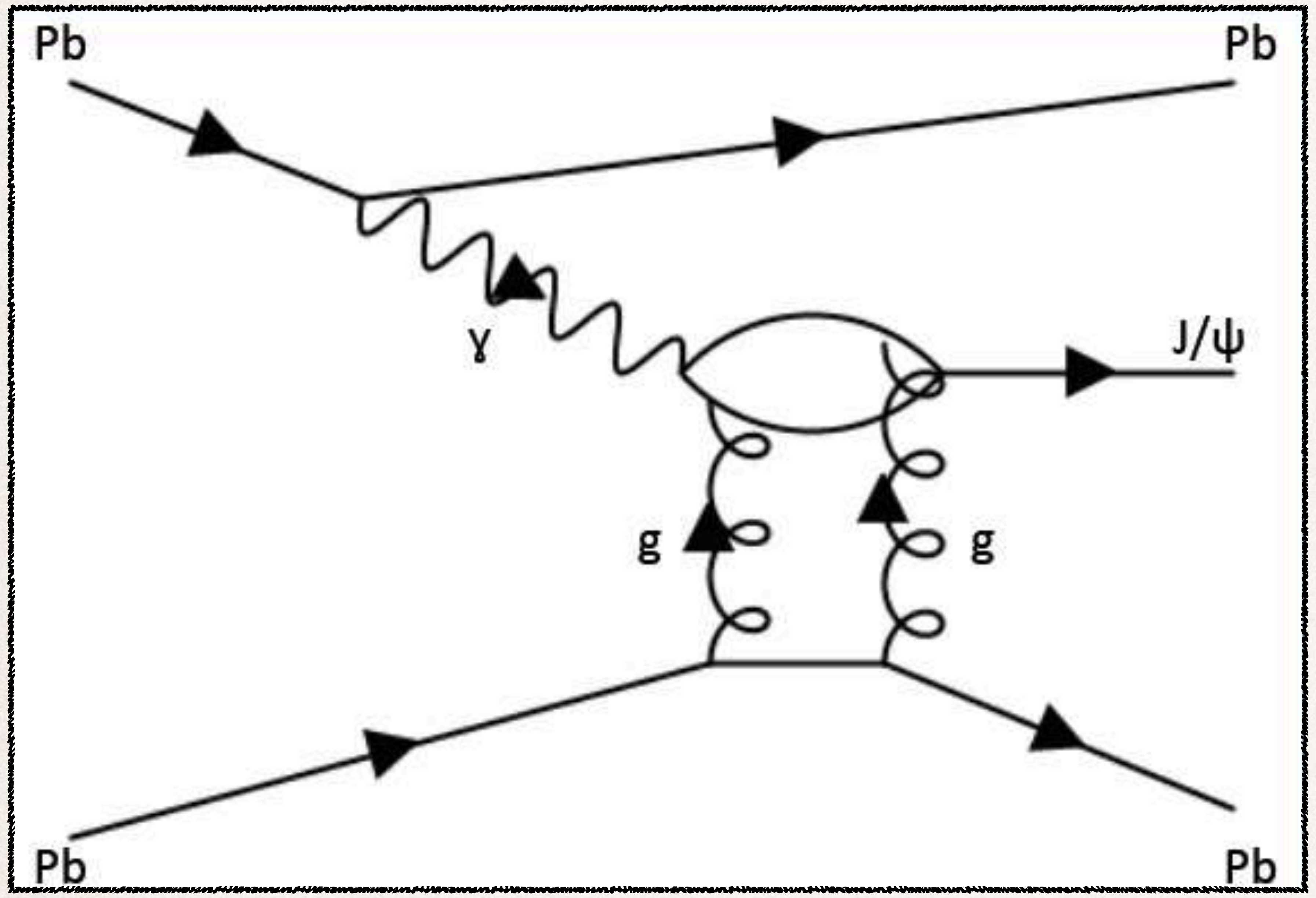


I’m working on this hadronic reaction described by this Feynman diagram!

Several different physics processes in UPC events :

- **Coherent photoproduction** : photon emitted couples to the **target nucleus as a whole;** 🎯⚛️

Ultra-peripherical collisions in heavy-ion collisions (3)



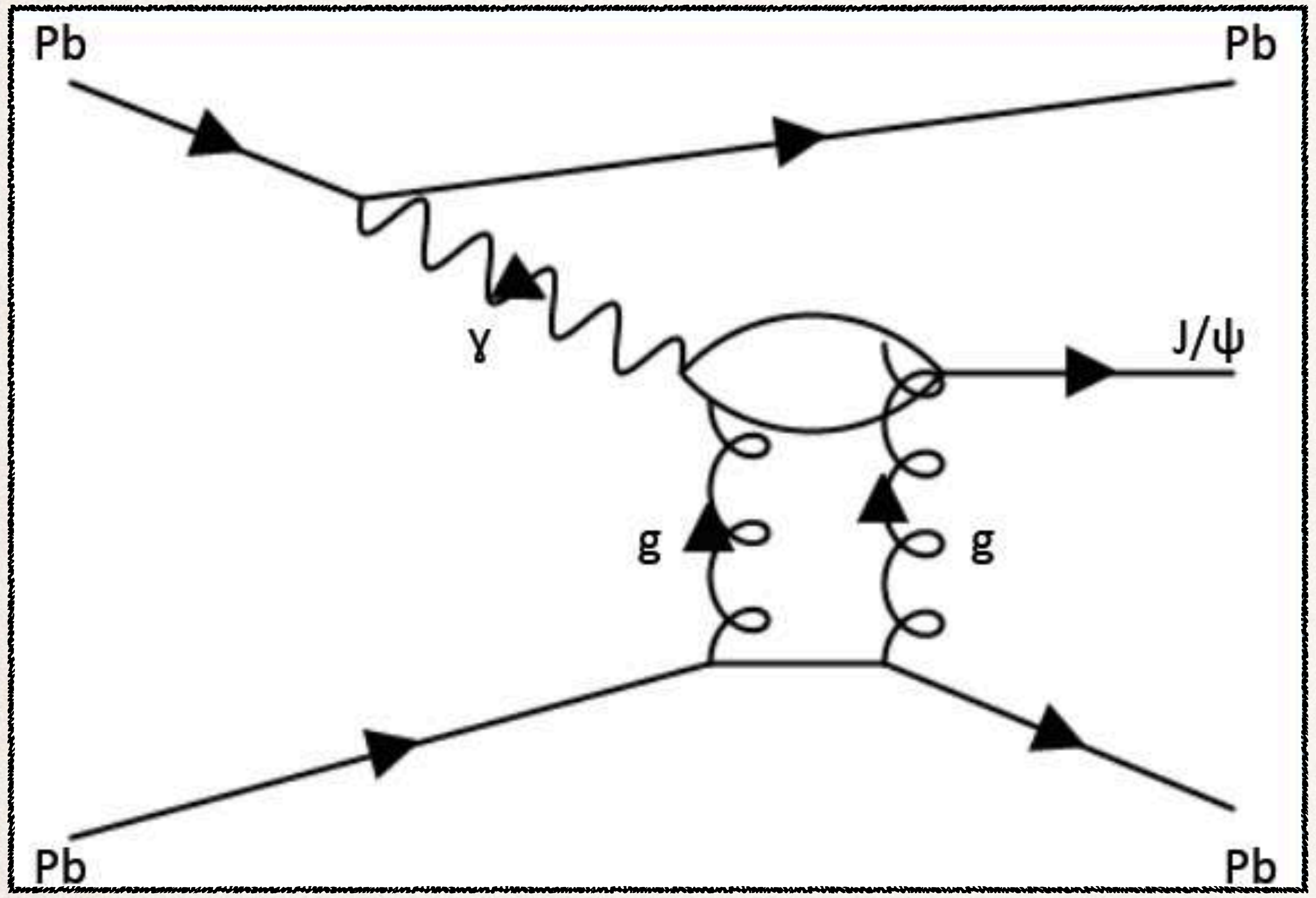
I'm working on this hadronic reaction described by this Feynman diagram!

Several different physics processes in UPC events :

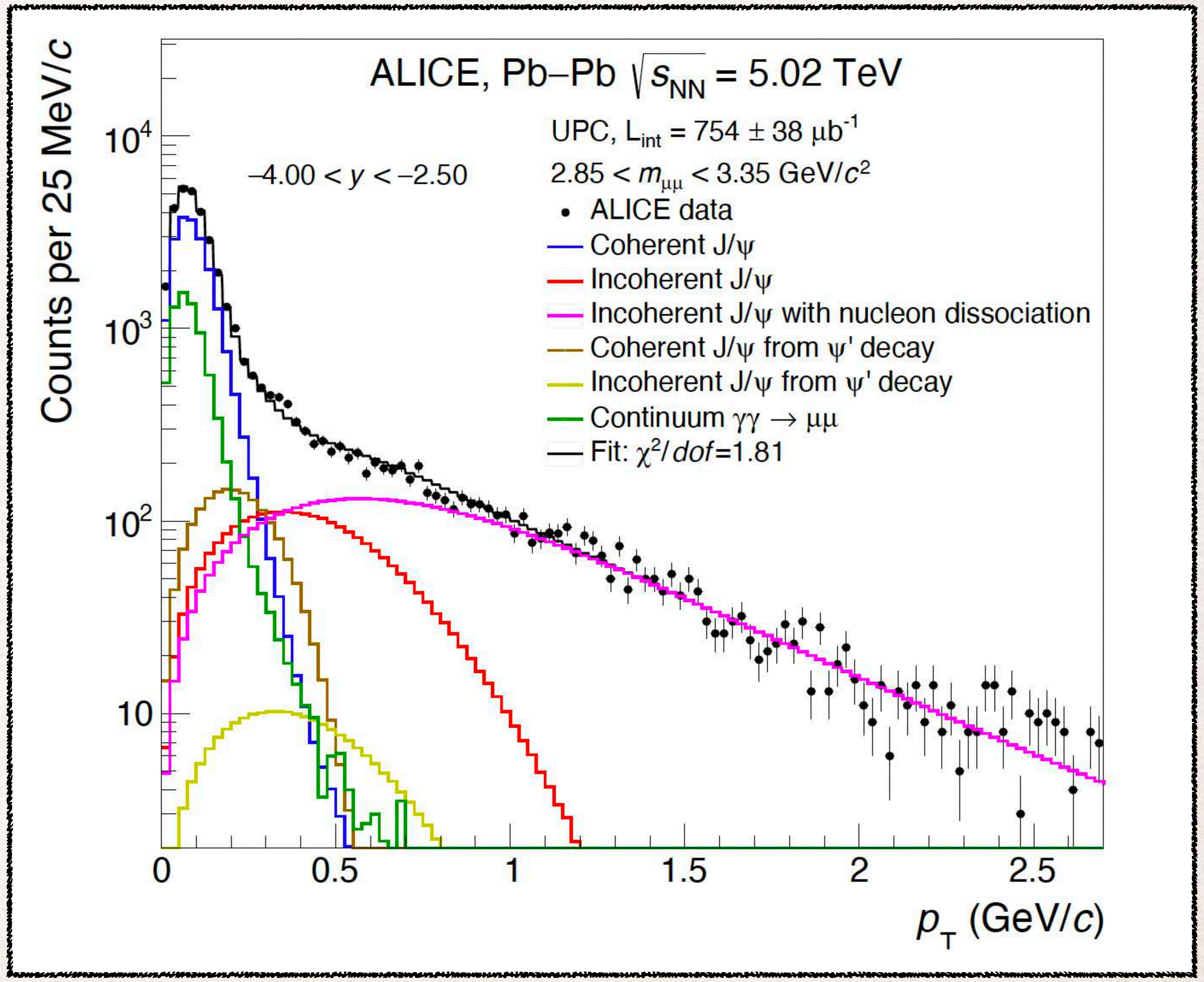
- **Coherent photoproduction** : photon emitted couples to the **target nucleus as a whole;** 🎯⚛️

- **Incoherent photoproduction** : photon couples to an **individual nucleon** within the nucleus.🎯1️⃣☄️

Ultra-peripherical collisions in heavy-ion collisions (3)



I'm working on this hadronic reaction described by this Feynman diagram!

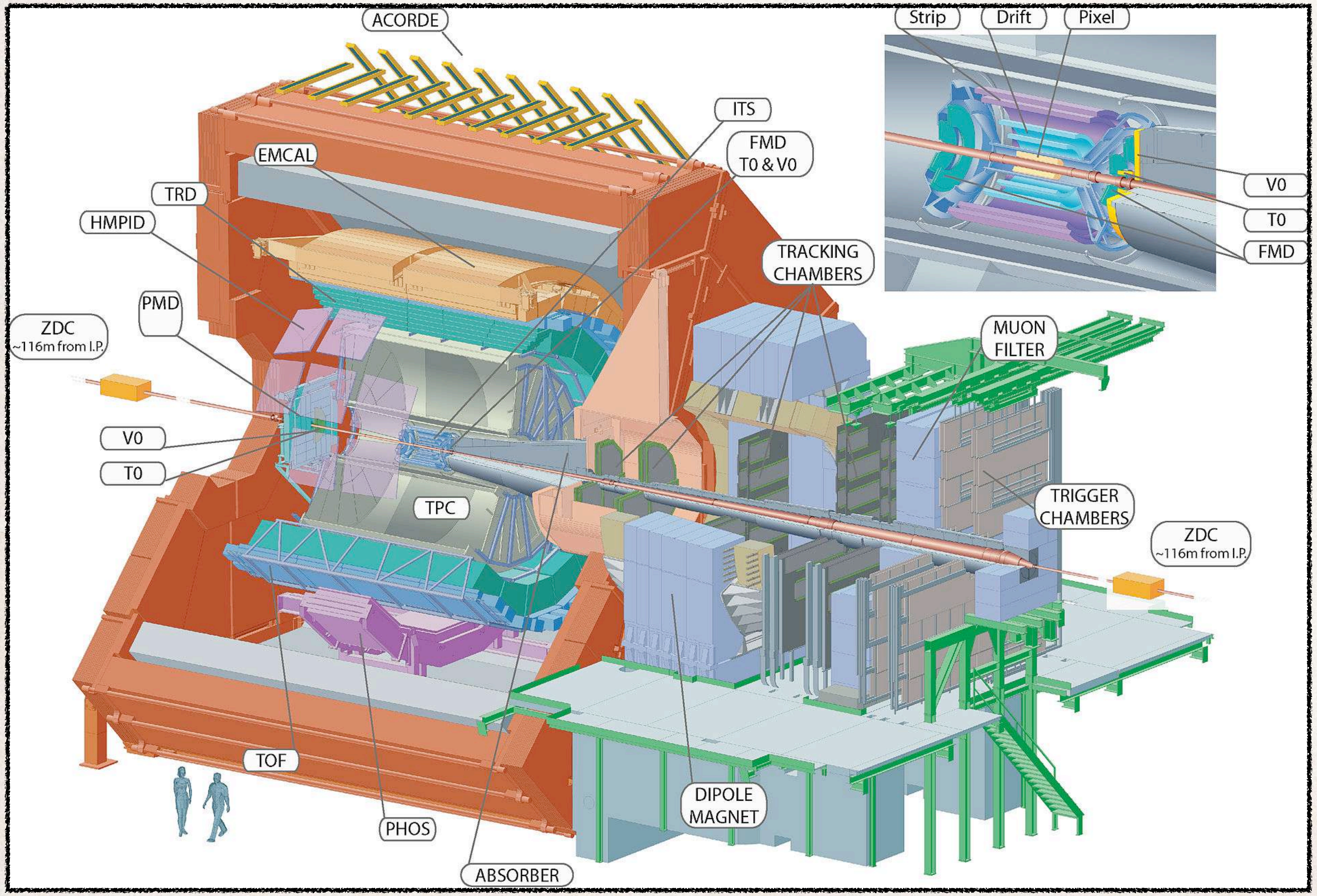


arXiv:1904.06272v2

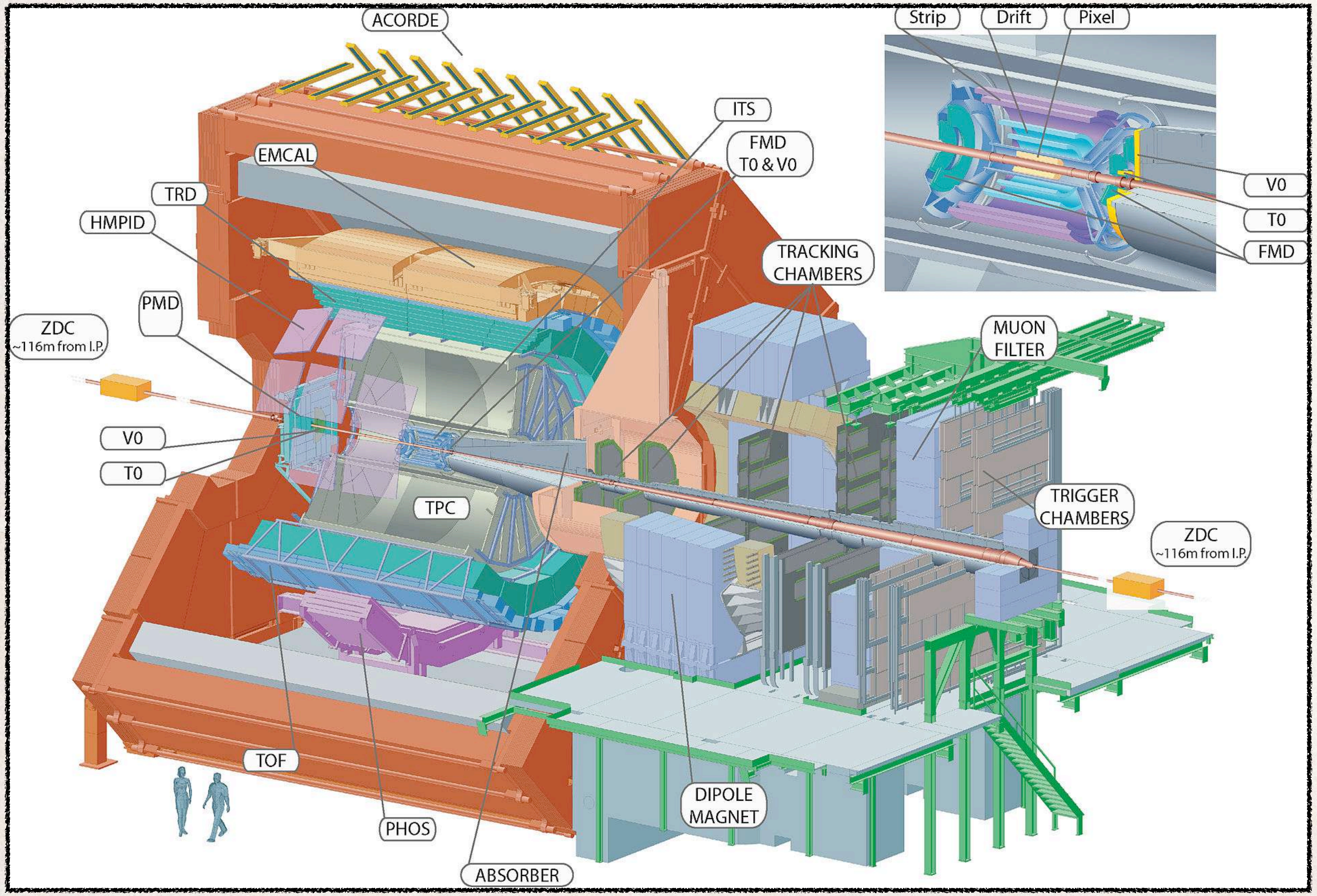
Several different physics processes in UPC events :

- **Coherent photo-production** : photon emitted couples to the **target nucleus as a whole;** 🎯⚛️
- **Incoherent photo-production** : photon couples to an **individual nucleon** within the nucleus.🎯1️⃣☄️

ALICE experiment

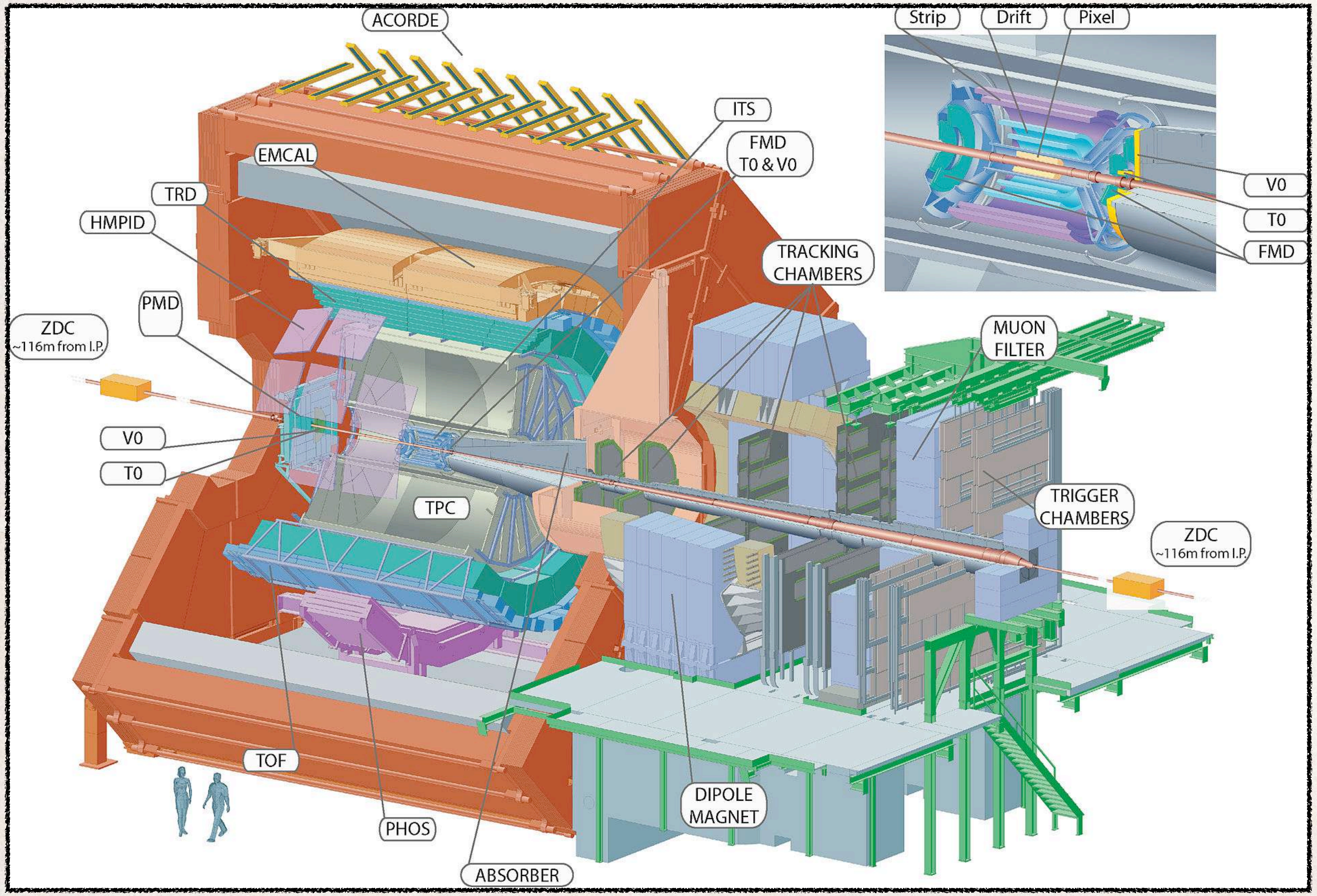


ALICE experiment



ALICE (A Large Ion Collider Experiment) is one of the four big experiments at LHC-CERN. 4️⃣◯☄️⚡💥🇨🇭

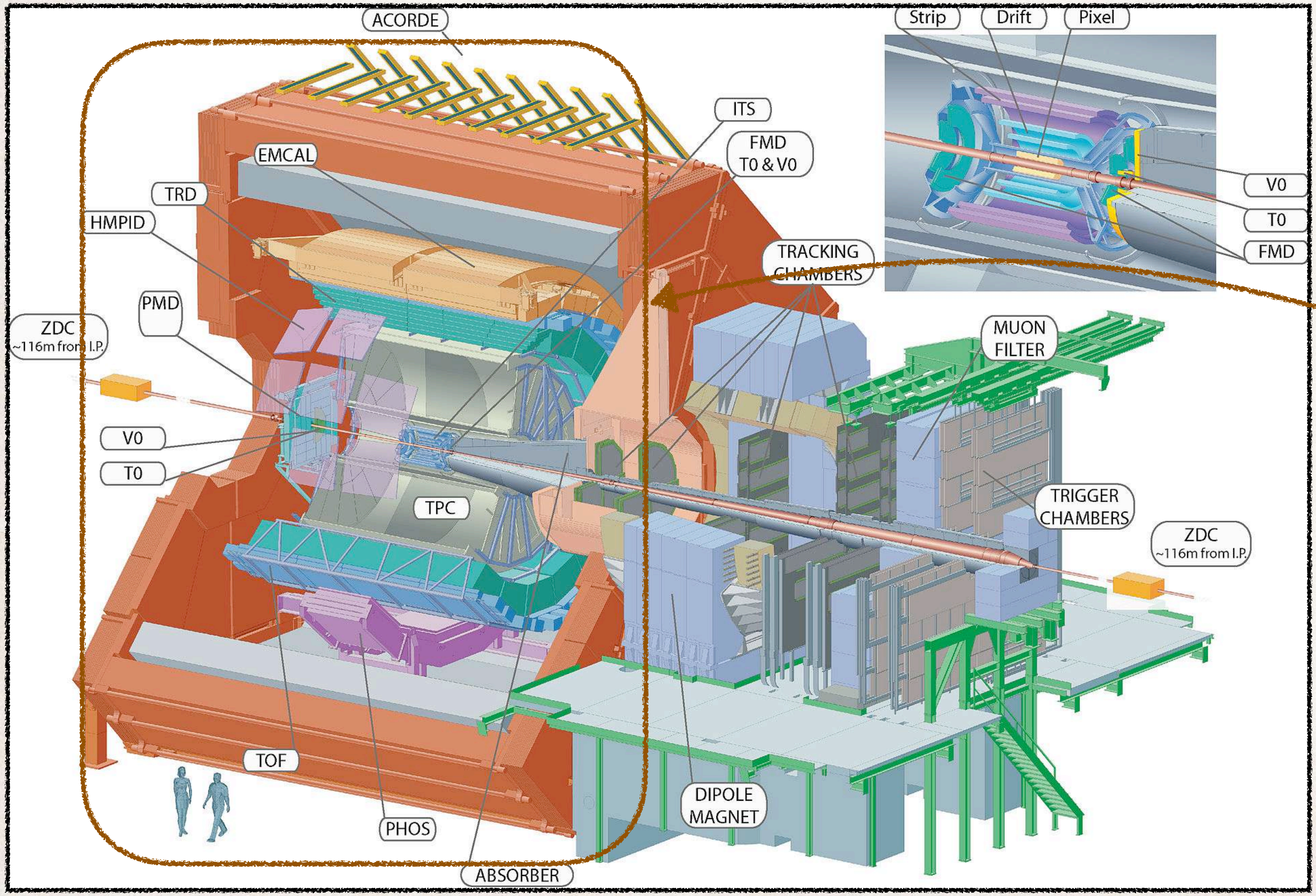
ALICE experiment



ALICE (A Large Ion Collider Experiment) is one of the four big experiments at LHC-CERN. 4️⃣◯☄️⚡💥🇨🇭

Two main parts of the detector 2️⃣:

ALICE experiment

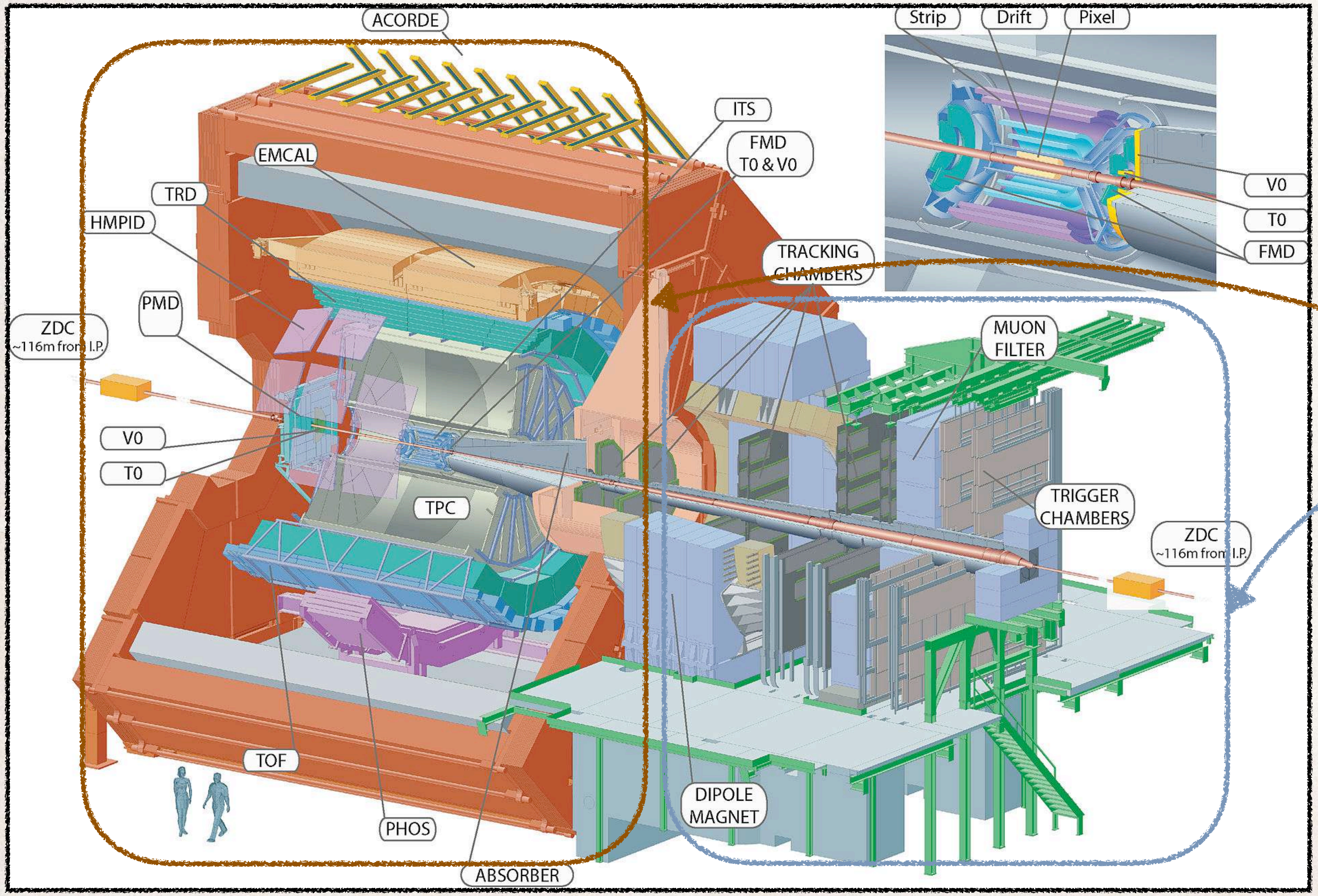


ALICE (A Large Ion Collider Experiment) is one of the four big experiments at LHC-CERN. 4️⃣⚪☄️⚡💥🇨🇭

Two main parts of the detector 2️⃣:

- Central part around the point of interaction;

ALICE experiment

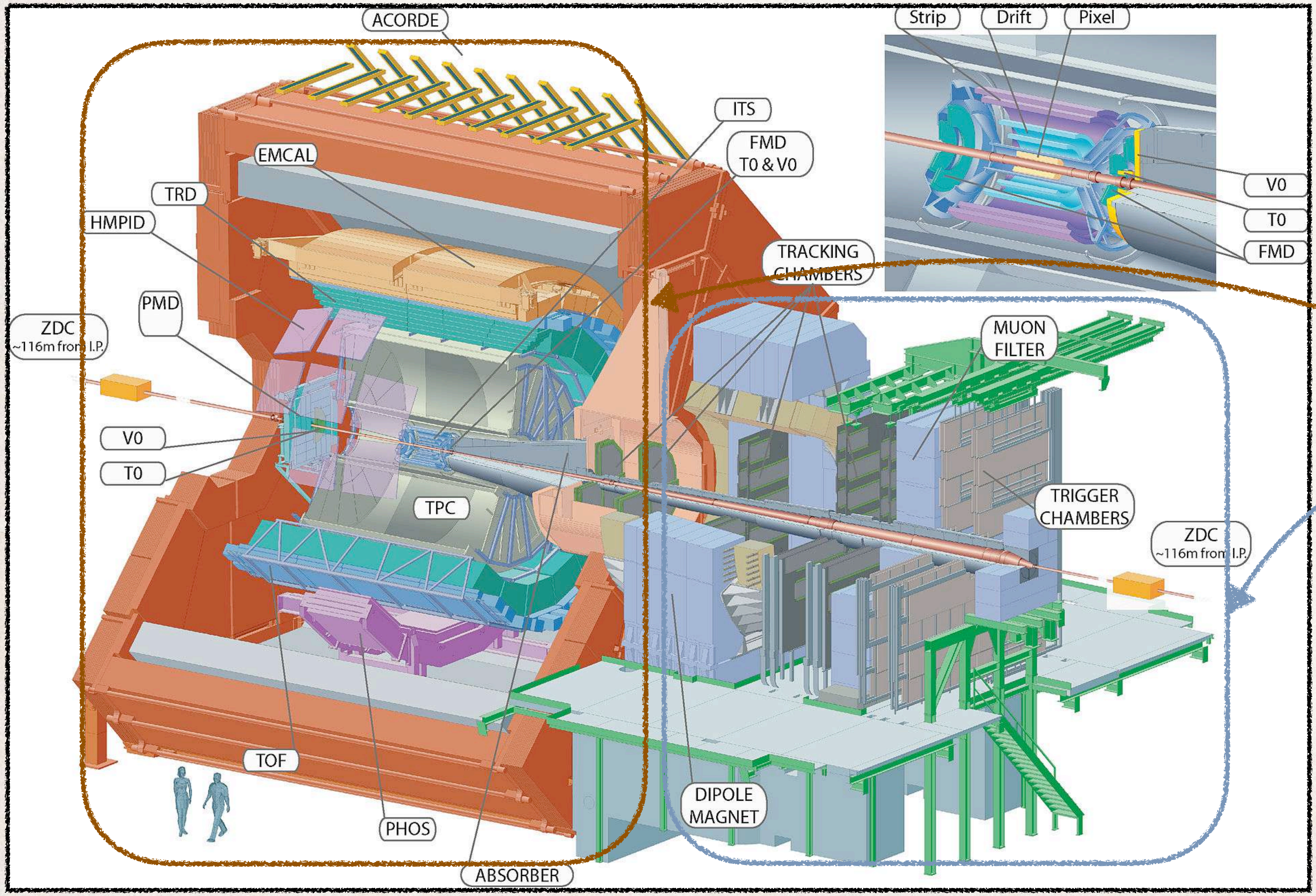


ALICE (A Large Ion Collider Experiment) is one of the four big experiments at LHC-CERN. 4️⃣⚪☄️⚡💥🇨🇭

Two main parts of the detector 2️⃣:

- Central part around the point of interaction;
- Front spectrometer for muon measurement.

ALICE experiment



ALICE (A Large Ion Collider Experiment) is one of the four big experiments at LHC-CERN. 4️⃣⚪☄️⚡💥🇨🇭

Two main parts of the detector 2️⃣:

- Central part around the point of interaction;
- Front spectrometer for muon measurement.

I'm analysing the data Pb-Pb 2018 at $\sqrt{{}^{s}NN} = 5.02$ TeV at forward rapidity (collected by the muon spectrometer) 👩‍💻💻 💾

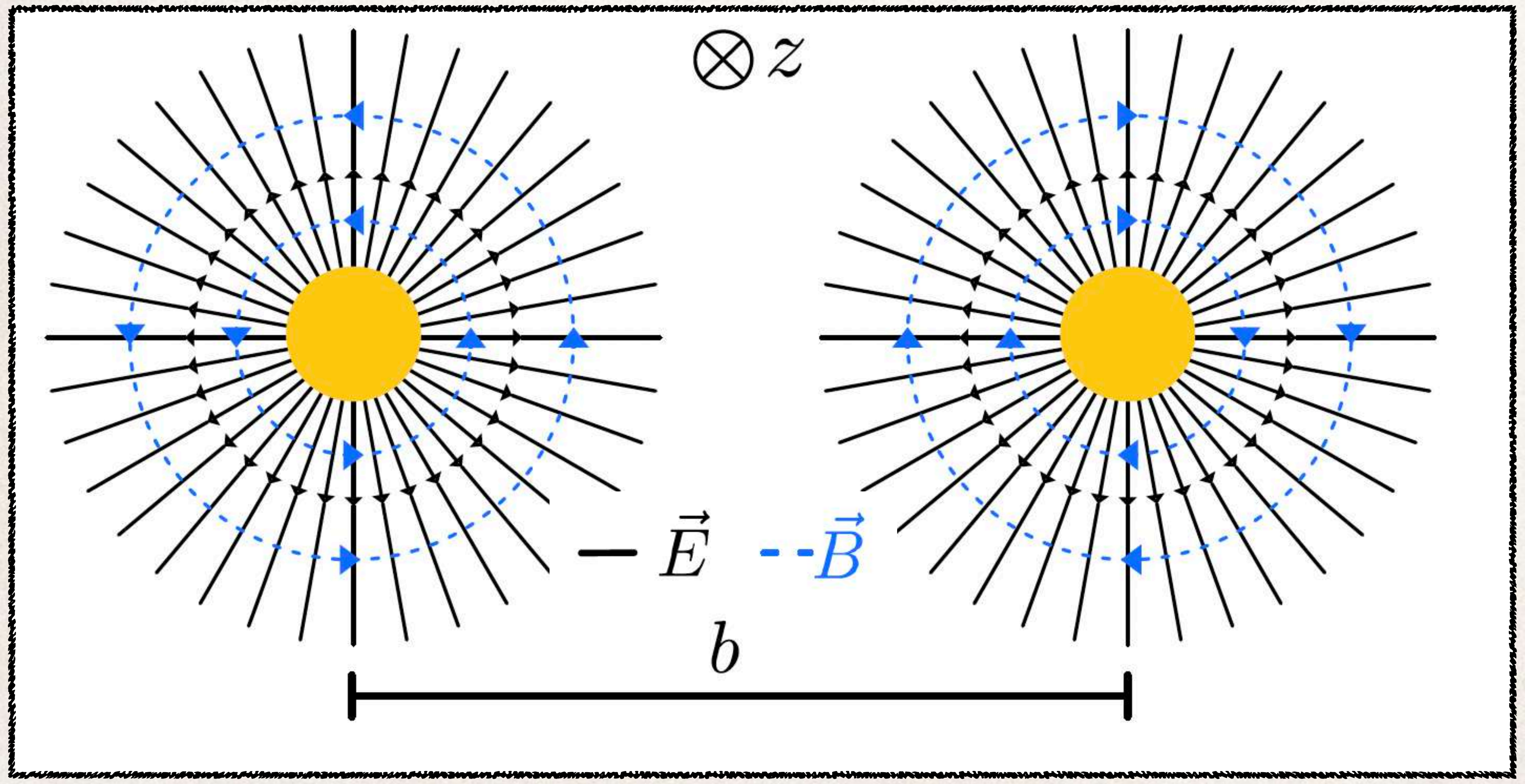
Which is the purpose of my analysis?

STAR collaboration discovered a transverse angular modulation for the UPCs (Daniel Brandenburg Slides) ⭐💡:

Which is the purpose of my analysis?

STAR collaboration discovered a transverse angular modulation for the UPCs (Daniel Brandenburg Slides) ⭐💡:

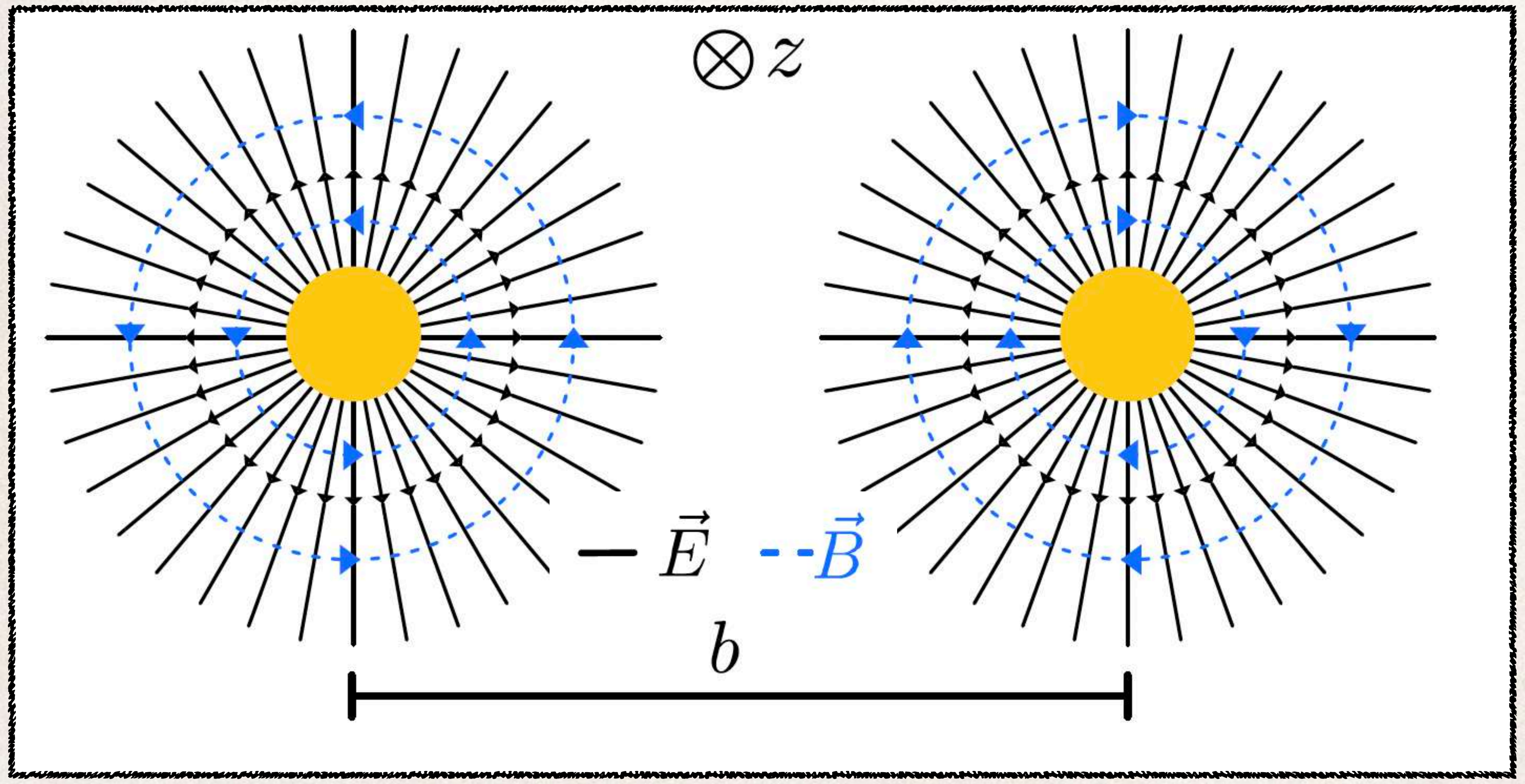
Extreme Lorentz contraction of EM fields → Quasi-real photons should be linearly polarised in transverse plane ($\vec{E} \perp \vec{B} \perp \vec{k}$)

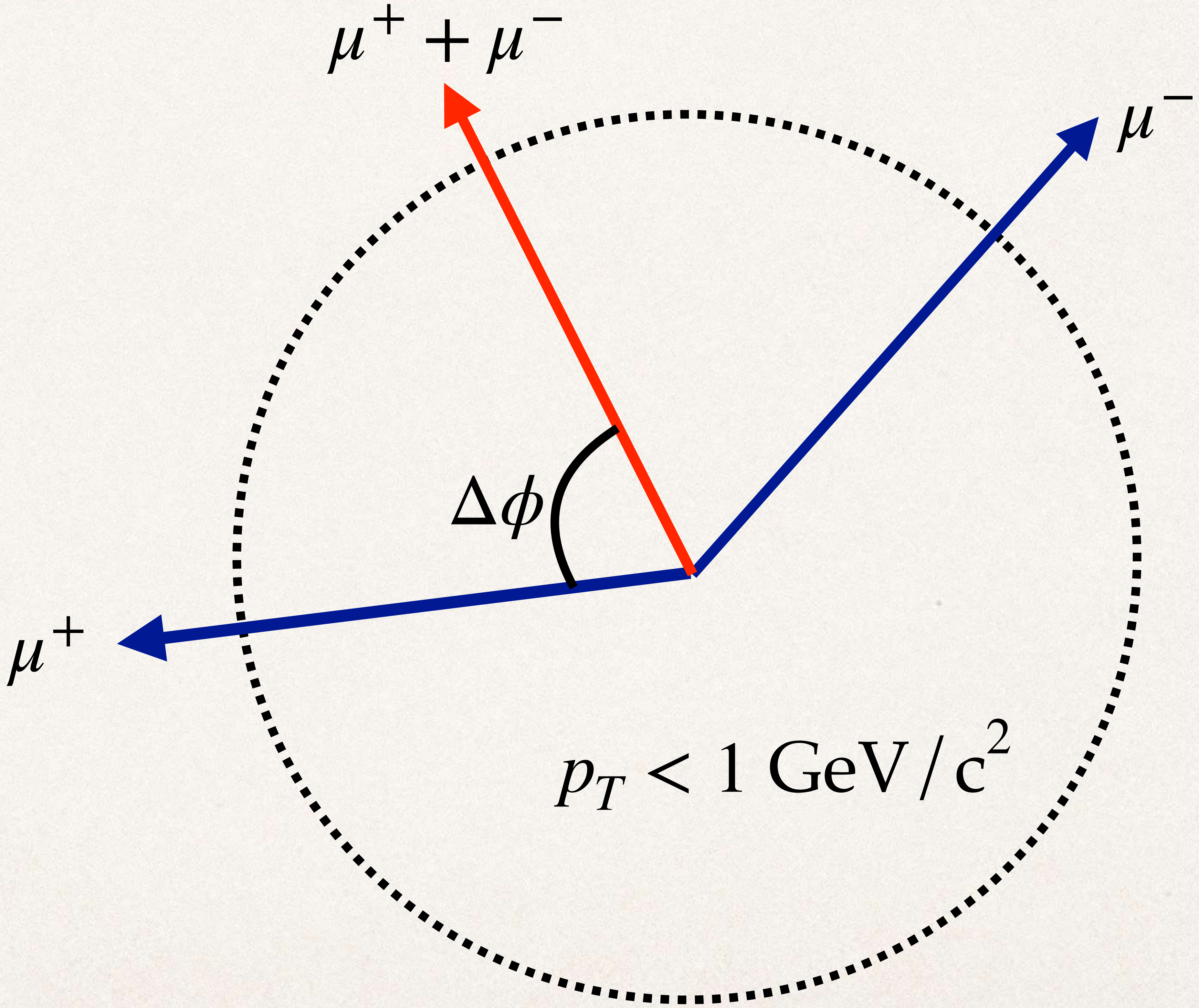


Which is the purpose of my analysis?

STAR collaboration discovered a transverse angular modulation for the UPCs (Daniel Brandenburg Slides) ⭐💡:

Extreme Lorentz contraction of EM fields
→ Quasi-real photons should be linearly polarised in transverse plane
($\vec{E} \perp \vec{B} \perp \vec{k}$)





$$\Delta\phi = \Delta\phi[(\mu^+ + \mu^-), (\mu^+ - \mu^-)]$$
$$\sim \Delta\phi[(\mu^+ + \mu^-), \mu^+] \text{ at small } p_T$$

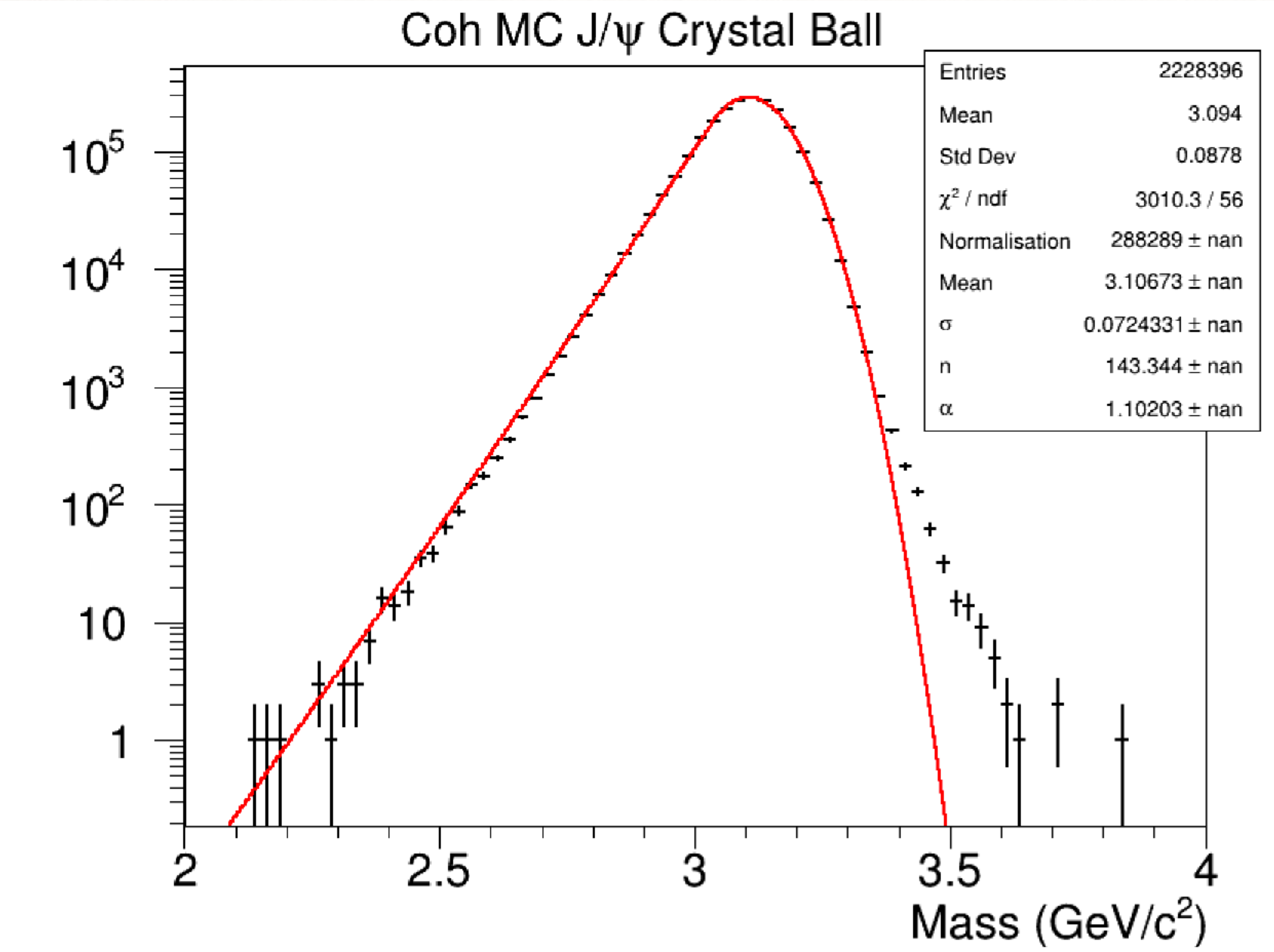
C. Li, J. Zhou, Y.-j. Zhou, Phys. Lett. B 795, 576 (2019)

Some teeny-tiny results (1)

Fitted the MC production anchored to the Pb-Pb 2018 data using two different functions for J/ψ 🔨🪚📐.

Some teeny-tiny results (1)

Fitted the MC production anchored to the Pb-Pb 2018 data using two different functions for J/ψ 🔨🪚📐.



$$f(x;\alpha,n,\bar{x},\sigma) = N\cdot\begin{cases}\exp(-\frac{(x-\bar{x})^2}{2\sigma^2}), & \text{for } \frac{x-\bar{x}}{\sigma} > -\alpha\\ A\cdot(B-\frac{x-\bar{x}}{\sigma})^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma}\leqslant -\alpha\end{cases}$$

where

$$A = \left(\frac{n}{|\alpha|}\right)^n\cdot\exp\left(-\frac{|\alpha|^2}{2}\right),$$

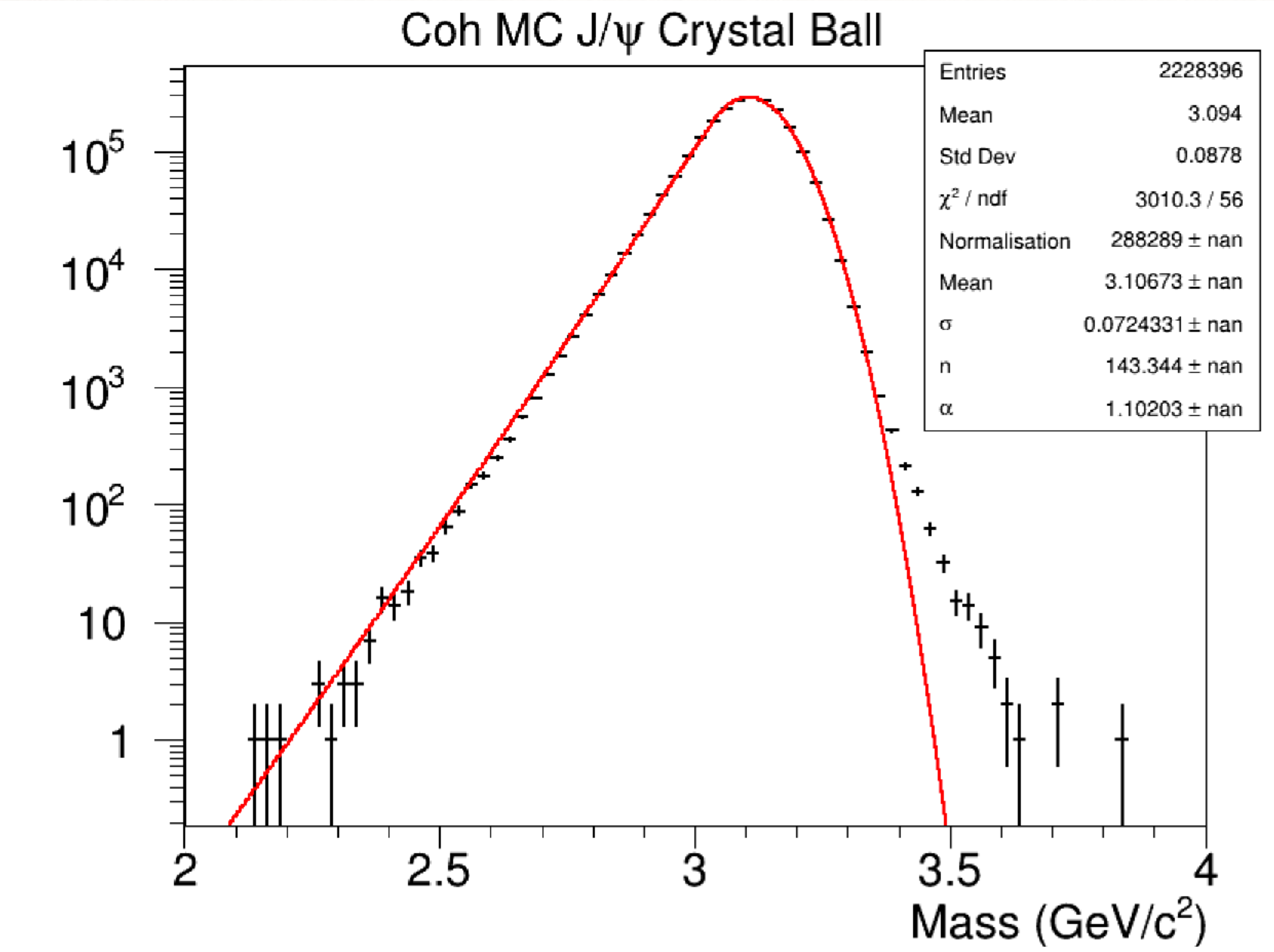
Crystal Ball

$$B = \frac{n}{|\alpha|}-|\alpha|,$$

L.C.Migliorin (l.migliorin@cern.ch)

Some teeny-tiny results (1)

Fitted the MC production anchored to the Pb-Pb 2018 data using two different functions for J/ψ 🔨🪚📐.



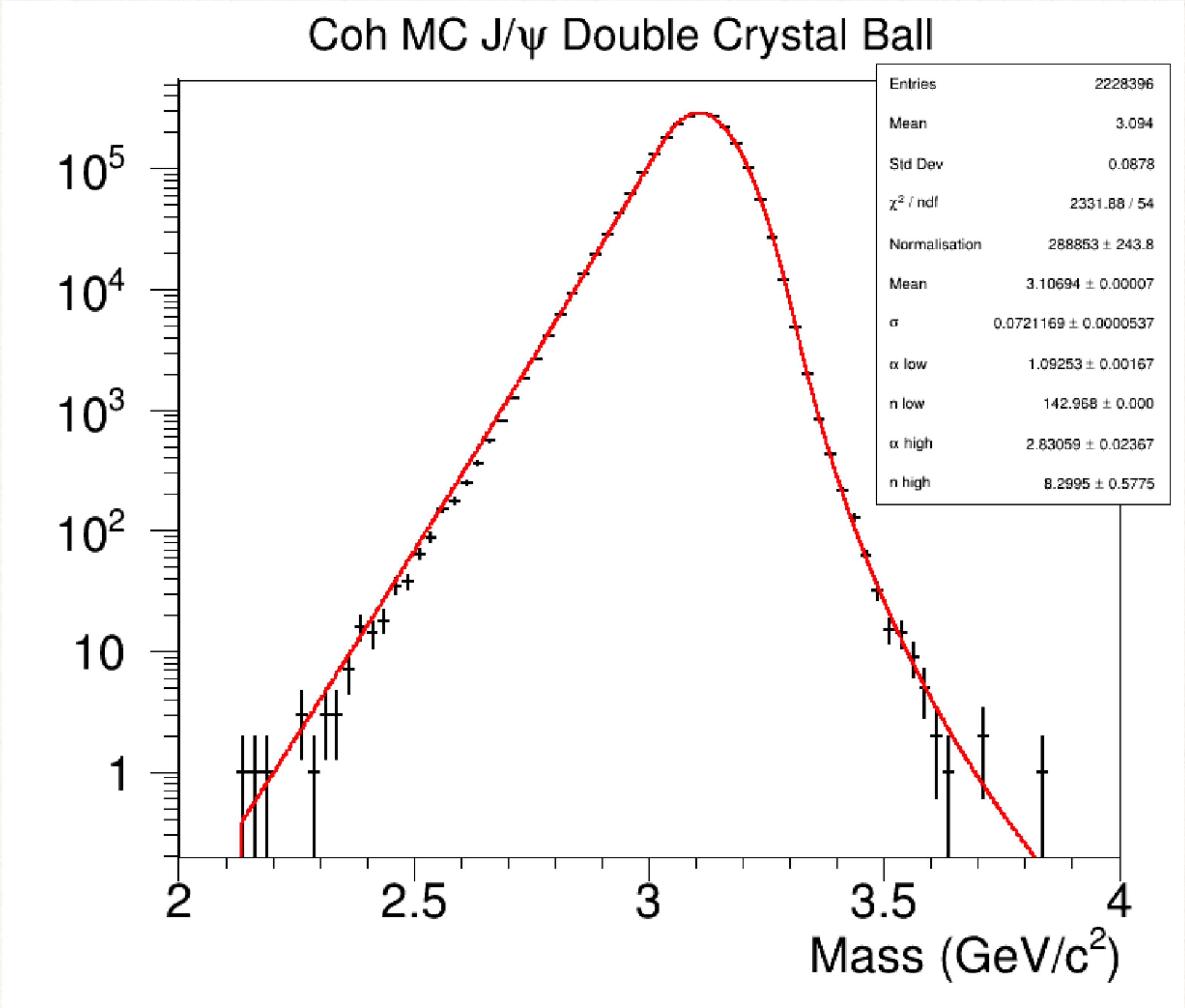
$$f(x;\alpha,n,\bar{x},\sigma) = N \cdot \begin{cases} \exp\left(-\frac{(x-\bar{x})^2}{2\sigma^2}\right), & \text{for } \frac{x-\bar{x}}{\sigma} > -\alpha \\ A \cdot \left(B - \frac{x-\bar{x}}{\sigma}\right)^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma} \leqslant -\alpha \end{cases}$$

where

$$A = \left(\frac{n}{|\alpha|}\right)^n \cdot \exp\left(-\frac{|\alpha|^2}{2}\right),$$

Crystal Ball

$$B = \frac{n}{|\alpha|} - |\alpha|,$$

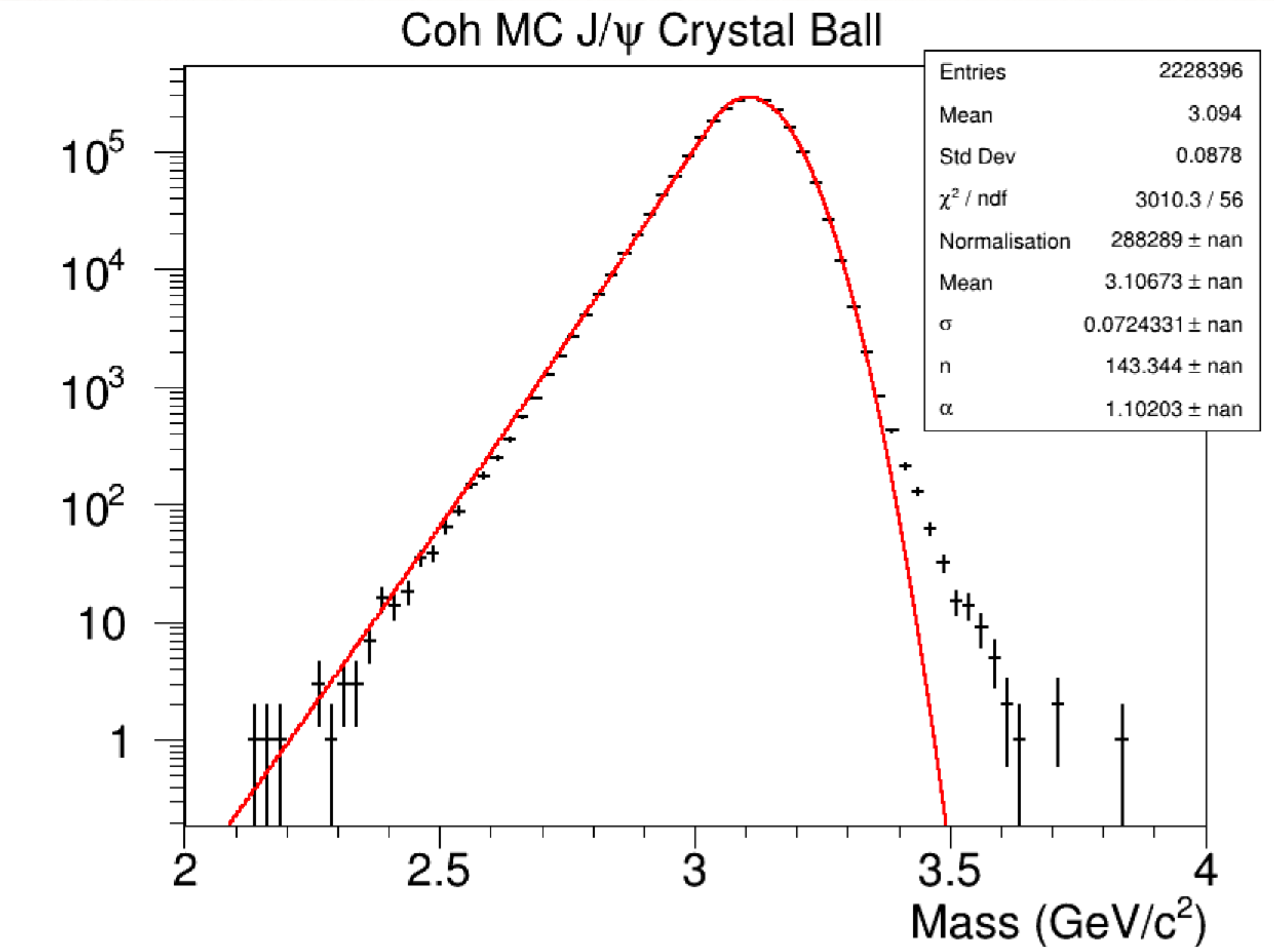


$$N \cdot \begin{cases} e^{-t^2/2} & \text{if } -\alpha_{Low} \geq t \geq \alpha_{High} \\ \dfrac{e^{-0.5\alpha_{Low}^2}}{\left[\frac{\alpha_{Low}}{n_{Low}}\left(\frac{n_{Low}}{\alpha_{Low}} - \alpha_{Low} - t\right)\right]^{n_{Low}}} & \text{if } t < \text{-}t = \Delta m_X/\sigma_{CB},\ \Delta m_X = m_X - \mu_{CB} \\ \dfrac{e^{-0.5\alpha_{High}^2}}{\left[\frac{\alpha_{High}}{n_{High}}\left(\frac{n_{High}}{\alpha_{High}} - \alpha_{High} + t\right)\right]^{n_{High}}} & \text{if } t > \alpha_{High}, \end{cases}$$

Double Crystal Ball

Some teeny-tiny results (1)

Fitted the MC production anchored to the Pb-Pb 2018 data using two different functions for J/ψ 🔨🪚📐.



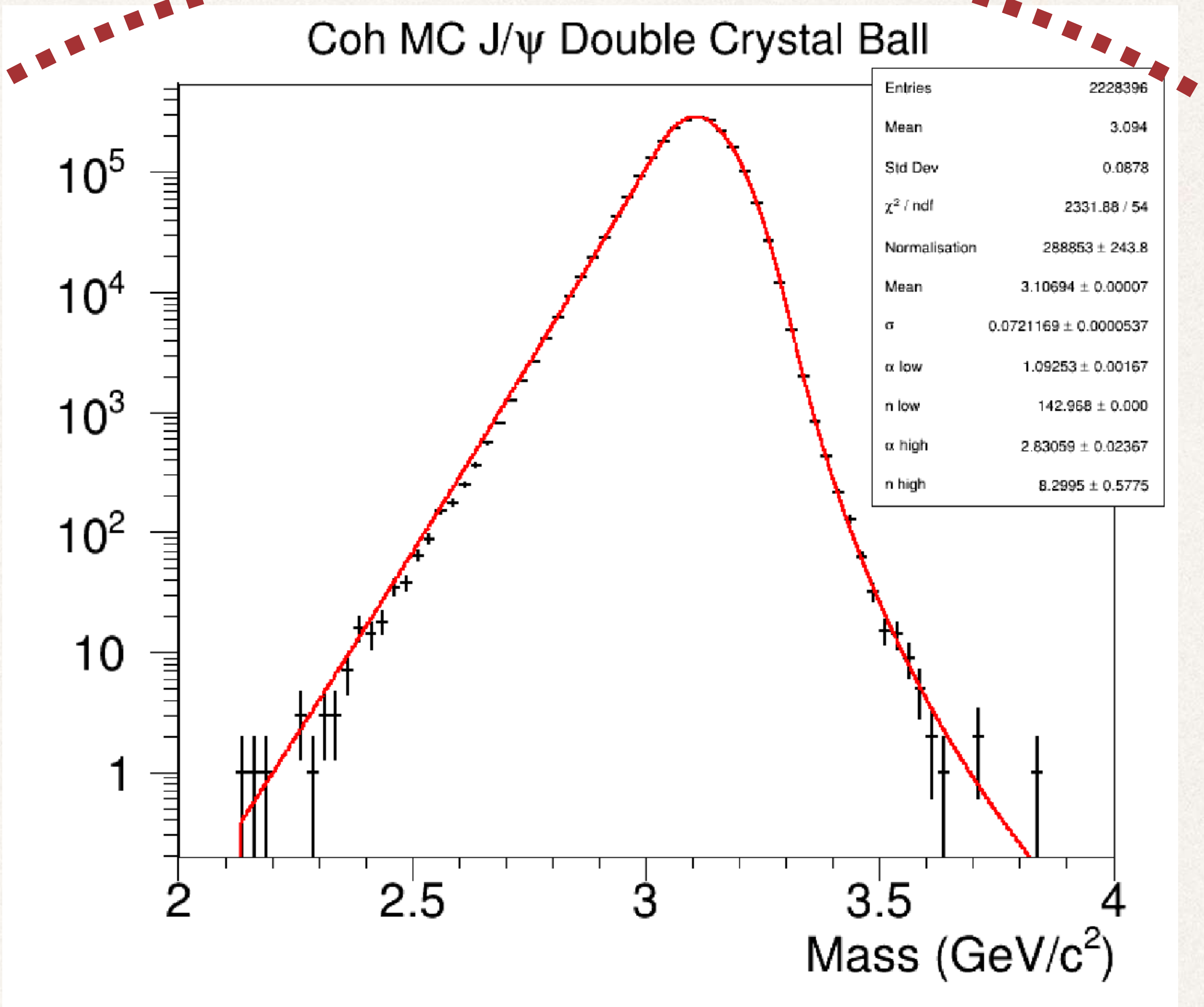
$$f(x;\alpha,n,\bar{x},\sigma) = N\cdot\begin{cases}\exp(-\frac{(x-\bar{x})^2}{2\sigma^2}), & \text{for } \frac{x-\bar{x}}{\sigma} > -\alpha\\ A\cdot(B-\frac{x-\bar{x}}{\sigma})^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma}\leqslant -\alpha\end{cases}$$

where

$$A = \left(\frac{n}{|\alpha|}\right)^n\cdot\exp\left(-\frac{|\alpha|^2}{2}\right),$$

$$B = \frac{n}{|\alpha|} - |\alpha|,$$

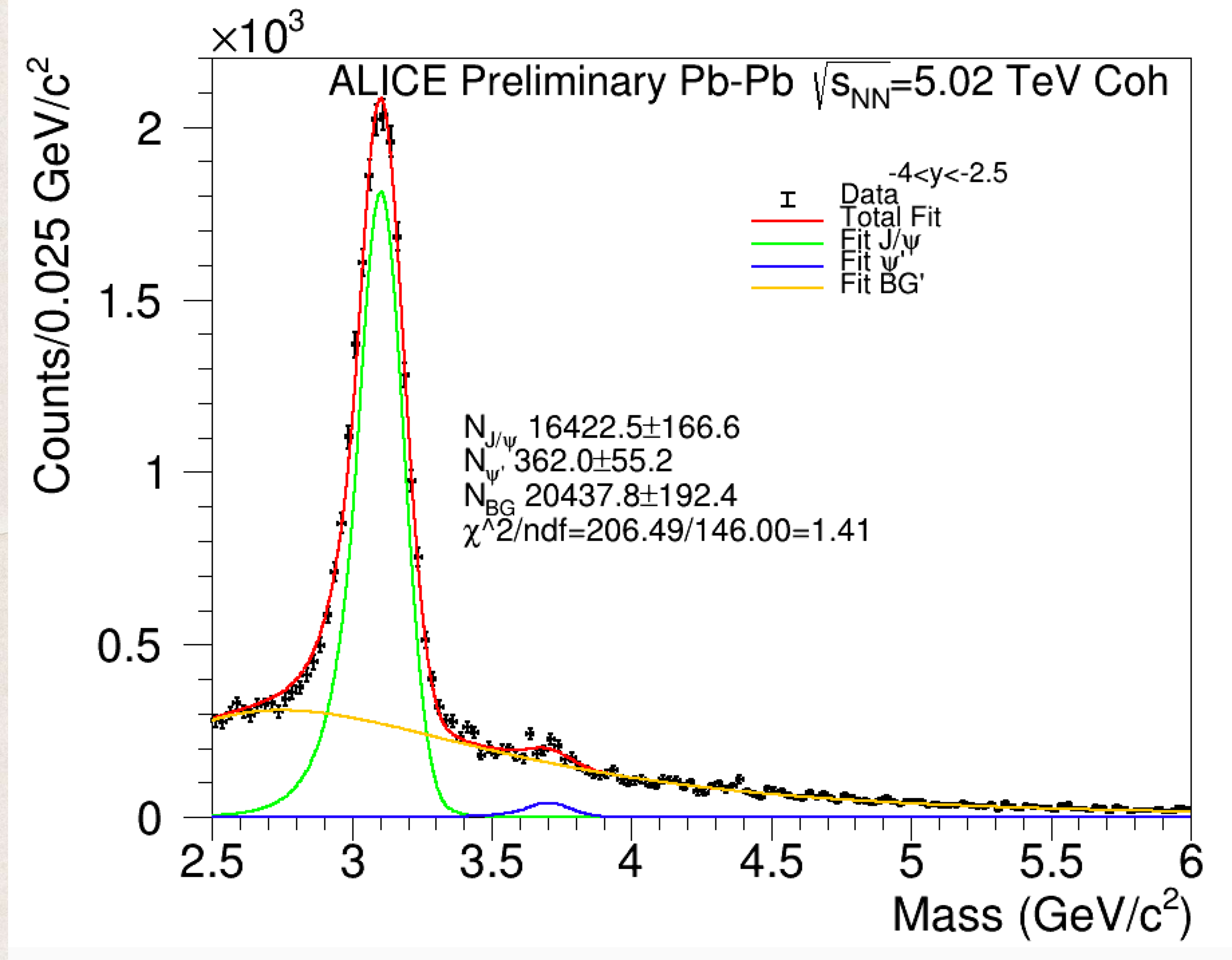
Crystal Ball



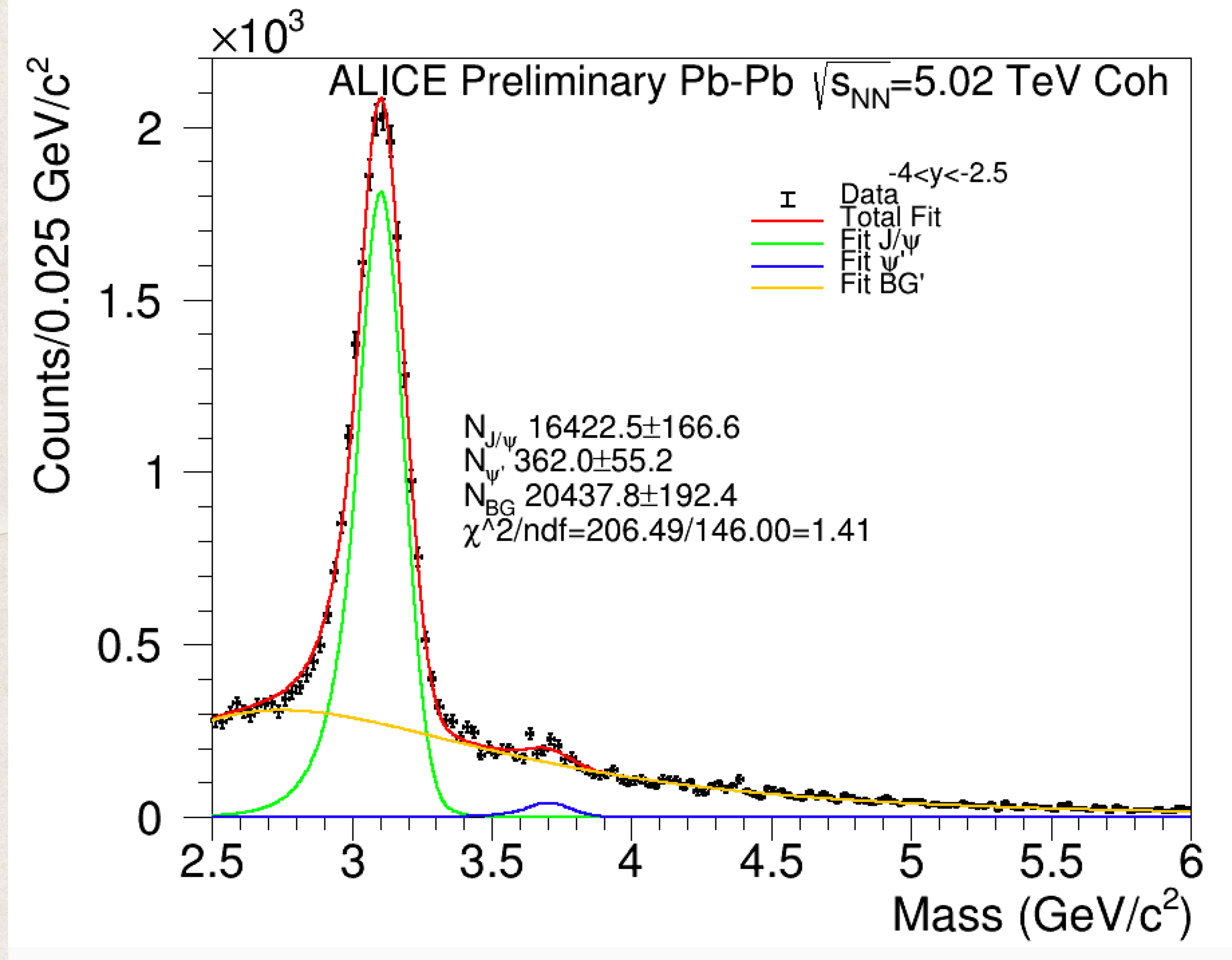
$$N\cdot\begin{cases}e^{-t^2/2} & \text{if } -\alpha_{Low}\geq t\geq\alpha_{High}\\ \dfrac{e^{-0.5\alpha_{Low}^2}}{\left[\frac{\alpha_{Low}}{n_{Low}}\left(\frac{n_{Low}}{\alpha_{Low}}-\alpha_{Low}-t\right)\right]^{n_{Low}}} & \text{if } t < \text{-}t = \Delta m_X/\sigma_{CB},\ \Delta m_X = m_X-\mu_{CB}\\ \dfrac{e^{-0.5\alpha_{High}^2}}{\left[\frac{\alpha_{High}}{n_{High}}\left(\frac{n_{High}}{\alpha_{High}}-\alpha_{High}+t\right)\right]^{n_{High}}} & \text{if } t > \alpha_{High},\end{cases}$$

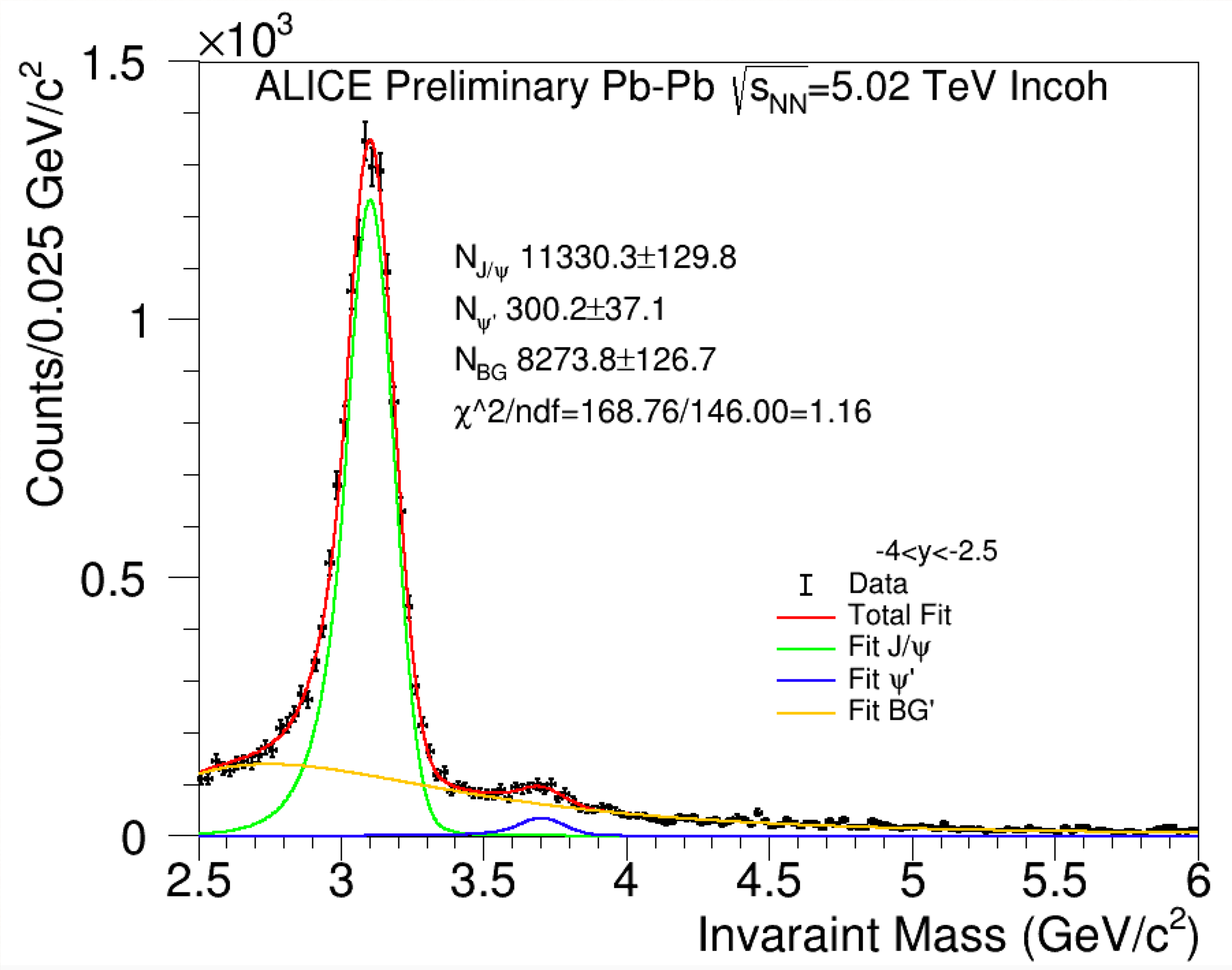
Double Crystal Ball

Some teeny-tiny results (2)

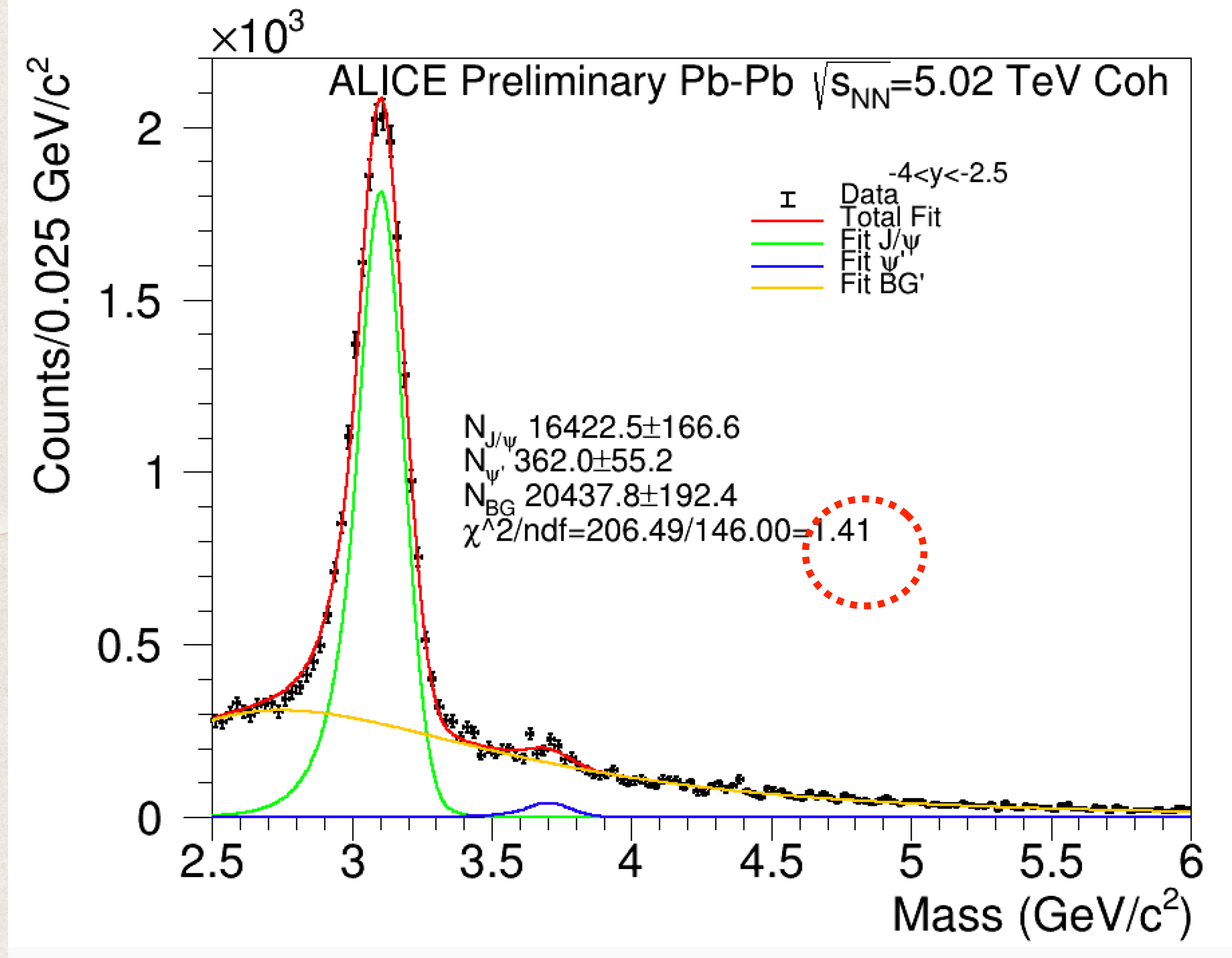


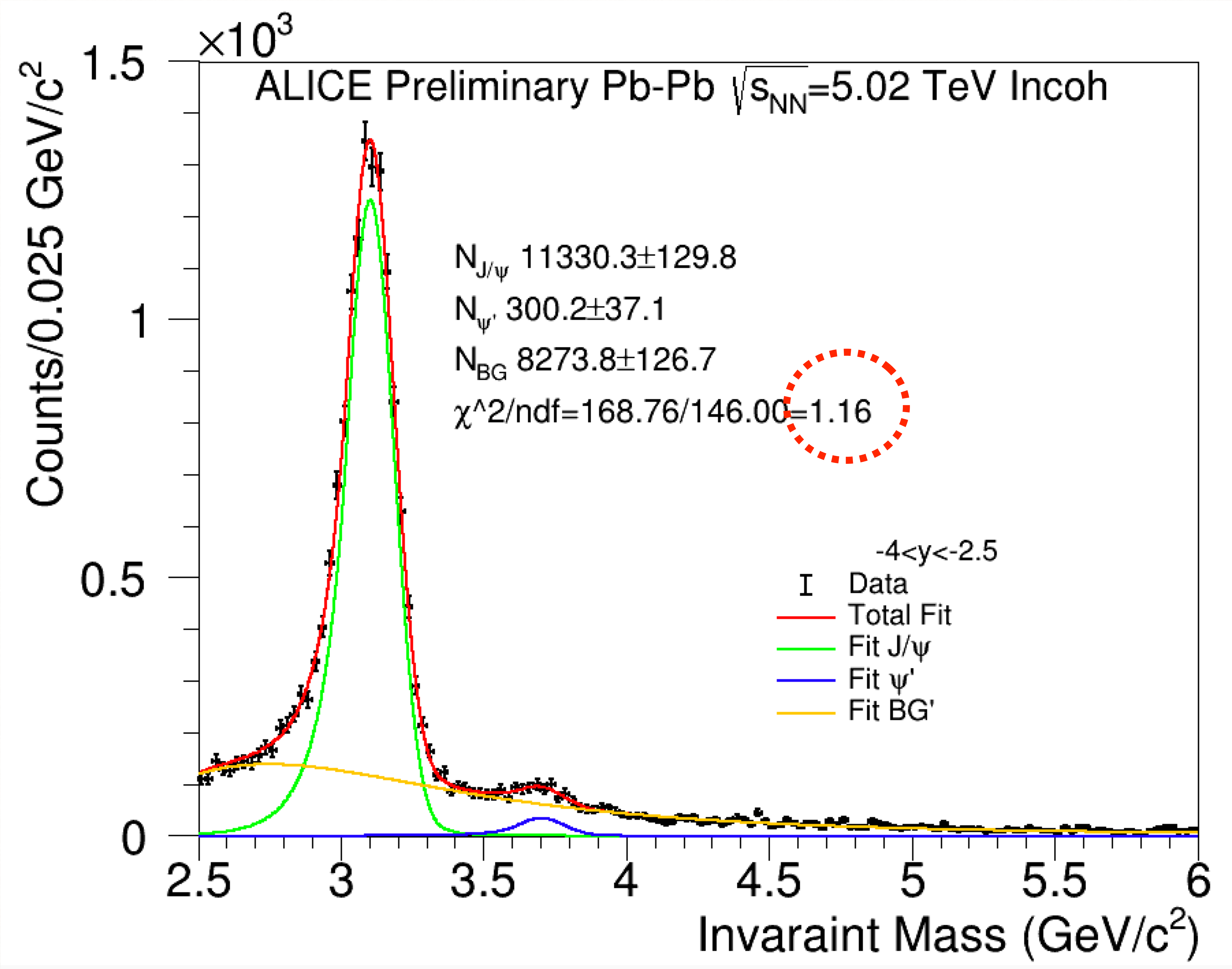
Some teeny-tiny results (2)





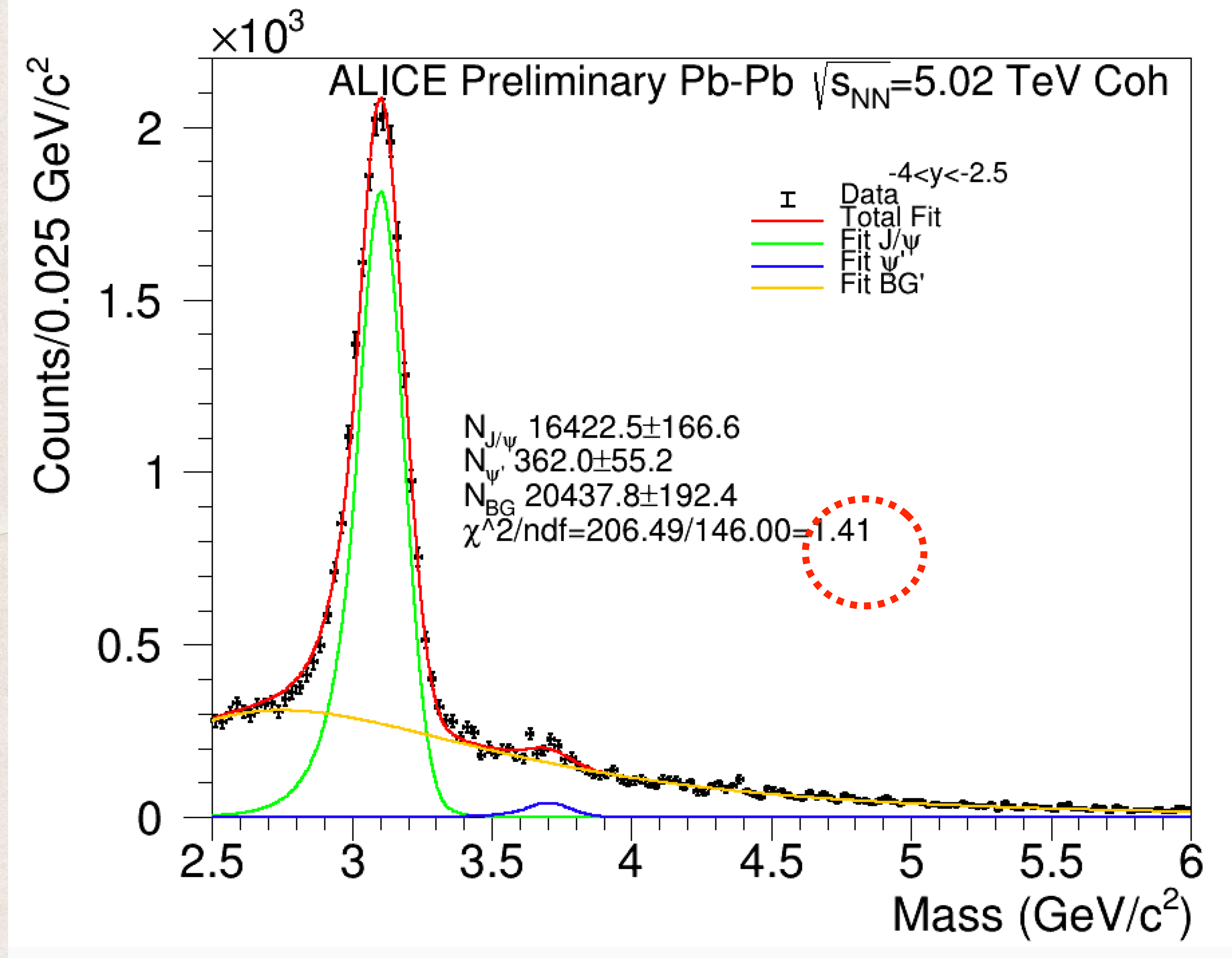
Some teeny-tiny results (2)

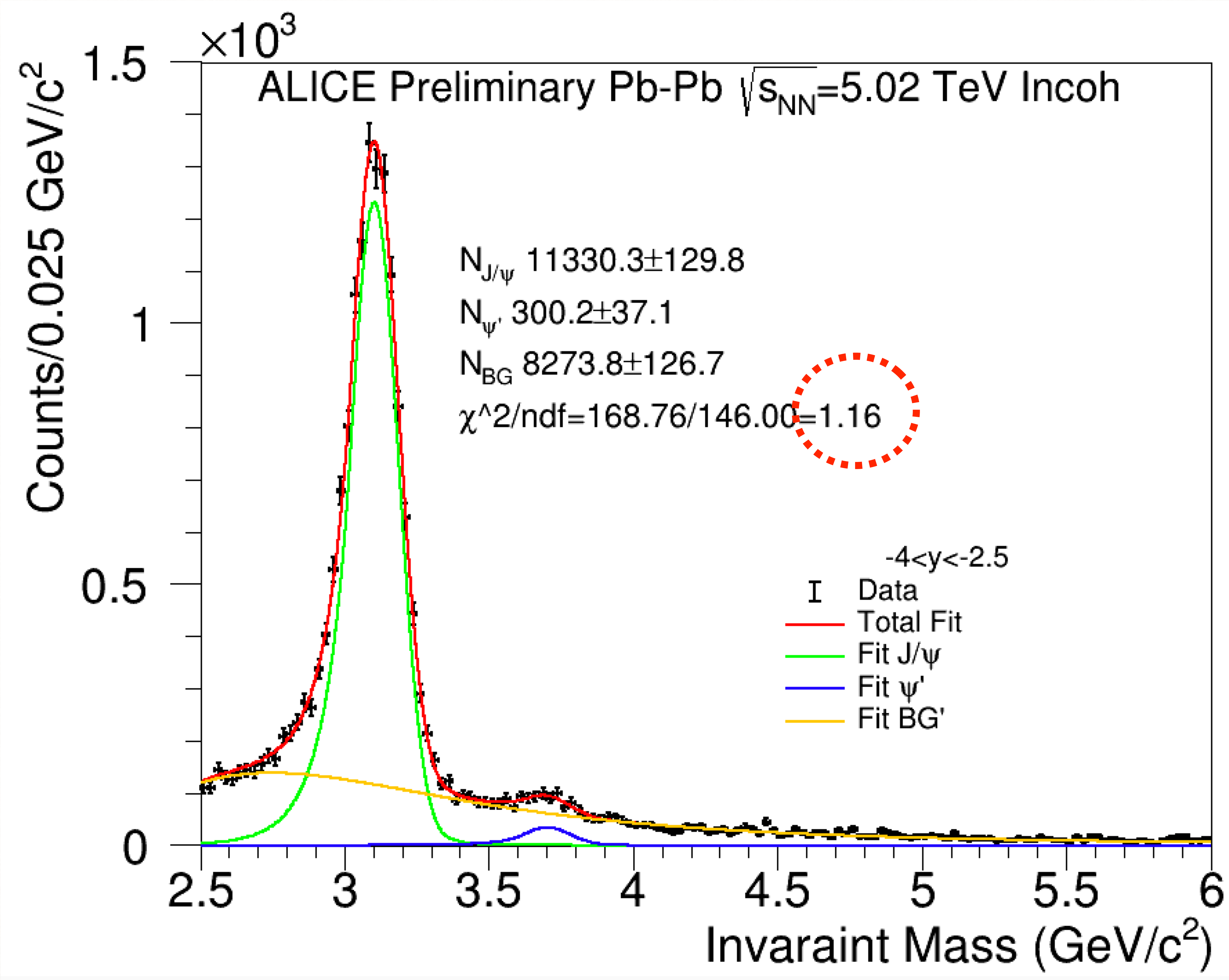




Some teeny-tiny results (2)

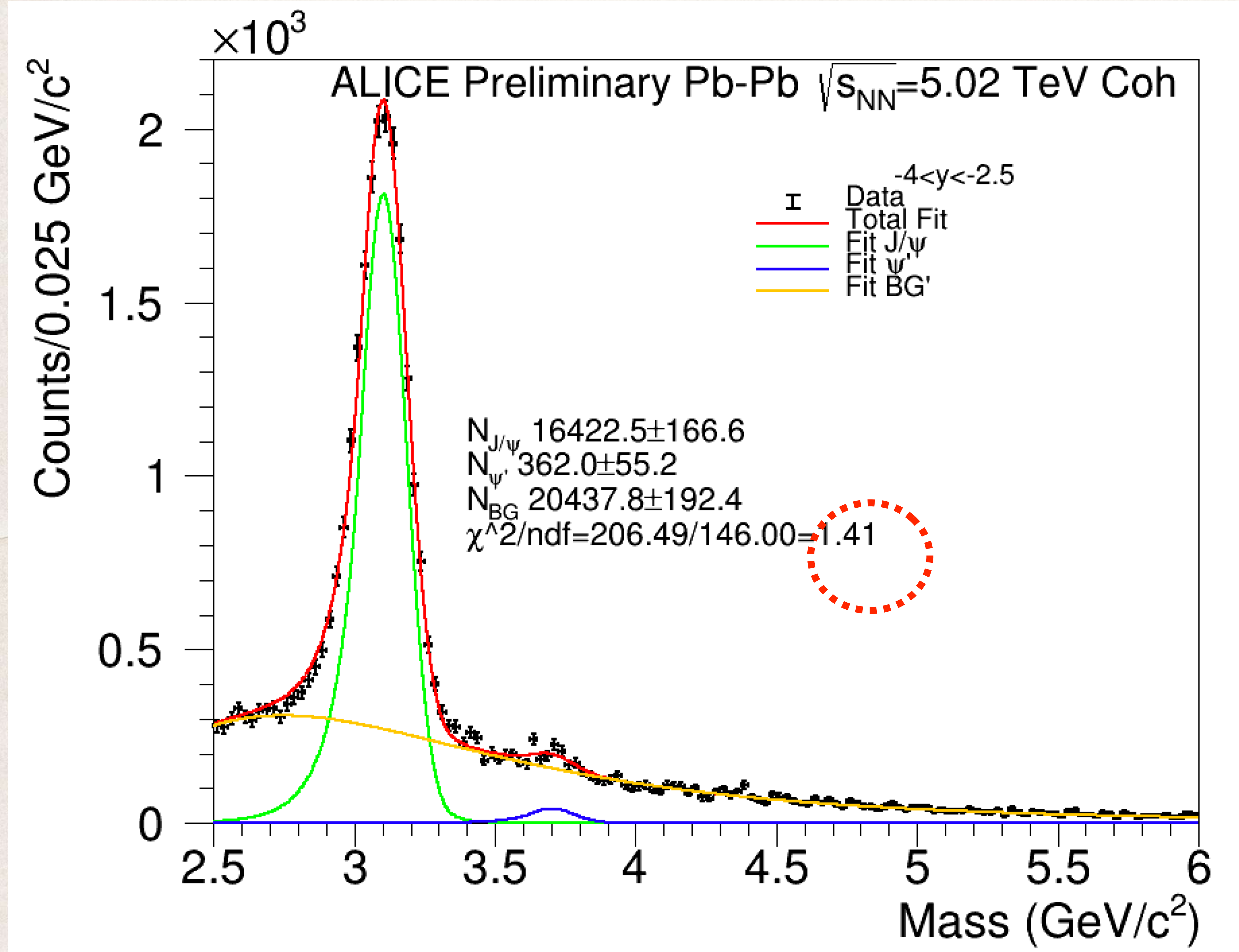
χ^2/ndf ~ 1, fit works ! ⭐⭐

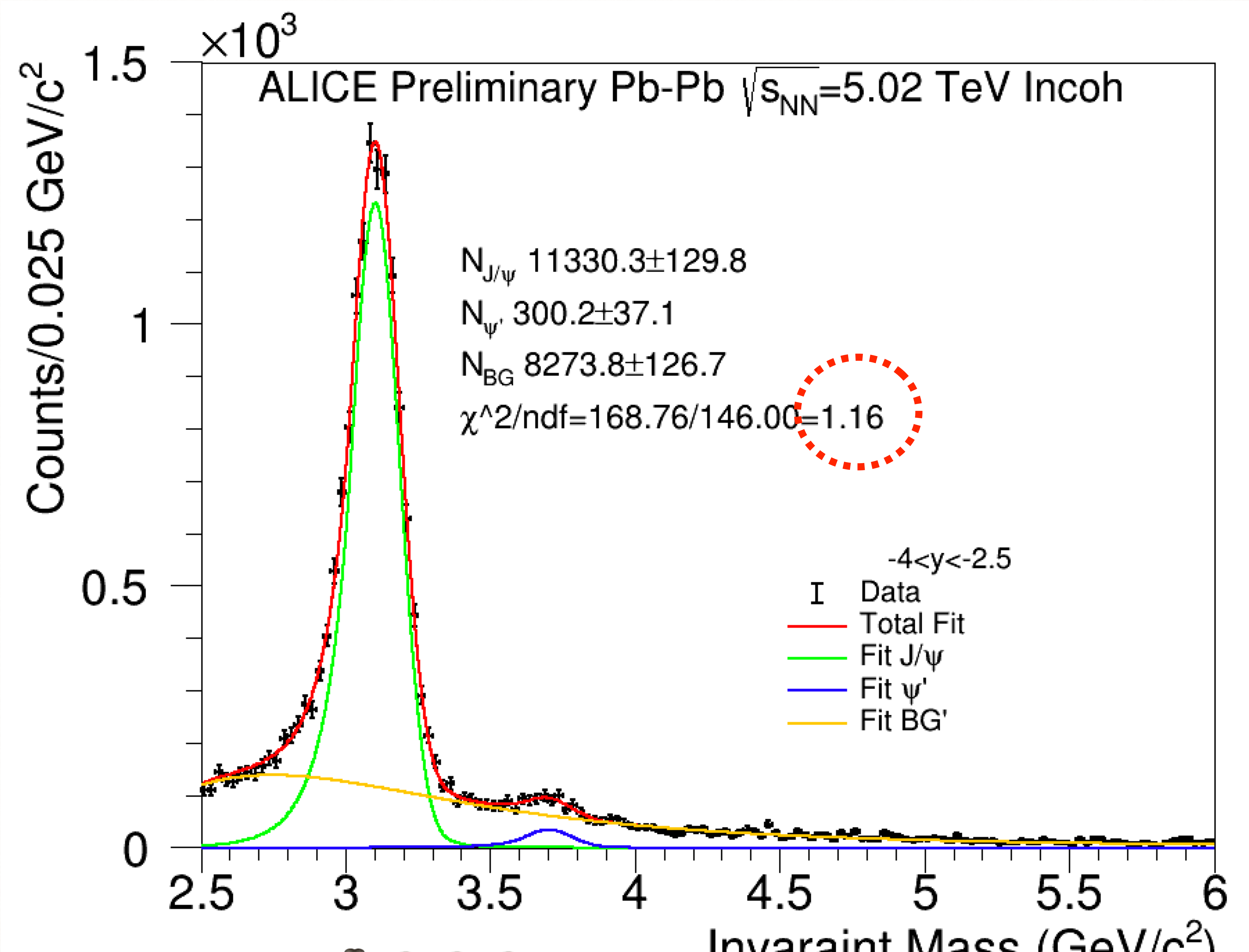




Some teeny-tiny results (2)

χ^2/ndf ~ 1, fit works !





Other results are still on a on-going work!

The future of ALICE experiment

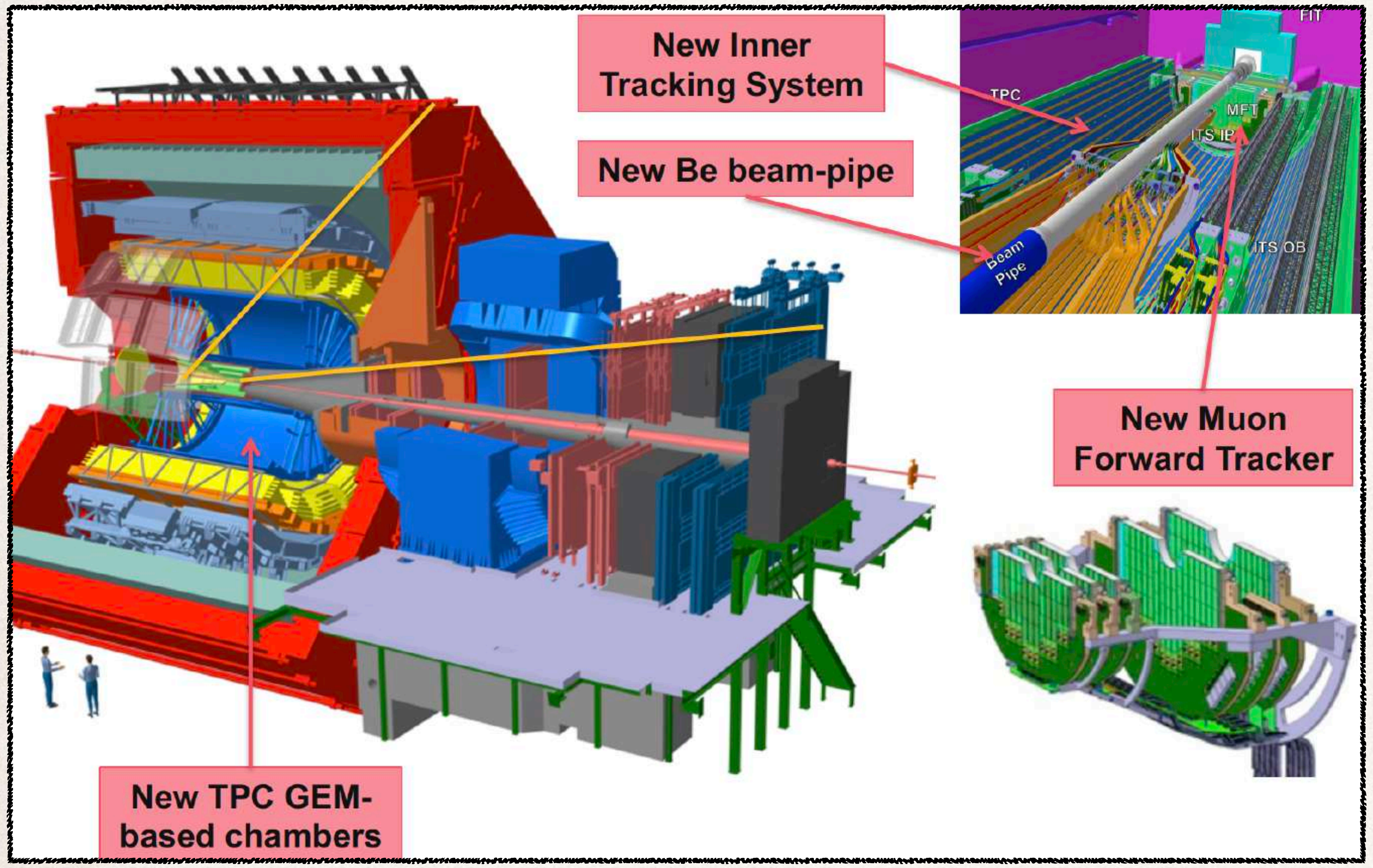
LHC Energy and Luminosity ↗ ⚡⚡ = more data produced

The future of ALICE experiment

LHC Energy and Luminosity ↗ ⚡⚡ = more data produced

Need more performing detectors
and a faster acquisition system 💻💨

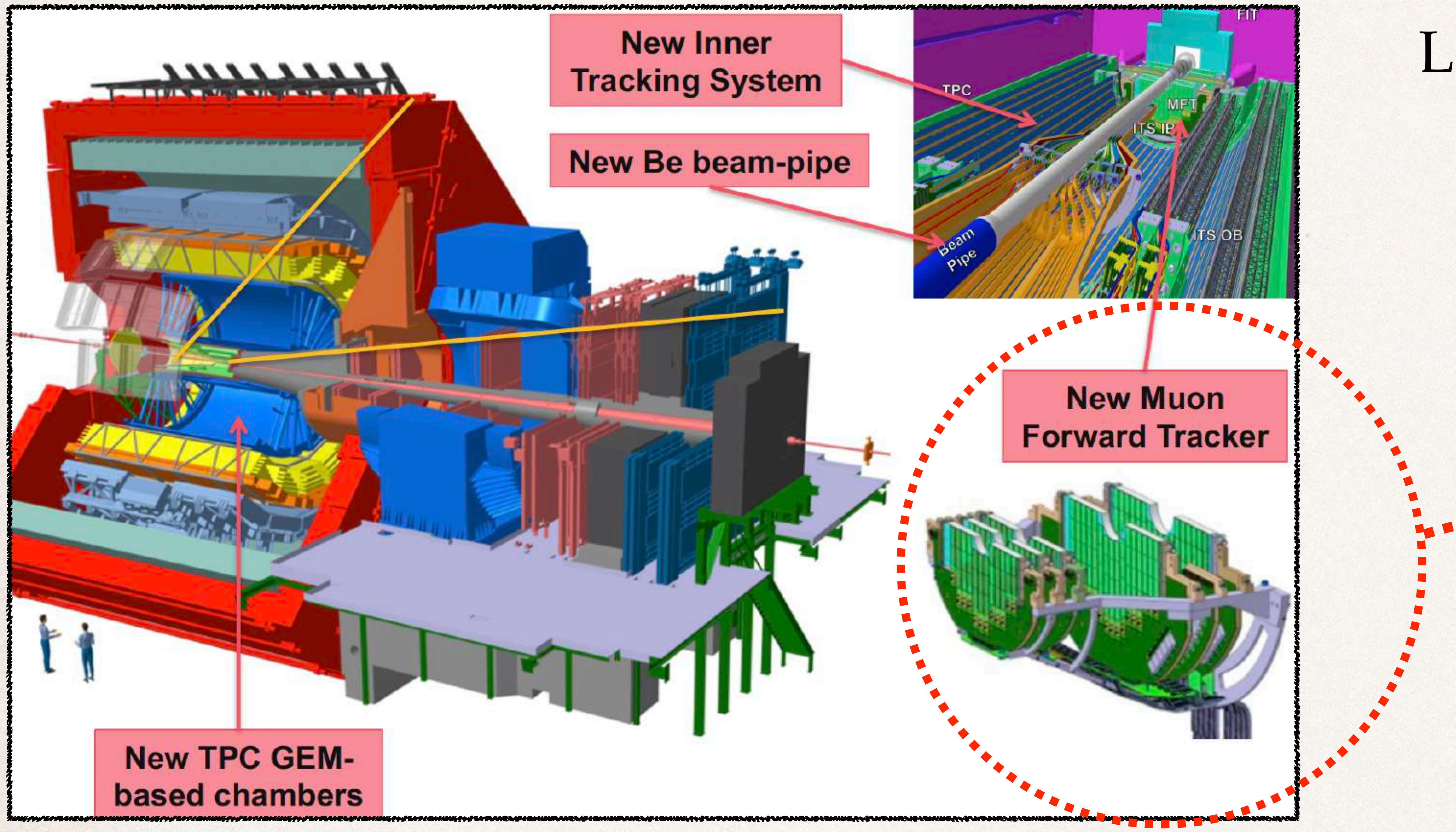
The future of ALICE experiment



LHC Energy and Luminosity ↗ ⚡⚡ = more data produced

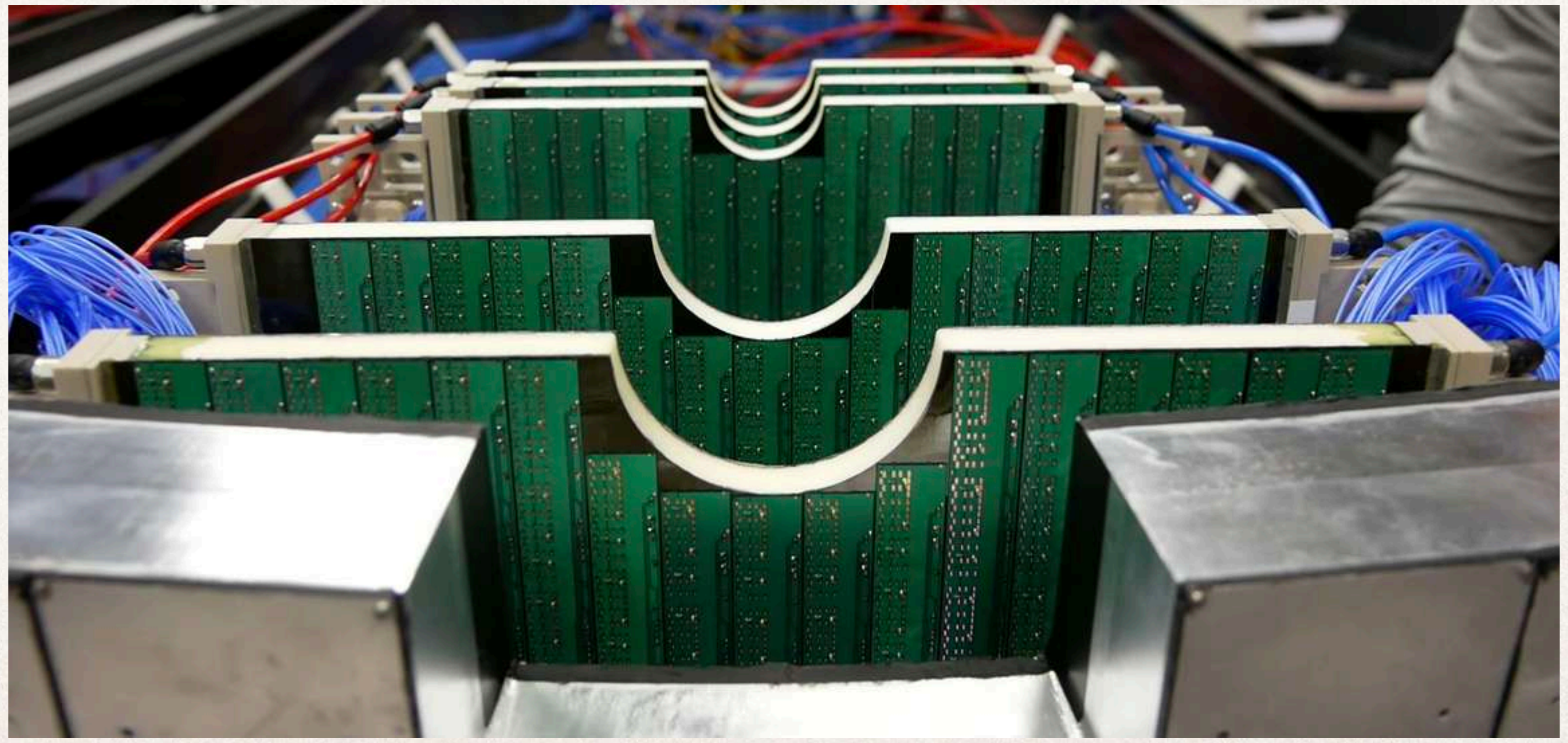
Need more performing detectors
and a faster acquisition system 💻💨

The future of ALICE experiment

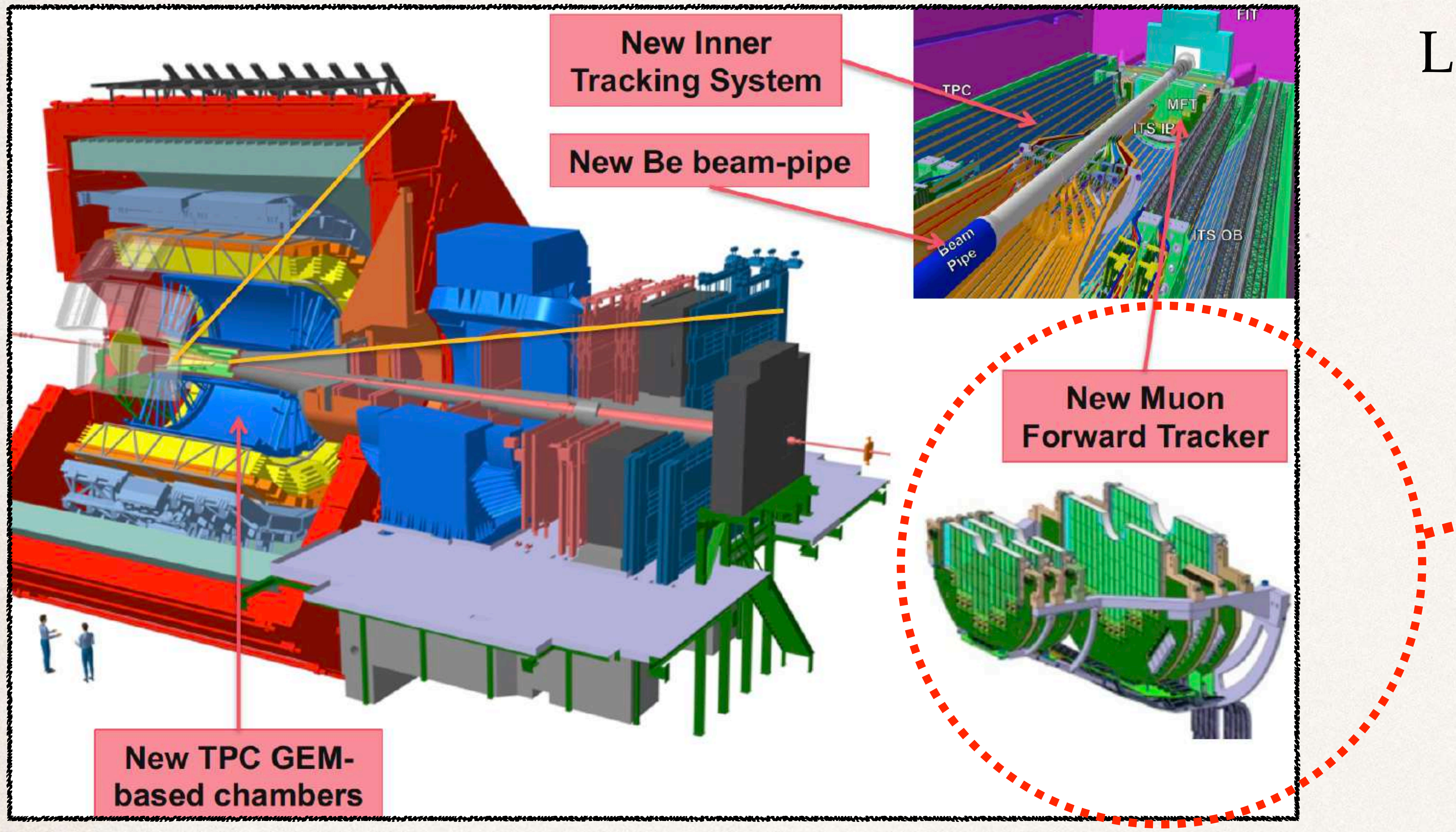


LHC Energy and Luminosity ↗ ⚡⚡ = more data produced

Need more performing detectors
and a faster acquisition system 💻💨



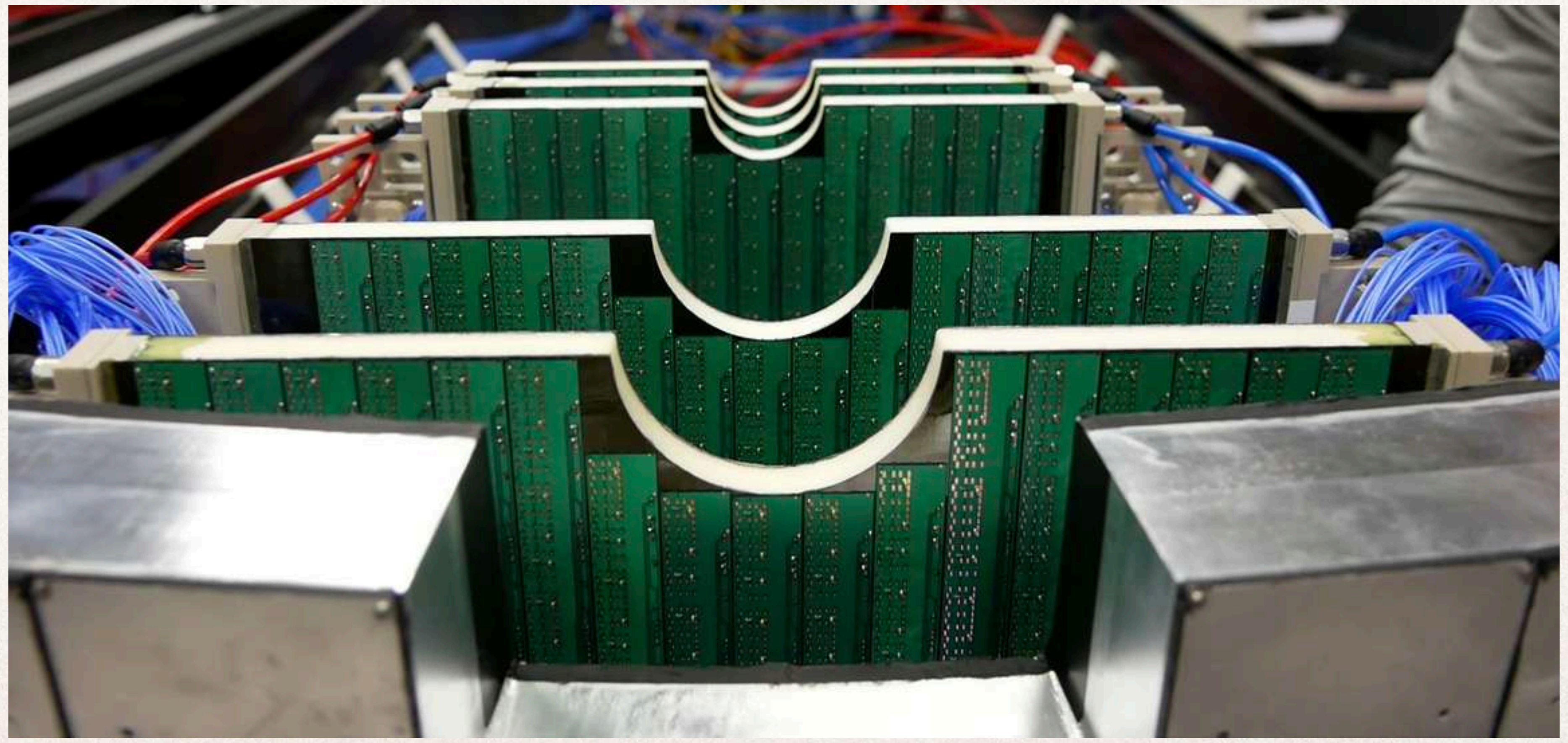
The future of ALICE experiment



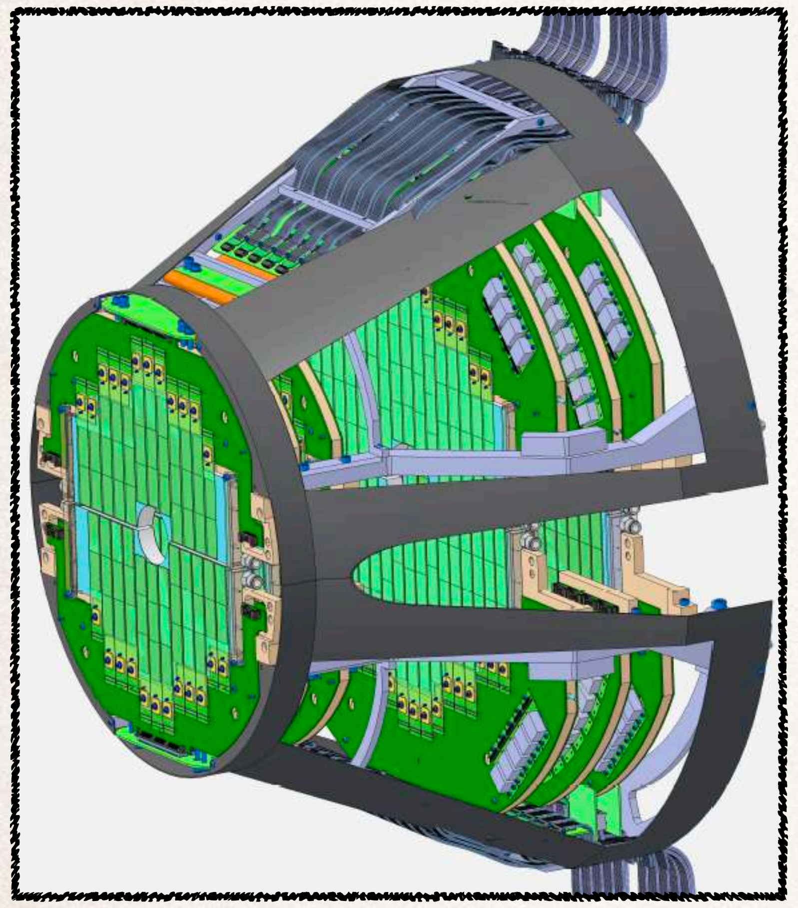
LHC Energy and Luminosity ↗ ⚡⚡ = more data produced

Need more performing detectors
and a faster acquisition system 💻💨

The Muon Forward Tracker (MFT) detector is
designed for LHC RUN3 and RUN4

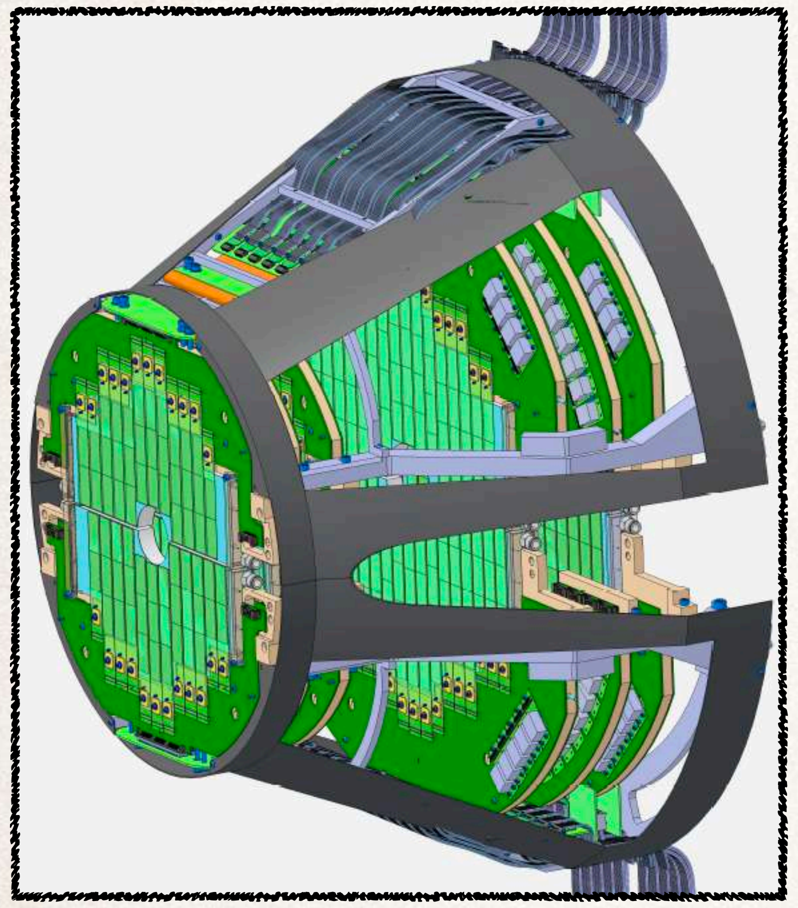


MFT and its commissioning (1)



Type of detector: internal all-silicon-pixel tracker which will give a precise determination of the muon production vertex. 👾🛤️

MFT and its commissioning (1)

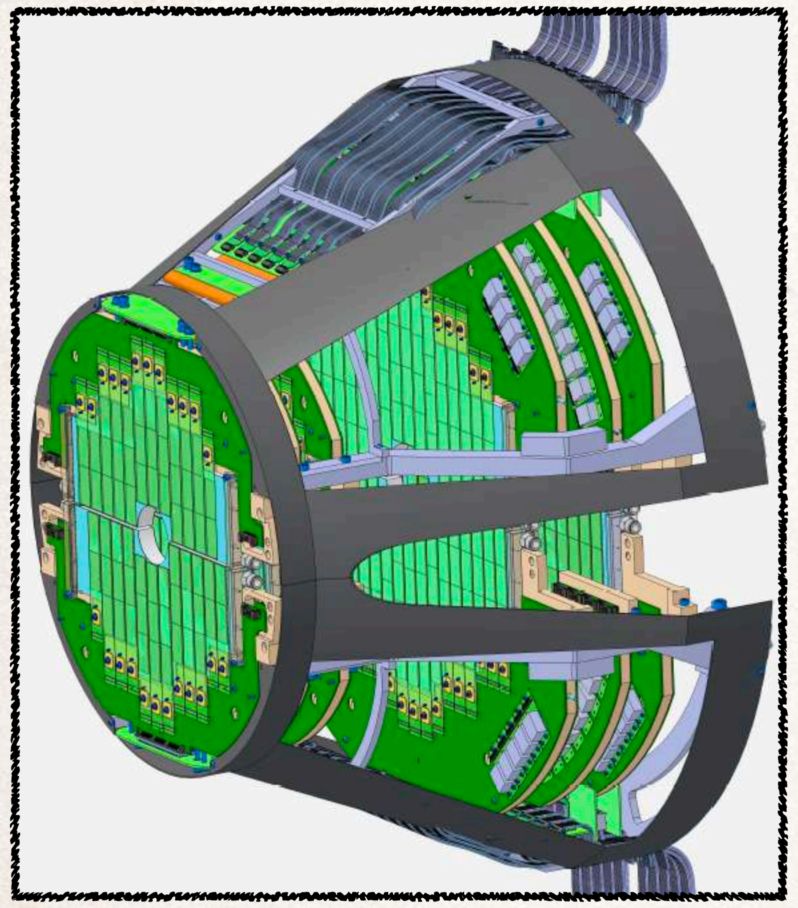


Type of detector: internal all-silicon-pixel tracker which will give a precise determination of the muon production vertex. 👾🛤️

Main objectives of the MFT:

- measure the trajectory of muons before they pass through the absorber; 🔎☄️
- discriminate between "prompt" and "not-prompt" J/ψ mesons.

MFT and its commissioning (1)

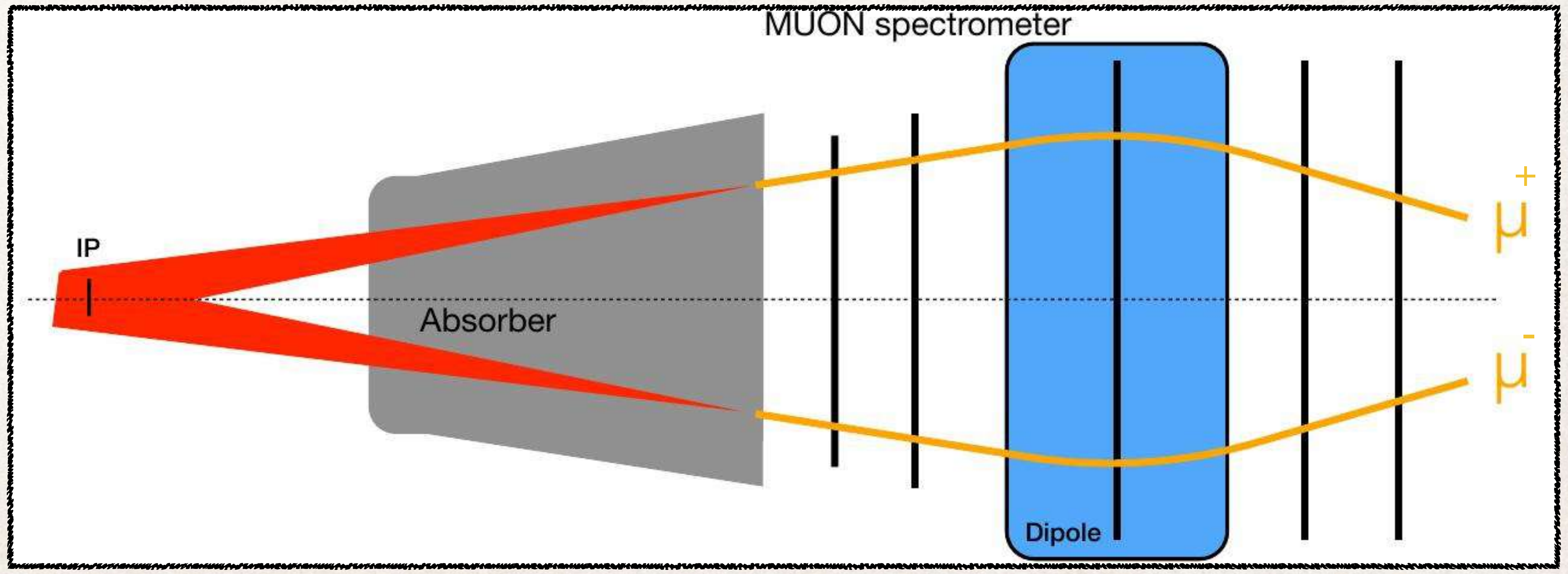


Type of detector: internal all-silicon-pixel tracker which will give a precise determination of the muon production vertex. 👾🛤️

Main objectives of the MFT:

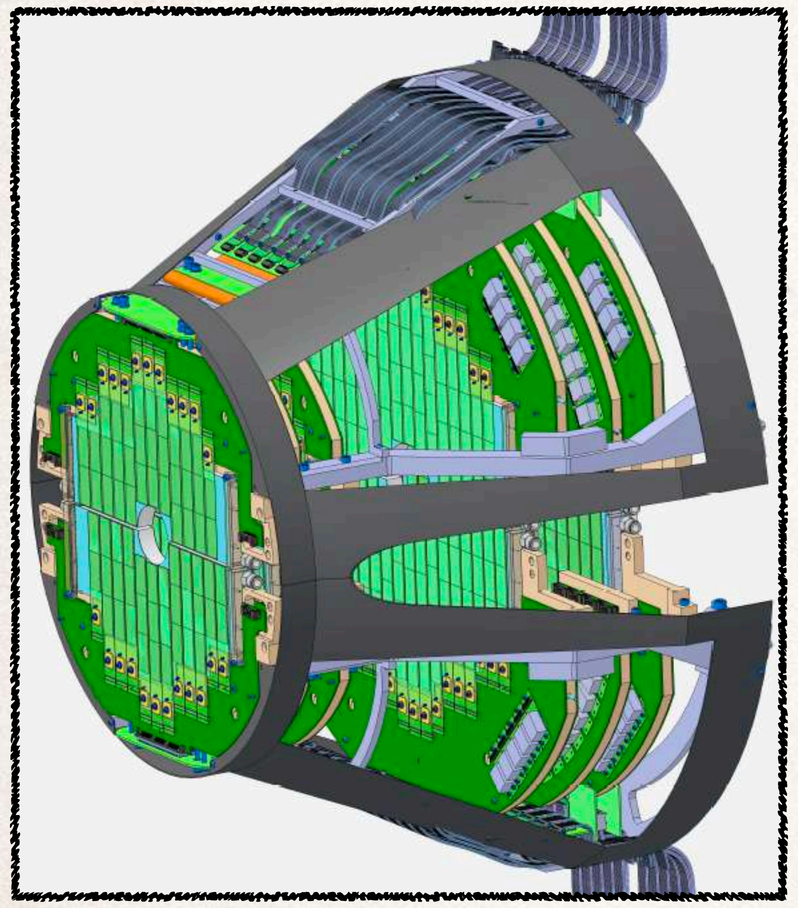
- measure the trajectory of muons before they pass through the absorber; 🔎☄️
- discriminate between “prompt” and “not-prompt” J/ψ mesons.

ALICE BEFORE



(SHE HAS MYOPIA......)

MFT and its commissioning (1)

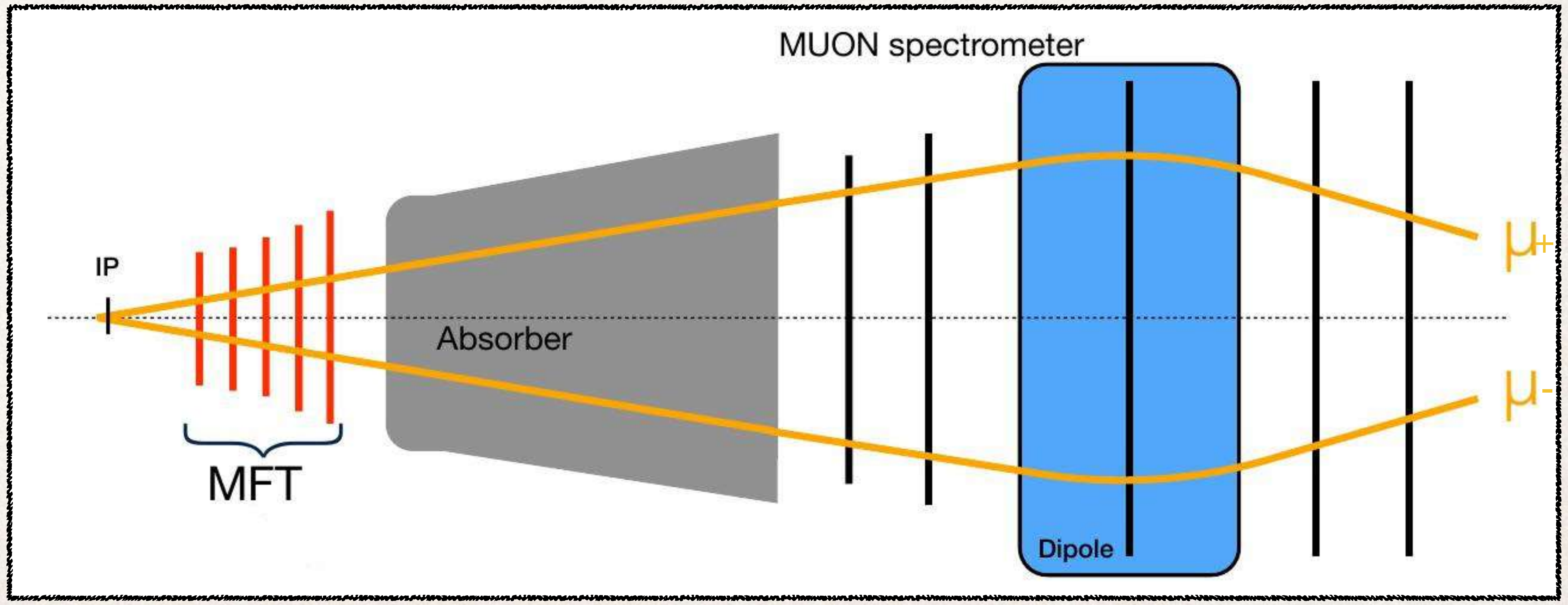


Type of detector: internal all-silicon-pixel tracker which will give a precise determination of the muon production vertex. 👾🛤️

Main objectives of the MFT:

- measure the trajectory of muons before they pass through the absorber; 🔎☄️
- discriminate between "prompt" and "not-prompt" J/ψ mesons.

ALICE AFTER



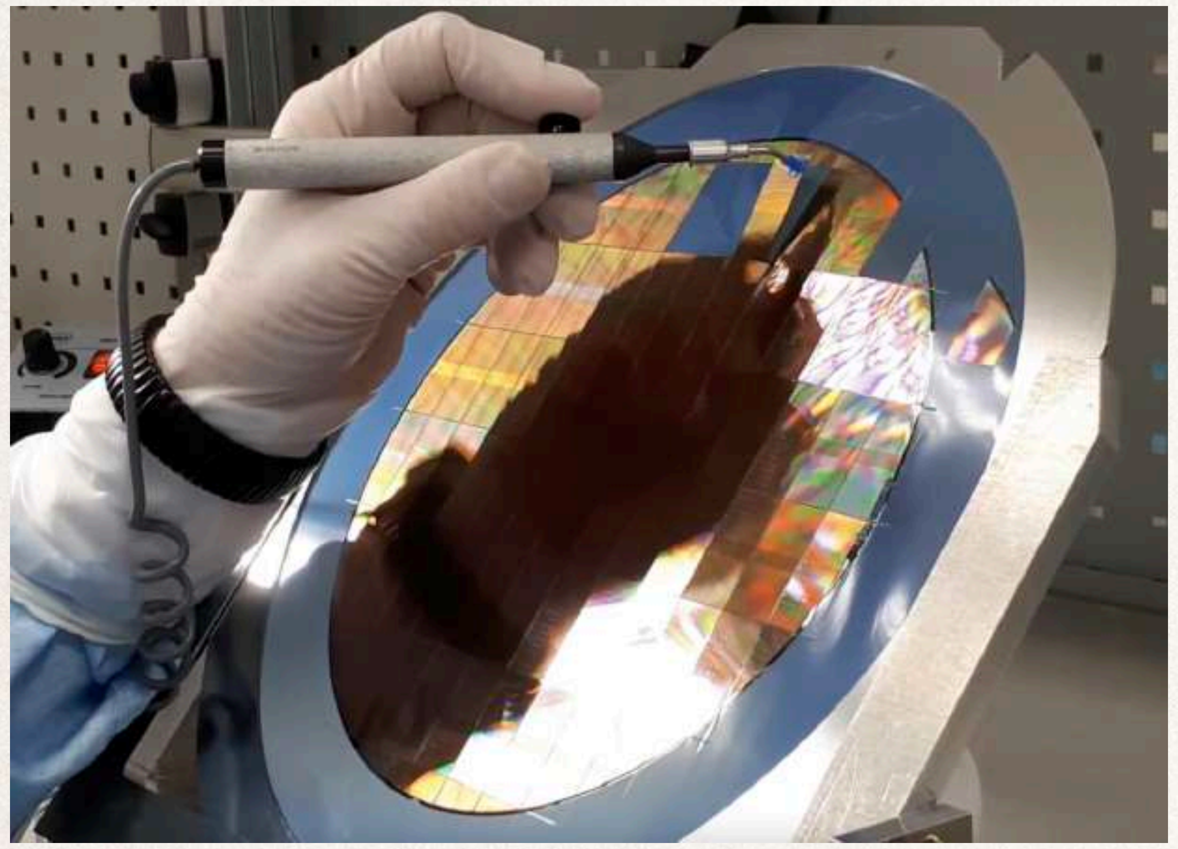
(NOW SHE HAS NEW GLASSES!)

MFT and its commissioning (2)

MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 μm x 28 μm.

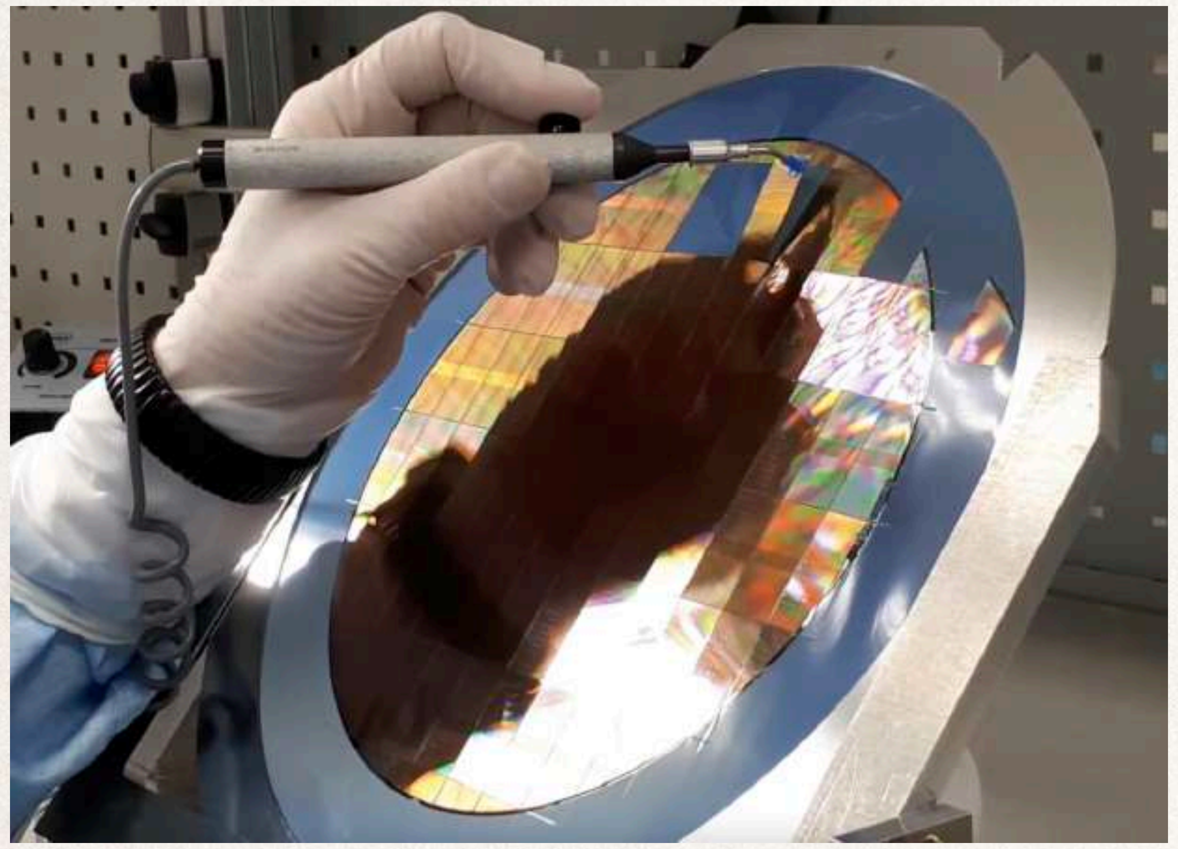
MFT and its commissioning (2)

MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 µm x 28 µm.



MFT and its commissioning (2)

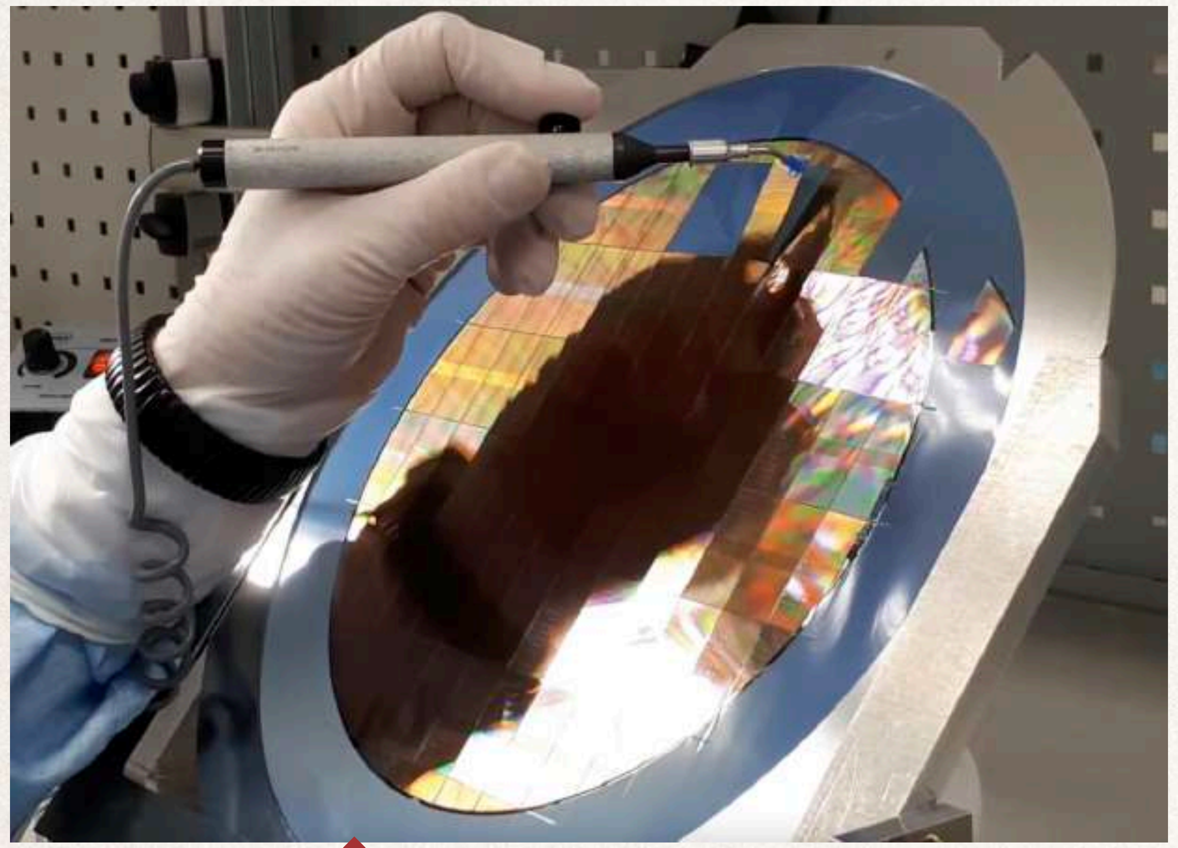
MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 µm x 28 µm.



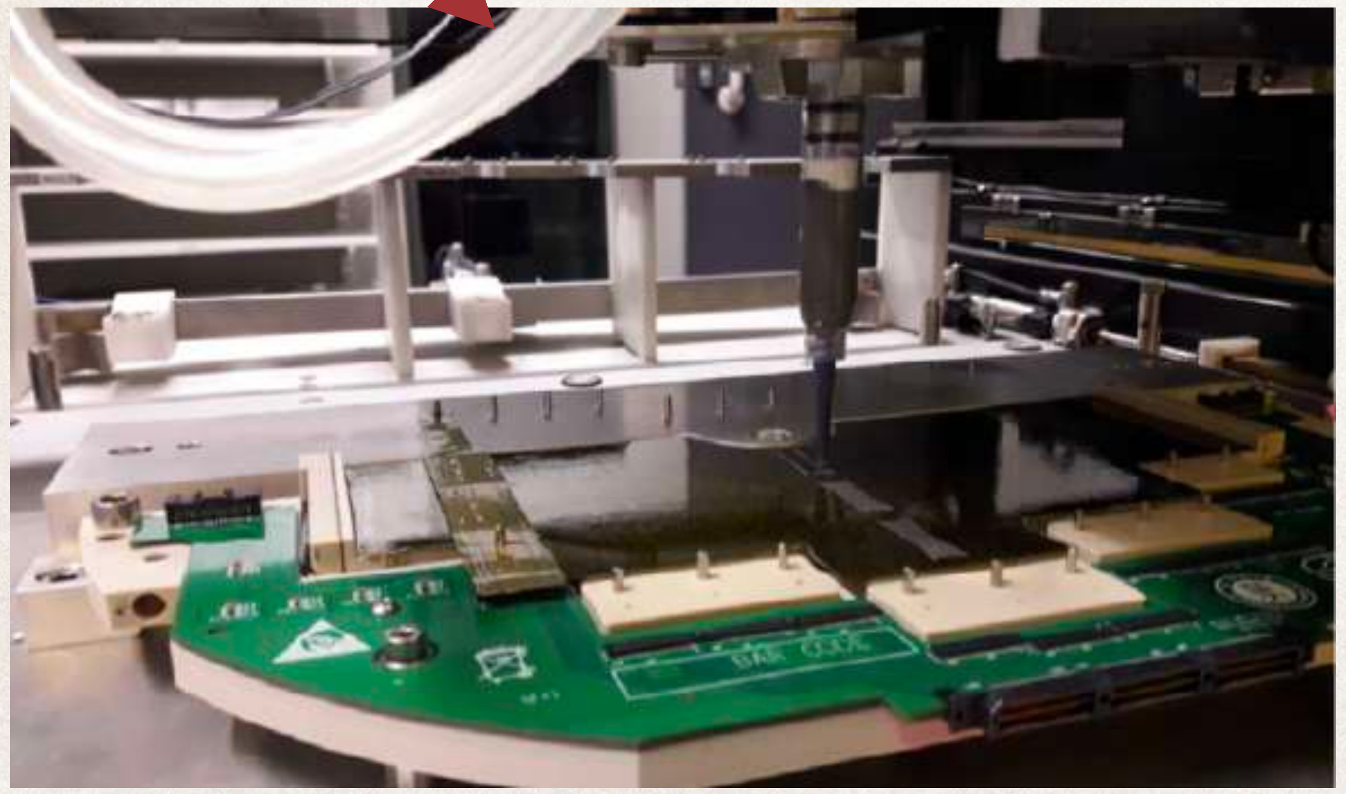
The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.

MFT and its commissioning (2)

MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 μm x 28 μm.



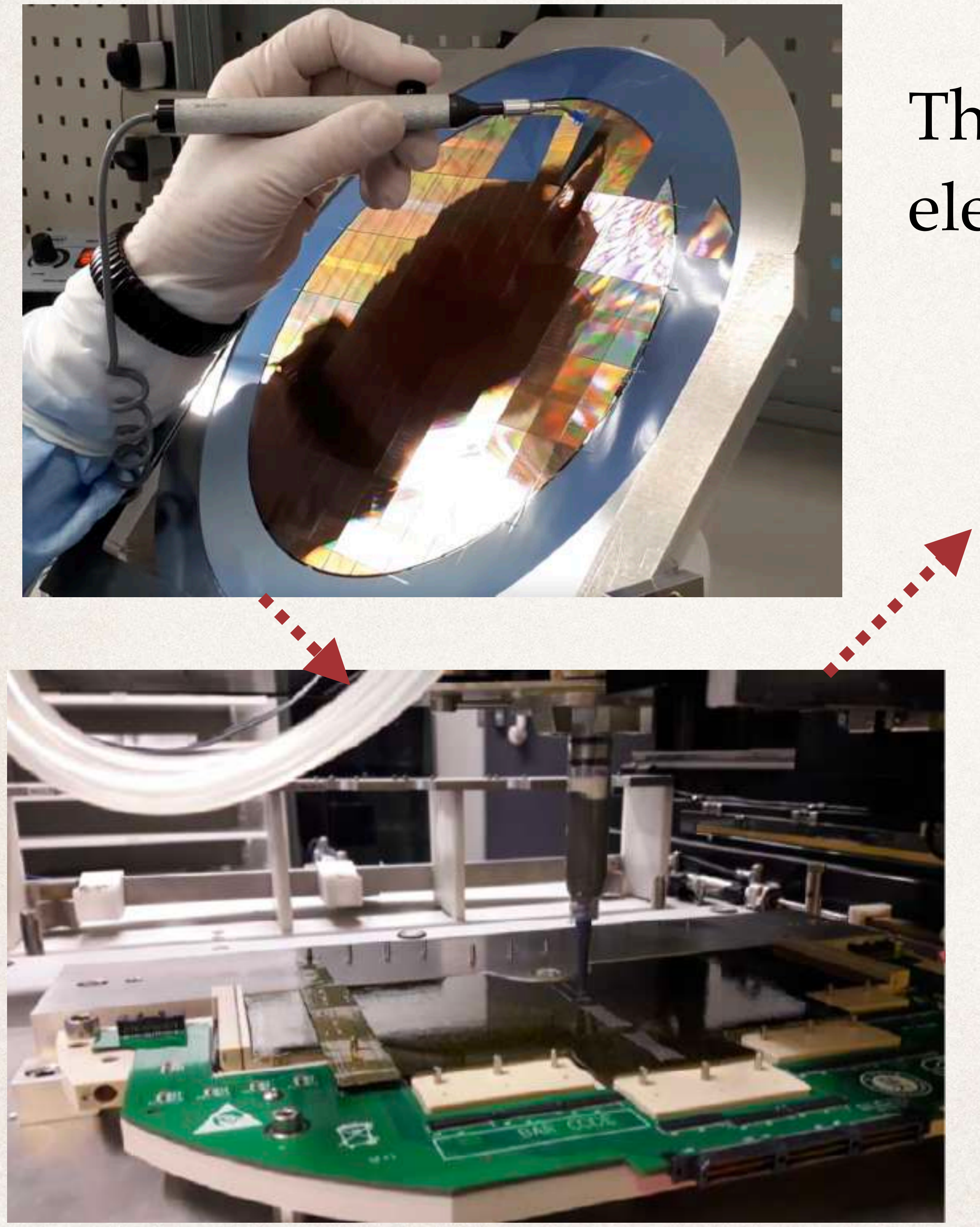
The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.



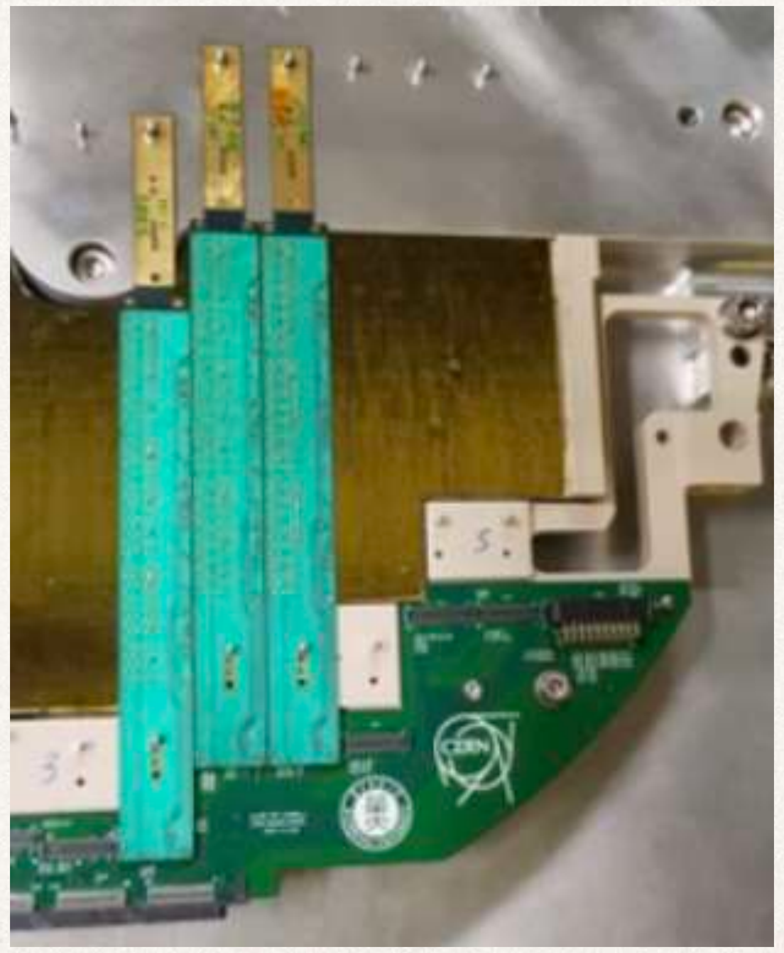
L.C.Migliorin (l.migliorin@cern.ch)

MFT and its commissioning (2)

MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 µm x 28 µm.

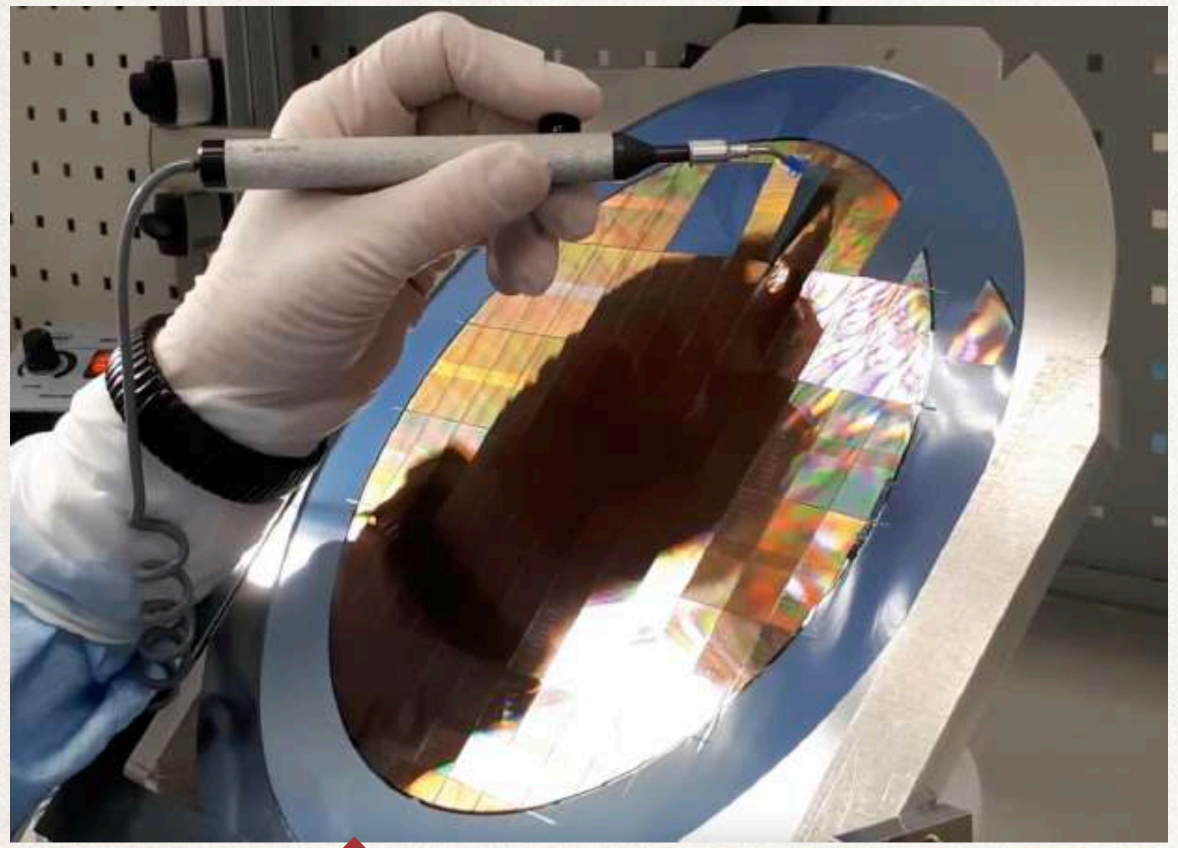


The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.

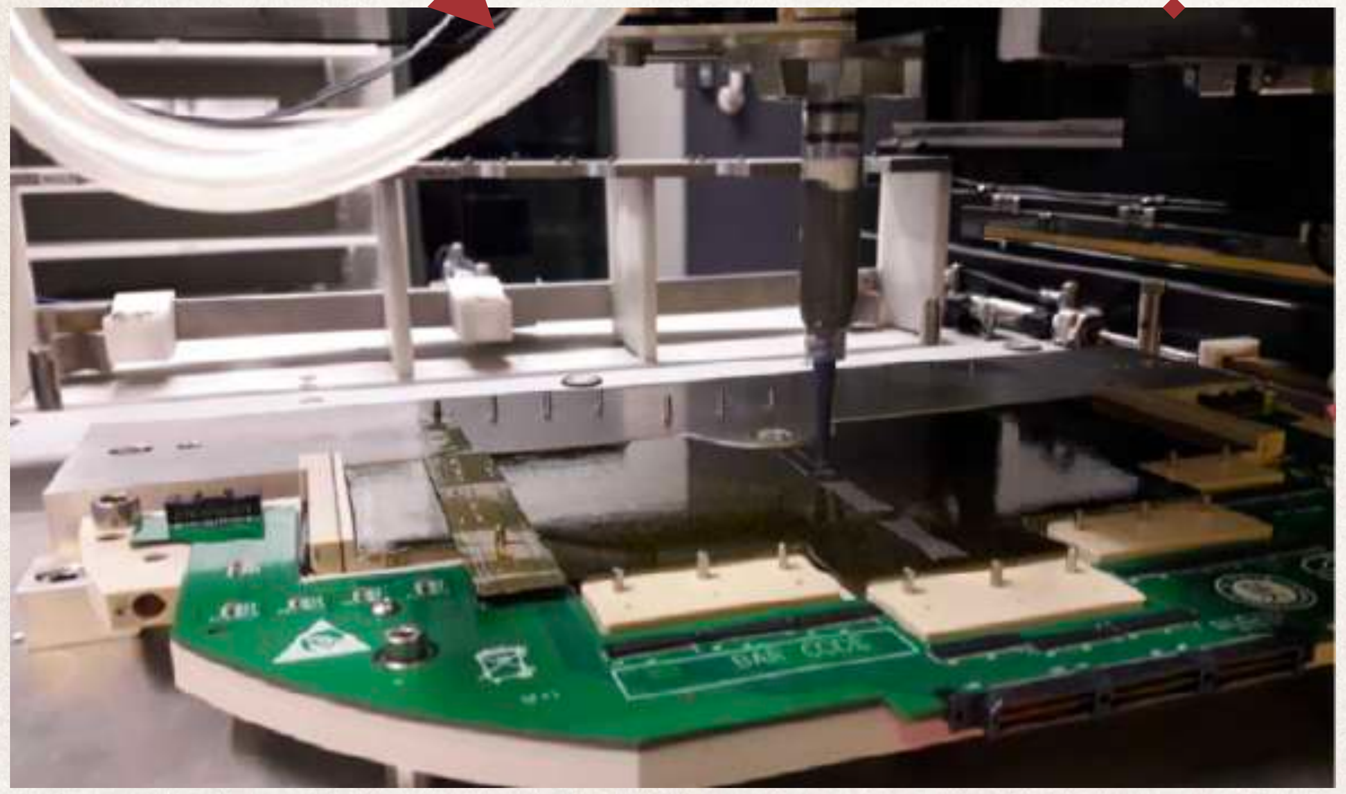


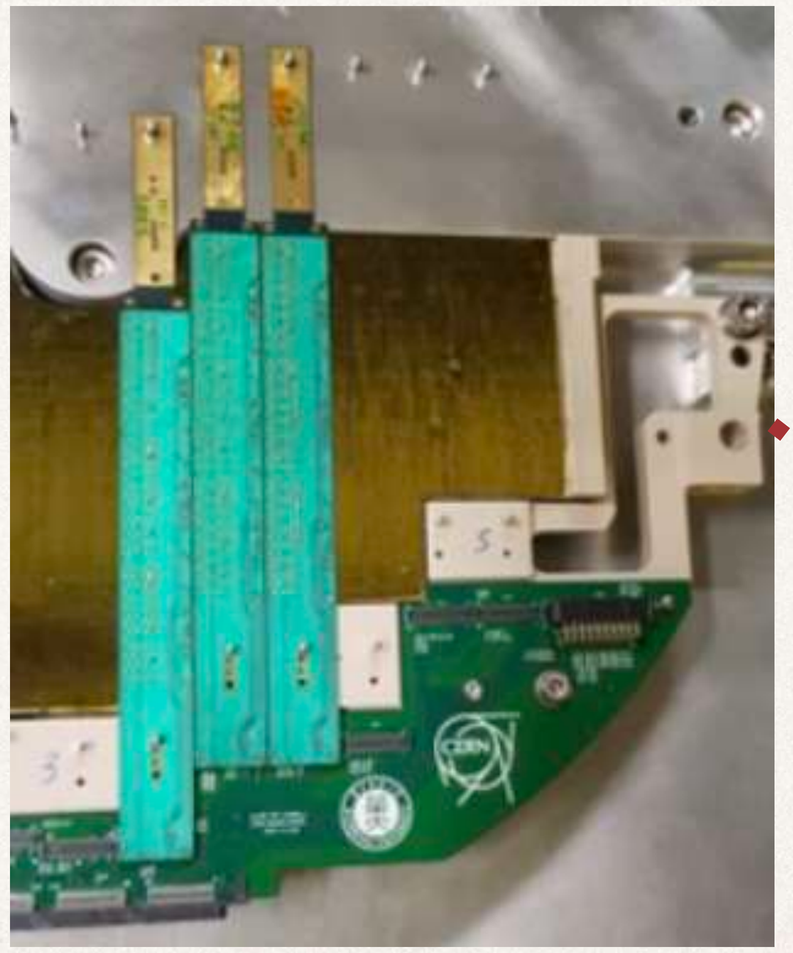
MFT and its commissioning (2)

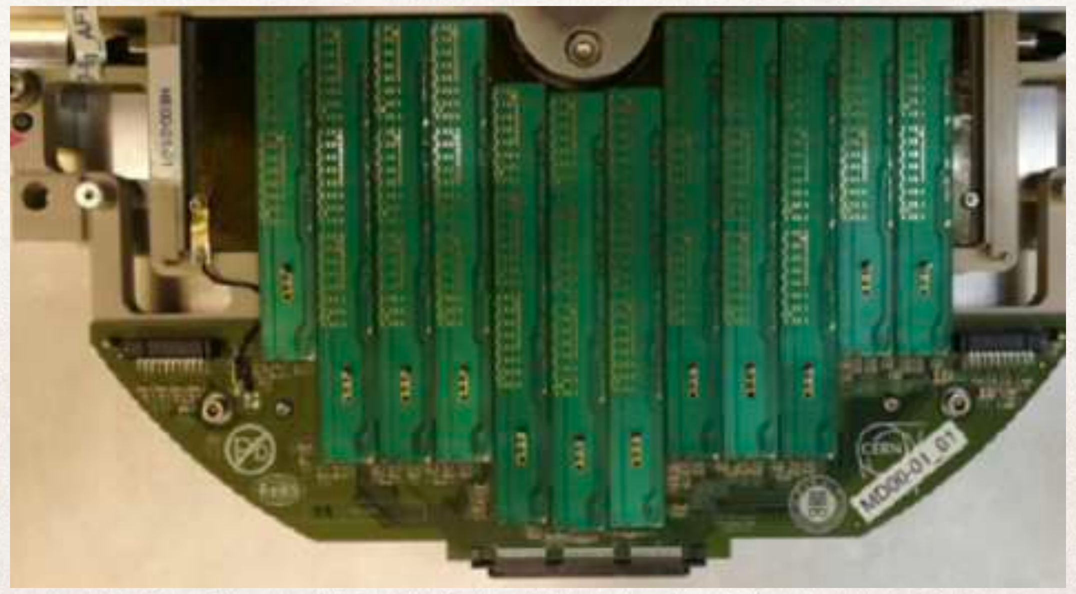
MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 μm x 28 μm.



The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.

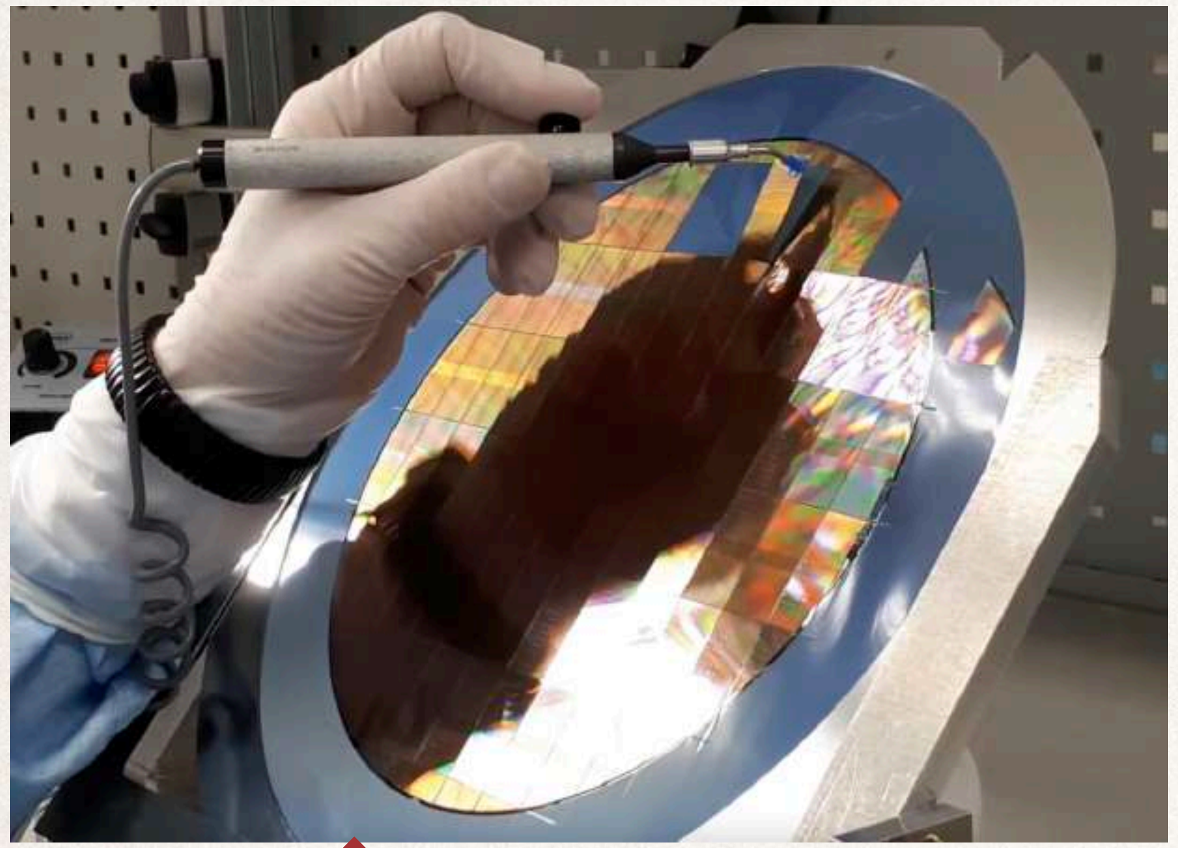


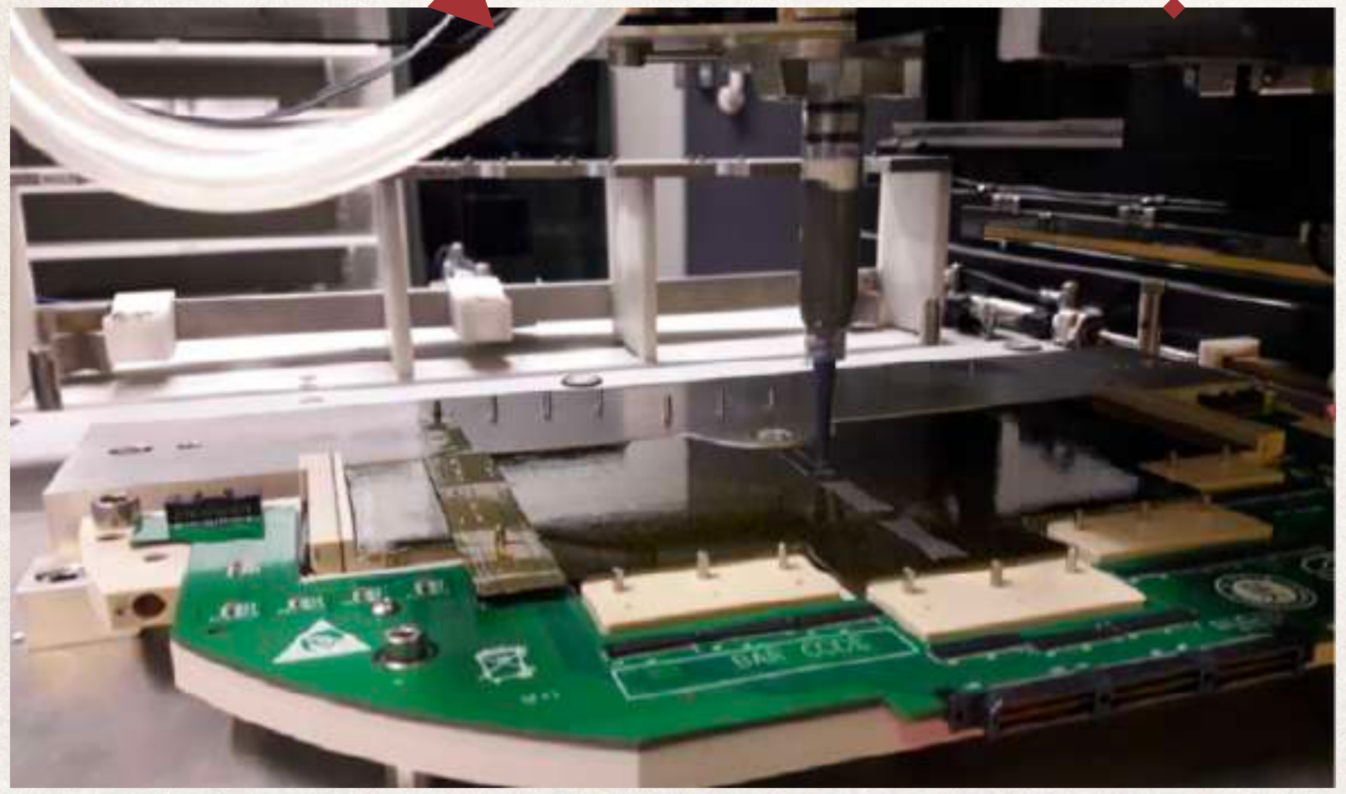




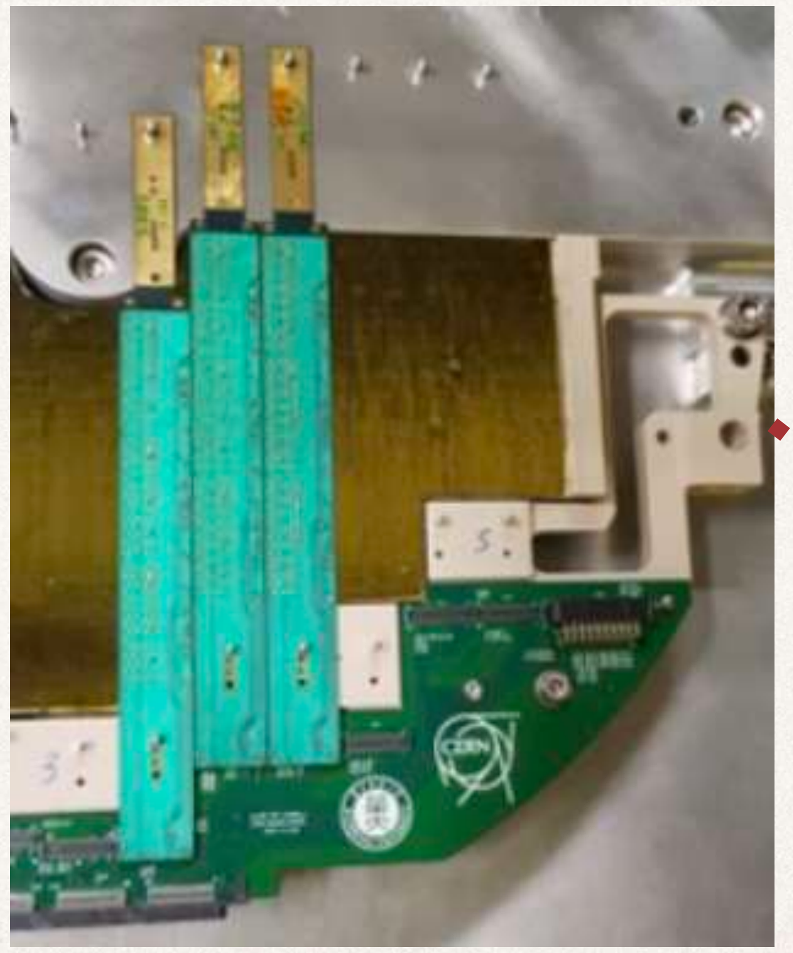
MFT and its commissioning (2)

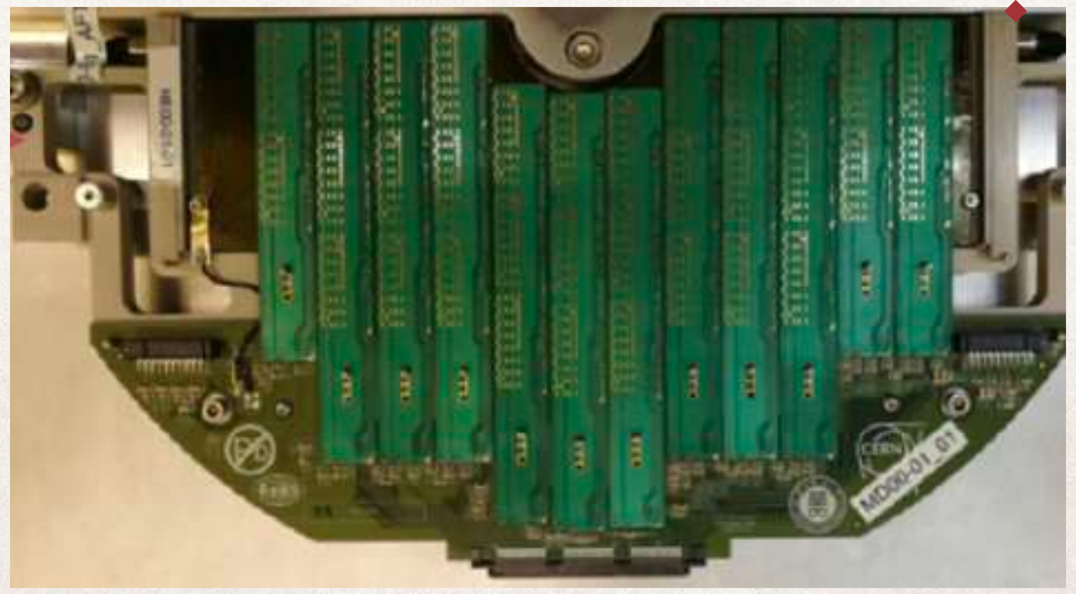
MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 μm x 28 μm.

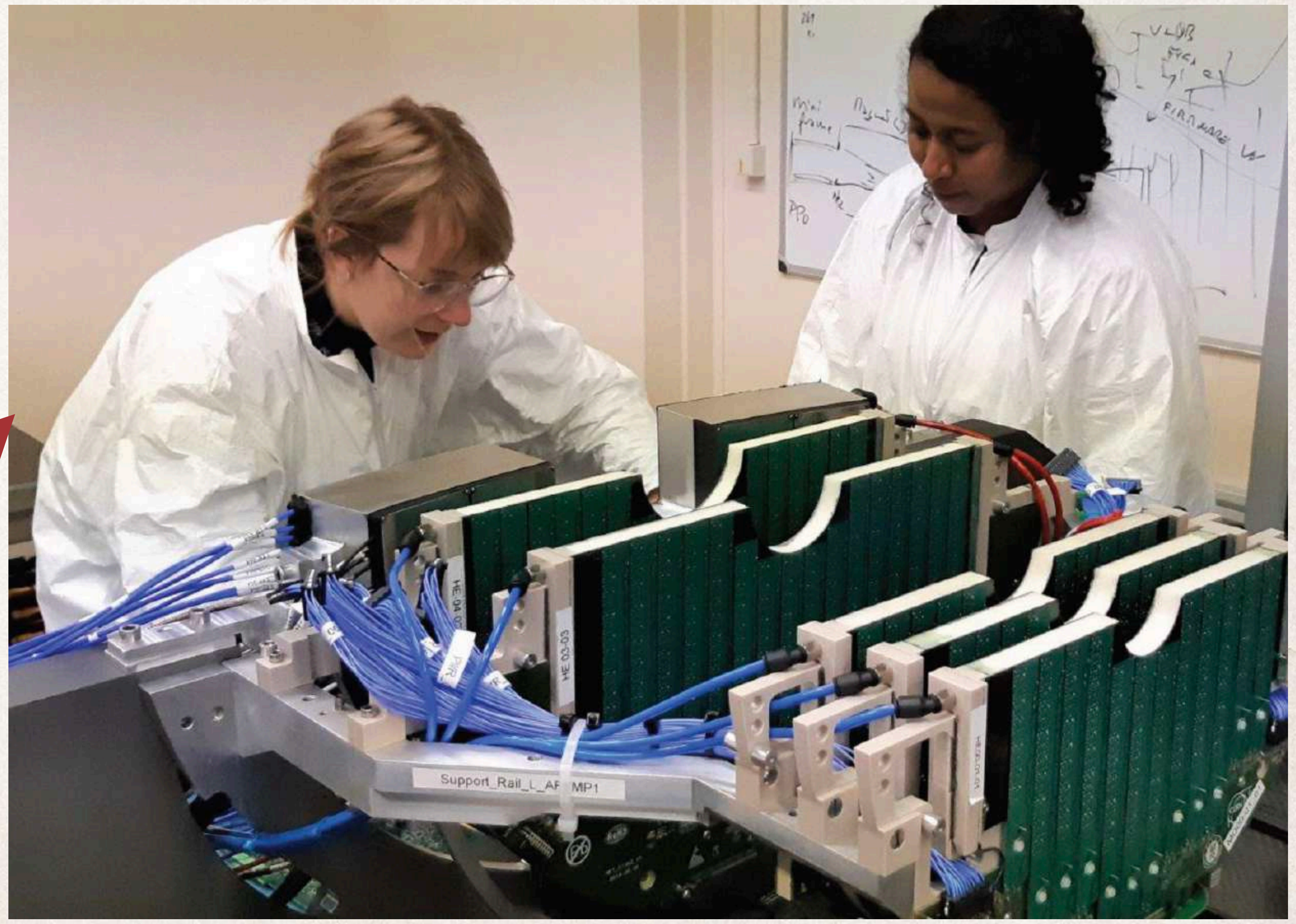




The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.

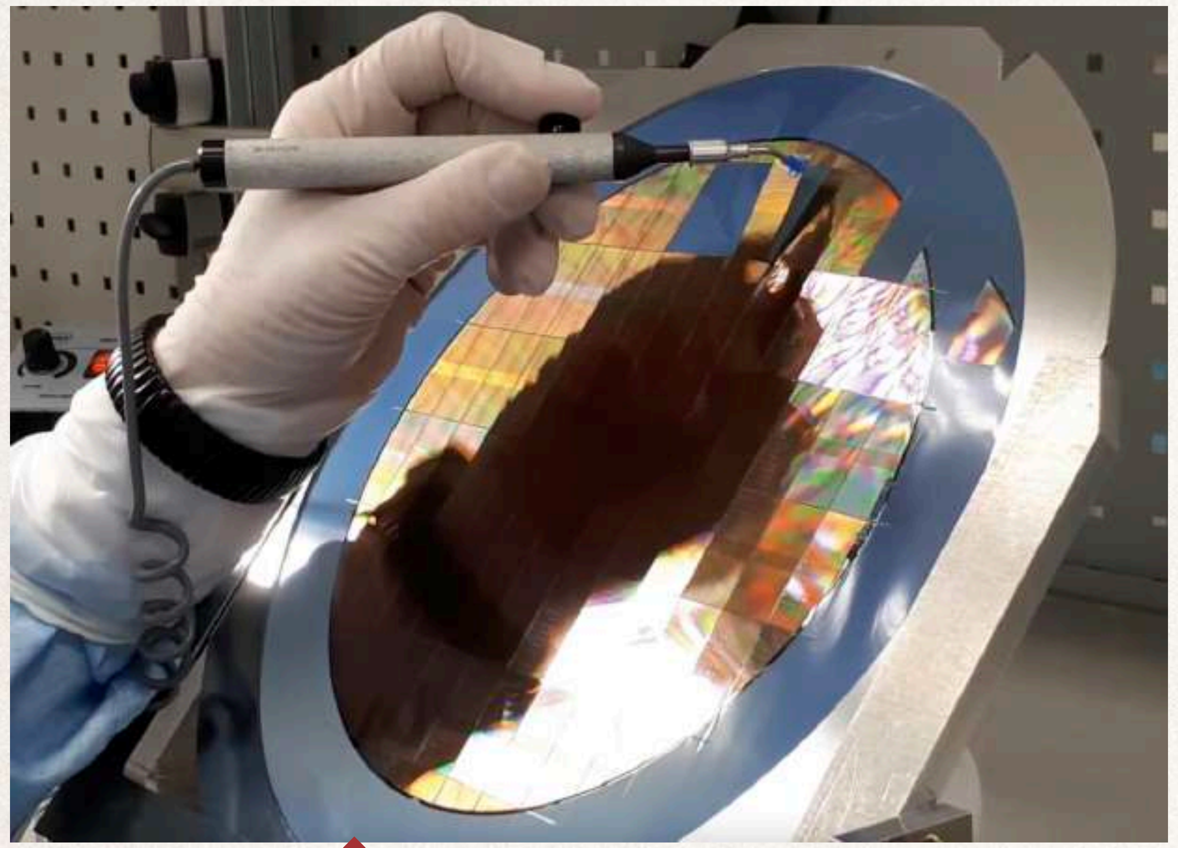




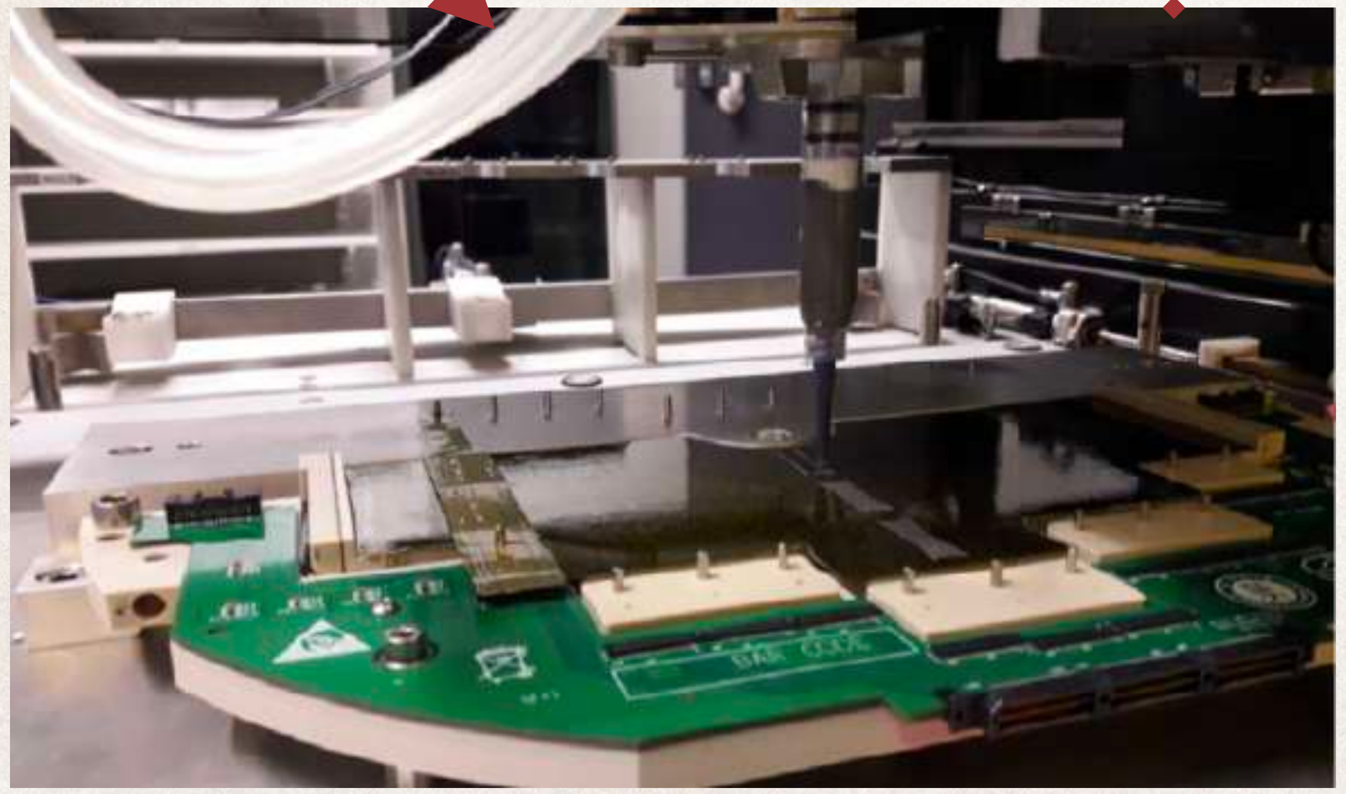


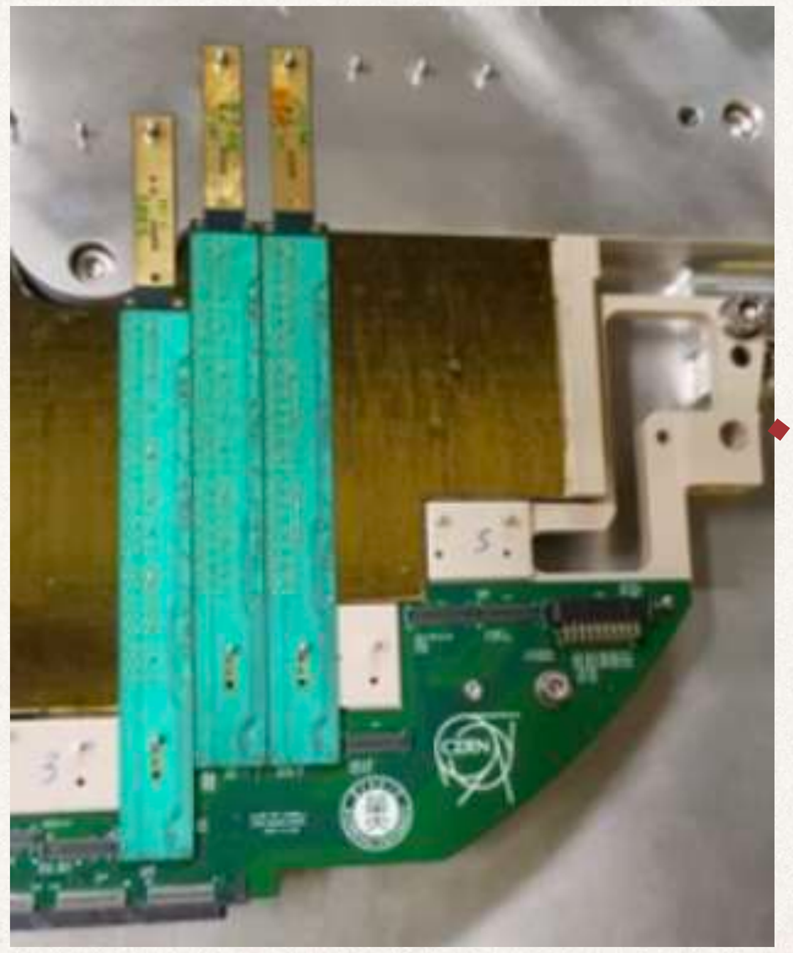
MFT and its commissioning (2)

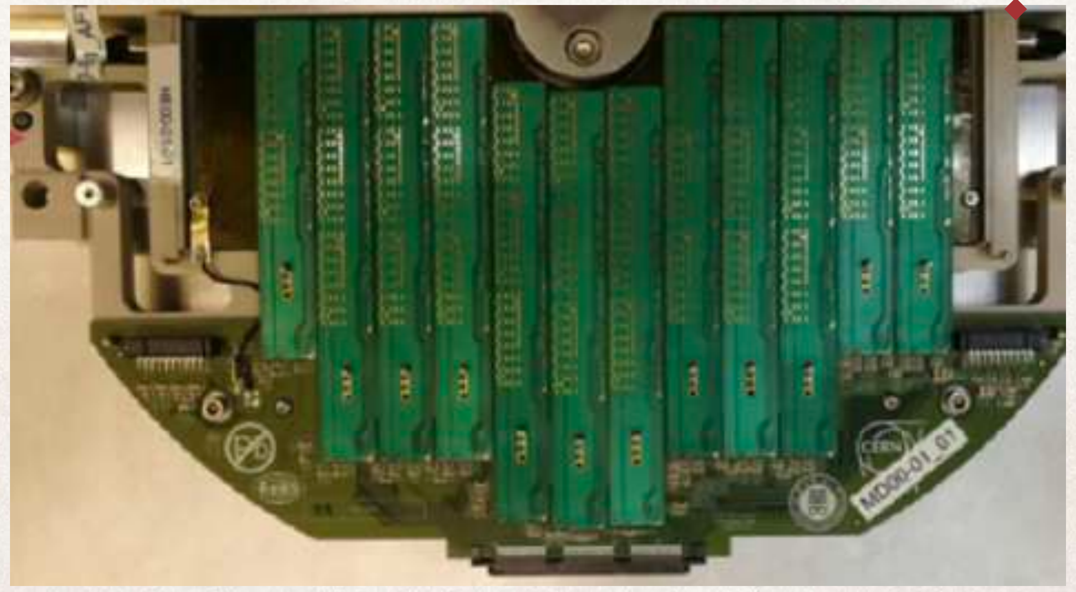
MFT is composed of **936** ALPIDE sensors distributed on **5 disks**. Each sensor is made up of 1024x512 silicon pixels of size 28 μm x 28 μm.

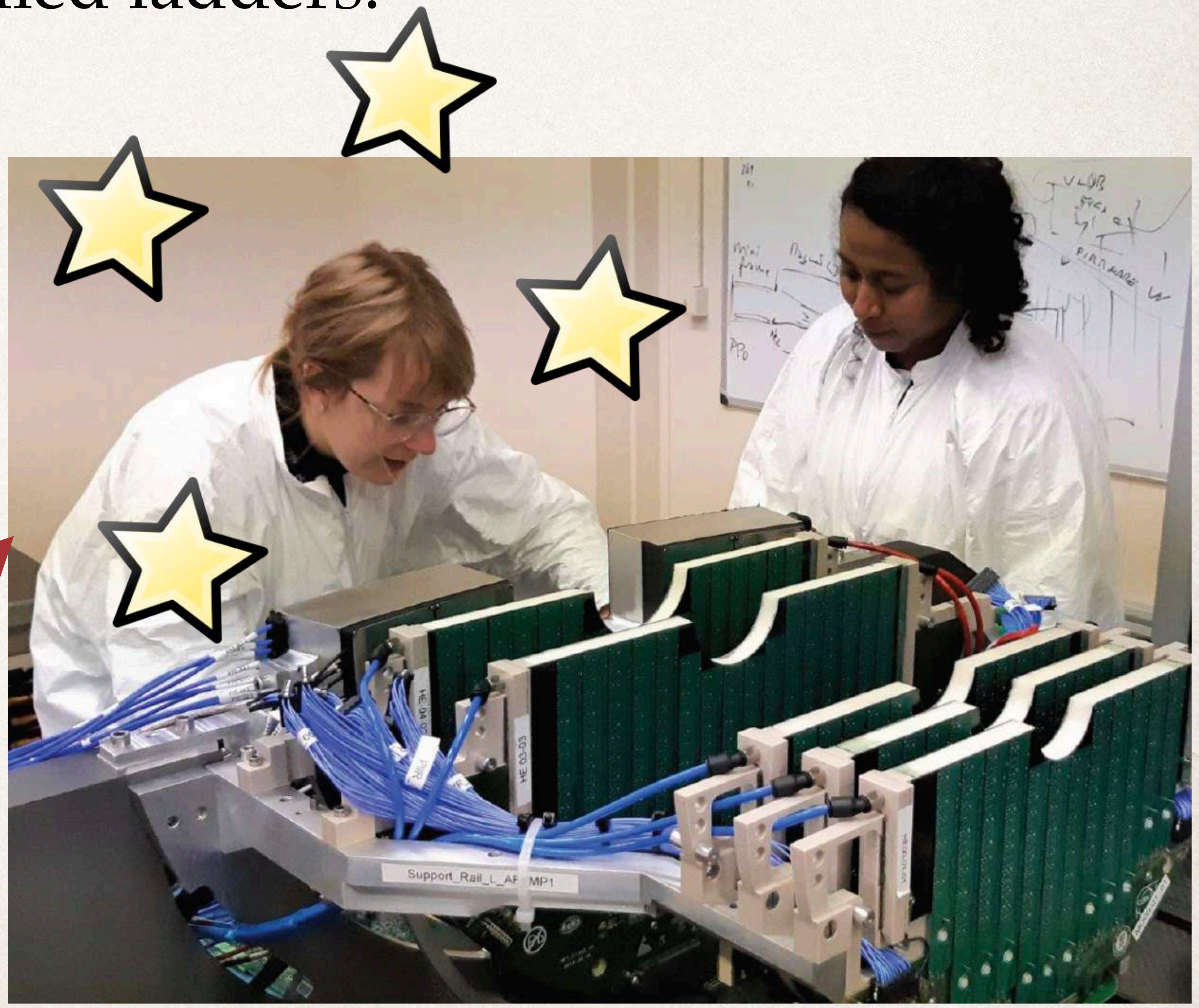


The sensors are glued on Flexible Printed Circuit (FPC) and connected by electronic micro-bridging creating structures called ladders.









MFT and its commissioning (3)

- Qualification work on disks and ladders; 💿🪜📝

MFT and its commissioning (3)

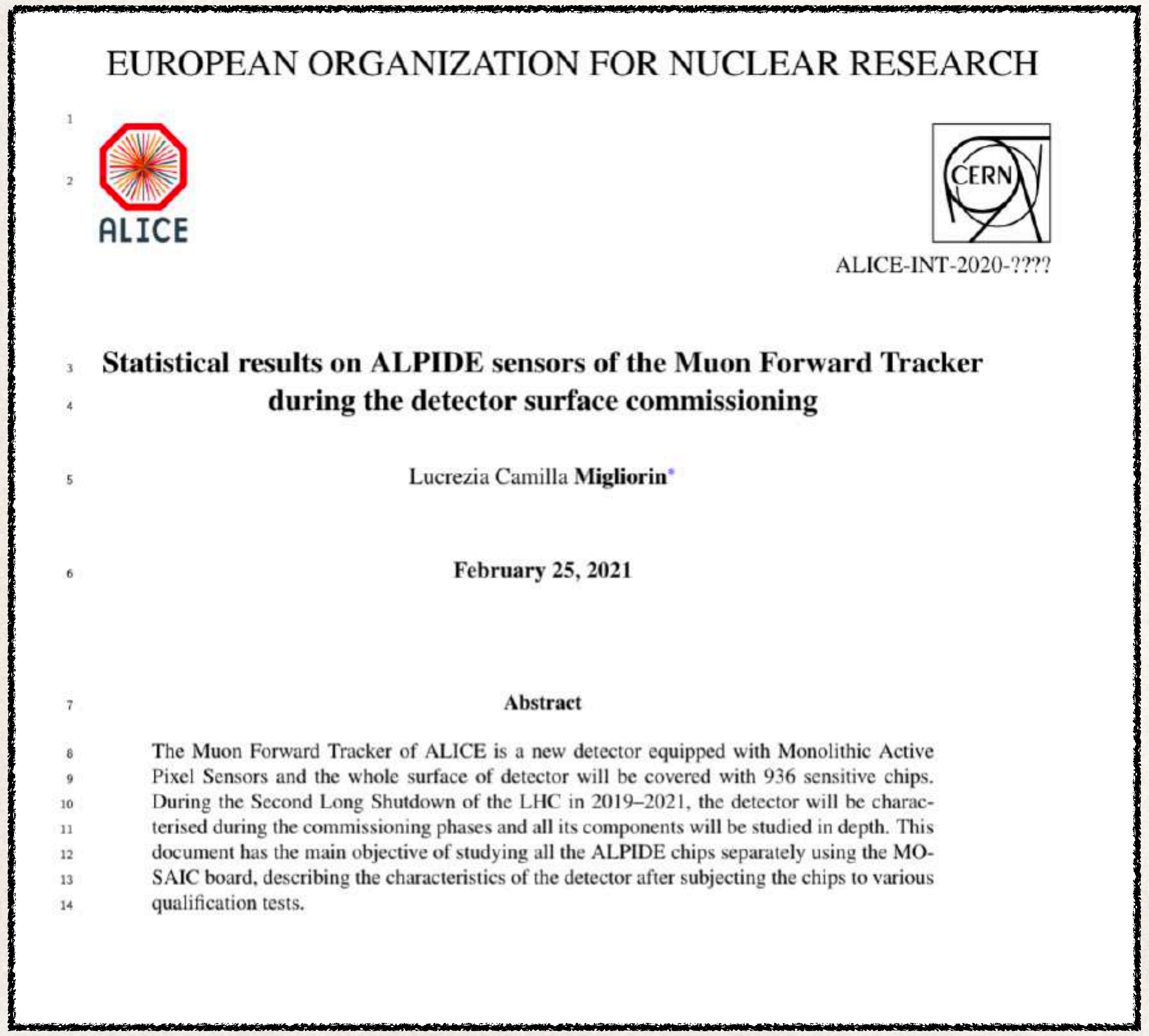
- Qualification work on disks and ladders; 💿🪜📝
- Simulation of the MFT detector with the calculation of the acceptance reduction due to defective sensors; ☰

MFT and its commissioning (3)

- Qualification work on disks and ladders; 💿🪜📝
- Simulation of the MFT detector with the calculation of the acceptance reduction due to defective sensors; ≣
- Development of code for readout and decoding of raw data; 🚫🔐

MFT and its commissioning (3)

- Qualification work on disks and ladders; 💿🪜📝
- Simulation of the MFT detector with the calculation of the acceptance reduction due to defective sensors; ☰
- Development of code for readout and decoding of raw data; 🚫🔐
- Writing of an internal note on the qualification of the records. ✍🏻📝



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

ALICE

CERN

ALICE-INT-2020-????

Statistical results on ALPIDE sensors of the Muon Forward Tracker during the detector surface commissioning

Lucrezia Camilla **Migliorin**[*]

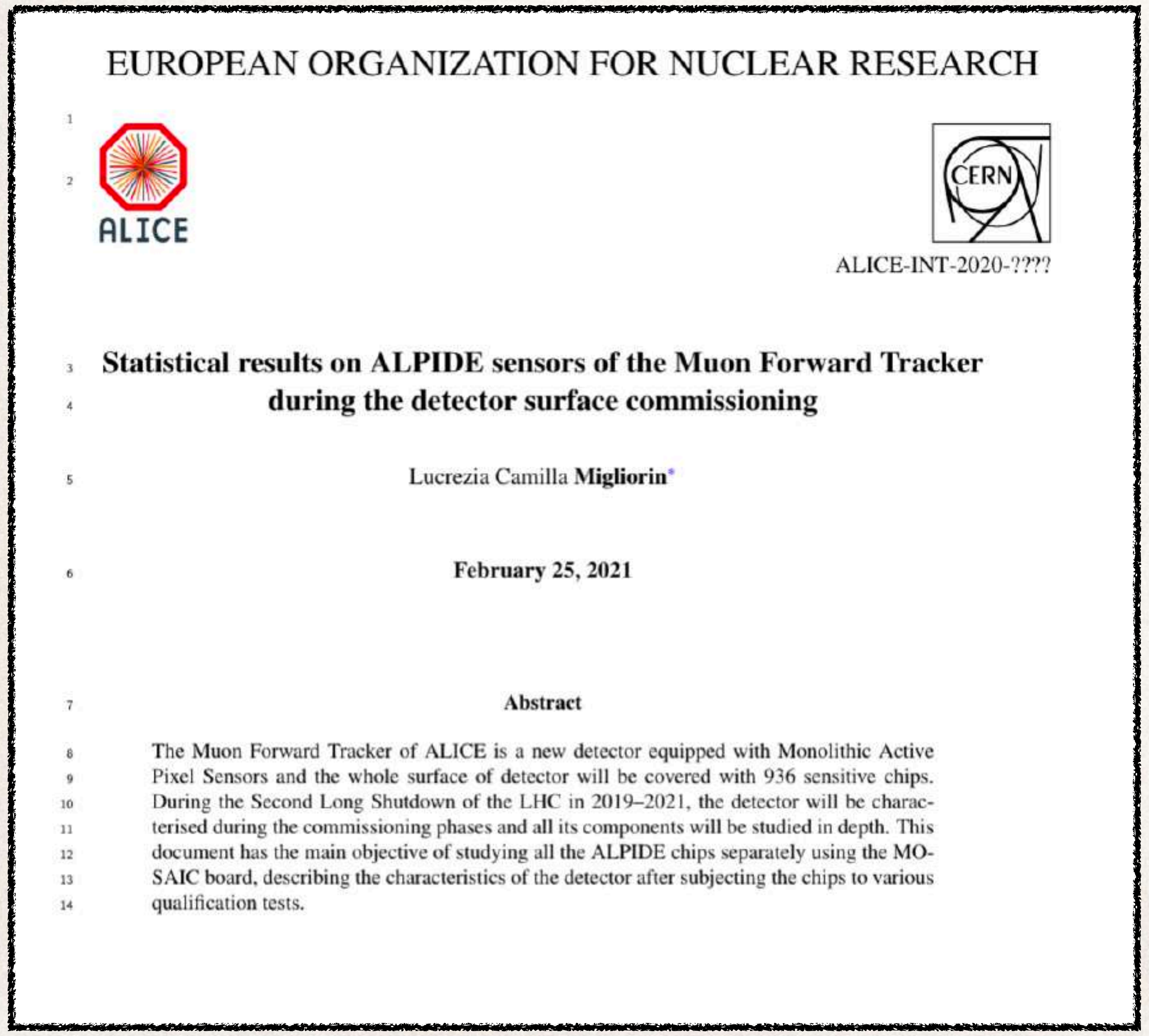
February 25, 2021

Abstract

The Muon Forward Tracker of ALICE is a new detector equipped with Monolithic Active Pixel Sensors and the whole surface of detector will be covered with 936 sensitive chips. During the Second Long Shutdown of the LHC in 2019–2021, the detector will be characterised during the commissioning phases and all its components will be studied in depth. This document has the main objective of studying all the ALPIDE chips separately using the MOSAIC board, describing the characteristics of the detector after subjecting the chips to various qualification tests.

MFT and its commissioning (3)

- Qualification work on disks and ladders; 💿🪜📝
- Simulation of the MFT detector with the calculation of the acceptance reduction due to defective sensors; ☰
- Development of code for readout and decoding of raw data; 🚫🔐
- Writing of an internal note on the qualification of the records. ✍🏻📝



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

ALICE-INT-2020-????

Statistical results on ALPIDE sensors of the Muon Forward Tracker during the detector surface commissioning

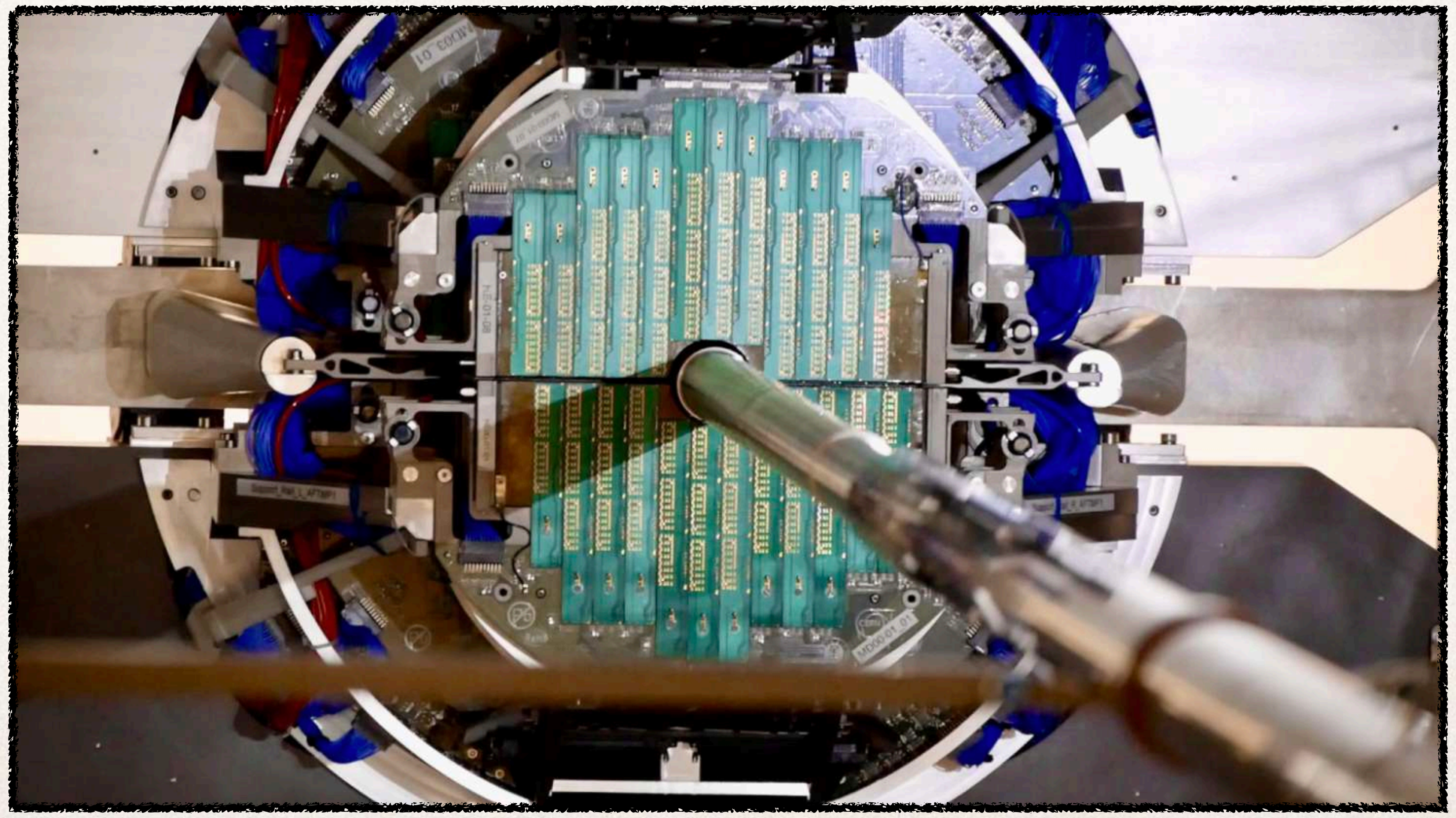
Lucrezia Camilla **Migliorin***

February 25, 2021

Abstract

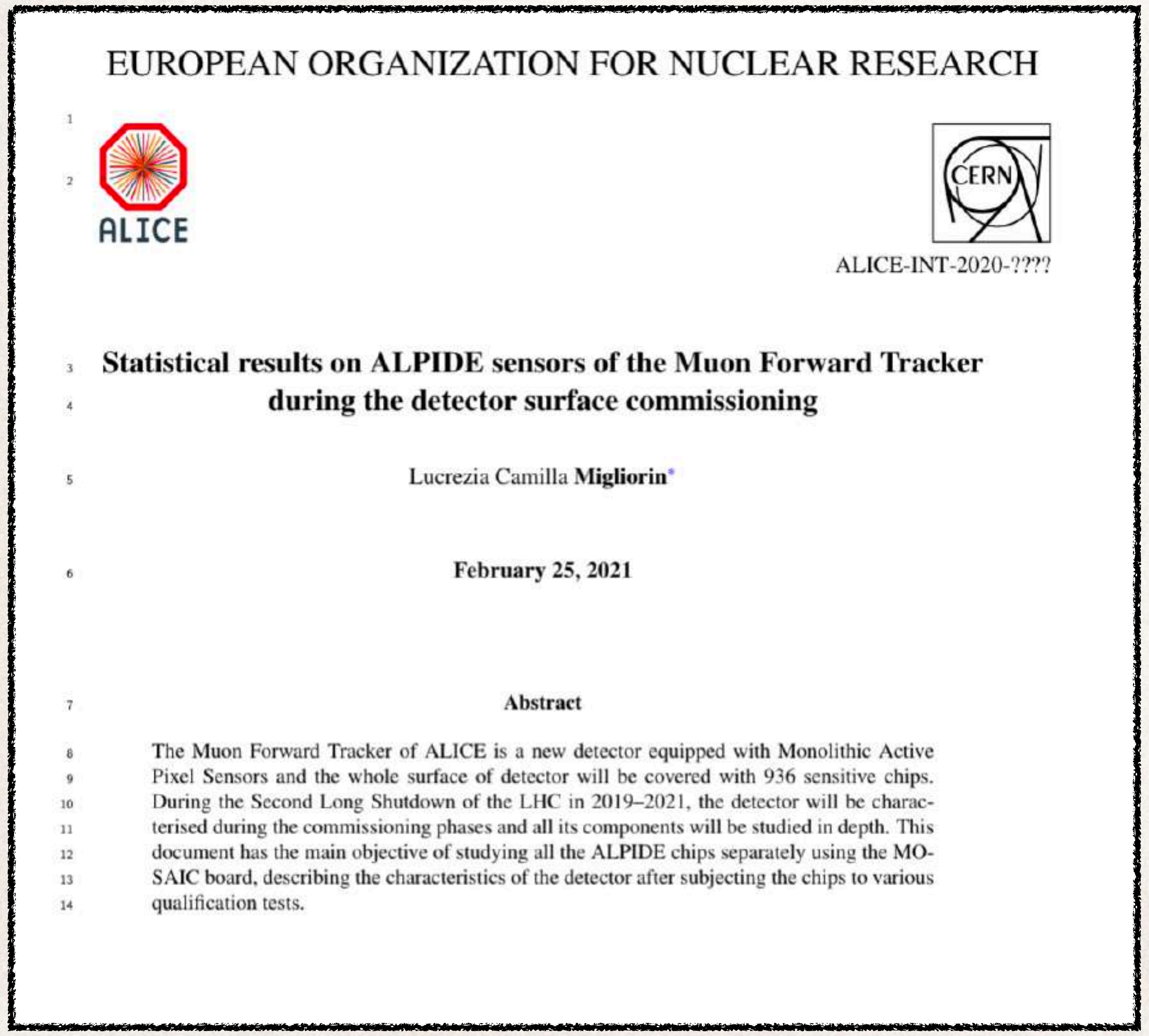
The Muon Forward Tracker of ALICE is a new detector equipped with Monolithic Active Pixel Sensors and the whole surface of detector will be covered with 936 sensitive chips. During the Second Long Shutdown of the LHC in 2019–2021, the detector will be characterised during the commissioning phases and all its components will be studied in depth. This document has the main objective of studying all the ALPIDE chips separately using the MOSAIC board, describing the characteristics of the detector after subjecting the chips to various qualification tests.

MFT is in ALICE Cavern (ALICE Website) !



MFT and its commissioning (3)

- Qualification work on disks and ladders; 💿🪜📝
- Simulation of the MFT detector with the calculation of the acceptance reduction due to defective sensors; ☰
- Development of code for readout and decoding of raw data; 🚫🔐
- Writing of an internal note on the qualification of the records. ✍🏻📝



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

ALICE-INT-2020-????

Statistical results on ALPIDE sensors of the Muon Forward Tracker during the detector surface commissioning

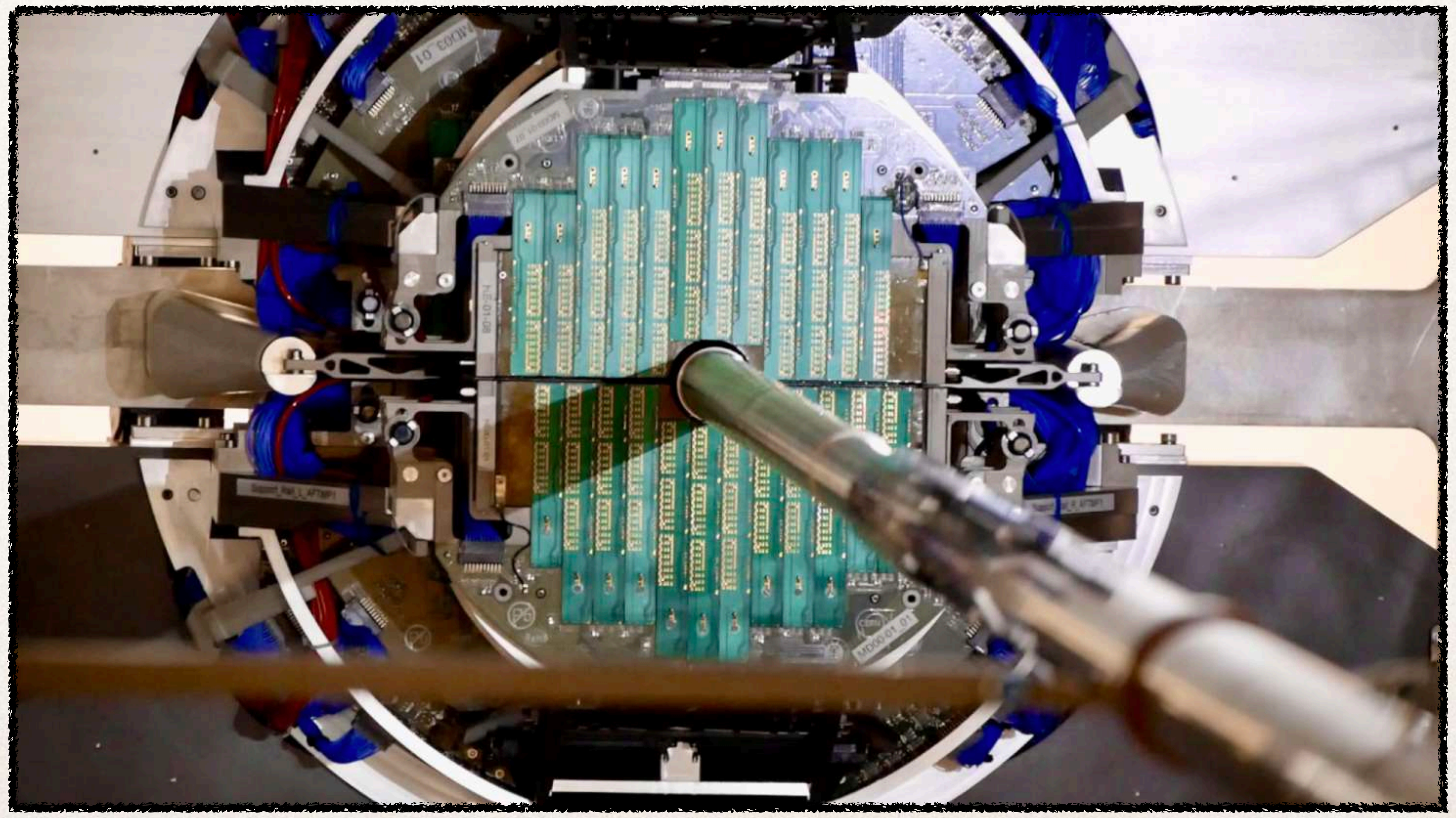
Lucrezia Camilla **Migliorin***

February 25, 2021

Abstract

The Muon Forward Tracker of ALICE is a new detector equipped with Monolithic Active Pixel Sensors and the whole surface of detector will be covered with 936 sensitive chips. During the Second Long Shutdown of the LHC in 2019–2021, the detector will be characterised during the commissioning phases and all its components will be studied in depth. This document has the main objective of studying all the ALPIDE chips separately using the MOSAIC board, describing the characteristics of the detector after subjecting the chips to various qualification tests.

MFT is in ALICE Cavern (ALICE Website) !



KEEP ALEEEERT!

THANKS FOR YOUR ATTENTION

THANKS FOR YOUR ATTENTION

ANY QUESTIONS?

Bjorken-x scale

In a typical deep inelastic scattering experiment the hadron state is left unidentified and only the scattered lepton momentum is measured.

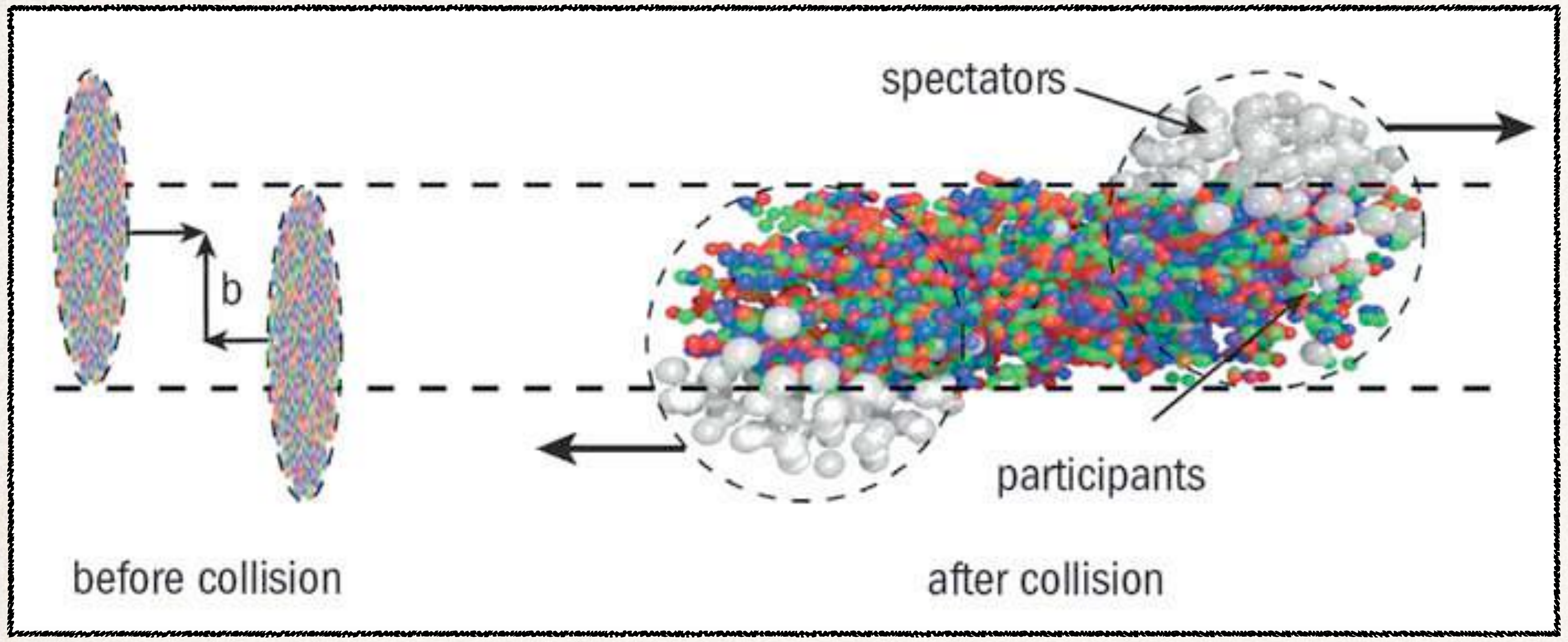
The electron interacts with the proton through the exchange of a highly virtual photon, which kicks out one of the proton's constituents, thus breaking the proton and probing its structure. In pre-QCD language, these are collectively called "partons", commonly known as quarks and gluons.

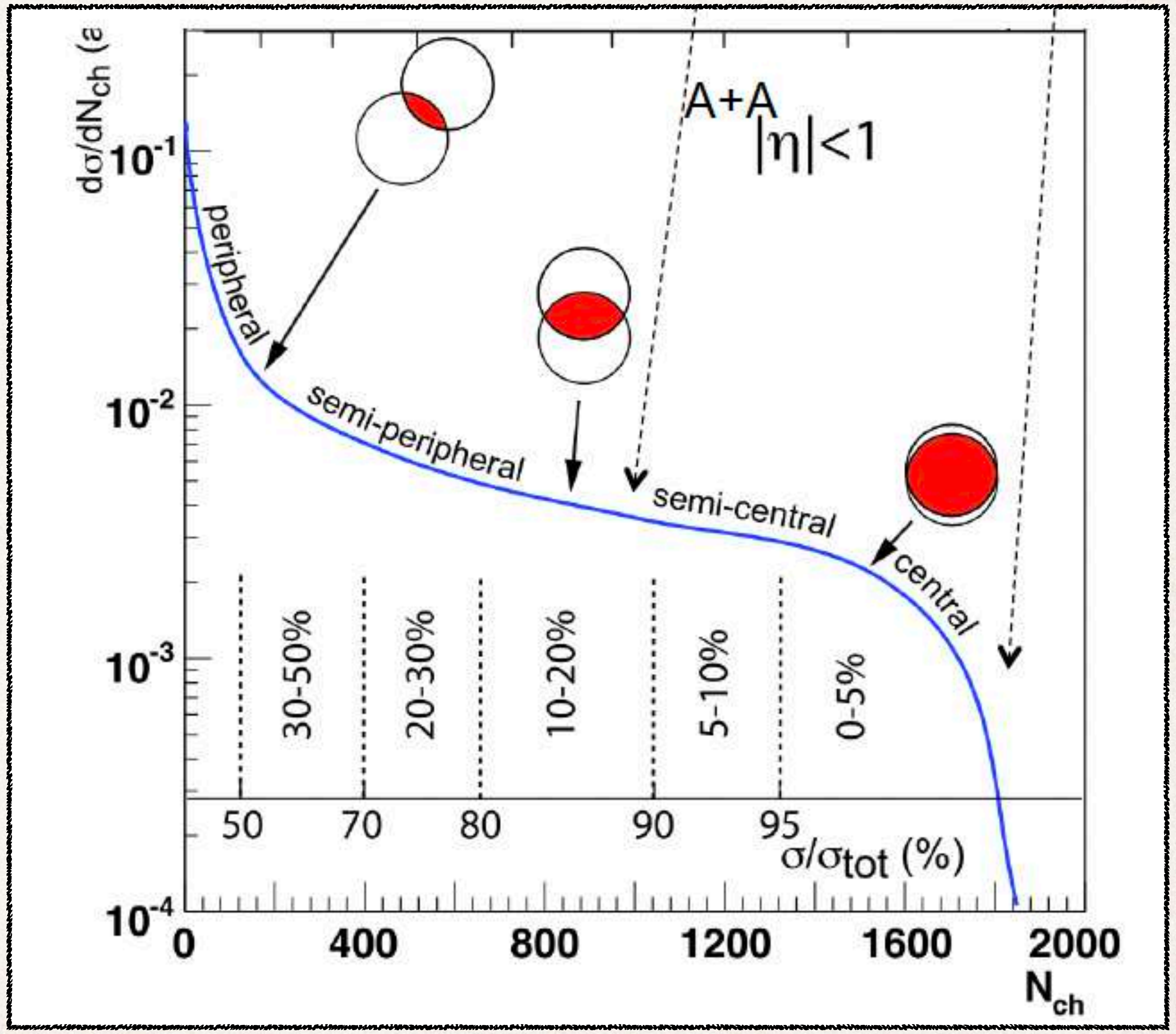
Bjorken's scale variables are dimensionless kinematic variables, between 0 and 1, defined within the particle's scattering framework, firstly introduced by James Bjorken. Conventionally, there's only one variable, nevertheless, it's usual to see a second one associated with it:

$x = \frac{Q^2}{2p\,.\,q}$ **This is the original Bjorken variable.** Within the framework of the parton model and under certain assumptions, the value of this variable represents the fraction of the nucleon's pulse carried by the part of the nucleon ("parton") which interacts with the photon. For an elastic collision, x is equal to 1.

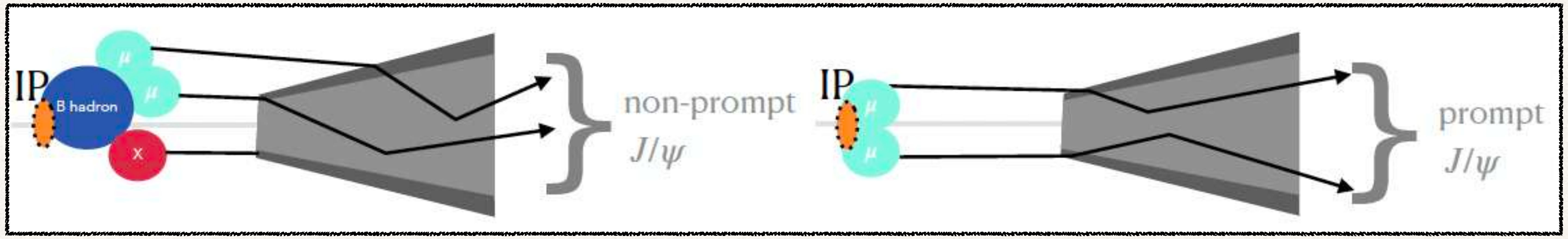
$y = \frac{p\,.\,q}{p\,.\,k}$ This unnamed variable is often associated with the original Bjorken variable. It represents the fraction of energy lost by the lepton (or the "inelasticity" of the event).

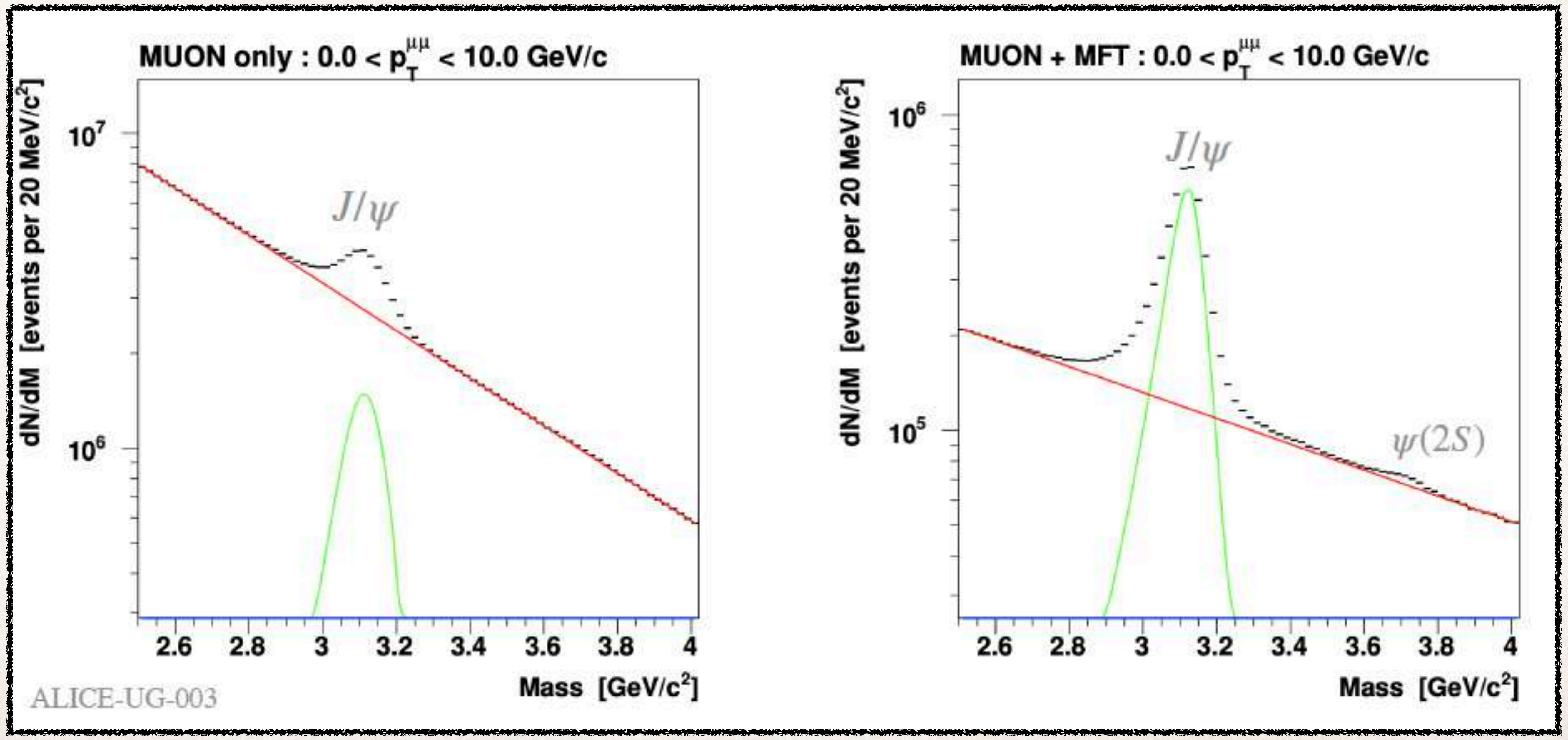
Centrality


spectators
b
participants
before collision
after collision


dσ/dNch
A+A
|η|<1
peripheral
semi-peripheral
semi-central
central
30-50%
20-30%
10-20%
5-10%
0-5%
50
70
80
90
95
σ/σtot (%)
10-1
10-2
10-3
10-4
0
400
800
1200
1600
2000
Nch

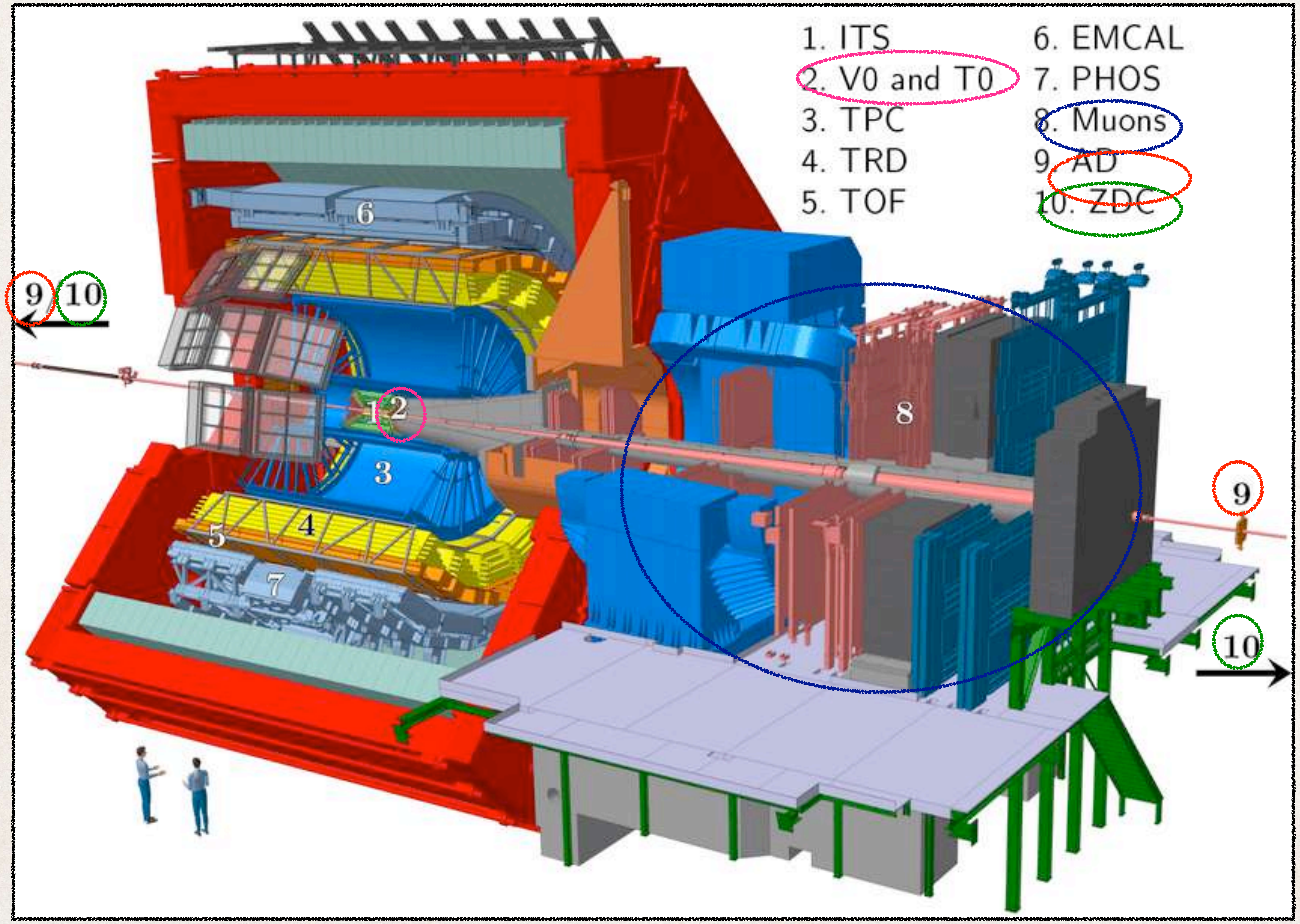
Prompt and not-prompt J/ψ

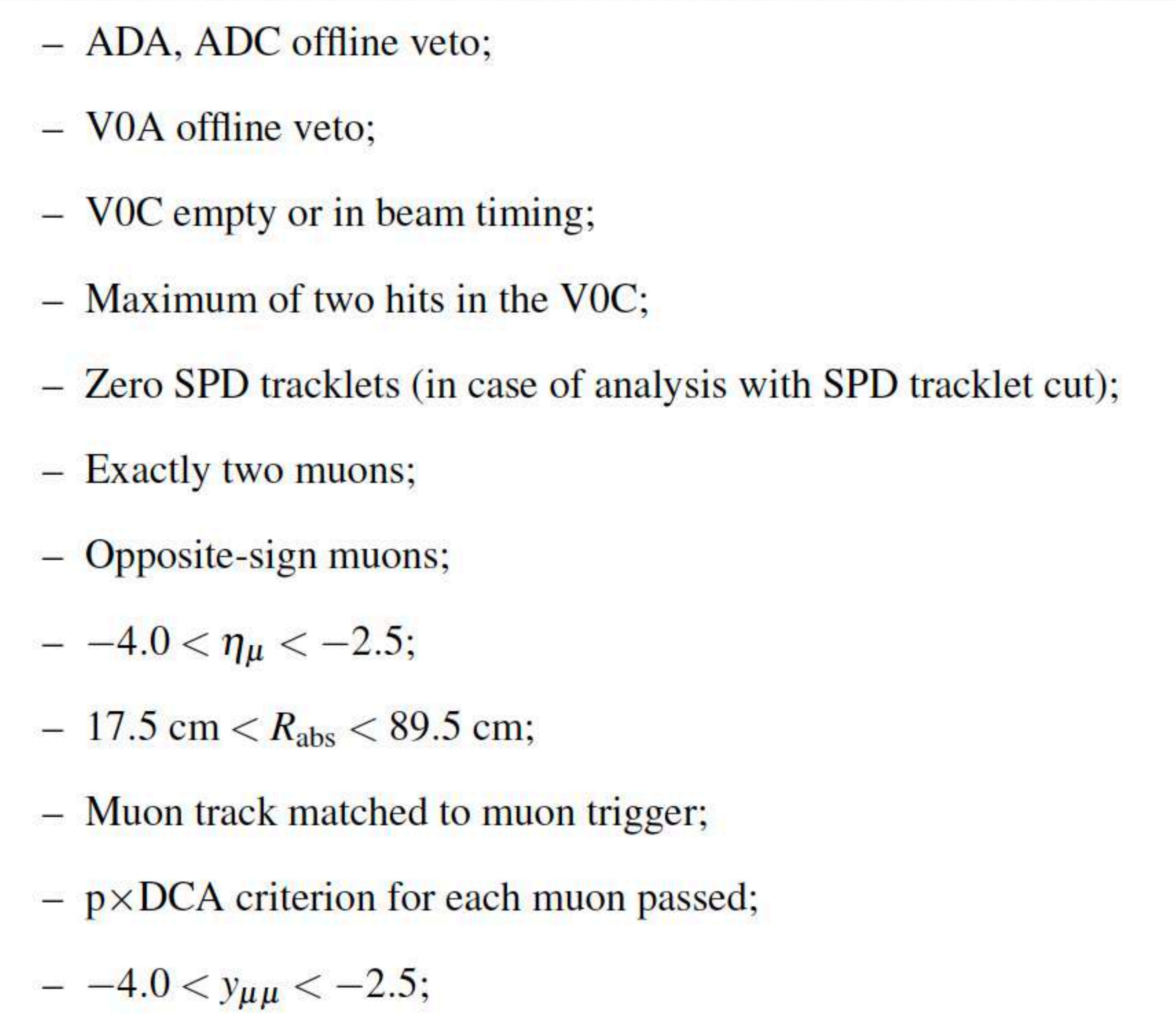




ALICE-UG-003

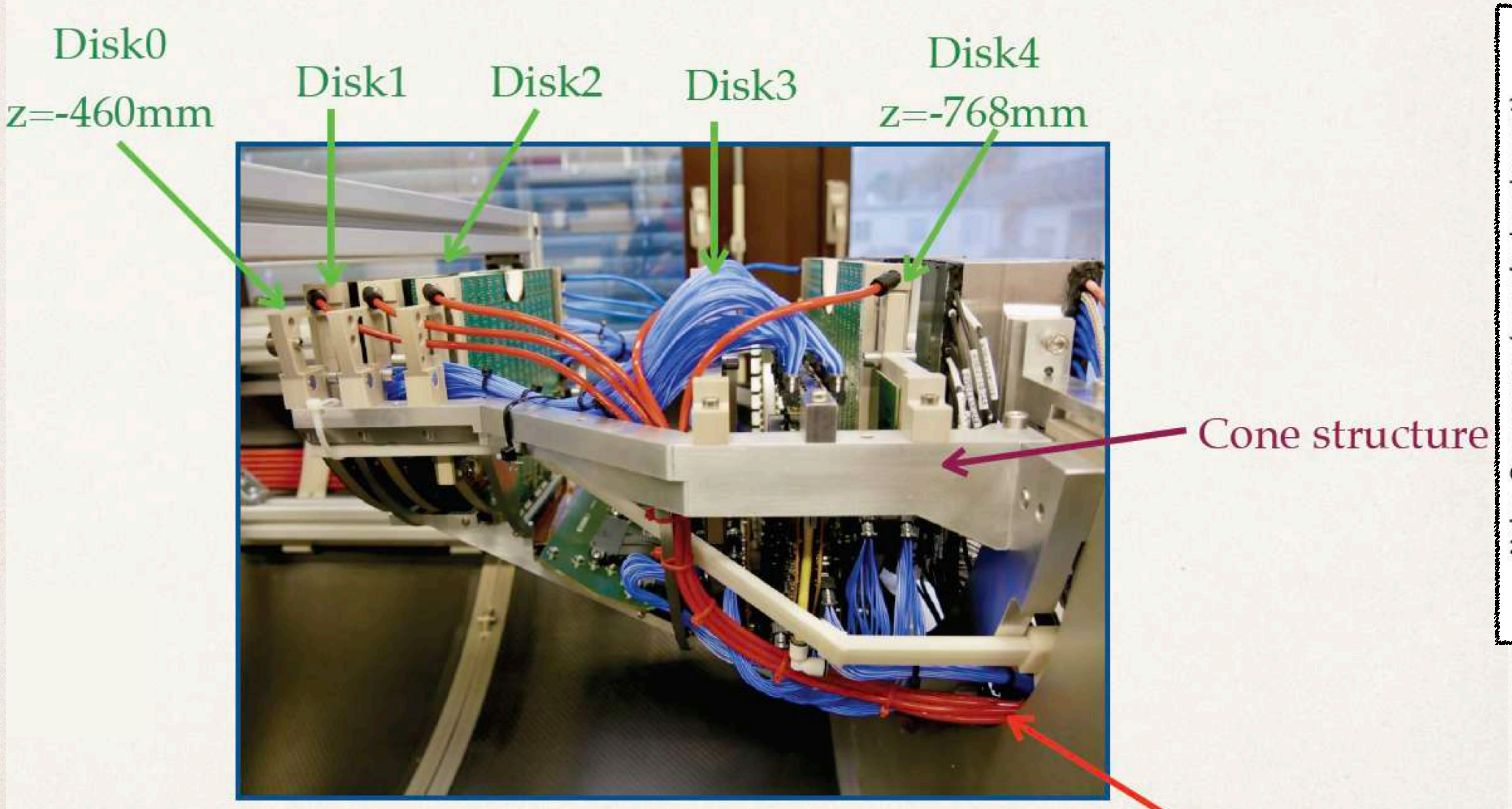
Detectors used for UPC



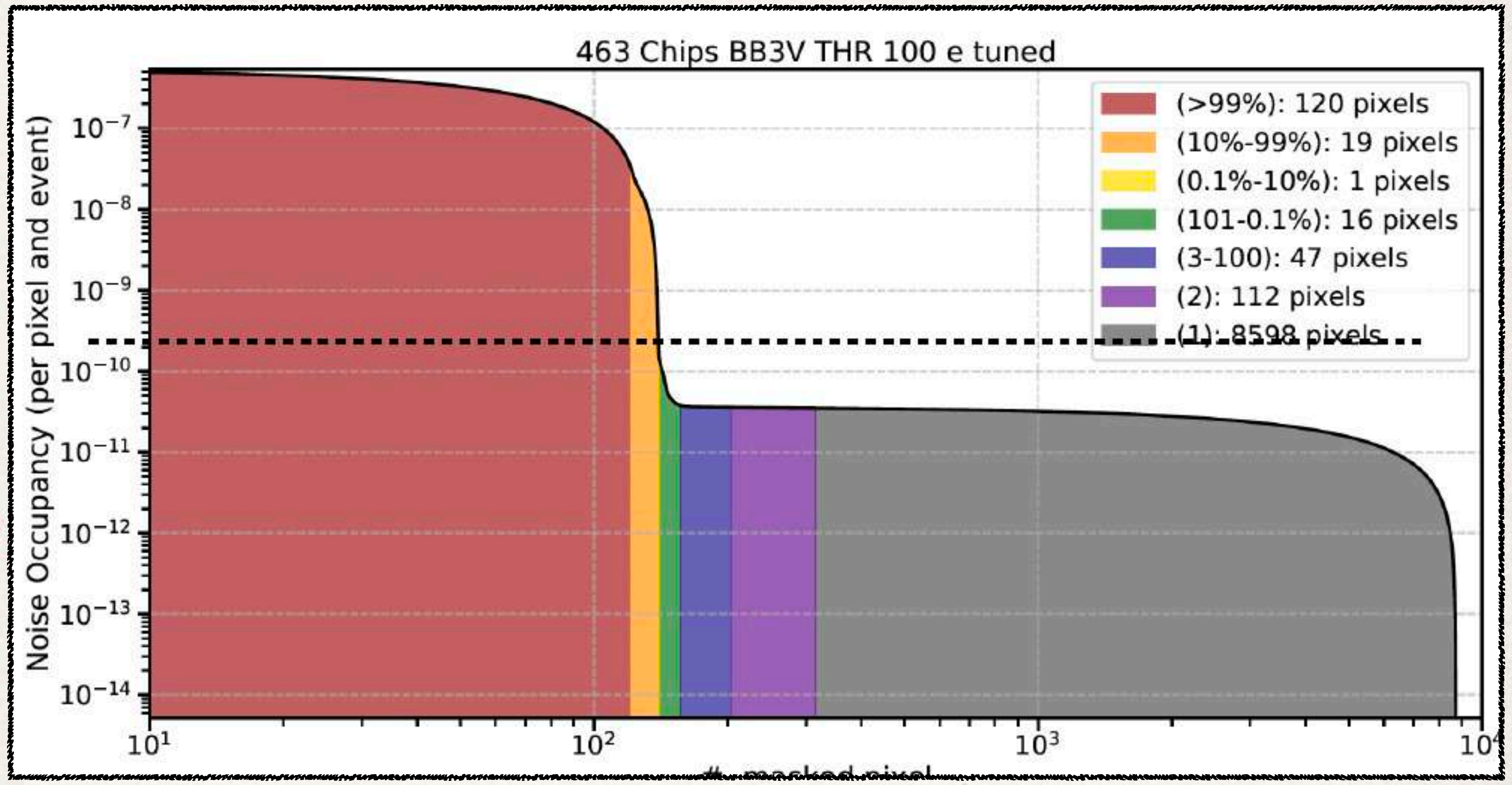


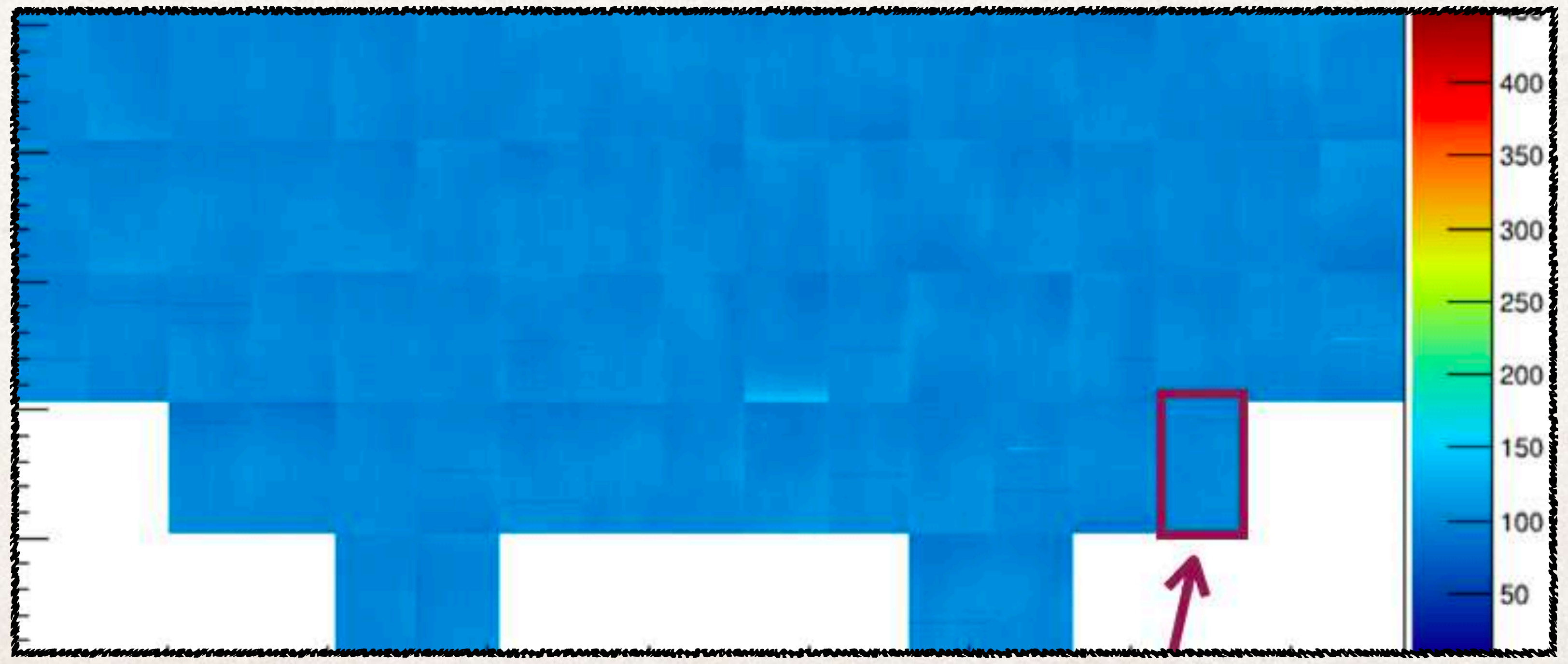
- ADA, ADC offline veto;
- V0A offline veto;
- V0C empty or in beam timing;
- Maximum of two hits in the V0C;
- Zero SPD tracklets (in case of analysis with SPD tracklet cut);
- Exactly two muons;
- Opposite-sign muons;
- $-4.0 < \eta_\mu < -2.5$;
- 17.5 cm $< R_{\mathrm{abs}} < 89.5$ cm;
- Muon track matched to muon trigger;
- p×DCA criterion for each muon passed;
- $-4.0 < y_{\mu\mu} < -2.5$;

MFT half-cone and commissioning

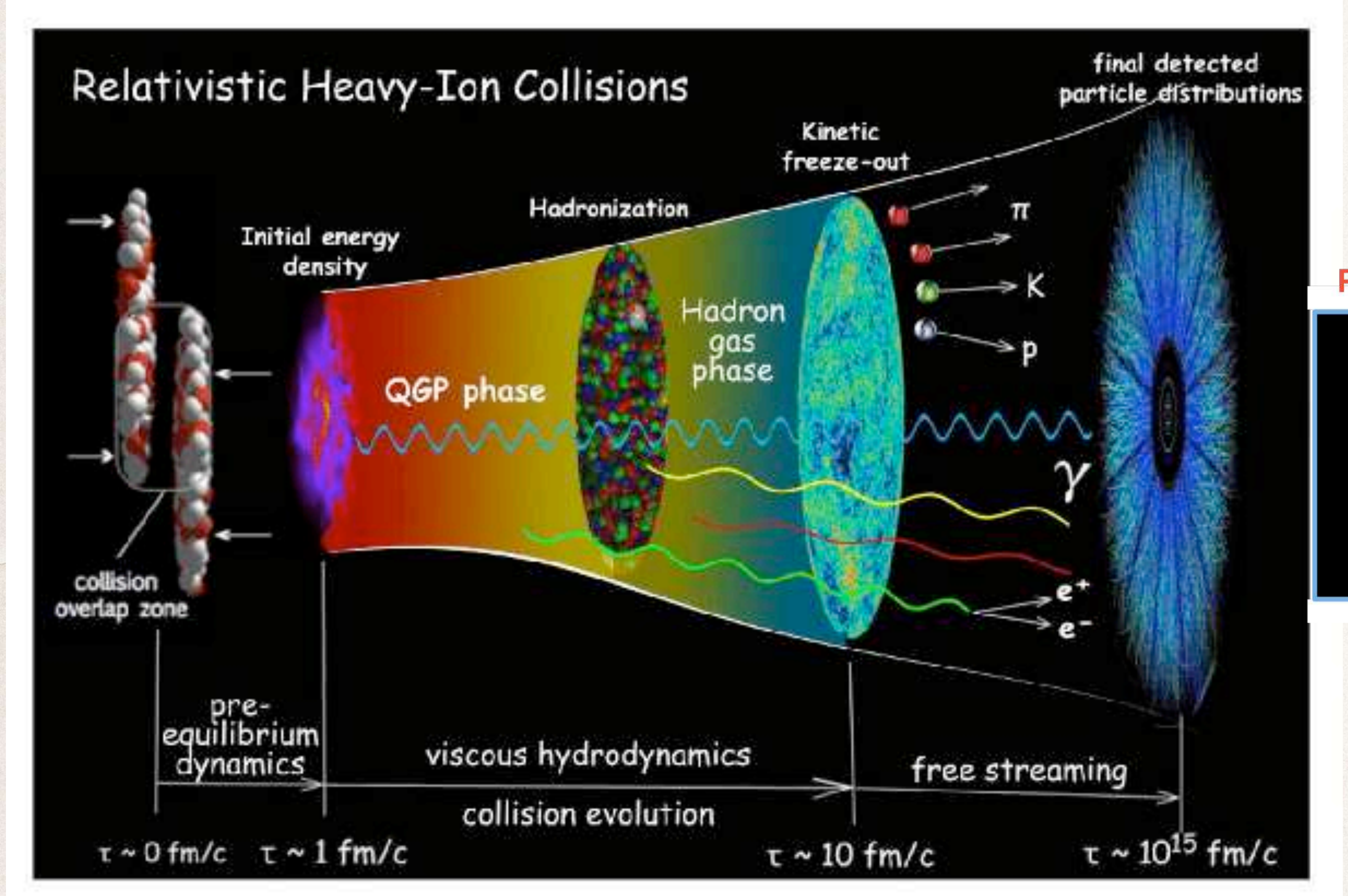


- 3.6 < η < - 2.5



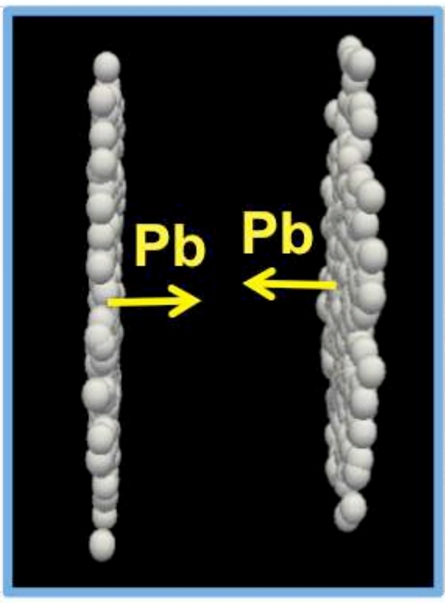


Evolution heavy-ions collision

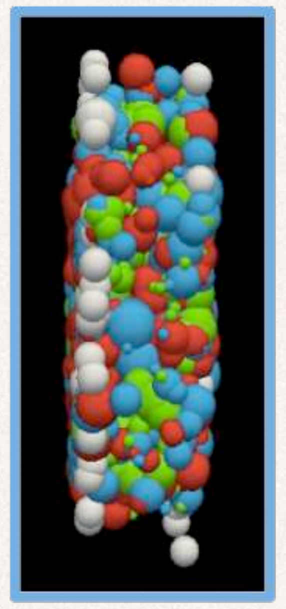


time

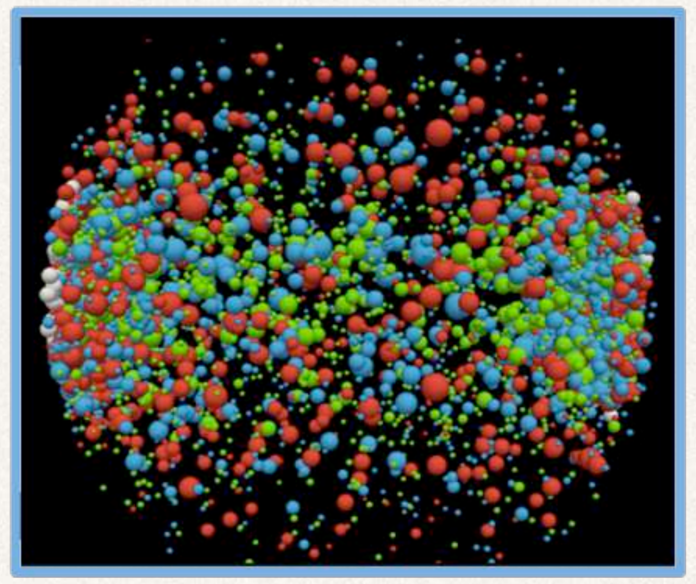
Pre-reaction



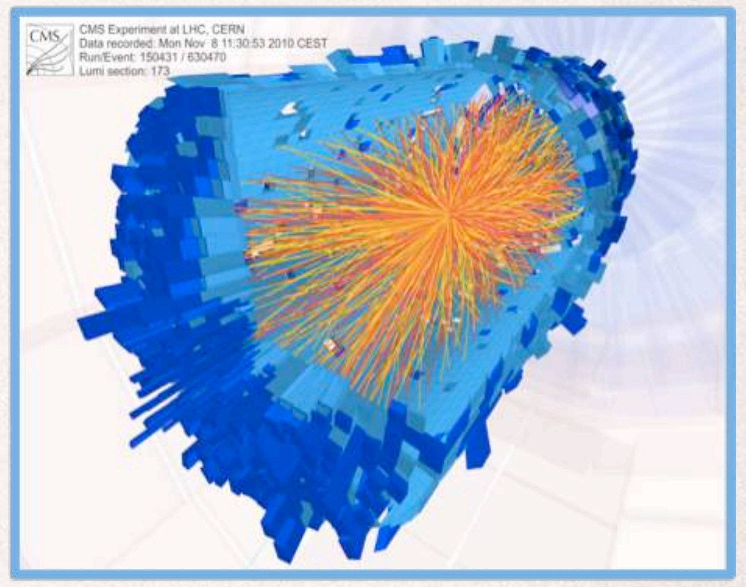
QGP



Hadronization



Detection



Deconfined matter