First pPb Run at LHC and Data Taking by CMS

KiSoo LEE*

(Korea University, for the CMS collaboration)

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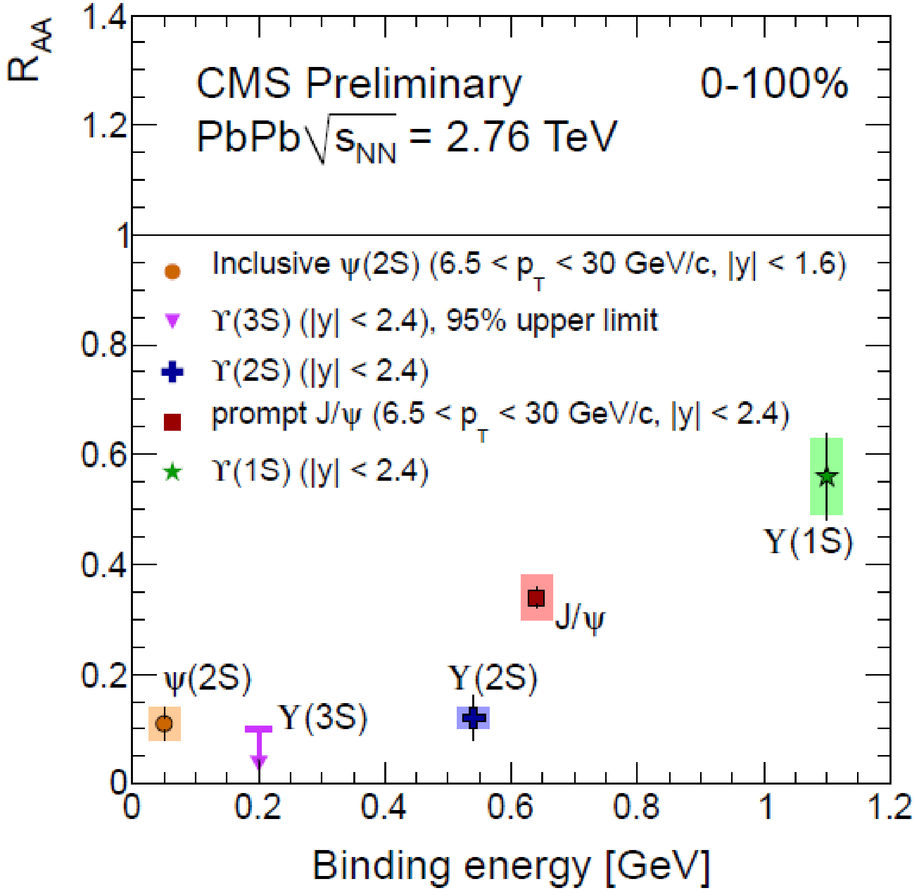
Why do pPb collisions?



- $R_{AA} = \frac{1}{\langle N_{coll} \rangle} \frac{d^2N_{AA}/dp_T d\eta}{d^2N_{pp}/dp_T d\eta}$
- $R_{AA} < 1$: suppression
- $R_{AA} = 1$: No difference with pp
- $R_{AA} > 1$: Enhancement

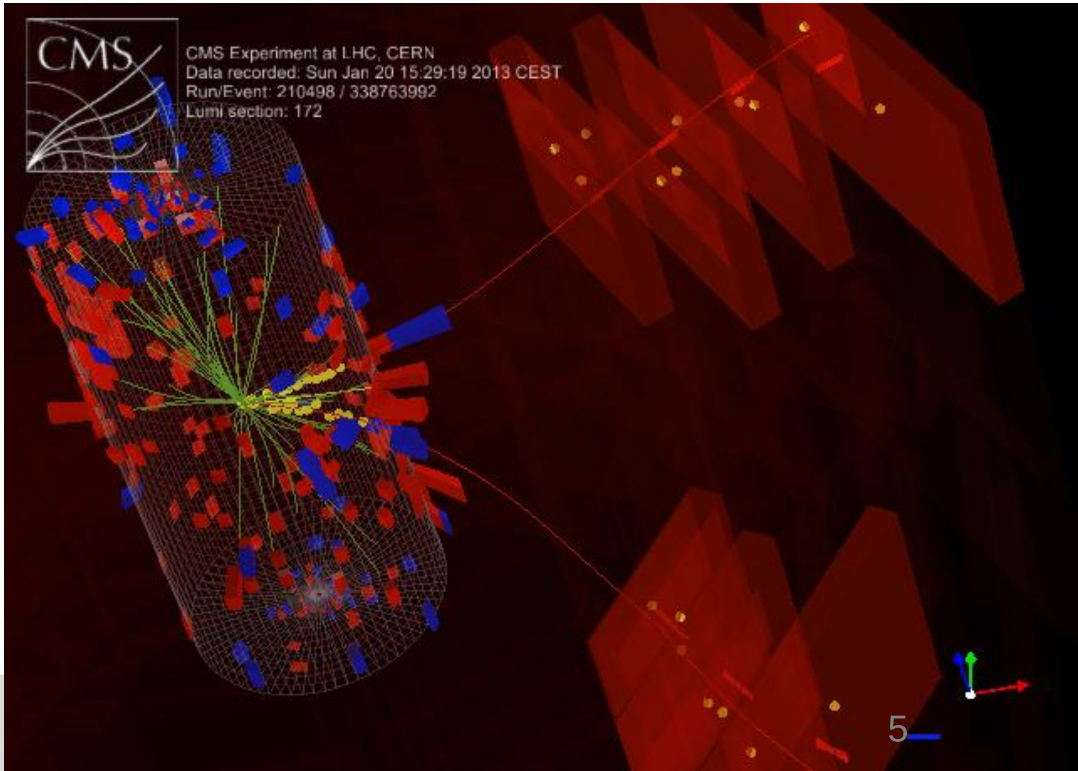
- Expect matter effects after the collisions of heavy-ion
- But suppression also can be coming from the initial effects(Cold Nuclear Matter(CNM))

Why do pPb collisions?

- We expect that collision of p and heavy ion don't create the hot & dense matter
- Through the pPb collisions, we would like to study the initial effects of the collisions
- Representative Initial effects
  - Modified parton distribution in nuclei
  - Initial state parton energy loss
  - Cronin effect
  - Comover beakup

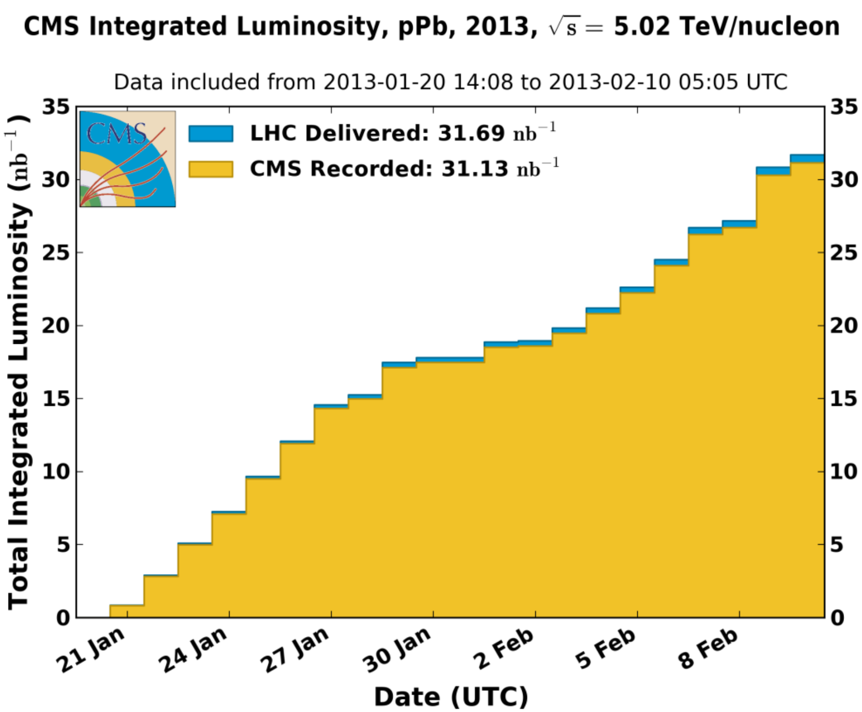
Information of 2013 pPb, pp collision

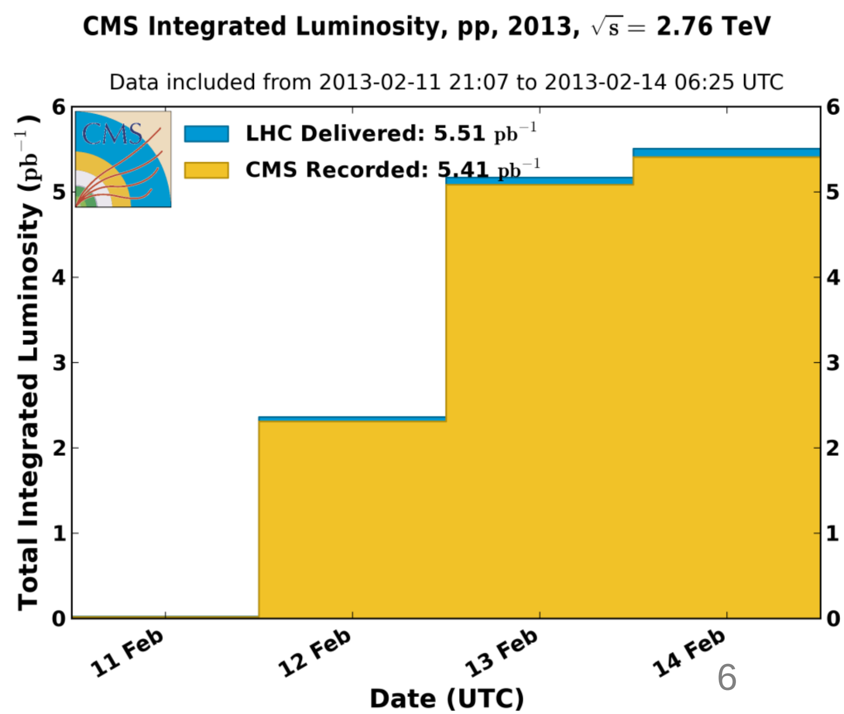
- pPb pilot: 2012 Sep.13th
- pPb collision: 2013 Jan.20th~Feb.10th
- 4 TeV p-equivalent
- $\sqrt{S_{NN}} = 2\sqrt{E_{\mathrm{p}}E_{\mathrm{Pb}}} = 2\sqrt{(4.0\ \mathrm{TeV})(1.58\ \mathrm{TeV})} = 5.02\ \mathrm{TeV}$
- Additional 2.76 TeV pp data collected: 2013 Feb.12th~Feb.14th



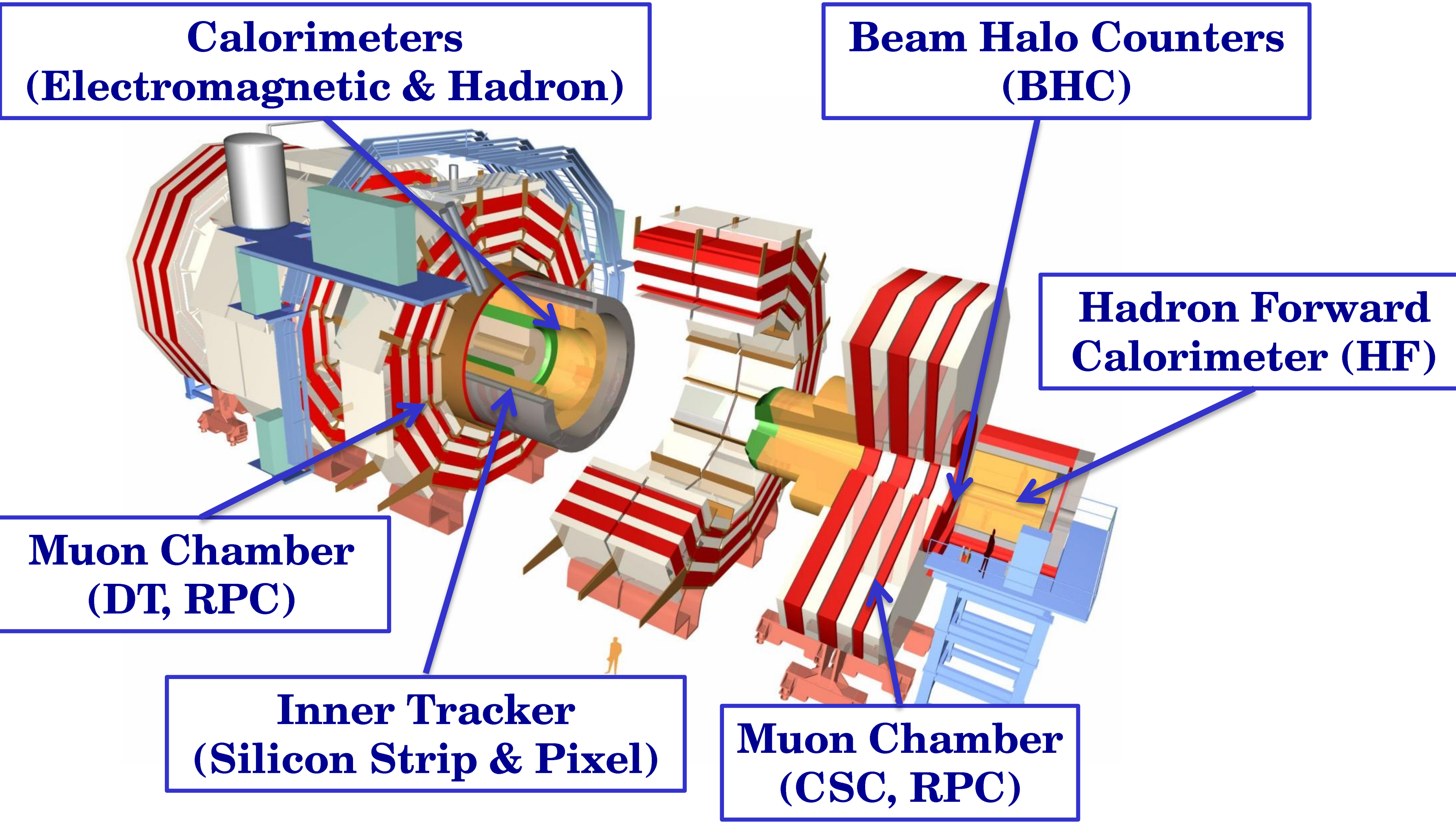
Information of 2013 pPb, pp collision

- Max.colliding bunches for pPb: 296 bunches
- Total recorded luminosity of pPb collisions: 31.13 nb^{-1}
- Max.colliding bunches for pp: 1278 bunches
- Total recorded luminosity of pp collisions: 5.41 pb^{-1}





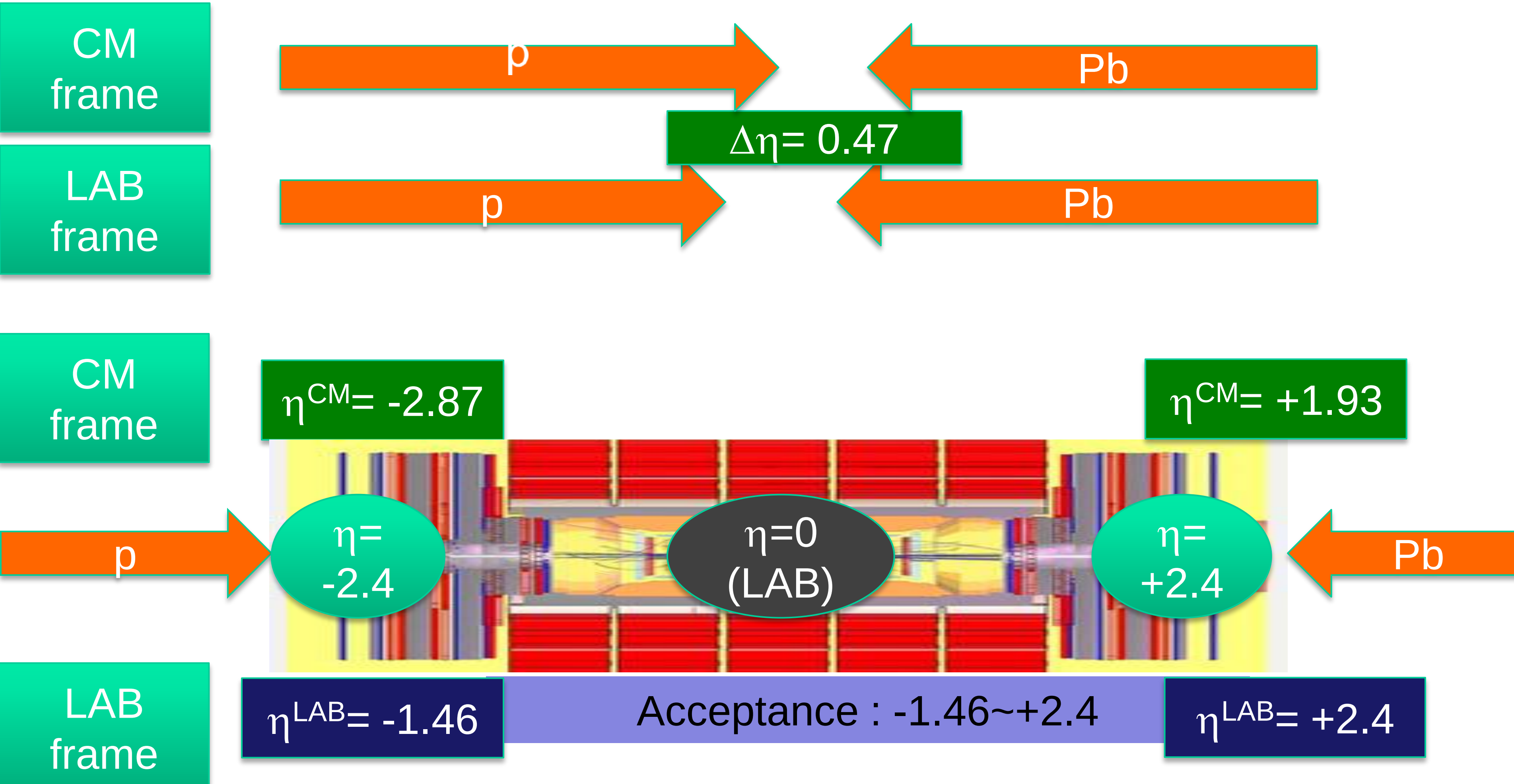
CMS detector configuration



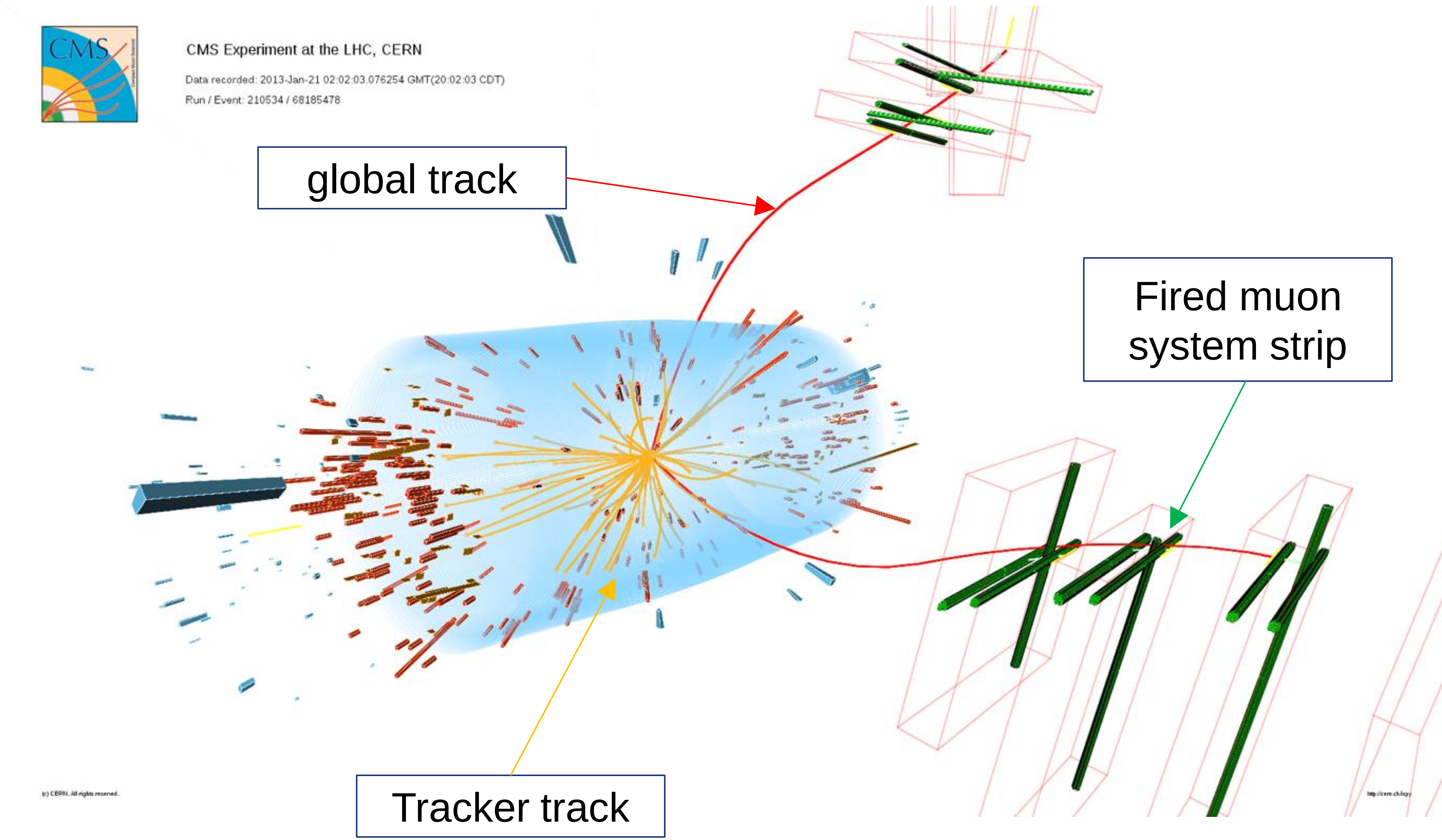
Configuration is same as pp collision

pPb geometrical acceptance

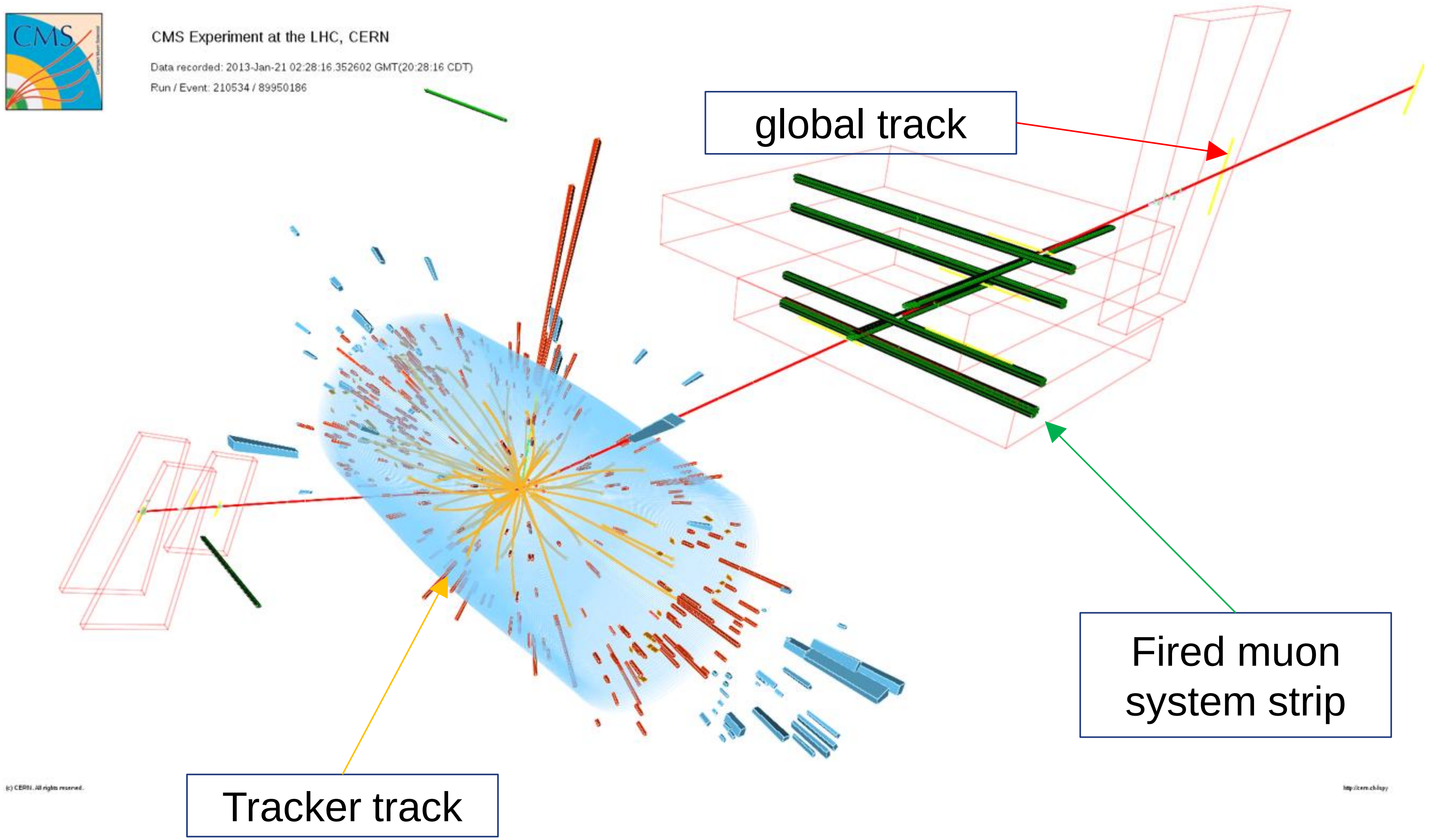
Because of the particles' boost, geometrical acceptance shifted



Y(1s) candidate



Z candidate

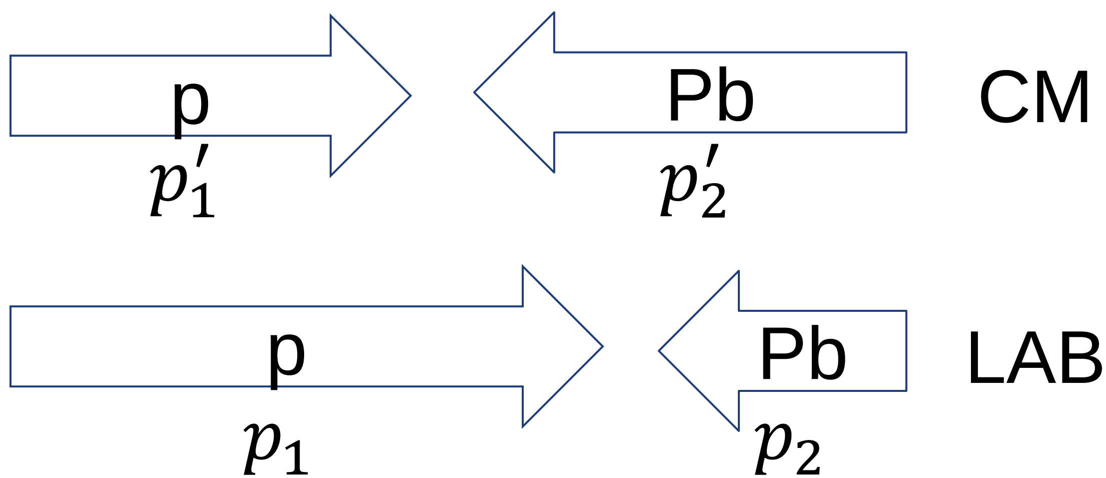

CMS
CMS Experiment at the LHC, CERN
Data recorded: 2013-Jan-21 02:28:16.352602 GMT(20:28:16 CDT)
Run / Event: 210534 / 89950186
global track
Fired muon system strip
Tracker track

Summary

- During 2013 pPb run period at the LHC, CMS received the data
- CMS collected data from 2.76 TeV pp collisions for the reference of PbPb and pPb data
- Applying the trigger and detector configuration, we collected the high quality collision data and stored at several Tier centers.
- Analysis with 2013 data is now on going

Backup

- Boost
- $p'_1 + p'_2 = 0, \frac{\overrightarrow{p_1}}{\overrightarrow{p_2}} = -\frac{A}{Z}$
- $p'_1 = \gamma(p_1 - \beta E_1), p'_2 = \gamma(p_2 - \beta E_2)$
- $p_1 \approx E_1, p_2 \approx E_2 \rightarrow \frac{A}{Z} = \frac{1-\beta}{1+\beta}$
- $\beta = \frac{A-Z}{A+Z} \approx 0.434$



Initial state energy loss

- Projectile partons interacts with target partons prior to hard scattering
- Results in the rapidity shift and suppression at forward rapidity

Cronin effect

- Multiple elastic scattering of incoming parton before hard collisions
- Broadening of the p_T spectra

Comover breakup

- Right after creation of particle the particle can interact with matter.
- This makes suppression not from hot & dense matter but heavy ion matter

Modified parton distribution in nuclei

- Gluon saturation
- Gluons in nuclei
- Parton distributions between p & A are different
- This distribution makes different result with pp collision