Magnet Stations for LHCb

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TTFU meeting, Elba, May 30, 2017

Outline

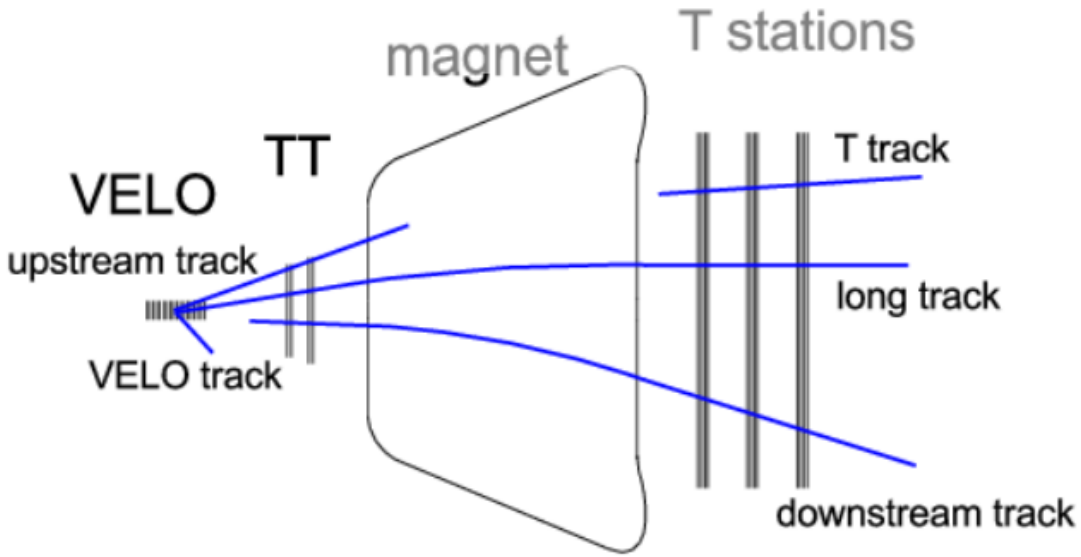
⇛ Introduction

⇛ We will review the effect of an improved tracking for specific channels:

- Prompt Charm decays
- $R(\Lambda_c^*)$
- $R(D^*)$
- Multibody B decays
- Σ_b.
- B^*.
- Gluon PDF.
- Spectroscopy.
- More stuff added during this workshop.

⇛ Outlook

The idea



⇛ Tracks with hits in the vertex locator and the TT/UT and not in the Tstations: UPSTREAM tracks.

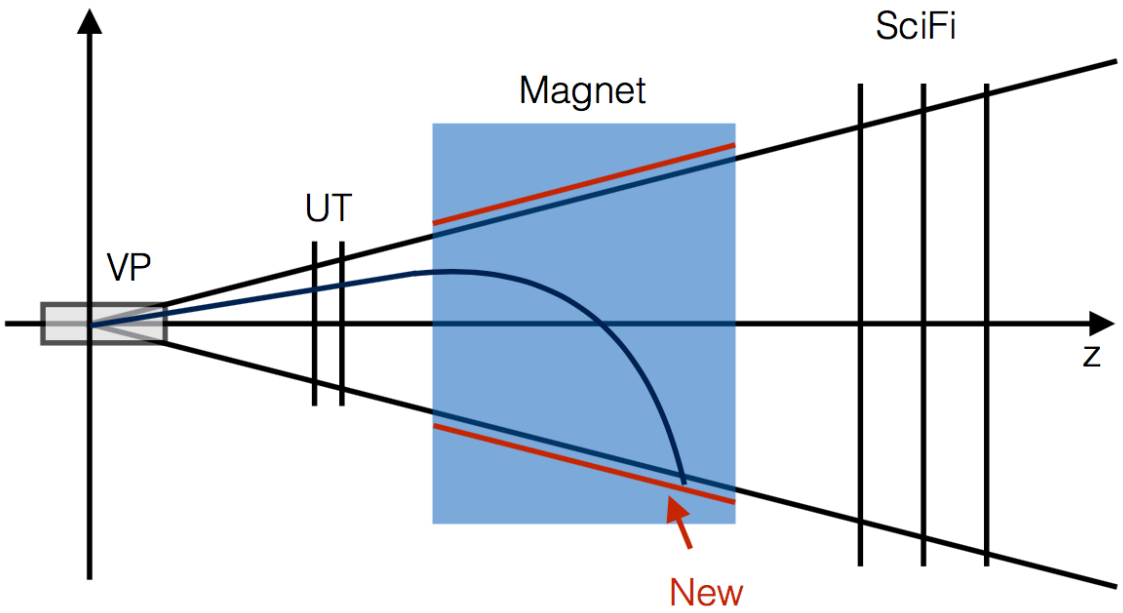
⇛ Those are bend outside of the T-stations acceptance by the magnetic field because of their low-momentum.

⇛ The reduced amount of field between the VELO and the TT, means that their momentum is computed with a large uncertainty.

$\Delta p/p = 20 - 25\%$ current, $\Delta p/p = 15 - 20\%$ upgrade

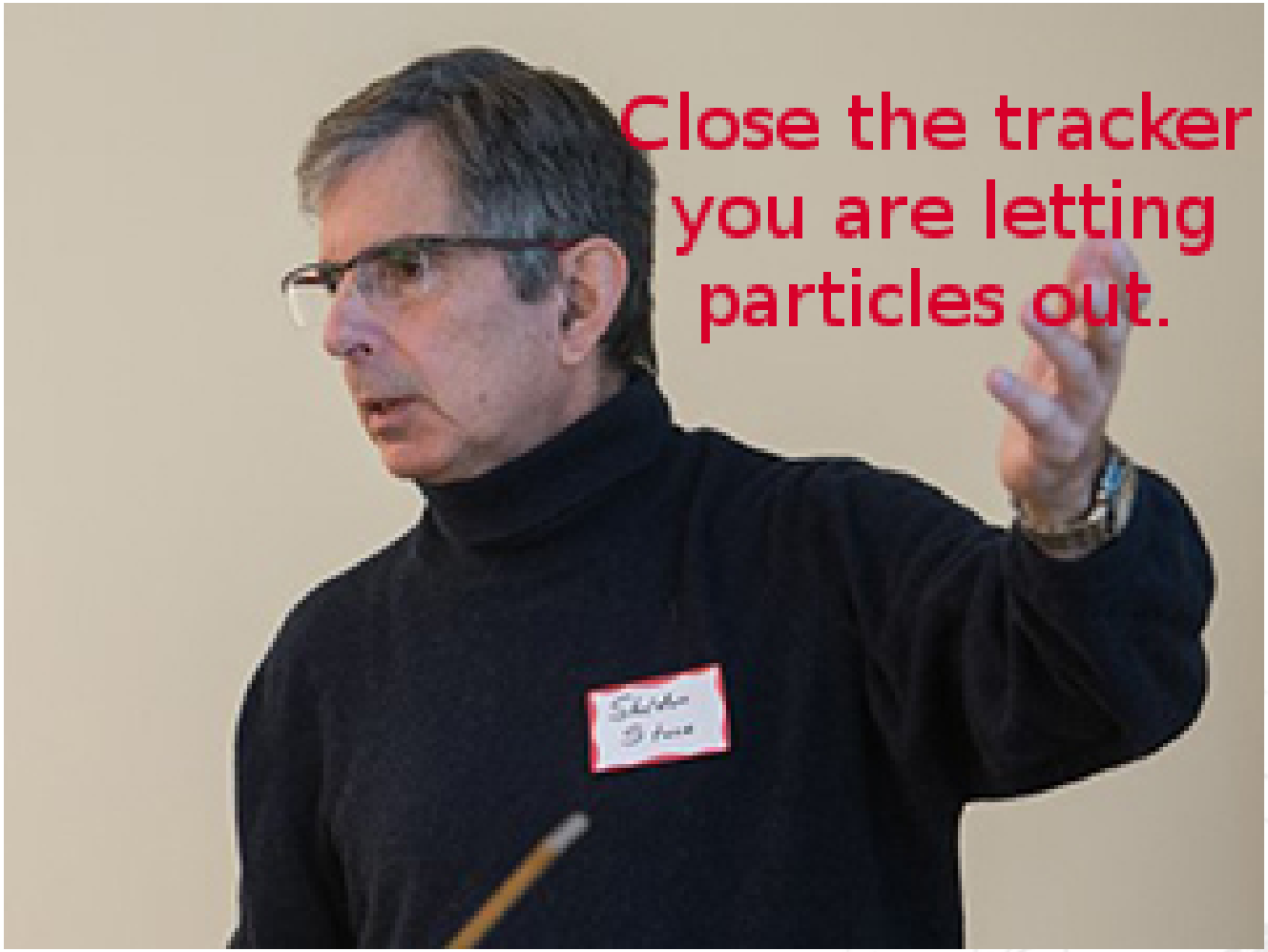
Proposal

⇛ Original idea comes from Sheldon Stone, Paolo Gandini, Liming Zhang: [Tuesday meeting Sept 2nd 2014]



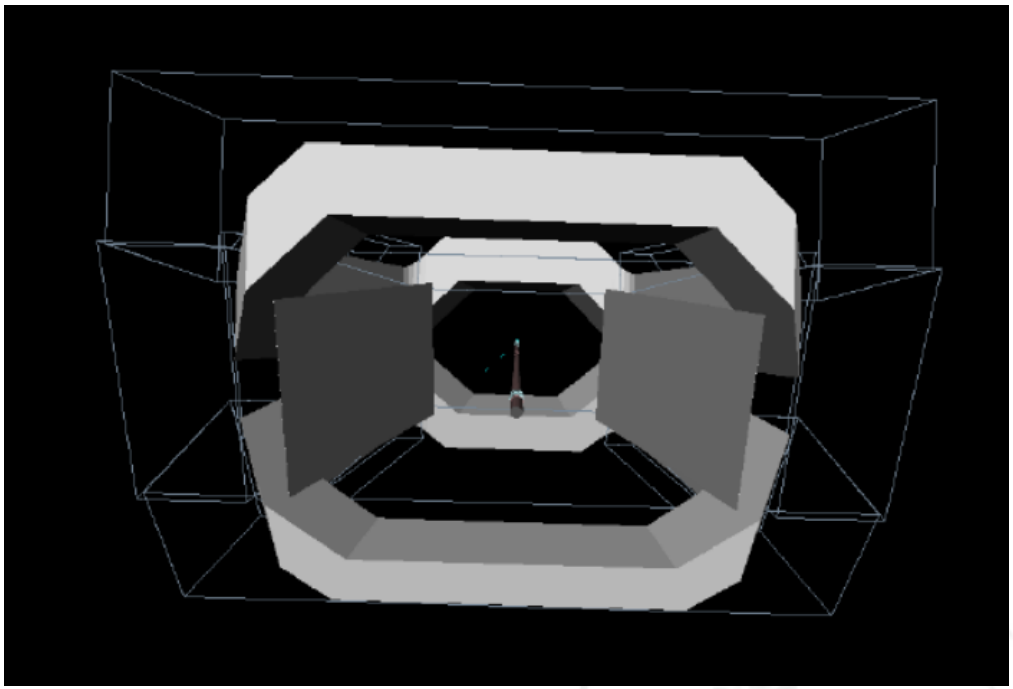
⇛ It is outside the LHCb acceptancen!! No X_0 added.
⇛ No need to have a high resolution. $\mathcal{O}(1\mathrm{mm})$ should be enough.
⇛ See Maurizio slides for details.

Proposal



The study

⇛ Take the Gauss `v50r0` for upgrade.
⇛ Simulate the particle gun.
⇛ Decays particles with `EvtGen`.
⇛ Put for now a plates in the Magnet (and beyond) and see where the particles hit them.
⇛ $\nu = 7.6$.



Prompt charm decays

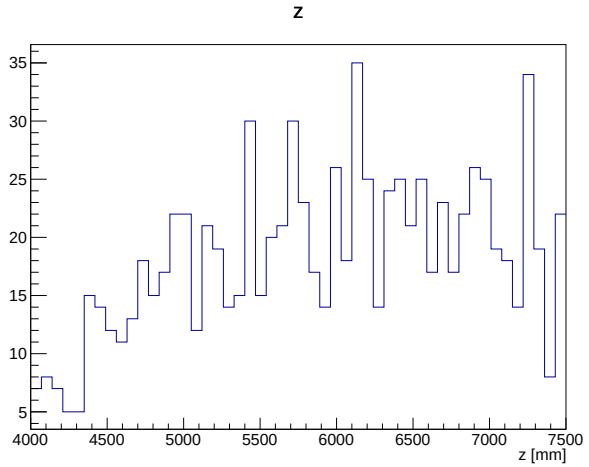
⇛ Study the prompt production: $D^* \longrightarrow D(\pi K)\pi_{\text{slow}}$.

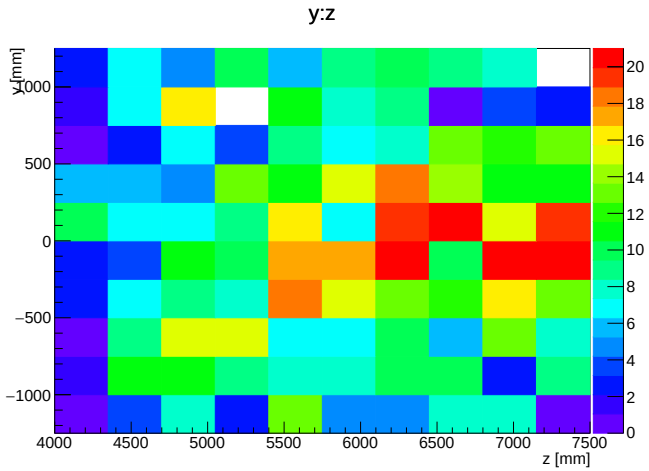
⇛ The study is based on two type of cases:

- Slow π hits UT + FT and K, π in UT + FT
- Slow π hits UT + MS and K, π in UT + FT

⇛ The gain in terms of statistics:

$$\text{gain} = 20.7\%$$





$\Lambda_b \to \Lambda_c^* \tau \nu$

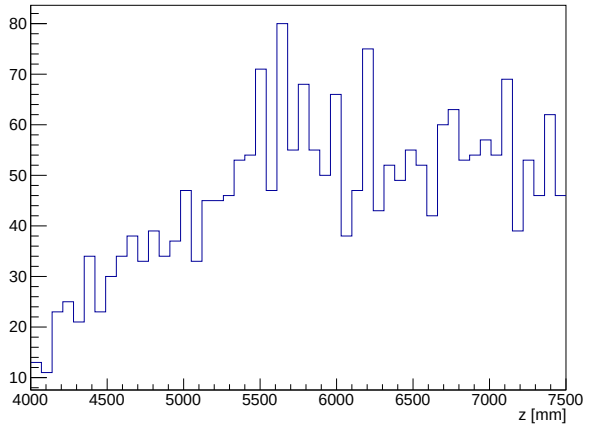
$\Rightarrow$ Study the LUV in: $\Lambda_b \to \Lambda_c^* \tau \nu$

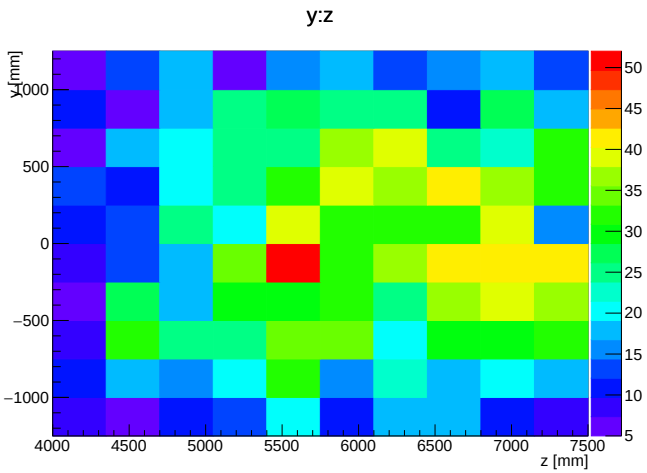
$\Rightarrow$ The study is based on two type of cases:

- Two slow π hits UT + FT and p, K, π in UT + FT
- One slow π hits UT + MS(FT) and p, K, π in UT + FT
- Two slow π hits UT + MS and p, K, π in UT + FT

$\Rightarrow$ The gain in terms of statistics:

$$\text{gain} = 60.0\%$$





$B \to D^* \tau \nu$

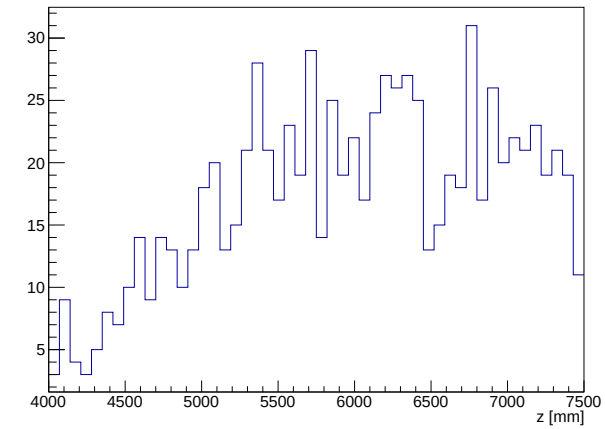
⇛ Study the LUV in: $B \to D^* \tau \nu$

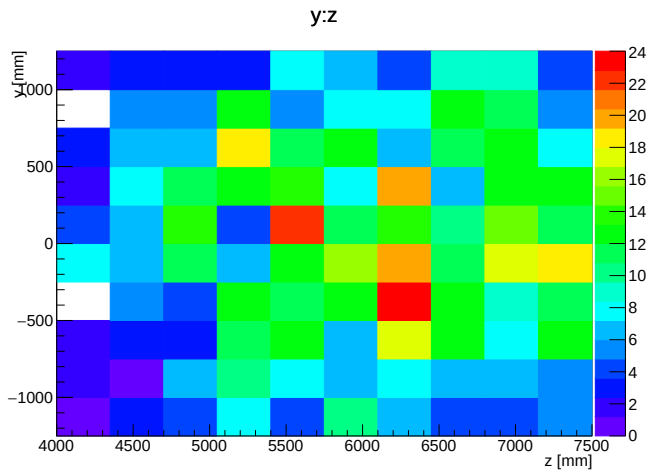
⇛ The study is based on two type of cases:

- Slow π hits UT + FT and K, π in UT + FT
- Slow π hits UT + MS and K, π in UT + FT

⇛ The gain in terms of statistics:

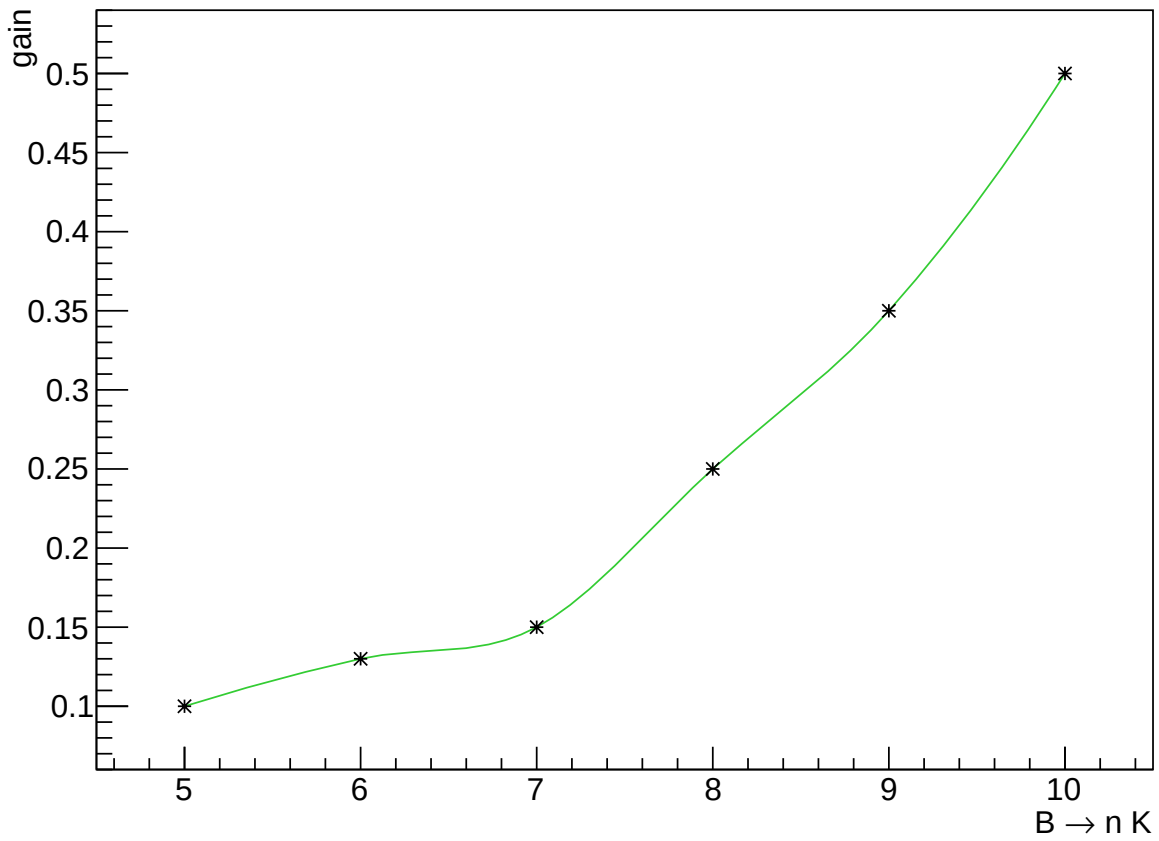
$$\text{gain} = 26.0\%$$





$B \longrightarrow nK$

$\Rrightarrow$ Study the multi body decays: $B \longrightarrow nK$:



$\Rrightarrow$ Clearly a threshold effect, the less PHSP you have the more you gain.

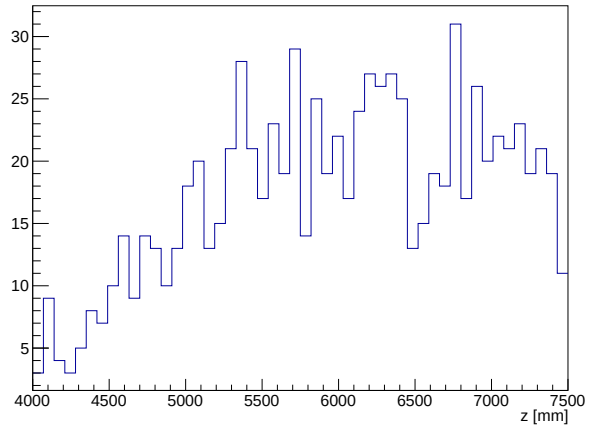
$\Sigma_b \longrightarrow \Lambda_b \pi$

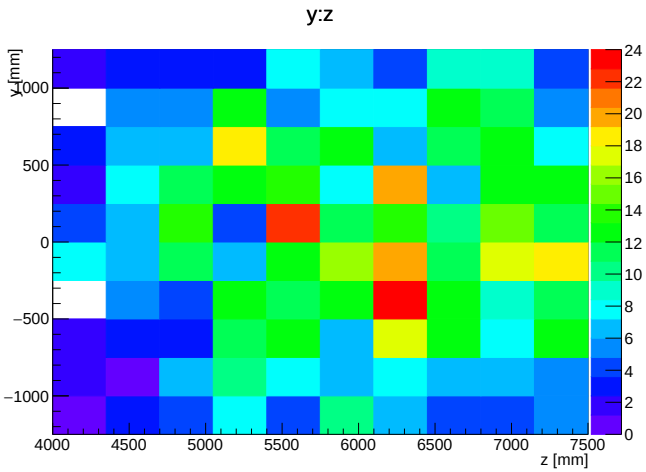
$\Rightarrow$ The study is based on two type of cases:

- Slow π hits UT + FT and Λ_c, D_s in UT + FT
- Slow π hits UT + MS and Λ_c, D_s in UT + FT

$\Rightarrow$ The gain in terms of statistics:

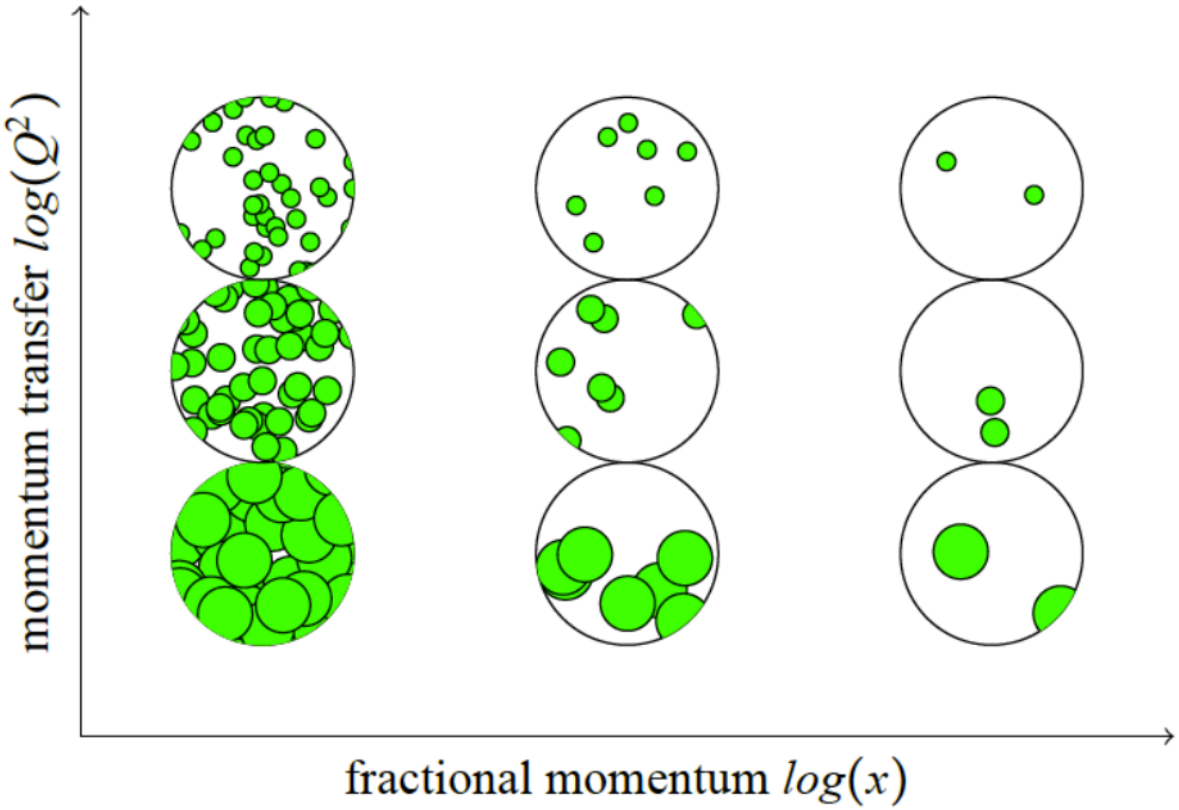
$$\text{gain} = 29.0\%$$





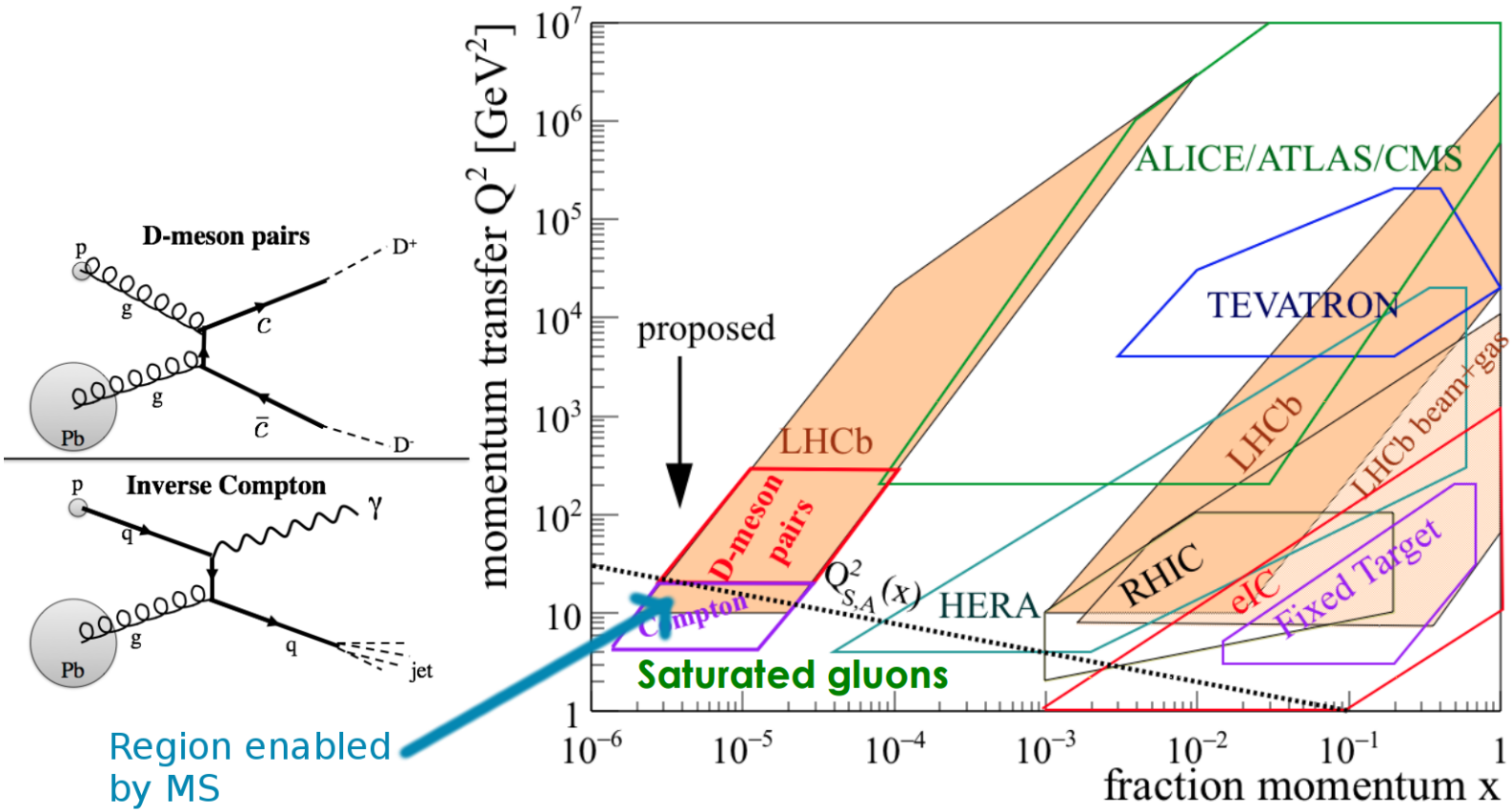
Gluon PDF

$$Q^2 \propto \frac{1}{R^2}$$



$\Rightarrow$ The Gluon PDF saturates the low momentum transfer and fractional momentum.

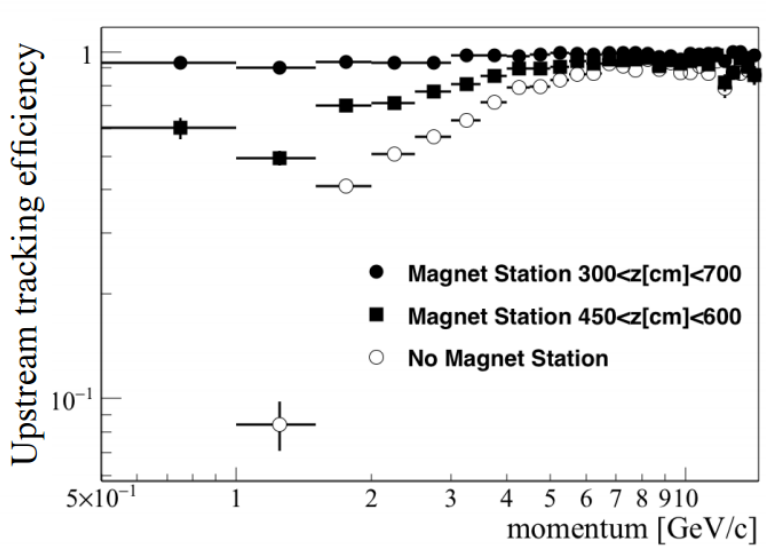
Gluon PDF

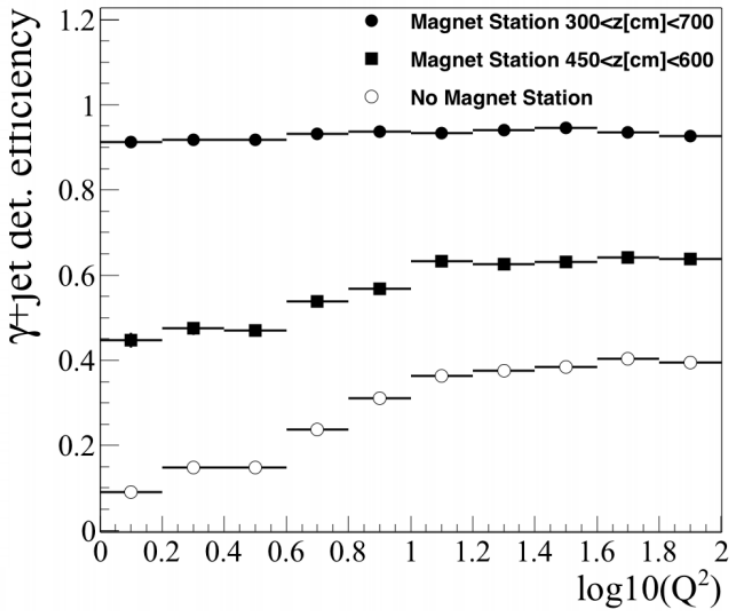


Region enabled by MS

Gluon PDF efficiency

⇛ If one looks at the efficiency for the low tracks, one finds where is the improvement:





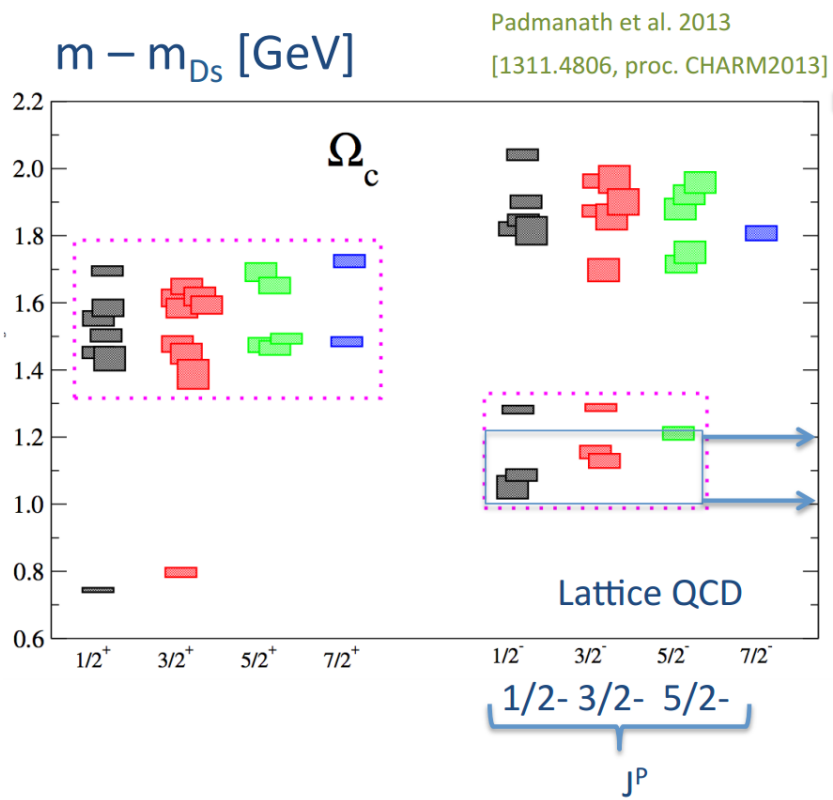
⇛ For more details see Cesar Luiz da Silva; Tuesday Presentation

Spectroscopy

Excited Ω_c^*

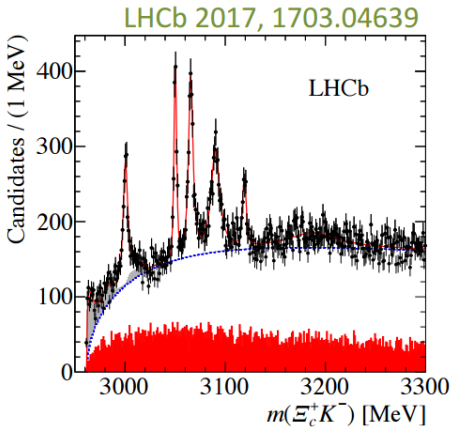
CSS

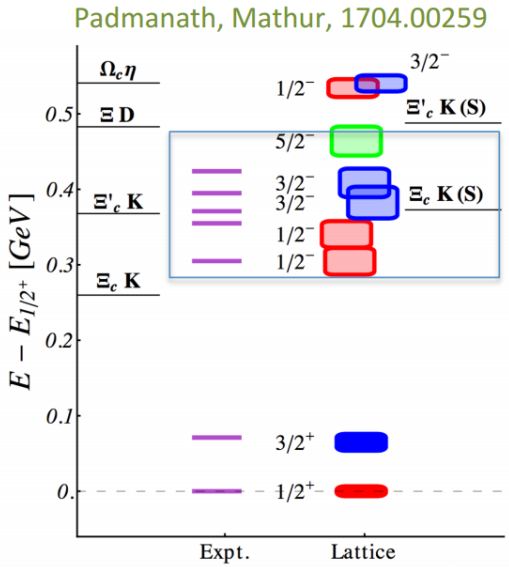
treated in lattice QCD ignoring their strong decays



Padmanath et al. 2013
[1311.4806, proc. CHARM2013]

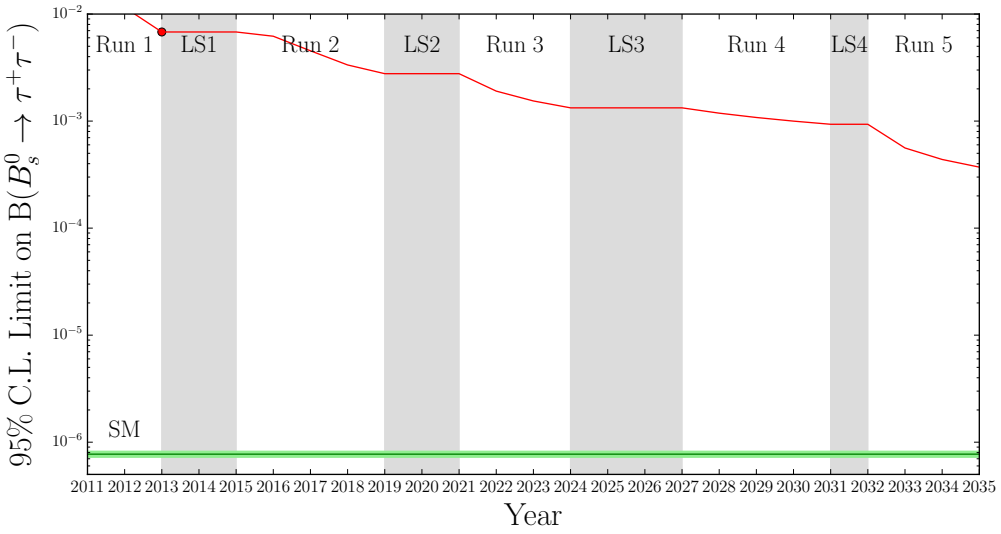
same results

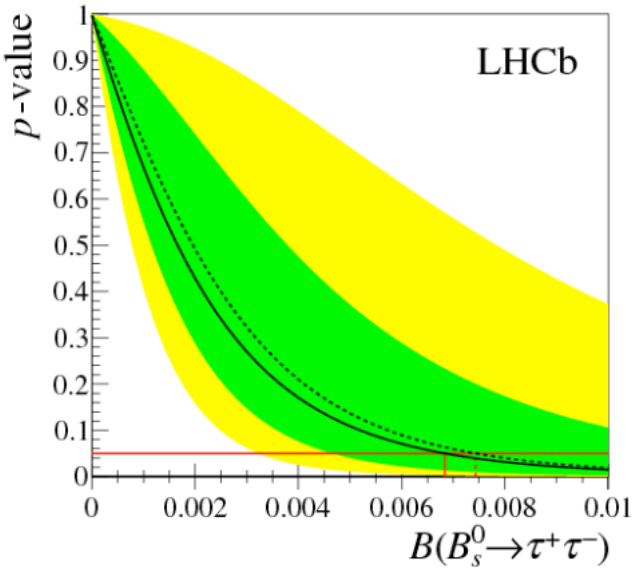




Idea from this workshop: $B \to \tau\tau$

⇛ LHCb has recently measured: $B_{s/d} \to \tau\tau$ arXiv::1703.02508





⇛ As a multibody decay it will probably have non-negligable gain from MS.

⇛ From preliminary studies $\mathcal{O}(24)\%$ gain.

Soft bomb events

⇛ All credits to Zoltan Ligeti.

⇛ Based on paper:arXiv::1612.00850

II. SOFT BOMB FRAMEWORK

A soft bomb event is generically represented by the process $pp \to \mathcal{B} + X$, where $\mathcal{B}$ is a multi-particle state of soft SM particles with very large multiplicity – $N \sim 10^2$ to 10^4 – roughly spherically distributed in the center-of-mass frame of $\mathcal{B}$ [47]. Such events may be generated by portals between the SM and a confining hidden valley, with appropriate fragmentation features and hadronization behavior.

⇛ The paper gives a lot of information how to select such events → Need new MC study.

Outlook

$\Rightarrow$ The physics program of magnet stations is enormous.
$\Rightarrow$ For many channels, the MS are improving the efficiencies from $20 - 30\%(R(D^*))$ to 60%.
$\Rightarrow$ For other, such as the study of Gluon saturation, the MS are enabling the measurement.
$\Rightarrow$ MS help when little PHSP is available.
$\Rightarrow$ We are extending the studies for more and more decays in the future.

Since Guy started...

”The extent of your consciousness is limited only by your ability to love”

Since Guy started...

”The extent of your consciousness is limited only by your ability to love”

”The extent of your ACCEPTANCE is limited only by your MAGNET STATIONS”

Backup