A first extraction and test of new association cuts

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for a PPS Meeting
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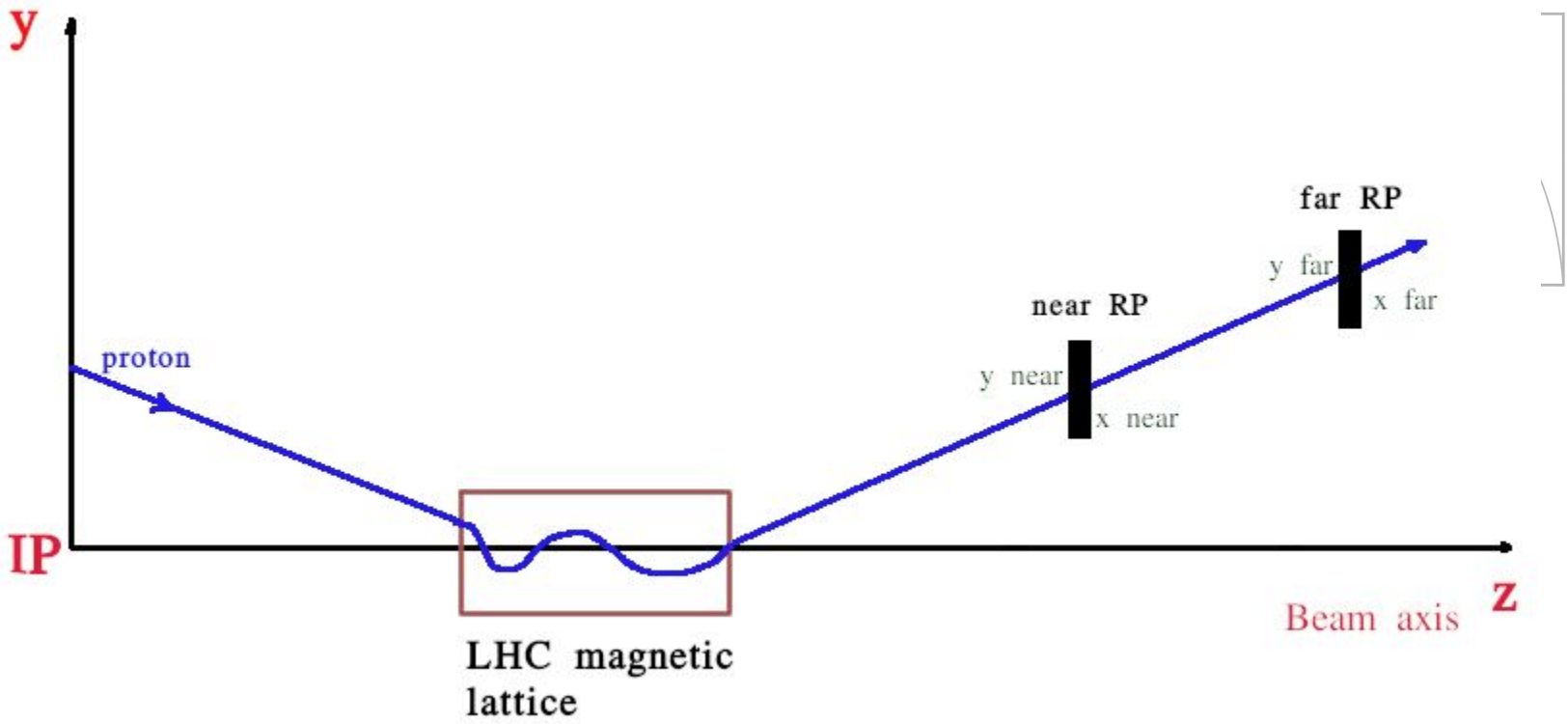
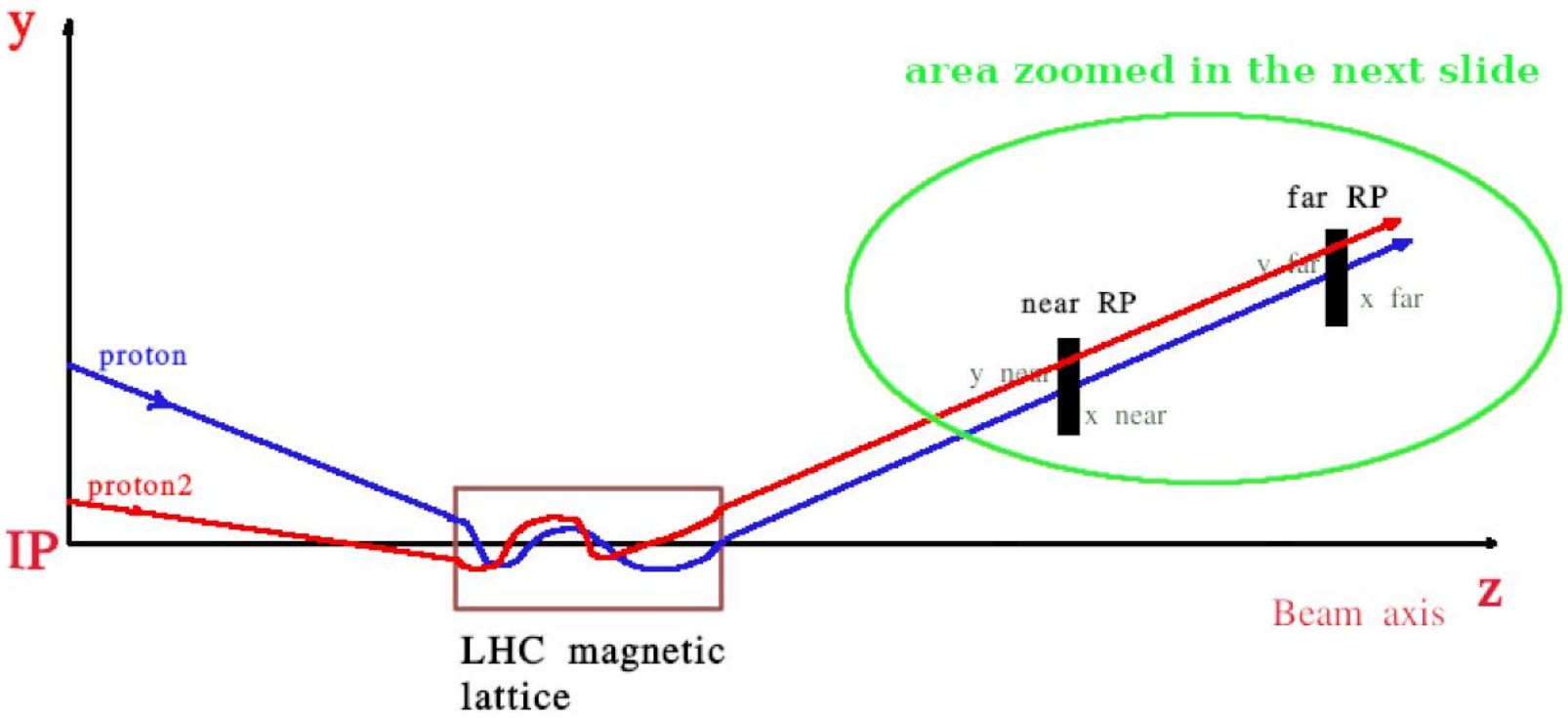


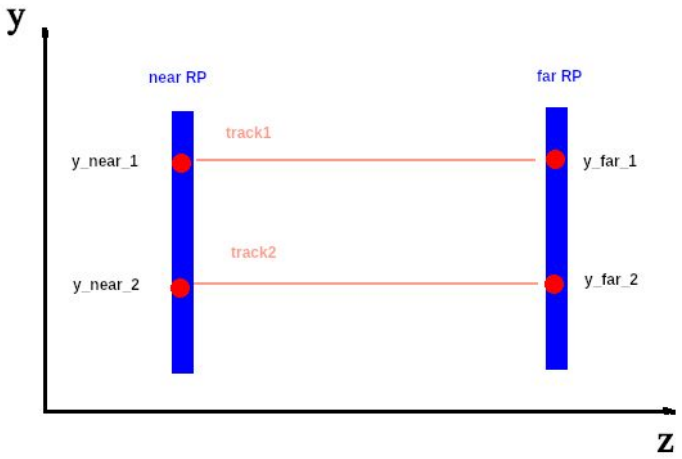
1. An interaction happens
2. Proton enters magnetic field.
3. Proton goes through near and far detector (RP)

Assume multicipacy =2

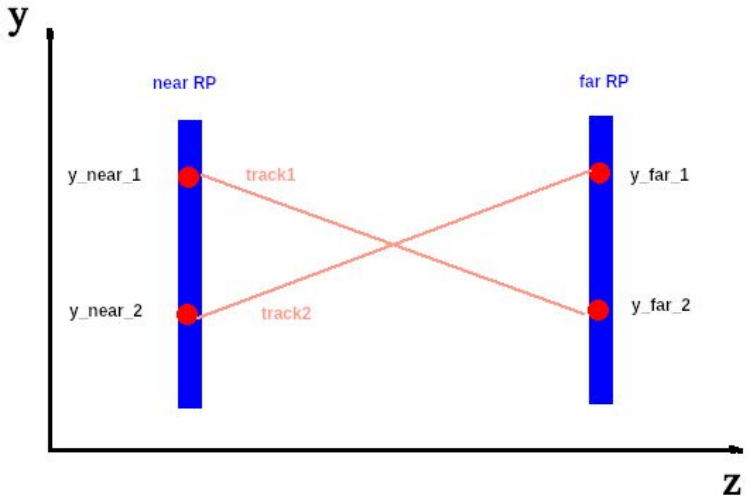


With higher multiplicity we need to match local tracks from the near and the far RP --> we need matching/associating rules

Assume multicipacy =2 (two protons): We need to choose case either A or B



Case A, correct matching



Case B, wrong matching

Association cuts:

1. are the rules that remove invalid tracks.
2. they should reflect the track distributions in the RPs, which follow from the kinematic distributions at the IP and LHC optics
3. are expressed by mathematical equation

An equation for Association Cuts

$\Delta y = y_{far} - y_{near}$

The approximation below would reflects the fact that the forward protons are almost parallel to the beam. It is too simple.

$|\Delta y| < \text{threshold}$

We use an improved approximation, which reflects better the LHC transport

$|\Delta y - \text{mean}| < \text{threshold}$

(and similarly for x)

|Δy - **mean**| < **threshold**

Run 2 (currently in CMSSW)

1. Mean and threshold were constants, hard-coded in a python config file
2. IOV granularity limited to per year

Run3 (what we propose for integration)

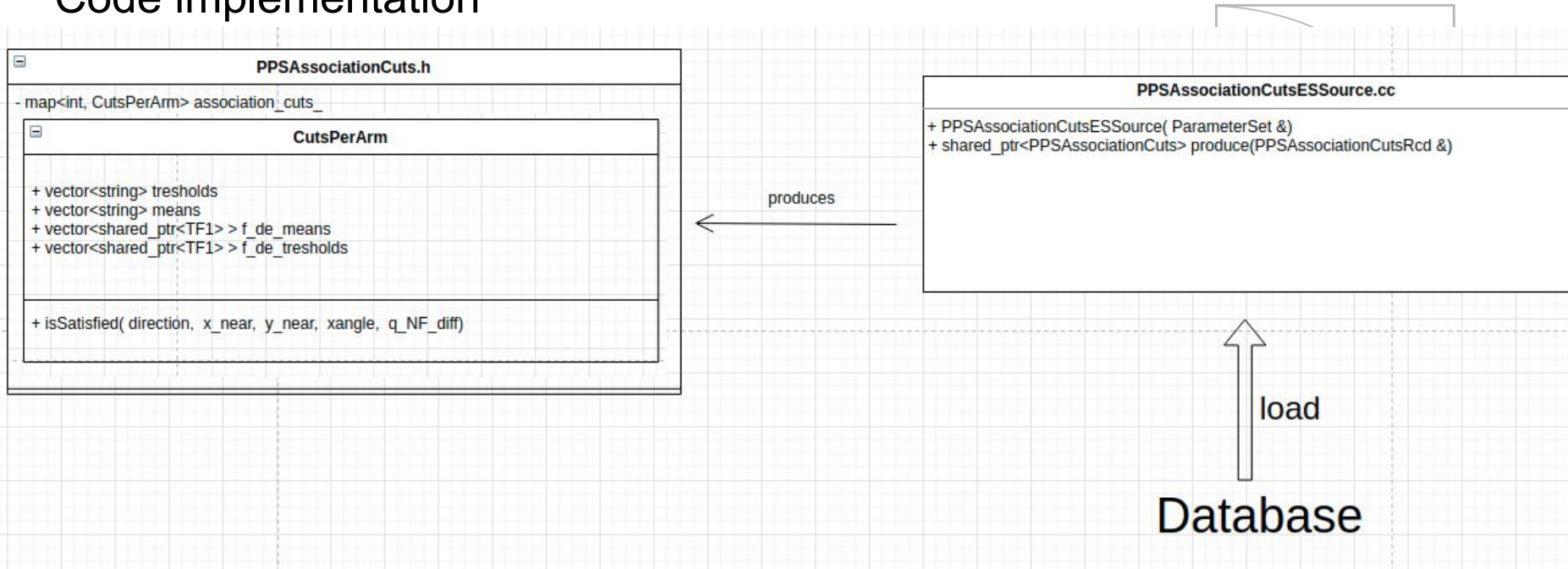
Mean and threshold:

1. can be functions of proton kinematics (x_near and y_near) and xangle [Improvement 1]
2. can be stored as standard EventSetup object. Can be saved in the database. Can be associated with arbitrary IOV [Improvement 2]

Effects of the proposed changes

- **Run 2** - no change, full backward compatibility
- **Run 3** - hope for a higher reconstruction efficiency

Code implementation



- PPSAssociationCuts can be serialized and stored in a database
- PPSAssociationCutsESSource:
  a. allows to change parameters when IOV changes
  b. produces PPSAssociationCuts objects

Summary & status

We propose un update of the N-F association cut mechanism including:

- saving the cuts as a standard EventSetup object
- means and thresholds are extended to possibly be functions of x_near, y_near and xangle.
    - The update has been tested and shown to result in improved efficiency --> see Jan's talk

Full CMSSW implementation exists and has been tested
https://github.com/CTPPS/cmssw/tree/association_cut_update
We are ready for opening a PR

We ask for the green light for opening the PR