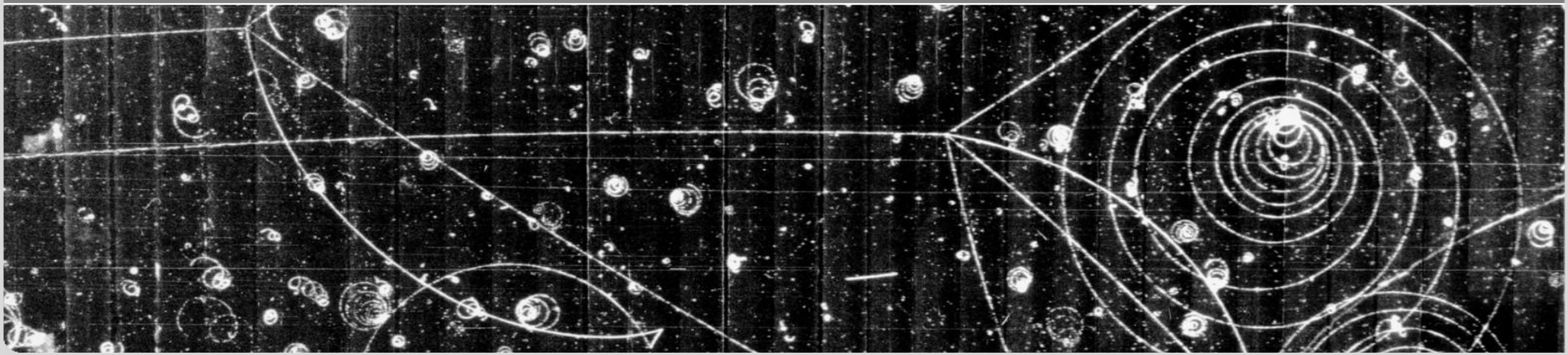
Karlsruhe Institute of Technology

Recent ArXiv Papers

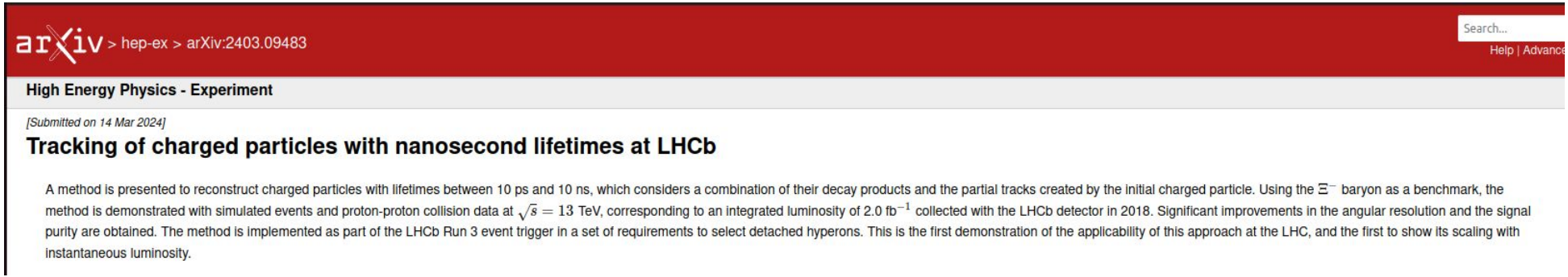
Weekly ETP Meeting
17th March 24
Karlsuhe

Lars Sowa

Institute for Experimental Particle Physics



“Tracking of charged particles with nanosecond lifetimes at LHCb” [arXiv:2403.09483]



arXiv > hep-ex > arXiv:2403.09483

Search...

Help | Advance

High Energy Physics - Experiment

[Submitted on 14 Mar 2024]

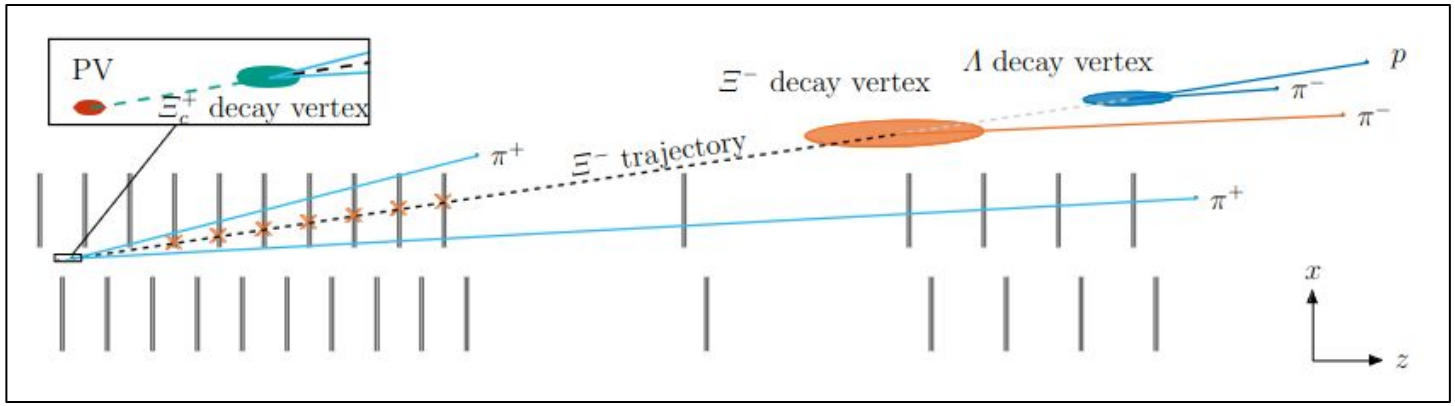
Tracking of charged particles with nanosecond lifetimes at LHCb

A method is presented to reconstruct charged particles with lifetimes between 10 ps and 10 ns, which considers a combination of their decay products and the partial tracks created by the initial charged particle. Using the Ξ^- baryon as a benchmark, the method is demonstrated with simulated events and proton-proton collision data at $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 2.0 fb^{-1} collected with the LHCb detector in 2018. Significant improvements in the angular resolution and the signal purity are obtained. The method is implemented as part of the LHCb Run 3 event trigger in a set of requirements to select detached hyperons. This is the first demonstration of the applicability of this approach at the LHC, and the first to show its scaling with instantaneous luminosity.

- Short lived particles are reconstructed exclusively by their decay products
- Long-lived Particles traverse the whole tracking system

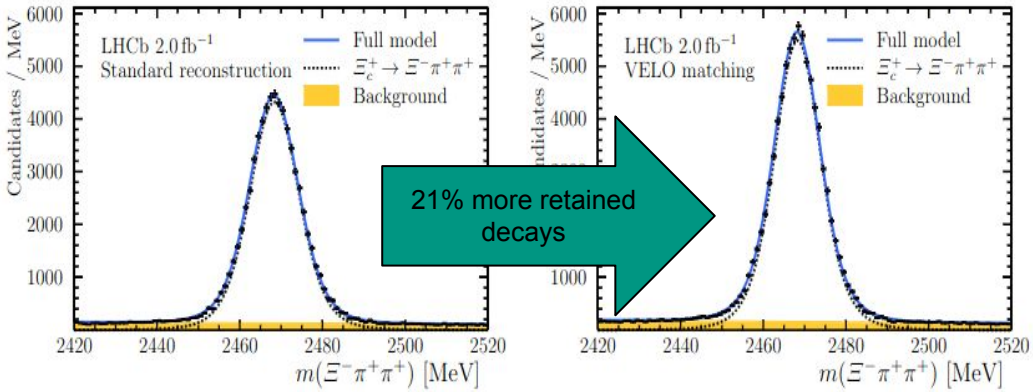
➢ Particles with lifetimes between 10 ps and 10 ns are in between and usually hard to track

“Tracking of charged particles with nanosecond lifetimes at LHCb” [arXiv:2403.09483]

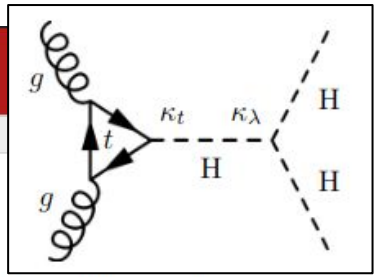


Key Idea

- Ξ^- decays in Vertex Location detector
- After Ξ^- reconstruction: search for other, possible tracks
- Refit these tracks taking Ξ^- momentum into account
- Find best track candidate via χ^2 matching
- Improved mass resolution of 20%



“Search for Higgs boson pair production in the bbWW decay mode in proton-proton collisions at √s= 13 TeV” [arXiv:2403.09430]



arXiv > hep-ex > arXiv:2403.09430

High Energy Physics - Experiment

[Submitted on 14 Mar 2024]

Search for Higgs boson pair production in the bbWW decay mode in proton-proton collisions at $\sqrt{s}$ = 13 TeV

CMS Collaboration

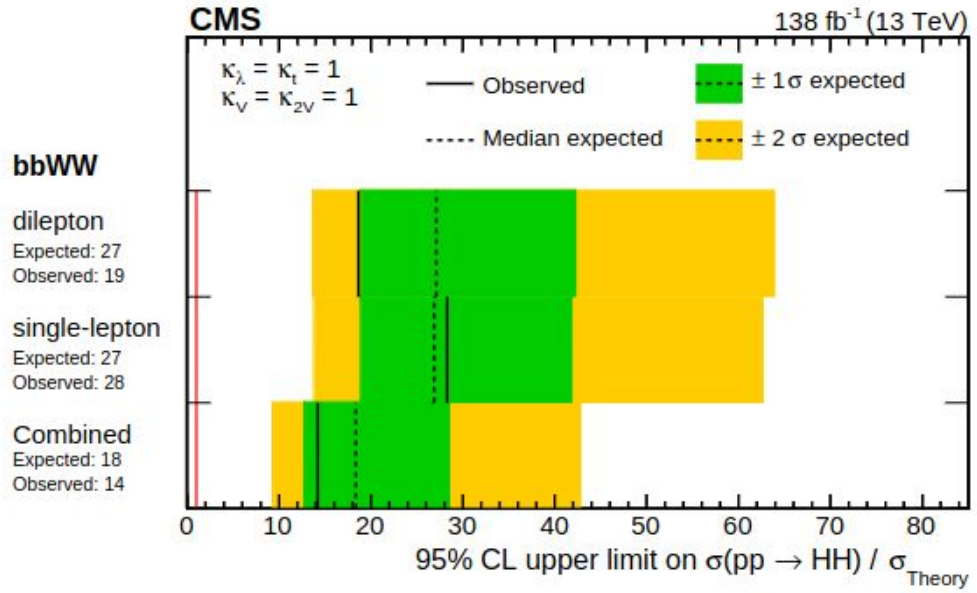
A search for Higgs boson pair (HH) production with one Higgs boson decaying to two bottom quarks and the other to two W bosons are presented. The search is done using proton-proton collisions data at a centre-of-mass energy of 13 TeV, corresponding to an integrated luminosity of 138 fb^{-1} recorded by the CMS detector at the LHC from 2016 to 2018. The final states considered include at least one leptonically decaying W boson. No evidence for the presence of a signal is observed and corresponding upper limits on the HH production cross section are derived. The limit on the inclusive cross section of the nonresonant HH production, assuming that the distributions of kinematic observables are as expected in the standard model (SM), is observed (expected) to be 14 (18) times the value predicted by the SM, at 95% confidence level. The limits on the cross section are also presented as functions of various Higgs boson coupling modifiers, and anomalous Higgs boson coupling scenarios. In addition, limits are set on the resonant HH production via spin-0 and spin-2 resonances within the mass range 250-900 GeV.

- Observation of Higgs self-couplings are an important, pending test for EWSB and determination of the Higgs potentials shape

- Single- and dilepton channel analyzed separately:
  - Train DNN for multivariate classification: Subcategories for Jet topologies
  - Perform a maximum likelihood fit

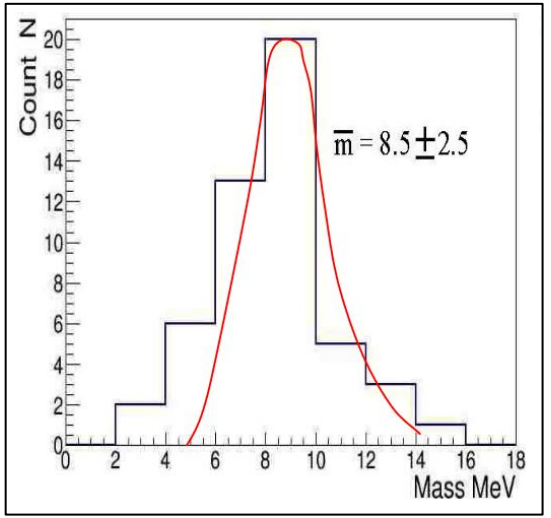
“Search for Higgs boson pair production in the bbWW decay mode in proton-proton collisions at $\sqrt{s}$= 13 TeV” [arXiv:2403.09430]

- No significant SM deviation found
- Set new upper limit for incl. nonresonant HH to bbWW: excluded to 14x SM prediction



“Search for a new charged particle in the mass range of 2-100 MeV” [arXiv:2403.06628]

- Reuse old dataset from the 60’s of Synchrophasotron, JINR (Dubna)
  - 10 GeV proton beam is used to produce $\gamma \to \ell^+\ell^-$ decays within a bubble chamber
  - 55 tsd. pictures to analyze
- Data is first digitized and analyzed again
- Search for new lepton with mass between 2-100 MeV
- Observation of 50 anomalous events around 8.5 MeV



Take away for data handling:

- Open Data is important to allow cross checks on physics results
- It is important to preserve data for new technologies in the future