

Bump hunting with the CMS e-lab

Homework due July 15, 2020

Instructions:

1. Go to the CMS e-lab: <https://www.i2u2.org/elab/cms/home/project.jsp>
Sign in as a guest if you do not have an account. Note that if you have a cosmic ray or LIGO e-lab account, you can use that for the CMS e-lab as well.
2. Explore the e-lab, trying to answer one of the exploration questions below. If you've never used the e-lab before, there is a very helpful screencast from Ken here: <http://www.screencast.com/t/m9QDaF4p>
3. Make a FlipGrid video (approximately 3 minutes) describing one of the plots you made on the e-lab.
 - a. Video explaining how to share your screen and make the FlipGrid video. <https://flipgrid.com/s/f2bb53eb2299>
 - b. Link to the FlipGrid topic for this assignment: <https://flipgrid.com/8014a6c3>.
The password is "Fermilab"
4. Watch at least 3 videos of your classmates describing their plots and be prepared to discuss during class.

Exploration questions:

1. **Confirmation of Z mass** - Confirm that the detector is able to measure the Z mass.
2. **Confirmation of J/Psi mass** - Confirm that the detector is able to measure the J/Psi mass.
3. **Confirmation of Upsilon mass** - Confirm that the detector is able to measure the Upsilon mass.
4. **Cosmic rays (challenge question)**: Can you find evidence for cosmic ray muons in the "dimuon events with invariant mass between 2-110 GeV" dataset? A single cosmic ray muon would be reconstructed as two "back-to-back" muons ($\Delta\phi = \pi$) with opposite charges and similar p_T . Hint: ϕ is the angle in the transverse plane, measured as the angle up from the horizontal axis pointing toward the center of the LHC ring.
5. **Come up with your own!**