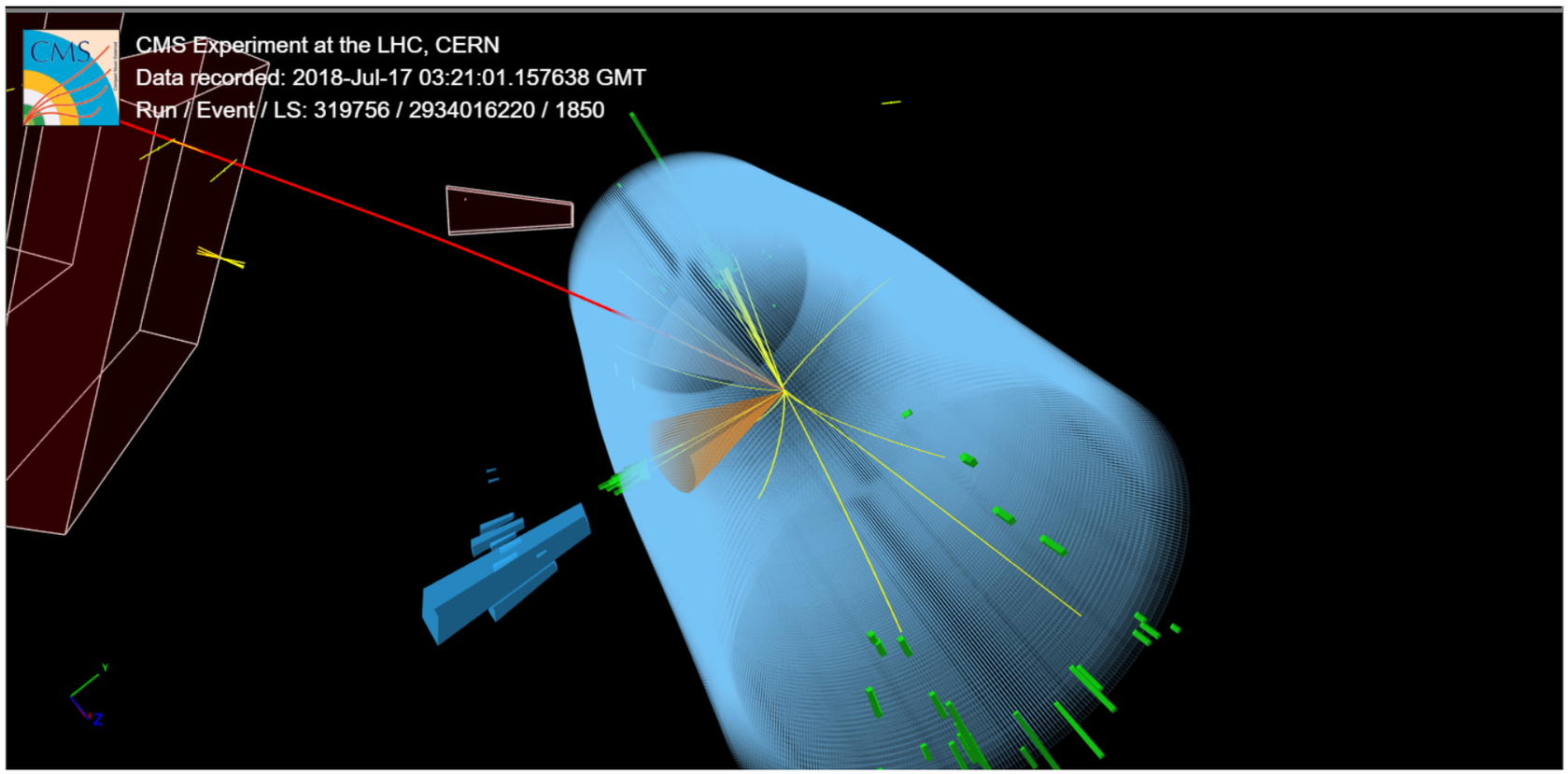
Imperial College London

IC plans for CP measurements in Run 3



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Person power

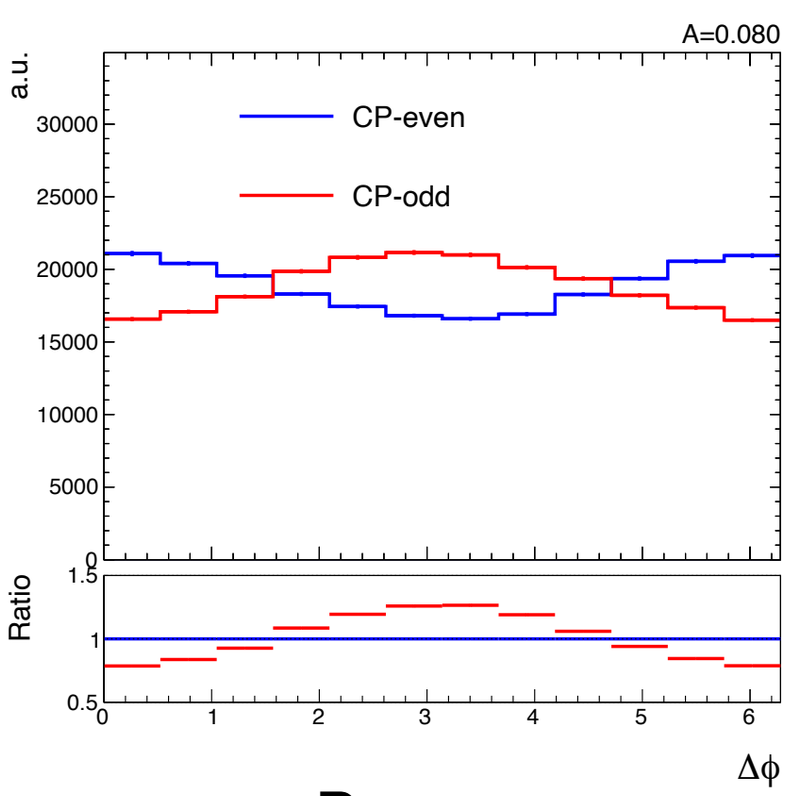
- Senior: David, Sasha
- Postdoc: Me
- PhD students:
  - Klitos (until March 25)
  - Would plan to get another PhD student overlapping with Klitos to take us to the end of the full Run 3 analysis
- MSc students:
  - Qintong (until Sep 22)
  - Possibility to get ~ 1 MSc student per year (masters projects related to HEP+ML)

General aims / plans

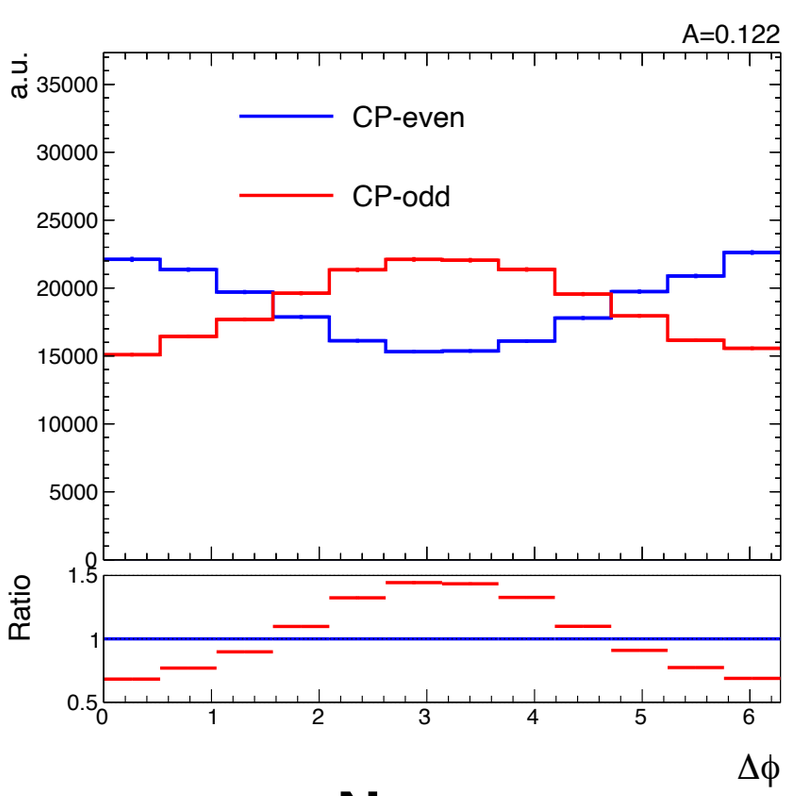
- Produce measurement of CP in HTT decays using Run 3 + Run 2 data
  - New analysis on Run 3 data + either re-analysis of Run 2 or combination with HIG-20-006
- Move analysis methods more towards polarimetric method for other channels
  - At least for a1 decays, and perhaps for other decay modes (i.e including additional information/ constraints e.g MET)
- Extract CP information in ggH production and decay simultaneously
  - Need appropriate MC samples for this
- Improve signal vs background separation
- Improve tau decay mode identification and reconstruction of π0
  - E.g Something similar to this interesting EGM paper about merged photons EGM-20-001

Moving to polarimetric vector method

- Tried very simple procedure to use polarimetric vector method for a1's in other channels
- We take the tau direction from SV-PV (+ a rotation for cases where GJ angle is > maximum)
- Absolute value of tau momentum from SV-fit
- Despite procedure being simple a significant improvement is observed in the separation e.f for ρ-a1 channel



Paper



New

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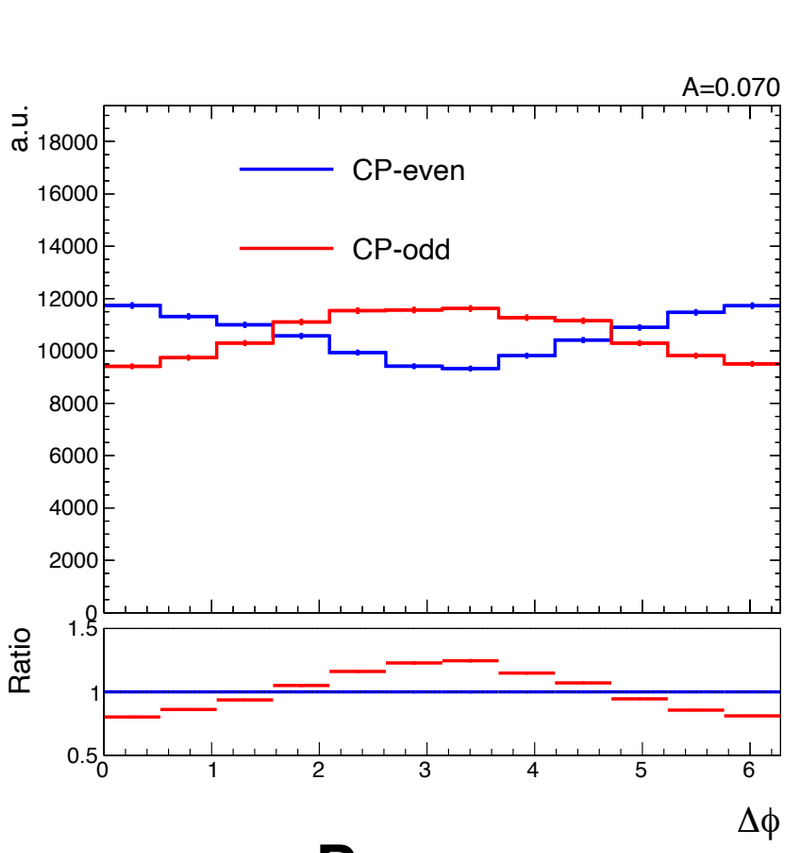
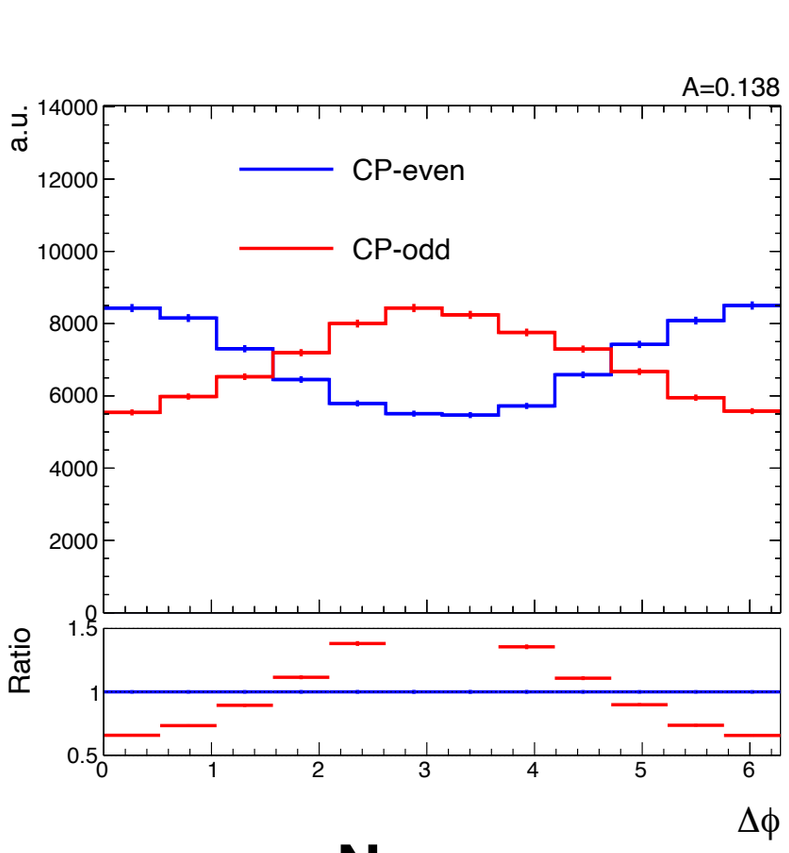


Paper



New

MC samples

- VBF+VH: Plan to use same setup as for Run 2 but will m make requests for Run 2 UL samples + eventually Run 3

- For ggH if we want to measure CP in production and decay need samples that can model production side

  - For HIG-20-007 we used Madgraph for this but large number of negative weights made this tricky (~9x as many events needed for NLO vs LO)

- However now possible to use a Madgraph+POWHEG interface (https://arxiv.org/abs/2008.06364) to reduce the number of negative weights (now need only ~ 1.5x as many events compared to LO)

- Already tested this for a few events - see right

- Will produce gridlocks for this soon + make requests