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CMS SP and UC visit to Bari

Bottomonium spectroscopy with Run-2 + Run-3 data

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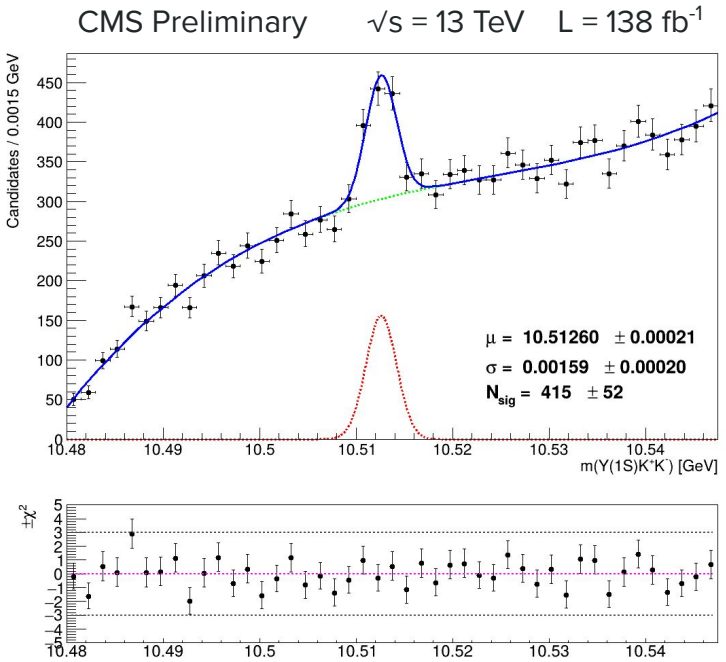
Structure observed in Y(1S)ϕ(➔ KK) invariant mass spectrum

- Charmonium-like states (possibly tetraquarks) observed in the J/ψϕ final state (in 3-body decays, e.g. B^+ ➔ J/ψϕK^+) suggest to search for **bottomonium-like states decaying into Υϕ: not yet done in CMS nor other experiments**

- Di-pion transitions (Υ(2S,3S) ➔ Υππ) are well-reconstructed in CMS despite the lack of hadronic PID and overwhelming background; the presence of **ϕ intermediate resonance helps to reject combinatorial background**

- The **analysis** is under review of BPH sub-group conveners and **towards pre-approval**. **We aim for a quick publication + a second publication with Run-2 + Run-3 data with further effort for the interpretation of the signal**



Local statistical significance > 9σ

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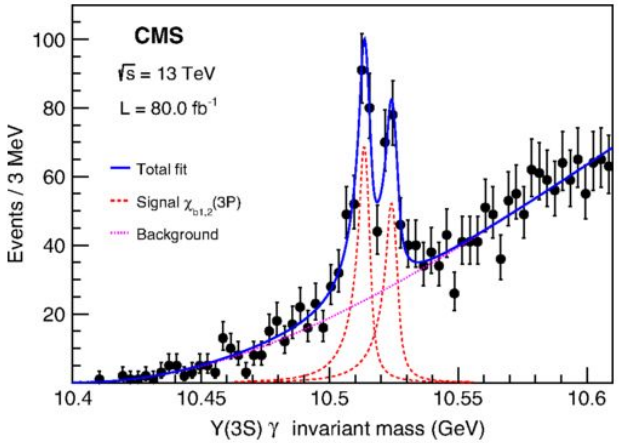
Observation compatible with $\chi_{b1}(3P)$, already measured at CMS in $\chi_{b1}(3P)$ ➔ Υ(3S)γ

Understanding the signal with Run-2 + Run-3 data

- Previous CMS analysis: two well-resolved peaks interpreted as $\chi_{b1}(3P)$ and $\chi_{b2}(3P)$

- **Second peak not observed in $\Upsilon\phi$:**
  - **difference in production mechanism?**
    - CMS result for $\chi_{b1/2}(1P)$: similar production x-sec
  - **difference in branching ratio to $\Upsilon\phi$?**
    - BELLE result: $\chi_{b2}(2P) \rightarrow \Upsilon(1S)\omega$ suppressed of factor 4-to-7 w.r.t. $\chi_{b1}(2P)$
  - **detector acceptance effect?**
    - angular distribution of different spins to be evaluated on MC (JHUGen)
  - **interpret the observed structure as an exotic?**
    - possibly a $b\underline{b}s\underline{s}$ tetraquark



- **Ongoing work within the BPH subgroup using all Run-2 + Run-3 data collected so far**
  - blind analysis in the $\chi_{b2}(3P)$ mass window