Recent measurements\textsuperscript{\cite{1}} of the azimuthal anisotropy of prompt $D^0$ mesons in PbPb collisions with the CMS detector at the LHC  
(on behalf of the CMS Collaboration)  
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**Physics motivation**  
- Mostly produced in primordial stages of collision (~0.1 fm/c).  
- Sensitive probe of strongly-interacting medium.  
- Low probability of annihilation  
- More data than the previous CMS publication\textsuperscript{\cite{2}}.

**Prompt $D^0$ reconstruction and optimization.**  
Prompt $D^0$ meson reconstructed in fully hadronic decay channel: $D^0 \rightarrow K^- + \pi^+$ (total BR: 3.89\% \textsuperscript{\cite{3}}).

**Invariant mass fit: 3 components.**  
- Signal: Double gaussian.  
- Swap: Single gaussian.  
- Combinatorial background: 3th polynomial.

**Analysis technique**  
1. **Scalar product method.**  
\[ v_n^{SP} = \frac{\langle Q_{HA}^0 Q_{HA}^* \rangle}{\langle Q_{HA} Q_N \rangle} \]  
\[ \sqrt{\langle Q_{HA} Q_{NC} \rangle} \]  
Where: $Q_{HA}$, $Q_{NB}$ and $Q_{NC}$ are Q-vectors.  
$Q_{HA}$: $HF (-5 < \eta < -3)$,  
$Q_{NB}$: $HF (3 < \eta < 5)$  
$Q_{NC}$: TRACKER ($-0.75 < \eta < 0.75$)

2. **Extraction of $D^0$ $v_2$.**  
\[ v_n^\text{sig+bkg} (m_{inv}) = \alpha(m_{inv}) v_n^\text{sig} + v_n^\text{bkg} (m_{inv}) (1-\alpha(m_{inv})) \]  
where:  
$m_{inv}$: $D^0$ invariant mass,  
$\alpha(m_{inv})$: $D^0$ signal fraction, is defined:  
\[ \alpha(m_{inv}) = (S(m_{inv}) + SW(m_{inv})) / (S(m_{inv}) + SW(m_{inv}) + B(m_{inv})) \]

**Result.**  
- With a high precision data, new results showed in Fig. 1 are consistent with publication results\textsuperscript{\cite{2}}.  
- Providing more differential information of $v_2$ and $v_3$ at low $p_T$.

- Rapidity dependence of Heavy flavor collective flow is explored for the first time, as shown in Fig. 2, and no significant rapidity dependence is observed.

- A clear increasing and then declining trend are shown in Fig. 3 from most central to mid-central and then to peripheral events, like charged particles.

**Data sample**  
- $4.27 \times 10^8$ minimum-bias Events from PbPb collisions events at $\sqrt{s_{NN}} = 5.02$ TeV at the LHC in 2018.  
- Monte Carlo (MC) samples ($D^0$): based on Pythia8.

**Event selection**  
- $|p_T| > 1.0$ GeV  
- $|\eta| < 2.4$

**Systematic uncertainty**  
- BDT selection.  
- Bkg. mass PDF.  
- Bkg. $v_n$ PDF  
- $D^0$ efficiency correction.  
- Non-prompt contamination.

\[ \begin{array}{c}  
\text{Fig. 1.} \ v_2^\text{D}\text{top} \text{and} v_3^\text{D}\text{bottom} \text{at} |y| < 1.0 \text{for 0-10\% (left), 10-30\% (middle) and 30-50\% (right).}  
\end{array} \]

\[ \begin{array}{c}  
\text{Fig. 2.} \ v_2^S\text{(top) and} v_3^S\text{(bottom) at} |y| < 1.0 \text{and at \text{1} < |y| < 2.0 \text{ for 0-10\%, 10-30\% and 30-50\%.}  
\end{array} \]

\[ \begin{array}{c}  
\text{Fig. 3.} \ v_2 \text{and} v_3 \text{as functions of centrality, for} 2.0 < p_T < 8.0 \text{ GeV/c and for rapidity} |y| < 1 \text{ and 1 < |y| < 2.}  
\end{array} \]

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\textsuperscript{\cite{1}} CMS-PAS-HIN-19-008 (2019). https://cds.cern.ch/record/2699493  