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New Strategic Project: Analysis and Phenomenology in HIN

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Results and Developments: current Thematic Project (2018-2025)

Experimental results

Experimental analyses developed by the SPRACE HI Group:

- ❑ femtoscopy in pp collisions at 13 TeV (FSQ-15-009, published)
- ❑ flow correlations with D^0 mesons $\rightarrow$ search for strong EM fields in PbPb collisions (César -- HIN-19-008, published)
- ❑ femtoscopic correlations with V^0 's in pPb collisions (Dener -- HIN-19-010 --> to be approved!)
- ❑ multiparticle correlations ($v_2\{4\}$) with D^0 mesons in PbPb collisions (César — HIN-20-001, published)
- ❑ Probing thermodynamics properties of hot QCD matter (PbPb and pPb collisions) — speed of sound (César -- HIN-23-003, published)
- ❑ CMS Analysis on the speed of sound in pPb collisions (César -- HIN-25-001, approved, almost in CWR)
- ❑ femtoscopy with charged hadrons in UPC at the LHC (Isabela, BEPE/FAPESP -- no CADI yet)
- ❑ Femtoscopic correlations of D^0 mesons and charged hadrons (Isabela)

Results in phenomenology

- ❑ Isabela's M.Sc. Dissertation : D^0D^0 femtoscopic correlations (paper in elaboration)
- ❑ Wei-Liang: Maximum Likelihood Evaluation (MLE) papers using CMS open data (Chong, Wei-Liang, César, Kodama, Sandra)



Current and Future Analyses Plan: Strategic Project (2026-2031)

Experimental investigations – I

- ❑ dE/dx: developed by André Stahl and now under studied by Florian
 - previously used in UPC and now calibrated for Oxygen run
 - planned to be extended to other collisions
 - PID method: not good for π 's ; works well for K's and p's
 - In Run4: use also MTD
- ❑ Femtoscopy
 - our expertise: has been used for (unidentified) charged hadrons
 - use identified particles (protons and kaons):
 - in particular for $\phi\phi$ and pp
 - estimating source effective dimensions
 - strong interactions between the particles involved
 - with MTD (Run IV) can also identify pions
 - $D^0\bar{D}^0$ in PbPb Run3?

Experimental investigations – II

Anisotropic Azimuthal Correlations & Flow

- ❑ flow measurements with identified $\phi\phi$ and pp
- ❑ multiparticle correlation and flow ($v_2\{4\}$) with D mesons: search for EM effects
- ❑ $D^0\bar{D}^0$ femtoscopy
 - preliminary studies developed with data in pPb collisions
 - not enough statistics, despite the large sample!

Probing thermodynamics of hot QCD matter

- ❑ analyses in OO, pO, NeNe
- ❑ new analysis of PbPb using $\langle p_T \rangle$ vs N_{ch} in 2-D (3rd alternative method)

Dileptons --> Z-boson mass and width deviations in PbPb collisions

- ❑ comparing to pp collisions:
 - presence of strong e.m. fields
 - initial state effect

Plans for Phenomenology

- ❑ search for EM effects in heavy ion collisions with produced Z boson (Ana Mizher, Alejandro Ayala)
 - follow up with experimental searches
- ❑ on-going and future MLE studies using open data (Chong, Wei-Liang, César, Kodama, Sandra)