

# LHC-Combine roadmap

## WP19 - JRA1 - Inter-experiment combination of heavy-ion measurements at the LHC

April 2020

The goal of the Strong-2020 WP19 is to improve communication between the four LHC collaborations (Alice, Atlas, CMS, LHCb) in the heavy-ion field, and to establish a data combination working group. It consists in two main tasks: 1/ the animation of a common forum to ensure a regular communication between the four collaborations; and 2/ cross-experiment combination work, including detailed comparisons of techniques or optimized statistical combination of results, leading to common publications. The first task is essentially fulfilled via the **kick-off activities** described below, while the second has started via the **planned activities**, described hereafter. Outside of the “strong” community, the work package is known as HonExComb (for Heavy ion experimental combination).

## 1. Kick-off activities

**Contact persons:** one person was identified to serve as entry point in each collaboration

- Alexander Kalweit (CERN) in Alice;
- Iwona Grabowska-Bold (Krakow, Poland) in Atlas;
- Raphaël Granier de Cassagnac (Polytechnique, France) in CMS;
- Giulia Manca (Cagliari, Italy) in LHCb.

**Meetings:** every last Tuesday of the month, starting in 2020, the 28th of January.

**Communication tools:**

- Wiki page: <https://twiki.cern.ch/twiki/bin/view/Honexcomb>
- Mailing list: <https://e-groups.cern.ch/e-groups/Egroup.do?egroupId=10352975> with more than 100 people
- Meeting platform and archive: <https://indico.cern.ch/category/11797/> with 4 meetings as of today

**Advertising the project:** The project was presented to the management of the collaborations and its relevant physics groups resulting in a regular attendance of >50 people in the public meetings.

## 2. Planned activities

The list below is a first roadmap, to be revised in an agile manner.

## 2.1 Combinations

Though the WP aims at being a very open forum for new ideas, four possible topics were originally identified and listed at the time of the proposal. They were reviewed, and several actions were identified.

- **Heavy flavours:** Combine the measurements from the four collaborations to compute the total charm cross section (as well as intermediate differential distributions). This goal triggered a lot of interest in the community and became our first priority. Two postdocs were identified (in Alice and LHCb) to lead the work.
- **Light-by-light scattering:** A final run 2 combination of ATLAS and CMS results is foreseen, but requires that the collaborations first work independently. It is also not clear that the manpower to perform the combination will be available.
- **Constraining nuclear PDF:** A discussion with two theoretical teams is initiated and shall lead to the identification of data to combine,
- **Quarkonia:** Though several opportunities were identified, no obvious combination action is taken; the comparison of the upsilon (preliminary) data from ATLAS and CMS triggered quite some attention in our first meeting and will be scrutinized.

New topics arose from the first meetings, for instance:

- **Top quarks:** in the same spirit as light-by-light scattering, this rare process might be the subject of a run 2 combination, but the collaborations first need to work independently.
- **Jets:** several people expressed interest in a common work regarding jet observables, that will be reviewed soon (probably in the May meeting).

## 2.2 Observables

Besides combination work, comparing methods was also identified as a possible work area for LHC Combine.

- **Centrality:** an existing activity about comparing the centrality definition of the four collaboration was moved to our forum (in our second meeting in February)
- **High multiplicity:** in the same spirit, the definitions of the (high) multiplicity observable in light collision systems (proton-proton and proton-nucleus)

## 2.3 Other activities

In addition to the above types of actions, two other unforeseen work activities were identified during the first discussions

- **Listing and solving tensions:** several results show differences between experiments and shall be followed on our forum. Atlas vs CMS Upsilon production was already mentioned above, but other examples are:
  - LHCb vs. ALICE :  $\Lambda_c/D0$  ratio in pPb;
  - LHCb vs. CMS : X(3872) production vs. multiplicity (but large uncertainties)
  - CMS vs. ALICE :  $R_{AA}$  measurement at high  $p_T$ ;
  - ...
  
- **Producing or endorsing comparison plots:** When conferences come, the need for comparison plots is vivid, and our forum could play a role in elaborating them.