

Summary of the Strong-2020 RIVET Workshop 8.4. 2021

The different contributions have shown that RIVET is a good starting point for the future comparison of the results of the so-called event generator and the experimental data. This interface, originally developed for pp collisions, has, in rare cases, already been applied to heavy ion reactions. All experimental groups expressed their intention to develop further this tool for the analysis of heavy ion collisions. The immediate effort of the experimental groups should consist in associating a “RIVET analysis” to each publication. An effort to “rivetize” already published key papers should be strengthened. A list of “wanted papers” for HI experimental results exists already, but it should be revised.

The people who have applied Rivet for the analysis of heavy ion collisions stressed that they experienced difficulties to use the HepMC format for heavy ion collisions (for what it is not made for) and to make RIVET working but also that the RIVET development team was very helpful in solving these problems. In the contributions and discussions it became also clear that before RIVET can become a general analysis tool several topics have to be addressed (and some of them can only be solved on the level of the experimental collaborations)

Experimentalists and theorists agree that a) any analysis has to be based exclusively on observables b) extrapolations (for example to obtain a rapidity distribution from a limited acceptance p_t -spectrum) have to be clearly distinguished from a direct data comparison. c) that observables which can only be calculated perturbatively (like photons, dilepton) can be analyze in. There are other points, which require a more intensive discussion between code owners and the RIVET development group.

- a) On which level the comparison in HI – collisions should be made (exclusively finally observed particles (and reconstruction of the others) or including resonances and weakly decaying particles from the codes).
- b) How to compare centrality dependent observables. This requires an understanding of how the centrality in theoretical calculations compares to the experimentally determined centrality.
- c) How to compare with data that are based on event mixing.
- d) In which form the theoretical data should be stored for a RIVET analysis: Oscar, ROOT or HepMC format? (touches problems like disc space etc.)
- e) Who performs the analysis? There different opinions have been advanced, from a delivery of the codes to the wish to keep the responsibilities for the analysis in the theoretical groups. It became clear that both ways have their risks and may be an individual solution has to be envisaged. In any case, a quality control of the results has to be established if the analysis is not made by the theorists.

Whereas these questions will be addressed in a future workshop of code owners, the Rivet development teams, and the RIVET representatives of the different experiments, the following questions need a broader discussion within the community, and in particular within the experimental collaborations, in a broader context than the specific case of RIVET as a tool for data-theory comparison. It has been discussed that a better procedure than the present one has to be found to improve the theoretical interpretation of experimental data by event generators. Presently it is based on preliminary data, which are not accessible and can therefore also not be used for a RIVET analysis. It is important for the theorists to have comparison with preliminary data available when these are discussed at the conferences and in the community. It has been proposed that together with the preliminary data also a RIVET analysis, where all cuts and procedure of the analysis are described and implemented, but without the associated “data”, is released by the experimental groups.

It remains to be discussed whether and how much this could solve the problem. In fact, because presently the final data appear usually much later, when the discussion of the results is more for the records than for the discussion, it was questioned whether it makes much sense to start only at this stage with a time and man-power consuming theory-experiment comparison.

So if one really wants to improve the collaboration between theory and experiment, a Rivet preliminary analysis associated to a preliminary analysis is a centerpiece. Obviously the theorist would prefer to have also the preliminary data to be released. Only then theorists and experimental groups can profit equally. The difficulties to do this have been discussed but this discussion should continue. In addition the work and projects of the PhD students of the model developing groups needs to be protected to avoid pre-publication of the expected results by other groups using Rivet.“

There were also more general discussions, not directly related to the usage of RIVET as a tool to facilitate the data-theory comparison. In particular:

Event generators predict simultaneously (almost) all of the experimental observables. In the experimental papers they are very often presented on the same footing as models whose predictive power is just limited to one observable. It would be helpful for the further development of the theory if the presentation of the results of both types of models is separated. The experimental groups need the event generators to interpret their results. On the other side, the theory groups need the experimental results for developing their approaches further. During a heavy ion collision situations occur for which a more fundamental theory does not provide a precise prediction and only with help of a comparison of different observables with data progress is achievable. How Rivet can serve for this purpose remains also to be discussed.