SHERPA-relatd activities at IPPP in 2019

Anke Biekoetter, **Lois Flower**, **Parisa Gregg**,
**Frank Krauss, Alan Price, Marek Schoenherr,
Gurpreet Singh Chahal**, **Joseph Walker**

(**Physicist Programmer, Postdoc, MCnet PhD student,
Data-science PhD student, Undergraduate**)

Code validation and tuning

- **code validation through physics projects**
- **look at processes with complicated signatures to test limits of SHERPA:**
  - **WBF/WBS-like signatures**
  - **many-body final states**
  - **SMEFT capabilities**
  - **when emplyoing the Data-Science PhD students, there will be a machine-learning/fitting dimension to it**

Code validation and tuning

- **associated Hγ production & constraining SMEFT operators:**

  - **a fresh look at WBF/WBS signatures and backgrounds**

    (Parisa, Anke, Marek, Frank + Raquel Gomez-Ambrosio)

  - **status: first exploratory studies concerning sensitivity to EFT operators**

Code validation and tuning

- **prospects for Charm-Yukawa measurements at HL-LHC in WH/ZH/WBF using fat jets**

  - **testing a lot of Higgs production processes outside ggF**

    (Joe, Frank)

  - **status: Joe will present first results next week in New York (ML for jets)**

  - **fun bit: lots of ML stuff**

Code validation and tuning

- **crash-testing EW corrections and multijet-merging in high-multiplicity final states (example: γ in WBF)**

  (driven by Marek, with various collaborators)

- **Marek will talk about this in more detail**

Code validation and tuning

- **tuning the new hadronization, beam remnants, and underlying event routines**

   (driven by Gurpreet, with help by Marek & Frank)

   – **Hadronization is more stable (new kinematics for gluon splitting and cluster decays)**

   – **Underlying Event does not write out libraries any more (re-implemented the original Sjostrand-van-der-Zijl on-the-fly algorithms), the original code was >10 years old, undocumented and pretty impossible to maintain**

   – **Beam remnants with new intrinsic k_T and colour handling, the original code was as old/undocumented as UE ...**

- **Gurpreet will talk about the status of the tunining in more detail**

Code & physics development

- one of the main obstacles, in my opinion is the huge threshold for newcomers to be able to add new physics to the code:

- this has two consequences:

  - PhD students and postdocs are either confined to validation only or we have to find well-separated and disjoint projects (examples to follow)

  - for some things the old guys have to do it themselves (examples: non-perturbative physics rewrites, higher-order parton shower ...)

Code & physics development

- **preparing SHERPA for FCC-ee/ILC: higher-order electroweak corrections to lepton colliders in YFS scheme**

  (Alan, Marek, Frank)

  – **use YFS scheme, allows systematic matching of fixed and resummed high-order corrections in QED (we use this already for QED FSR and we had something like this ~15 years ago, at resummed order only)**

- **Alan will talk about this in more detail**

Code & physics development

- **extending SHERPA to calculations of relic Dark Matter density**

  (Lois, Marek, Frank + Raquel Gomez-Ambrosio)

  - **main complication is the integration to calculate the velocity-weighted cross-section $\langle v\sigma \rangle$**

  - **also, want to go away from non-relativistic limit of initial DM particles (it's in the literature, but not always used)**

- **Status: Lois has produced some python code and cross-checked with MadDM, is now implementing into SHERPA as separate module (a new "Beam" class)**

Code & physics development

- **higher-order parton showering**

  (Stefan, Frank)

  - plan is to have two-independent implementations, building on and extending (mainly) Stefan's work so far
  - this is an important step towards a fully differential, process-independent NNLO matching

- **Status: it's complicated**