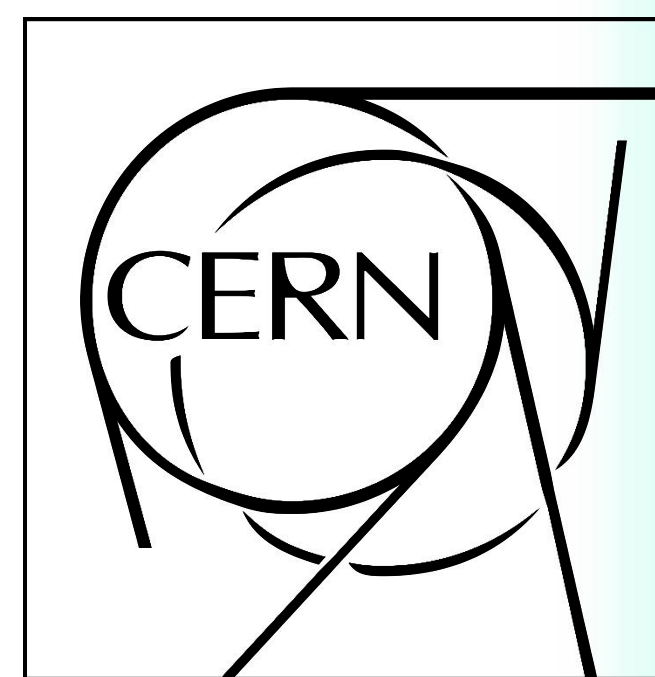
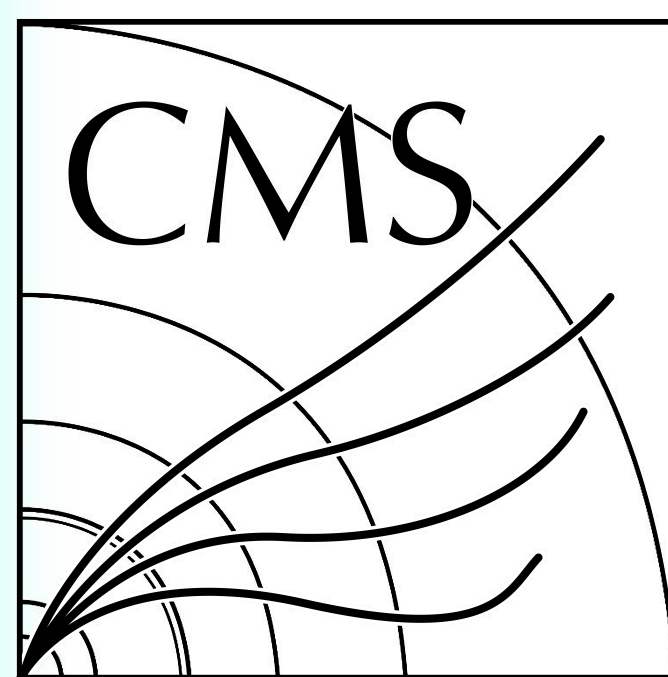


Introduction

HELAC-ONIA is a tool dedicated to matrix-element calculations and event generation within the NRQCD framework, which aim at providing general and user-friendly public tools for theorists and experimentalists to study the quarkonium physics.

The developer of HELAC-ONIA is Huasheng Shao. We figured out the method of producing color singlet and color octet Monte Carlo dataset under CMS framework. Published dataset for J/ψ pair and unpublished dataset for $J/\psi \Upsilon$ are already produced.



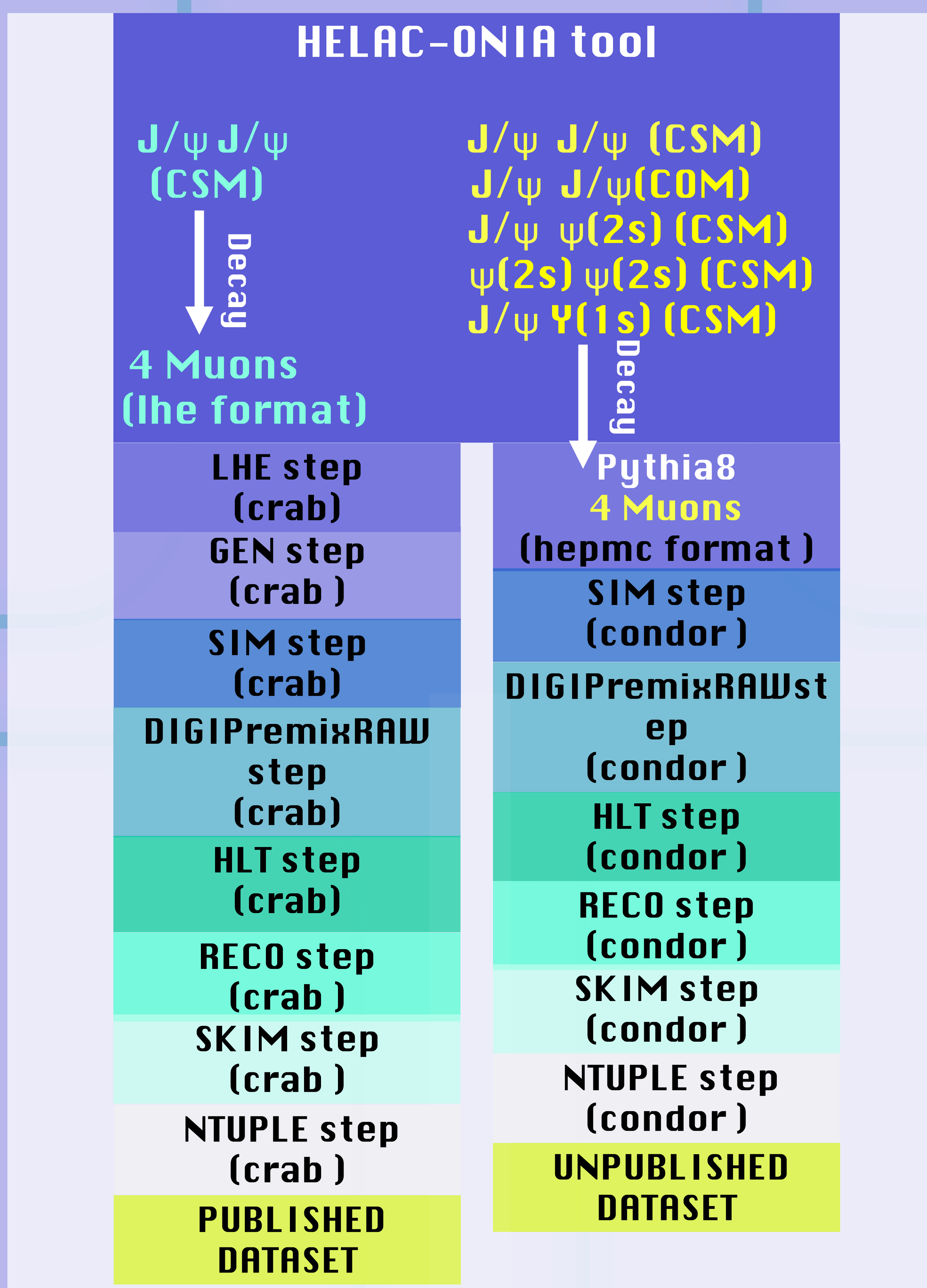
Use the Program for CMS

HELAC-ONIA can be used in a standalone way. When we produce dataset like J/ψ pair in color singlet mechanism, we could run HELAC-ONIA without linking to other packages. After compiling and setting configure option, you could start HELAC-ONIA by command line:

```
./Helac-Onia
```

For example, if one wants to calculate J/ψ pair production and let J/ψ decay into muon pair, the syntax should be generate $g g > cc\sim(3s11) cc\sim(3s11) decay cc\sim(3s11) > m+m- @ 1d0$. Then you will get the lhe files as output.

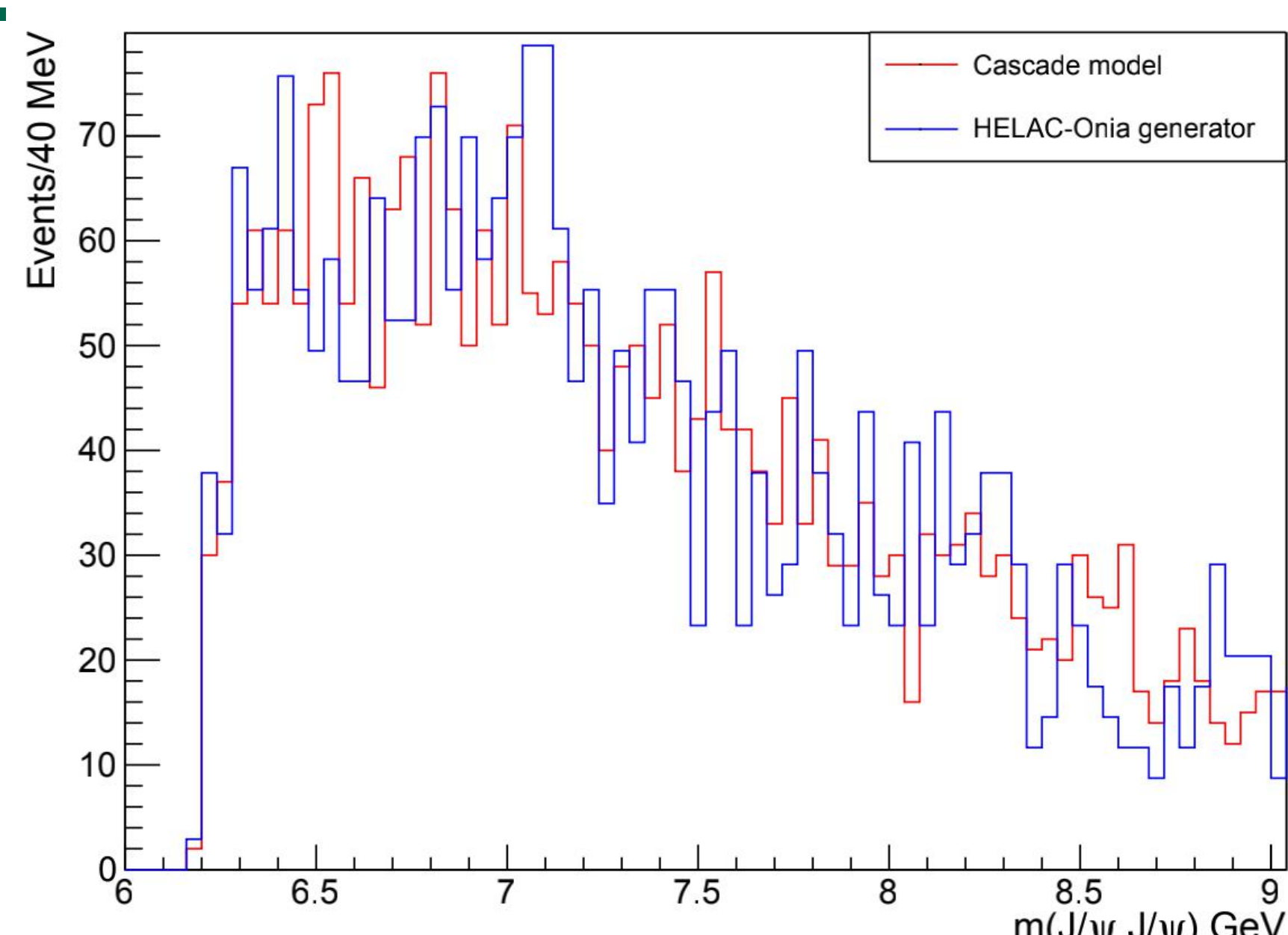
HELAC-ONIA for CMS



Example

The J/ψ pair dataset is produced in CMS framework. After setting environment and running HELAC-ONIA tool, we obtain the lhe format output files which contain 4 muons decay product.

Then we run GEN, SIM, DIGI, HLT, RECO, SKIM and NTUPLE steps using crab tool. Here is the plot of distribution of J/ψ pair mass. The histogram shows that the HELAC-ONIA results agree with the Cascade results.



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For processes that can not decay in HELAC-ONIA, we could generate the lhe files for unweighted events and call Pythia 8. One have to set correct path to both HepMC and Pythia 8 in the configuration file and compile HELAC-ONIA in proper way. In this case, the final output will be hepmc files which contains decay product.

The lhe files and hepmc files can be used to produce published and unpublished dataset for CMS physics analysis. For processes which have lhe format output, one could use crab tool. For hepmc format output, we have to use condor tool.

Reference

[1] "HELAC-Onia 2.0: An upgraded matrix-element and event generator for heavy quarkonium physics", 198, January 2016, Pages 238-259