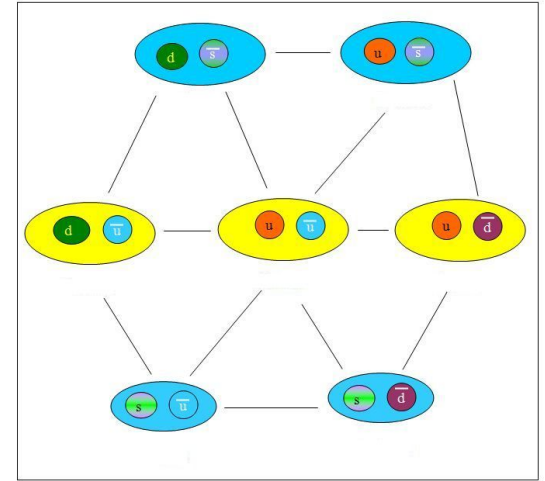# Hard exclusive meson production

- Simulating **multiple production modes** of heavy mesons
  - Quasi-photoproduction
  - Electroproduction
- Current mesons: **J/Ψ, Υ(1S, 2S, 3S)**
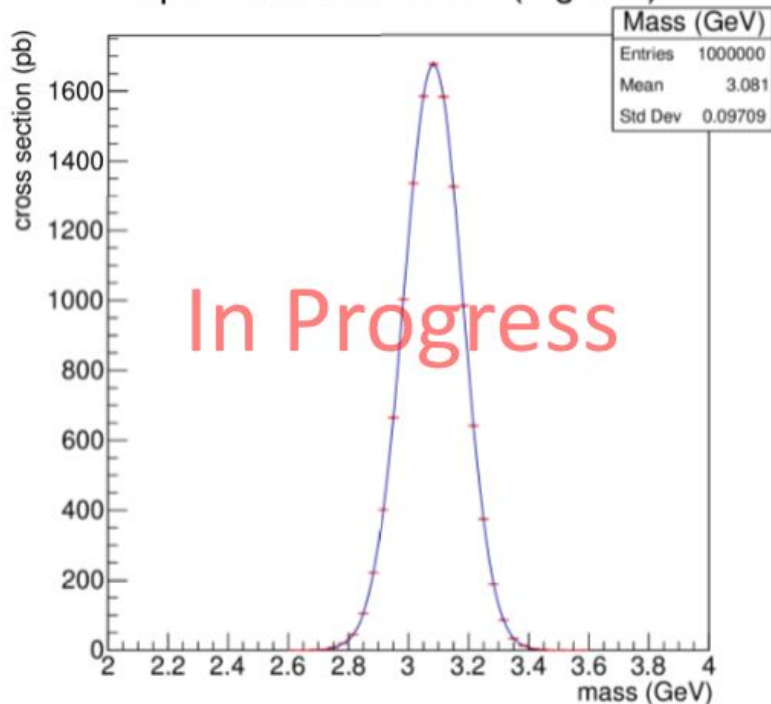 - Generator designed flexibly (**DEEPSim**)
  - Easy to add more

J/Ψ Production

- Mass distribution: **Gaussian**
  - Customizable width
- Both **two-** and **three-gluon** cross sections
  - Generated at any ratio
- Fairly basic **form factor**
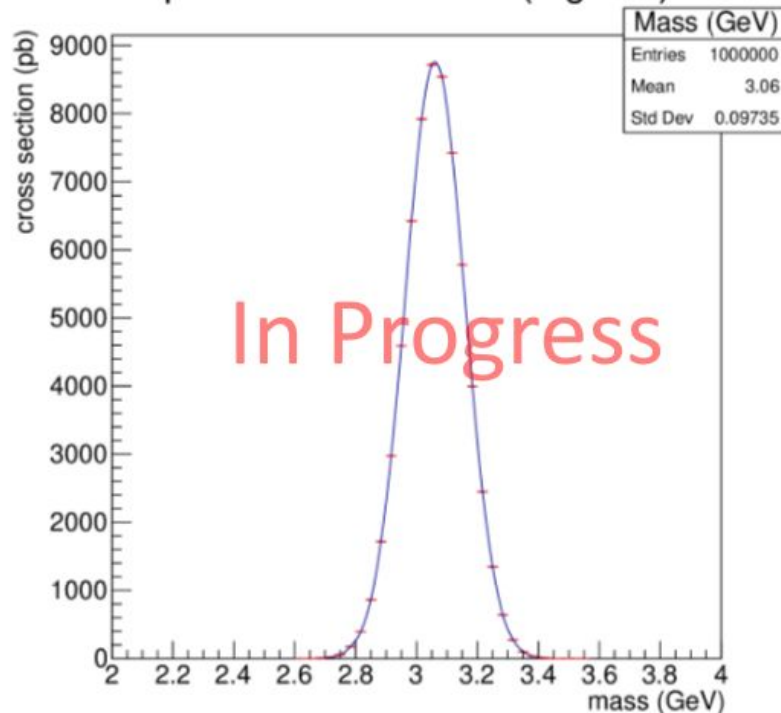 - Should consider **recombination of protons** after emitting quarks *(Brodsky et. al, 2018)*
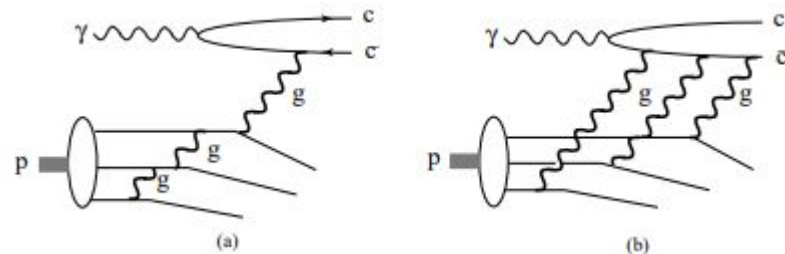
J/Ψ (Photoproduction) [Low E]

J/Ψ (Photoproduction) [High E]

J/Ψ (Electroproduction)
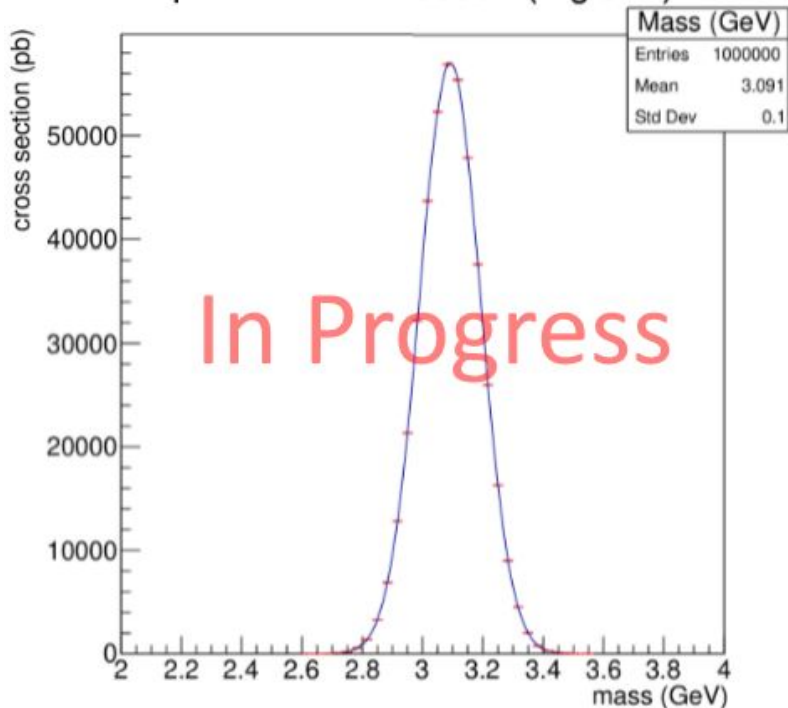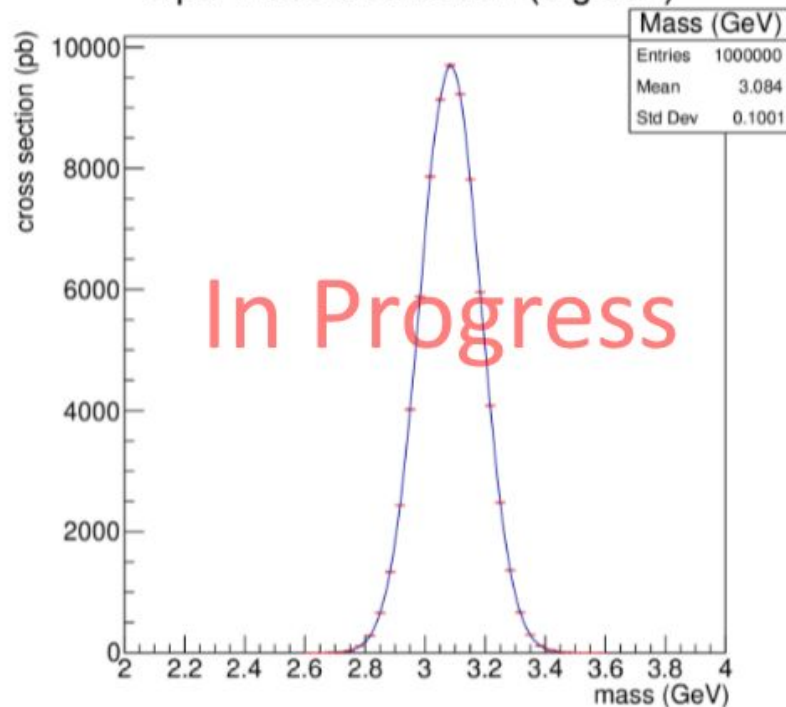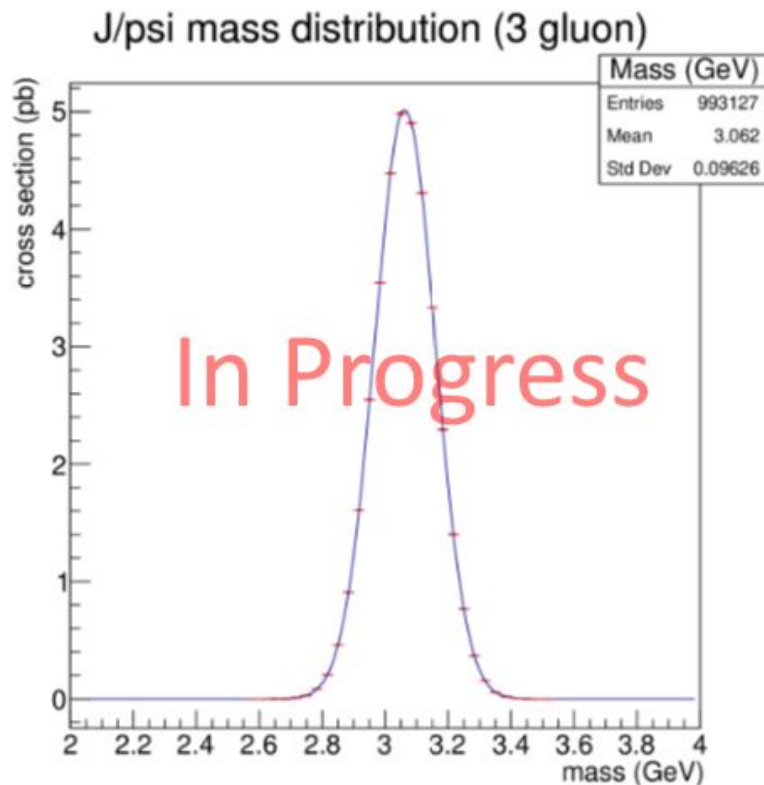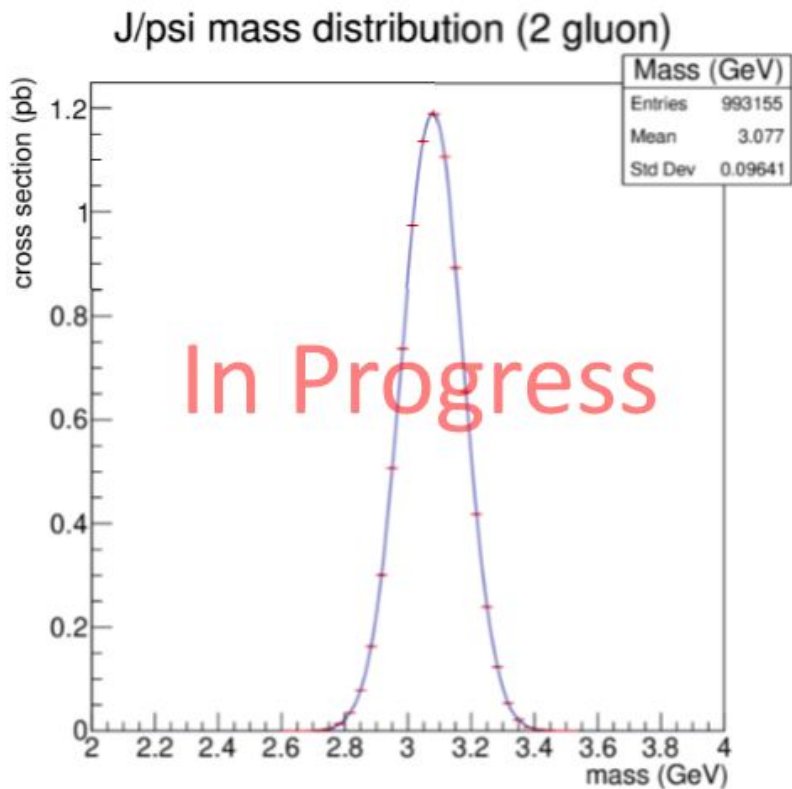
Υ Production

- Mass distribution: **Gaussians**
  - Normalization of 1S, 2S, 3S from LHC pp data
- Access both **quark** and **gluon GPDs** (numerical results from CTEQ)
  - Factorization scale: $M_Υ$
- Only **2-gluon exchange** (Forshaw & Poludniowski, 2003)

ϒ Production

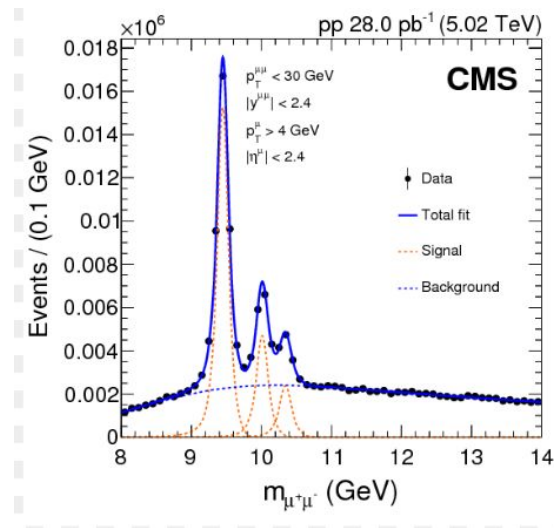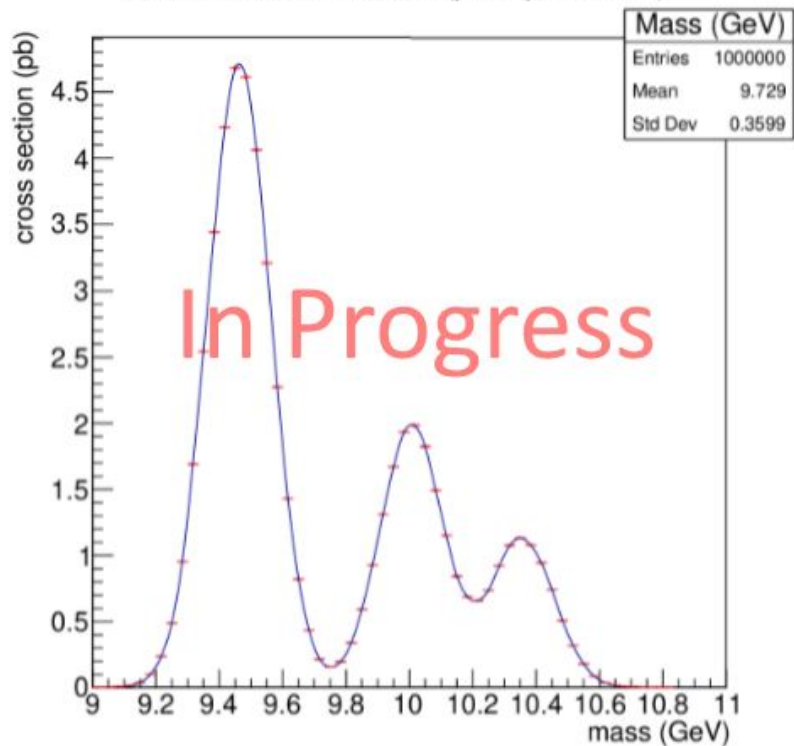Upsilon mass distribution (photoproduction)

Mass (GeV)	
Entries	1000000
Mean	9.729
Std Dev	0.3599

Upsilon mass distribution (electroproduction)

Mass (GeV)	
Entries	999937
Mean	9.682
Std Dev	0.3406

Next Steps

- **Better approximations**
  for Y production
  - CTEQ 6?
- Further refinements
  for **high-energy electroproduction**
- More mesons (ρ, ω?)
- **Completion & release of DEEPSim**

Sources

- https://epjc.epj.org/articles/epjc/abs/2003/01/100520411/100520411.html?mb=1
- https://pdg.lbl.gov/2014/listings/rpp2014-list-J-psi-1S.pdf
- https://arxiv.org/pdf/hep-ph/0010343.pdf
- https://cds.cern.ch/record/2319759/