A new event generator

Toward a cluster fragmentation model for SHERPA

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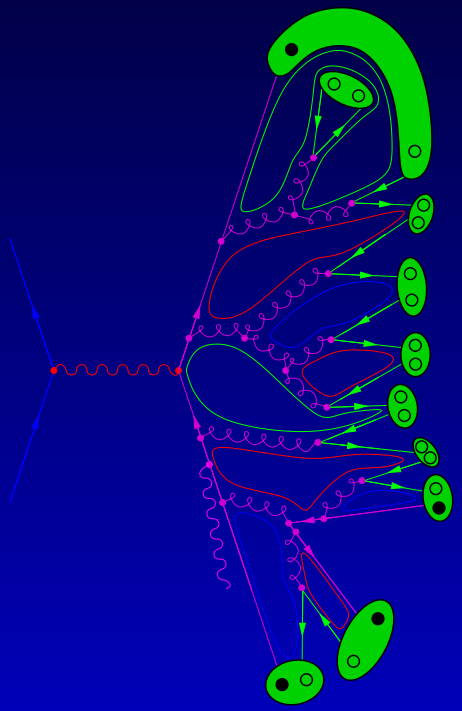
Outline:

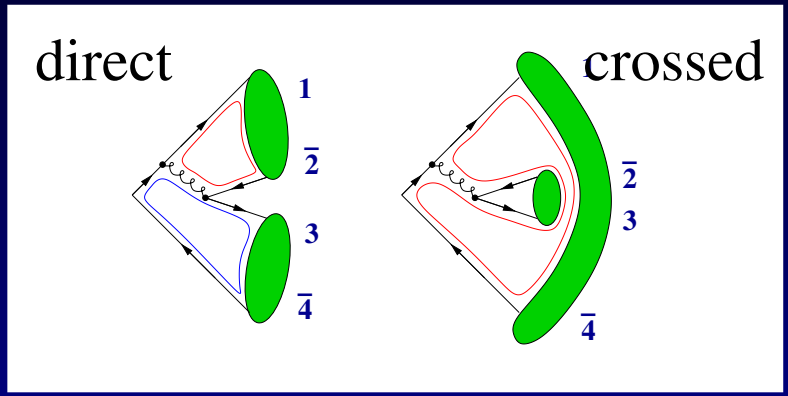
1. General remarks on cluster fragmentation
2. Cluster formation
3. Production of light flavour pairs
4. Cluster decays
5. A few results

Cluster formation I - principle



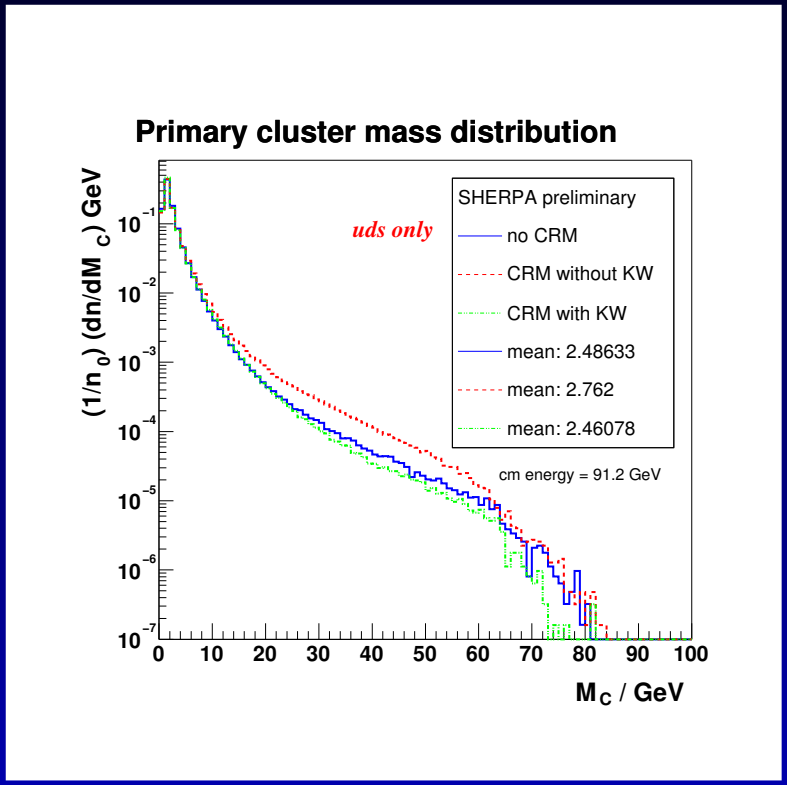
- Parton shower terminates at some $p_\perp^{\min} = \mathcal{O}(1\text{GeV})$.
- Partons are brought to constituent masses (in each colour singlet).
- Gluons ($m_g = \mathcal{O}(1\text{GeV})$ are forced to split, $\sim P_{g\to q\bar{q}}(z) \sim z^2 + (1-z)^2$. (May involve also diquarks.)
- Neighbouring colours form a neutral cluster.

Cluster formation II - details

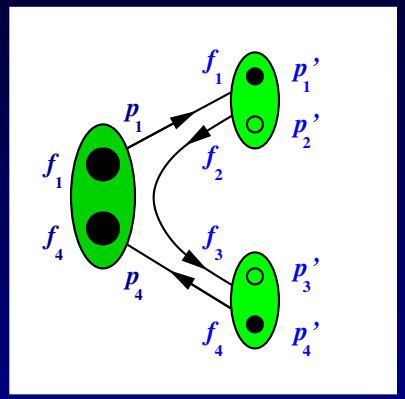


- Model soft, non-pert. colour reconnections.
- "Naive" relative weight crossed/direct $\sim 1/N_c^2$.
- Add a kinematic weight:
  $W = Q_H^2 / \left[Q_H^2 + 4(w_{\mathrm{ij}} + w_{\mathrm{kl}})^2\right]$, where
  Q_H = hadr. scale and $w_{ij} = m_{ij},\ p_{\perp,ij}, \ldots$.

Cluster formation II - details



Production of light flavour pairs



- Treat flavour just as "label".
- Anisotropic ("string-like") fission:
  $P_{12} = \left(1 - \frac{Q_f}{M}\right) p_1 + \frac{Q_f}{M} p_4$
  with Q_f = fission parameter.
- "Popping" of light quarks/diquarks:
  u, d, s, $ud_{0,1}$, $us_{0,1}$, $ds_{0,1}$, uu_1, dd_1, ss_1.

Two parameters: p_s, p_B for strangeness/baryon:

$$p_{u,d} = (1-p_B)\frac{1-p_s}{2},\ p_s = (1-p_B)p_s,$$

$$p^{S=0,1}_{ud,sd,su} = p_B\,\{1,\,3\}\cdot p_D,\ p^{S=1}_{dd,uu,ss} = 4p_B p_D,$$

$$p_D = \frac{p_{d,u}^{2-n_s} p_s^{n_s}}{3p_s^2 - 2p_s + 3}$$

Improvement: Add in constituent masses . . . .

Cluster decays I - principle

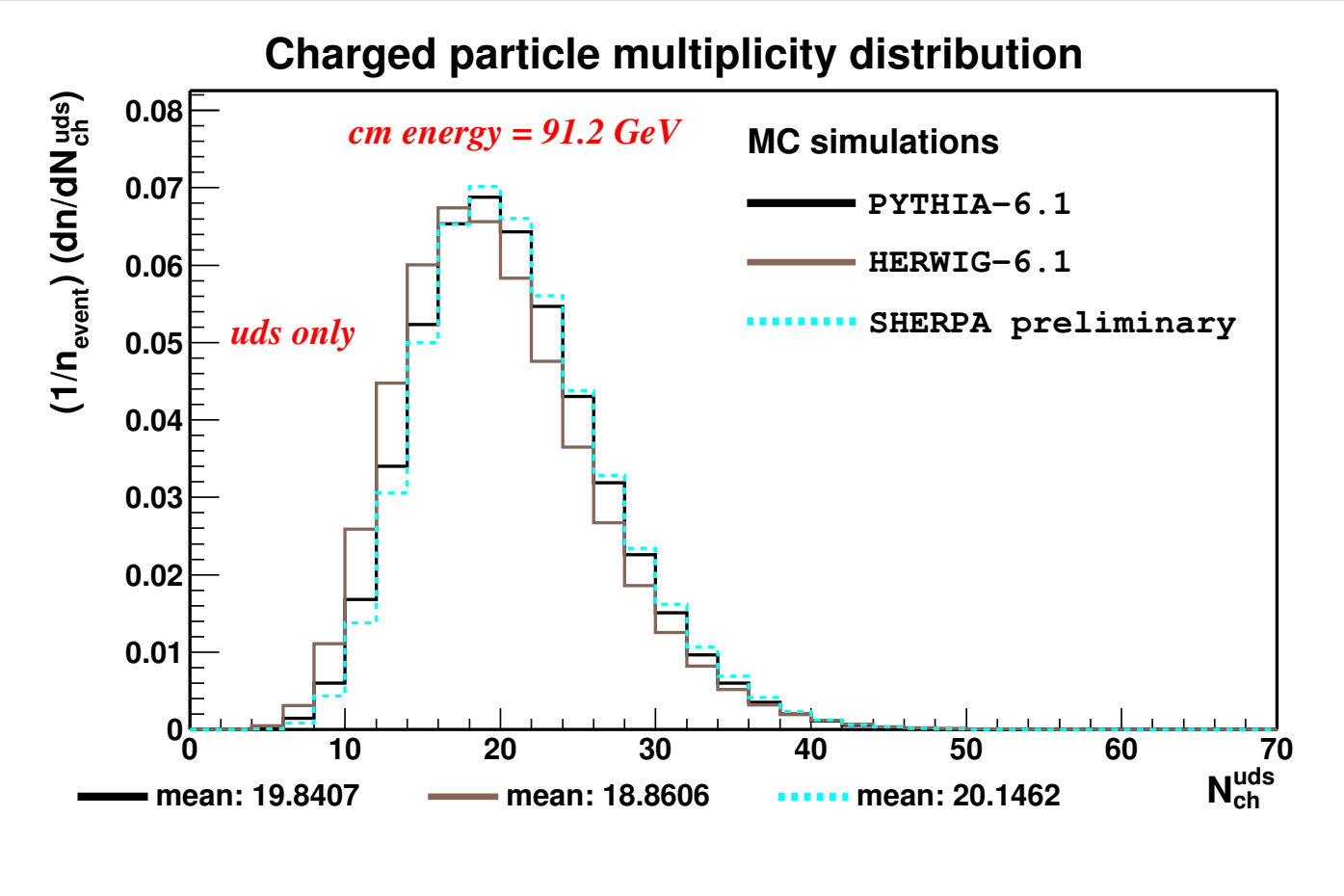
- Understand clusters as excited hadrons
  $\longrightarrow$ will decay further.
- In principle, there are various channels:
  $\mathcal{C} \to \mathcal{H}$, $\mathcal{C} \to \mathcal{C}\mathcal{C}$, $\mathcal{C} \to \mathcal{C}\mathcal{H}$, $\mathcal{C} \to \mathcal{H}\mathcal{H}$;
  have to separate regions of phasespace.
  (In Herwig: According to cluster mass.)
- In SHERPA: Dynamical separation.
  Mass of emerging compound(s) vs.
  mass of heaviest hadron with given flavour content.

Cluster decays II - details

- Select $\mathcal{C} \to \mathcal{H}$:
  Only hadrons with $m_H < m_C$ are allowed,
  spread leftover four-momentum over neighbours.
- For $\mathcal{C} \to \mathcal{C}\mathcal{H}$ and $\mathcal{C} \to \mathcal{H}\mathcal{H}$:
  Question : Which hadron to choose ?
  Answer : Combined weight
  phase space $\otimes$ flavour
  (overlap with spin-flavour wf. of hadrons,
  only complete multiplets ! strong isospin !)
  If $\mathcal{C} \to \mathcal{C}\mathcal{H}$: reshuffle momenta.
  If $\mathcal{C} \to \mathcal{H}\mathcal{H}$: isotropic in c.m. of $\mathcal{C}$.

Results (MCs):

Overall agreement (Tuned against Pythia 6.1)



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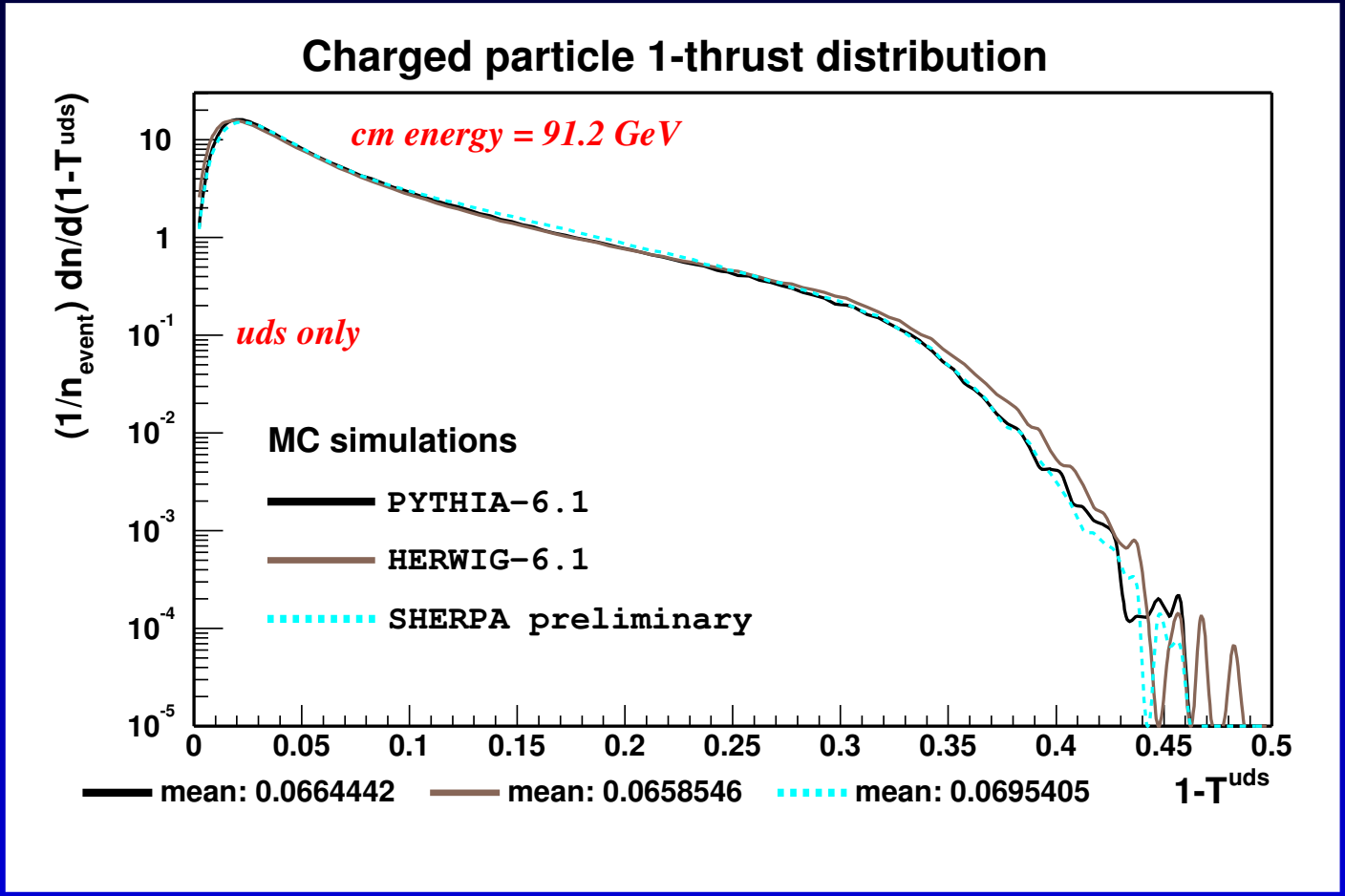

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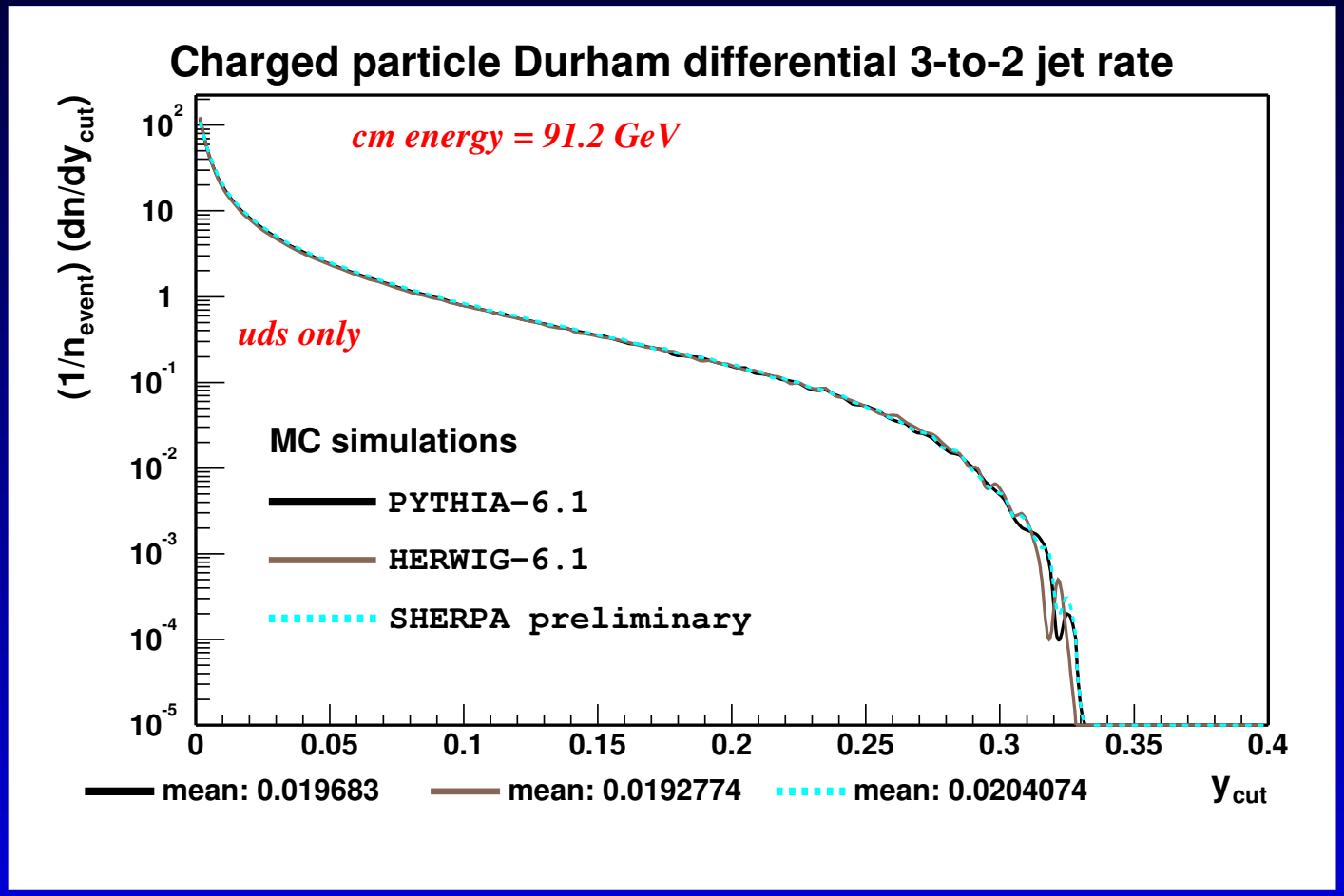
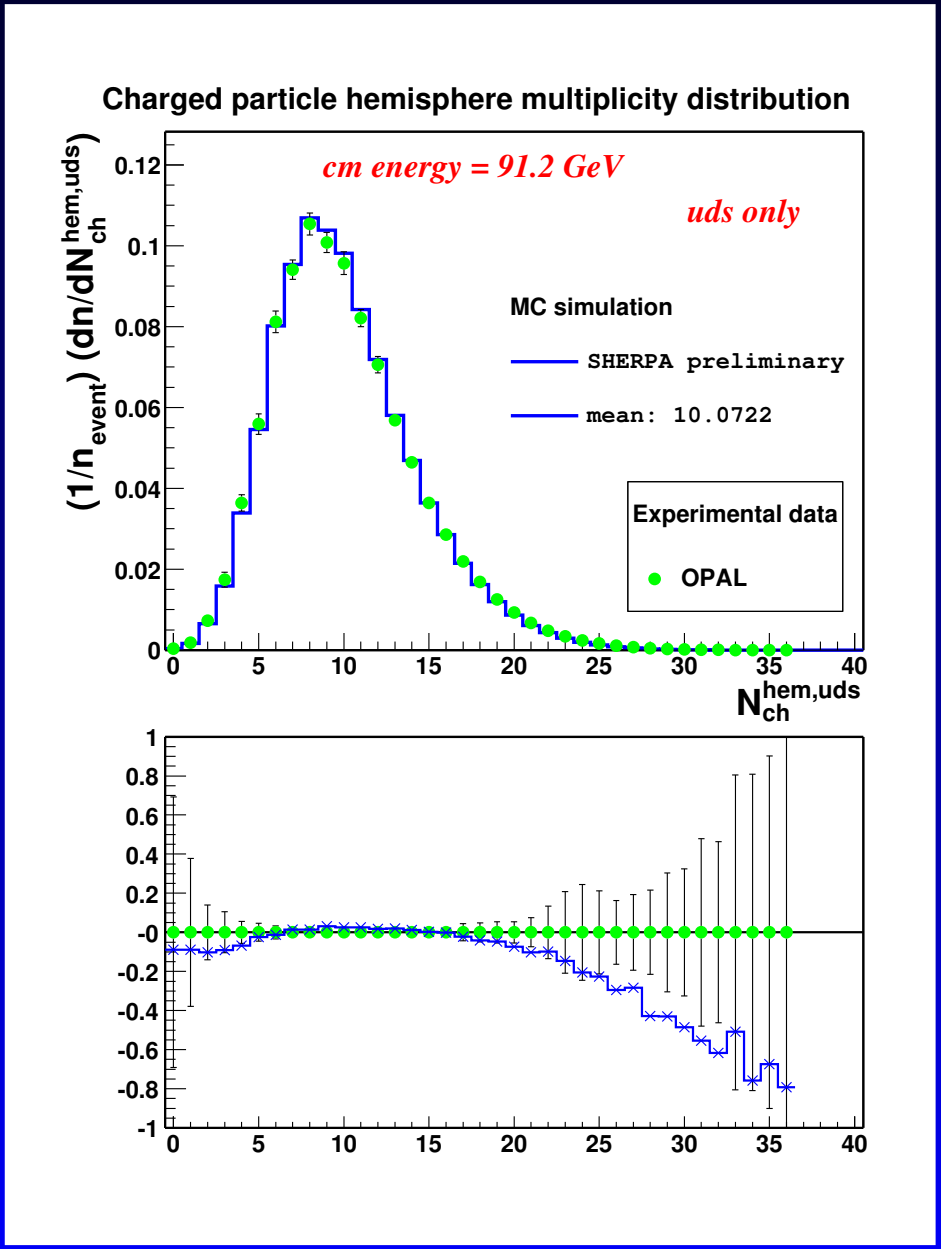


Results (Experiment):



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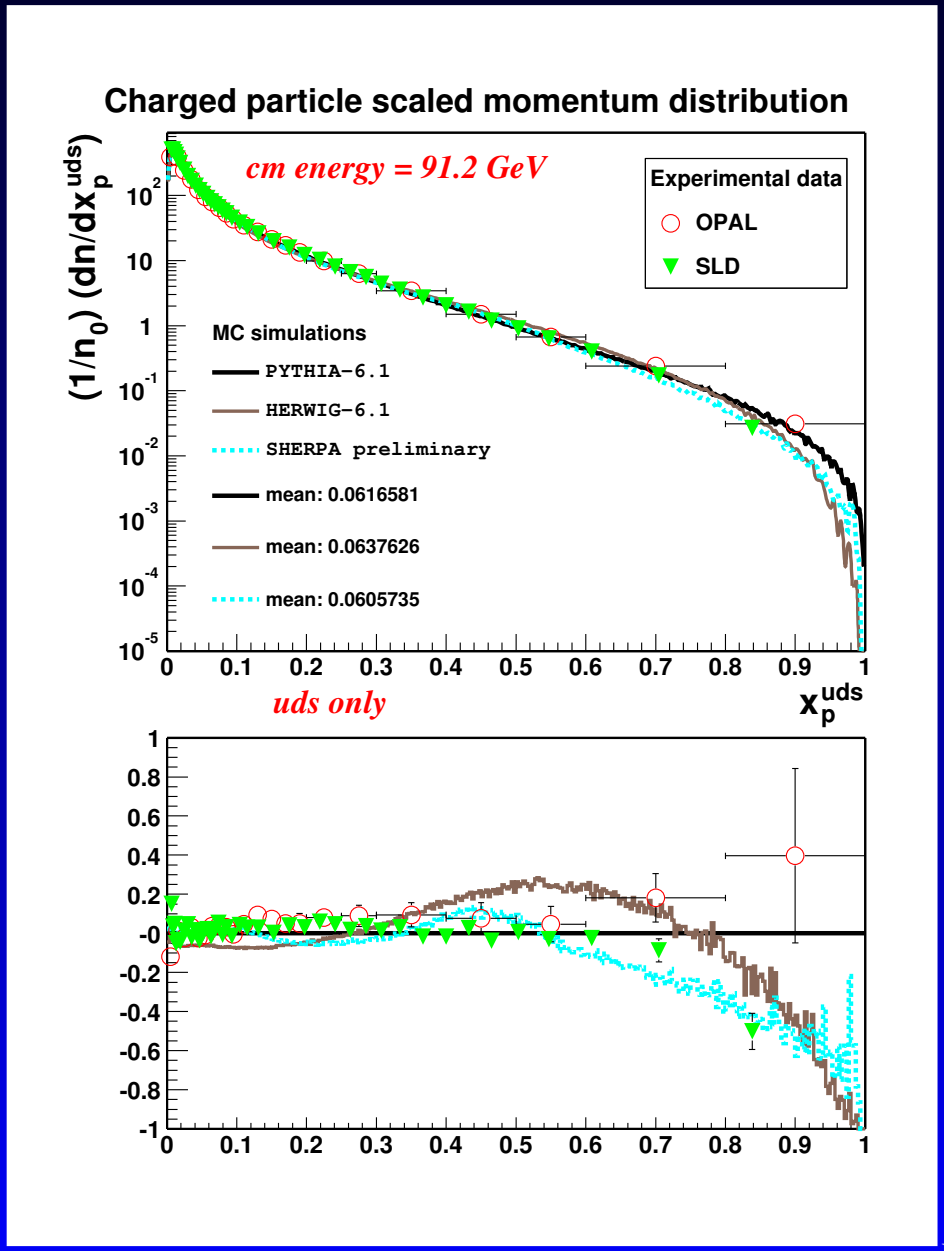

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