Pythia -Multiple Interactions Models

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Outline of the Talk

- Getting to know the "Jargon"
- "Old" Multiple-Parton-Interactions Model (CDF Default)
- "New" Multiple-Parton-Interactions Model
- Conclusions

Terminology Used

- First Hard Scattering- Hard Scattering with the Highest P_T (No Specific name for subsequent "Hard" Scatterings)
- Multiple-Parton-Interactions-Several Parton pairs undergo "Hard " Interaction in a hadron-hadron collision
- Pile-Up- Collision between beam particles in a Single Bunch Crossing
- Beam Remnants– Incoming Beam – (Intiaal State Shower +Hard Scattering)

Old MPI Model-Initial-State-Radiation (ISR)

- If the ISR is included:
  1. The ISR algorithm reconstructs ONE Shower intiator in Each beam
  2. Two Shower Initator (aka ISR) + Hard Intersction+ Final State Radiation (FSR) form the “Event” subsystem
  3. Whatever is left behind after 2. is called Beam Remants
- If ISR is not included :
  1. Only affect the properties of the Beam Remnants

PS: No Explicit definition or descriptions on what is considered Final-State-Radiation

Old MPI – Beam Remnants

- Could consist of Single or Multiple Beam remnants
- Shower Initiator (one of the two that lead to ISR) carries x fraction of Beam energy
- 1-x is divided between remaining beam remnants
- Energy and Momentum conservation required from the Beam Remnants
- Example for a Beam Remnant: If the initiator is u or d quark leaves behind a diquark beam remnant
- The intiator is given a primordial k_T ~ 300 MeV
- Shower does not evolve below 1 GeV

Old Multiple Parton Interactions Model

- Total Rate of parton-parton interactions as function of Transverse Momentum scale (p_T)– given by pQCD
- Perturbrative parton-parton scattering framework extended to Low- p_T too.
- Regularization of Divergence of σ when p_T -> 0 is introduced through a cut-off parameter $p_{T\ min}$
- Pair wise Parton-Parton interactions in a Single Hadron-Hadron Collision assumed to be independent of each other

New MPI Model

- Limitations of Old One:
  1. All subsequent interactions after the First Hard Interaction is simplified
  2. No way to Handle complicated Beam remnants scenario
  3. $p_{T\ min}$ is set
- New MPI Model:

  1.Generate sequence of p_T ordered interactions ($p_{T1} > p_{T2} > p_{T3}$ .....)

  2.Sequence cut-off at $p_{T\ min}$, which is smoothly damped

  3. Flavor and Color content of beam remnant is book kept religiously

  4. Flavor content of beam remnant is used to determine the possible flavors I n subsequent interactions

New MPI Model

- Standard Parton Distribution functions are used ONLY for "Hardest Interaction"
- The x scale of the parton densities is rescaled in subsequent interactions such that the new x' corresponds to remaining momentum rather than the

Original beam momentum

- Each subsequent interaction after the Hardest may now have Initial and Final state Shower activity associated with it
- Color Topologies:

  Scattered Partons connected to Beam remnants in Colors

Conclusion:

- Monte Carlo Sample with No Old Multiple – Parton Interactions Model is being genrated
- New Model requires Help for Sasha Glossonav