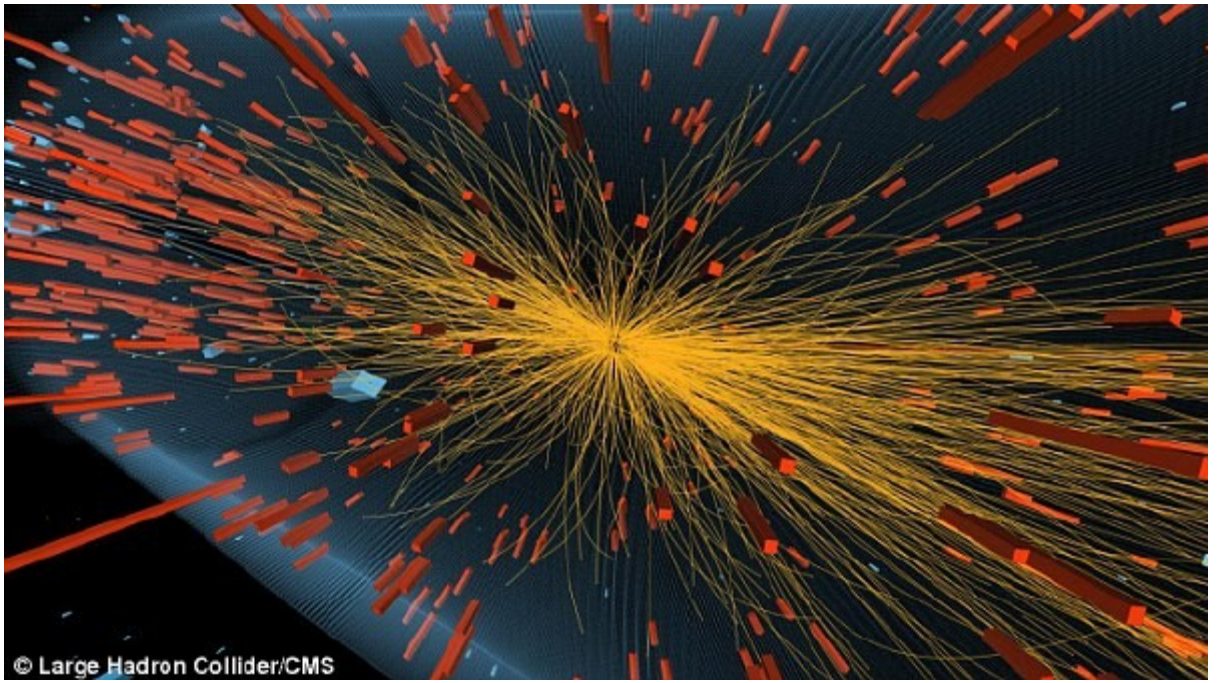
Uma Breve introdução ao Pythia



Uma Breve introdução ao Pythia

- Simulação Vs Realidade
- O Evento
- Estrutura da Geração de Eventos
- Saída
- Exemplo

Simulation Vs Reality

Simulation	'Real life'
Event Generation	**Collisions**
Tools: **MC** generators (PYTHIA, ...)	*Tools:* Accelerator (LHC, Tevatron ...)
Output: final state particles	*Output:* final state particles
Detector simulation	**Data acquisition**
Tools: **MC** simulators (GEANT)	*Tools:* Detectors (CMS, ATLAS,...)
Output: simulated detector response	*Output:* detector response
Event reconstruction	
Tools: Detectors' software packages (custom made; **MC** used in algorithms)	
Output: reconstructed physical objects (electrons, muons, jets ...)	
Data analysis	
Tools: Statistics (ROOT, ...; **MC** used in algorithms; f.g. **Toy MC**)	
Output: new knowledge (parameter/interval estimates, hypothesis tests, article, talks ...)	

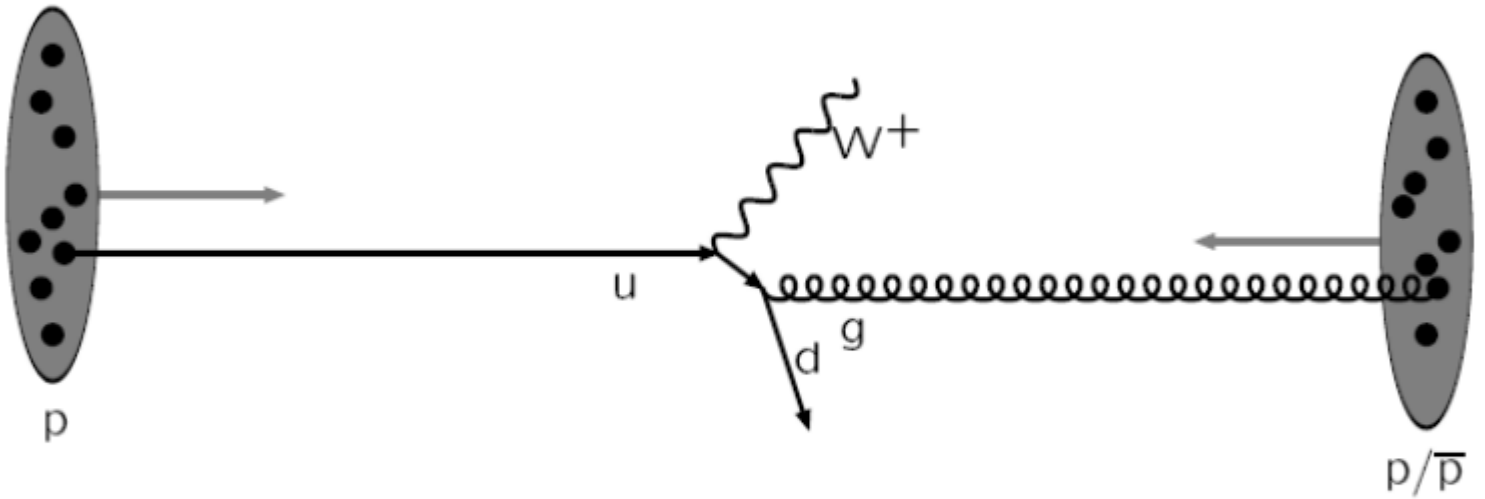
O Evento

Two beams coming in towards each other. Each particle is characterized by a set of parton distribution function, which defines the partonic substructure in terms of flavor composition and energy sharing.

Incoming beams: parton densities

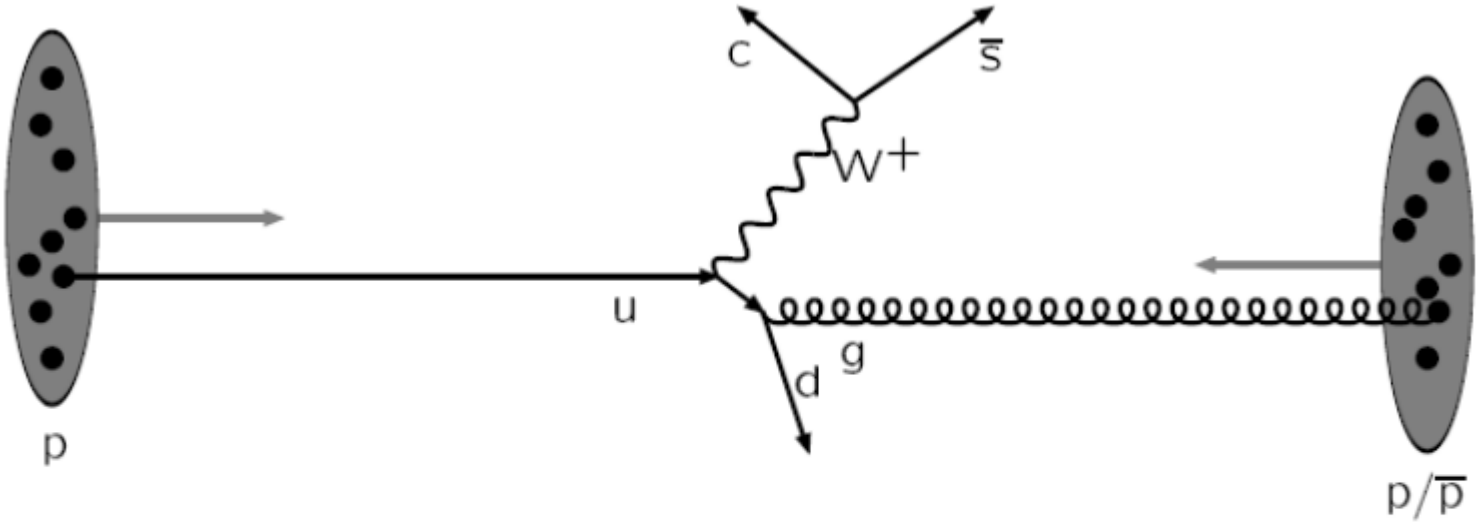
O Evento

One incoming parton from each of the two showers enters the hard process, where then a number of outgoing partons are produced, usually two. It is the nature of this process that determines the main characteristics of the event.



Hard subprocess: described by matrix elements

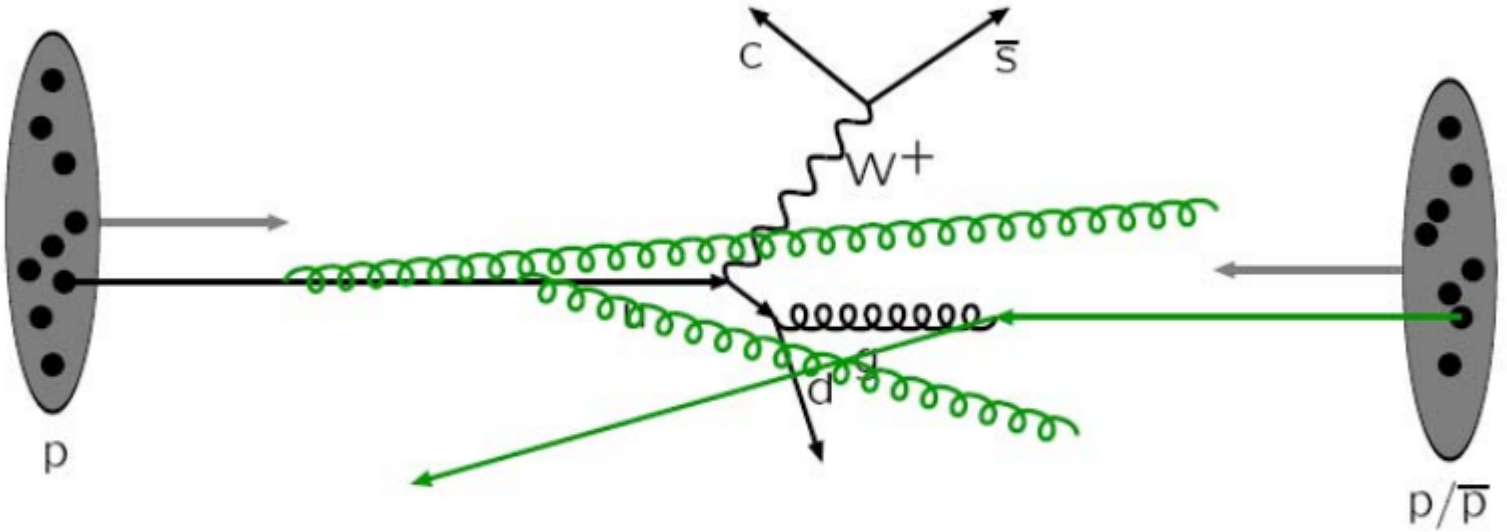
O Evento



Resonance decays: correlated with hard subprocess

O Evento

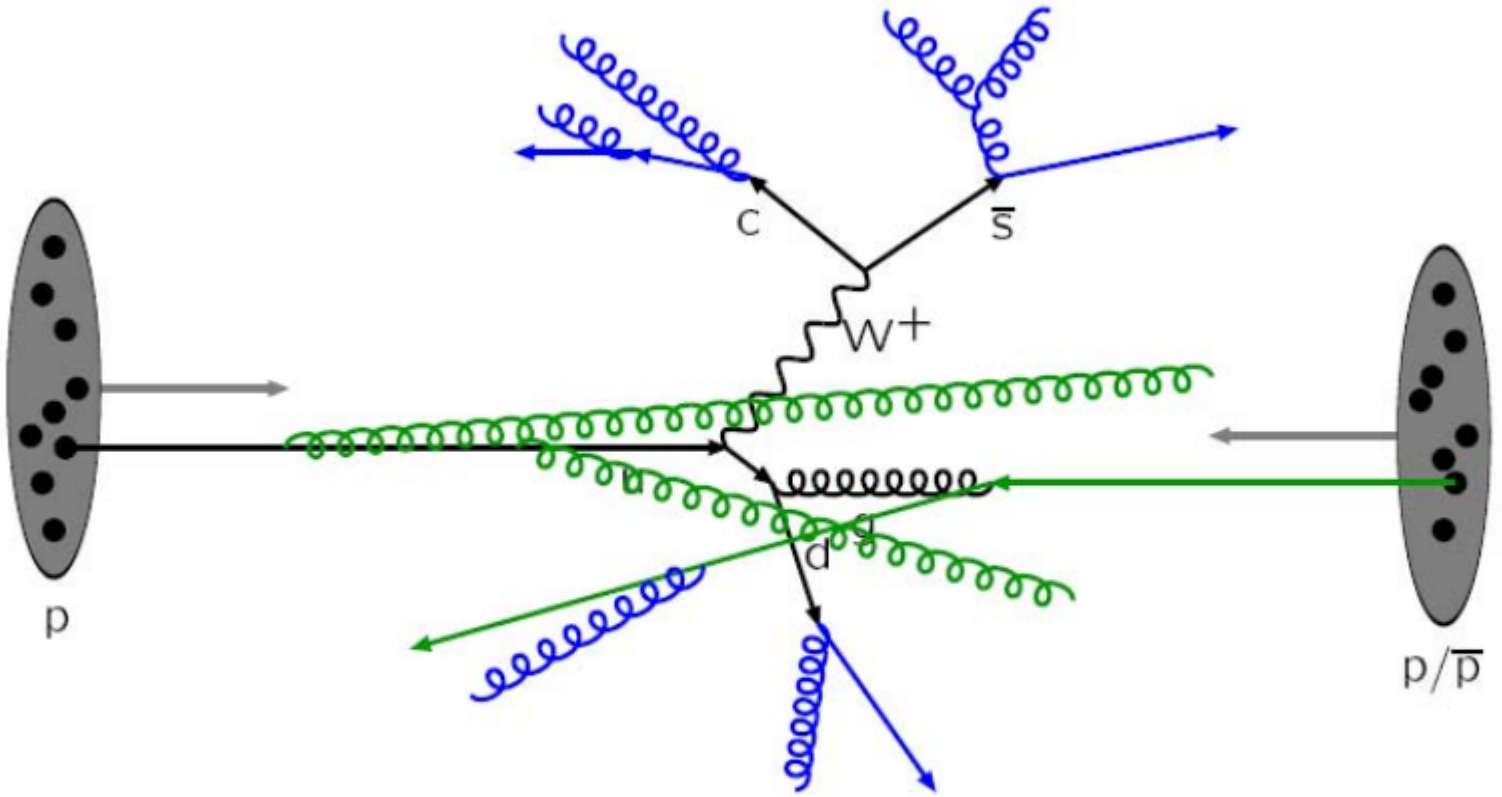
One shower initiator parton from each beam starts off a sequence of branchings such as $q \rightarrow qg$, which build up an **initial-state shower**.



Initial-state radiation: spacelike parton showers

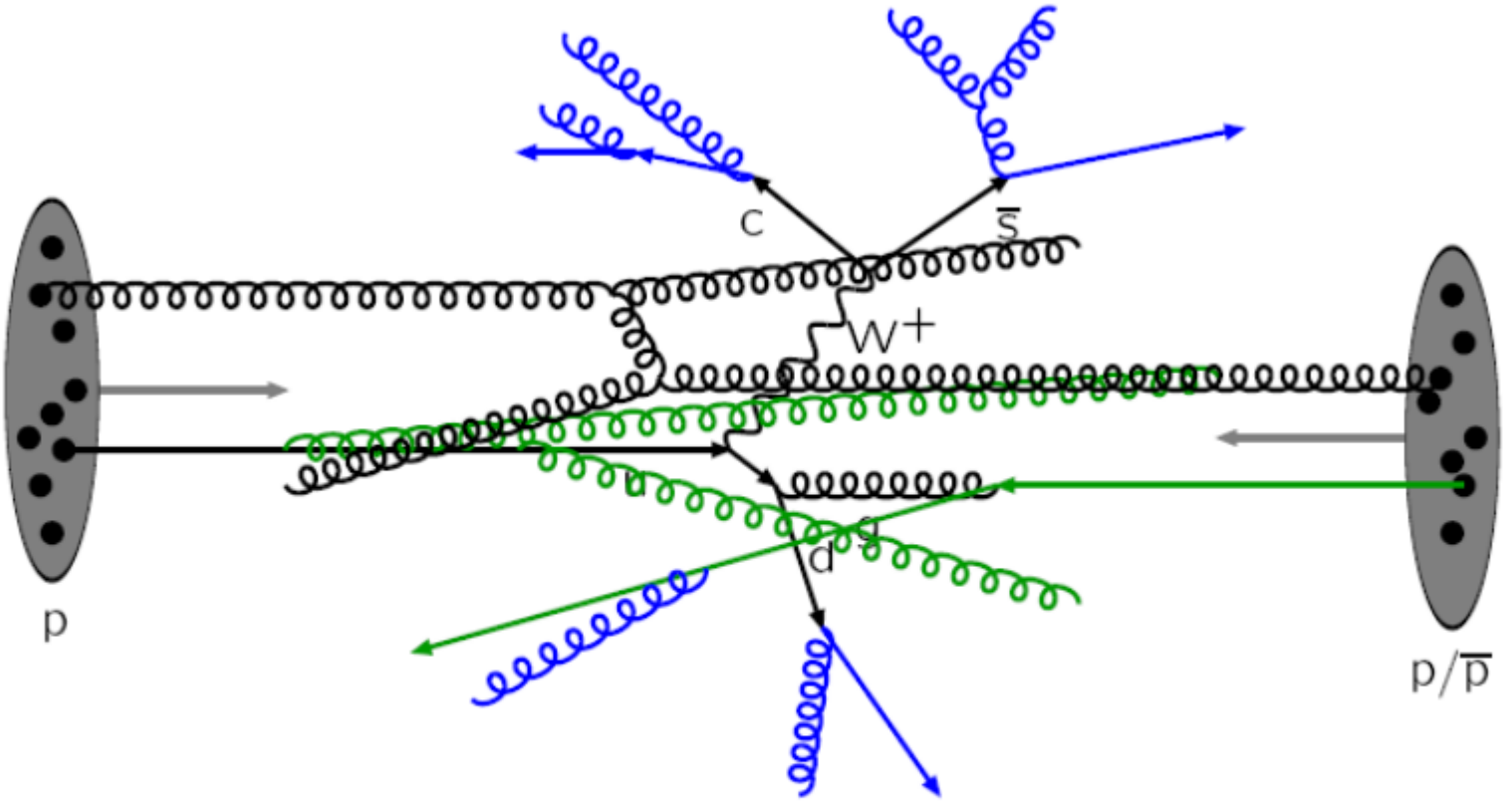
O Evento

Also the outgoing partons may branch (multiple interactions), to build up final-state-showers



Final-state radiation: timelike parton showers

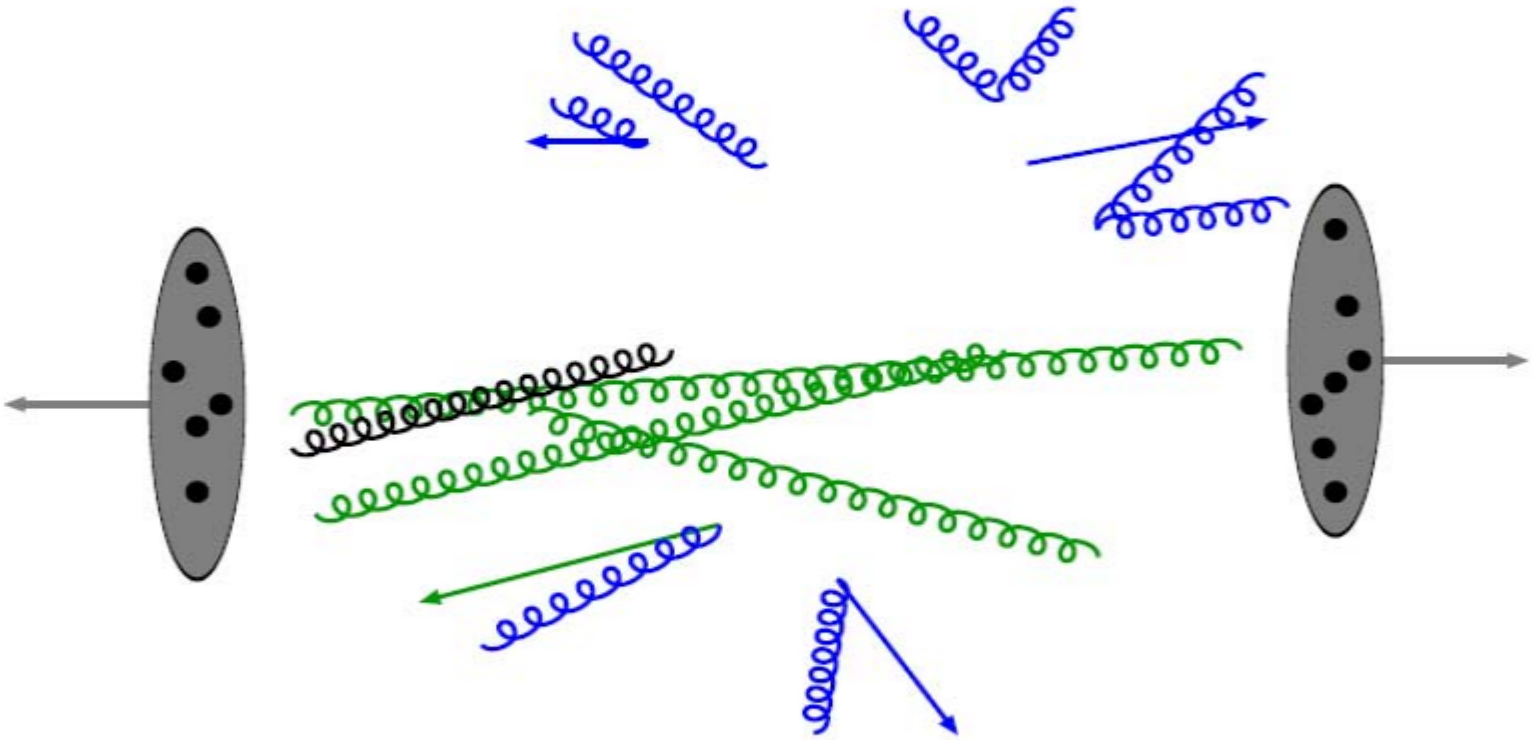
O Evento



Multiple parton–parton interactions . . .

O Evento

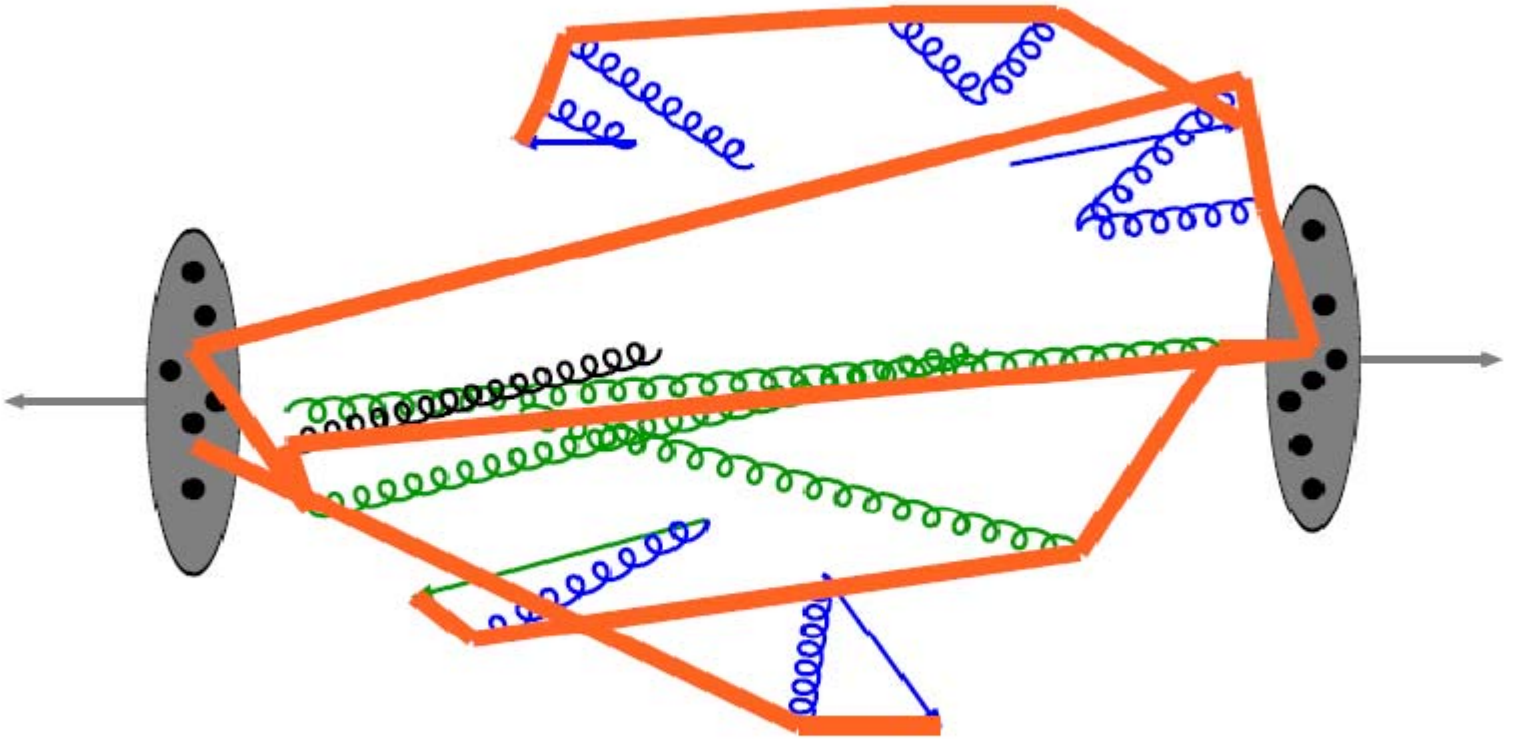
When a shower initiator is taken out of a beam particle, a beam remnant is left behind. This remnant may have an internal structure, and a net color charge that relates it to the rest of the final state.



Beam remnants and other outgoing partons

O Evento

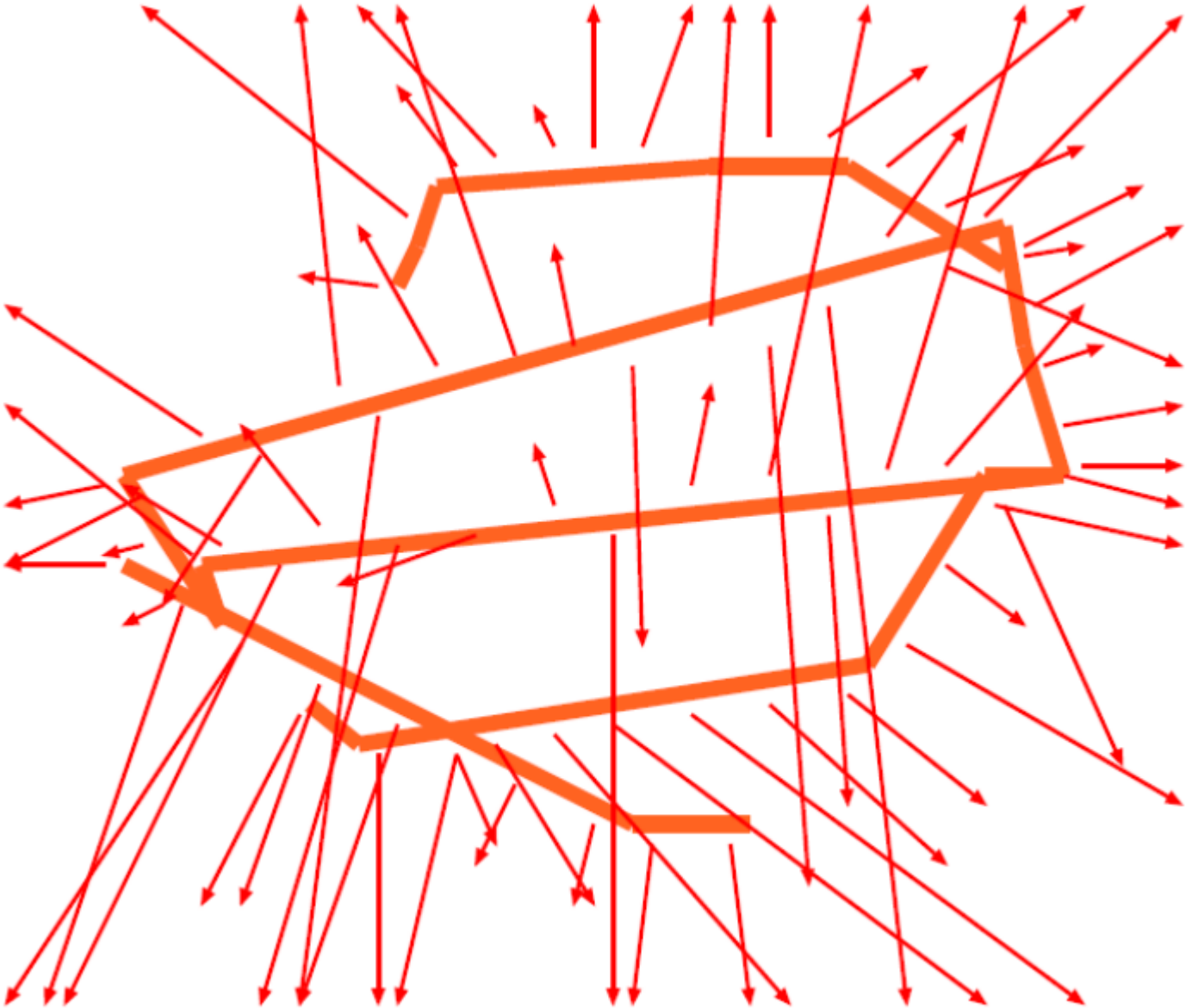
The QCD confinement mechanism ensures that the outgoing quarks and gluons are not observable, but instead fragment to color neutral hadrons.



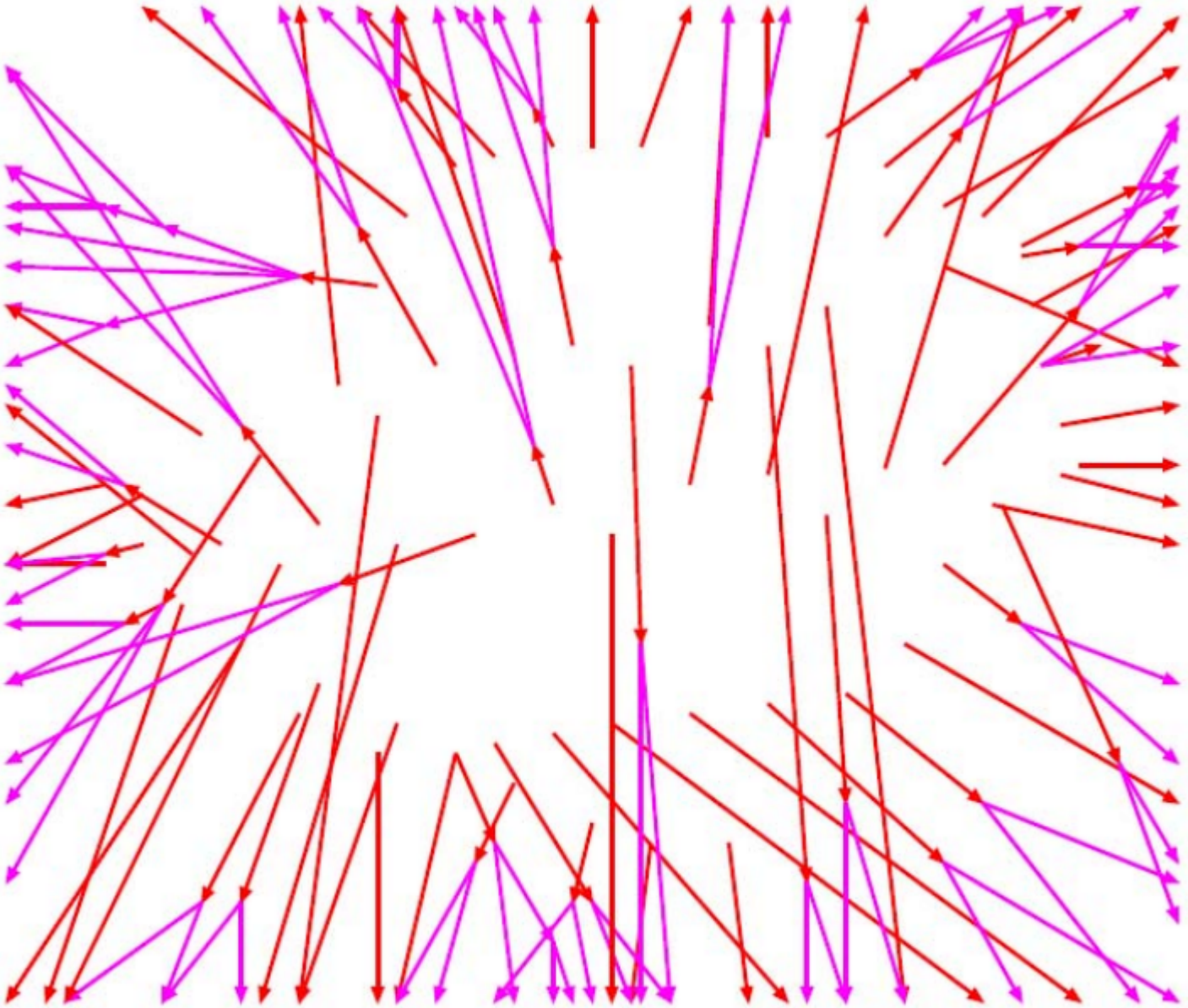
Everything is connected by colour confinement strings

Recall! Not to scale: strings are of hadronic widths

O Evento



O Evento



Estrutura da Geração de Eventos

- **Initialization step**
  - Select process to study
  - Modify physics parameters
  - Set kinematic constraints
  - Modify generator settings
  - Initialize generator
  - Book histograms
- **Generation loop**
  - Generate one event at a time
  - Analyze it
  - Add results to histograms
- **Finishing step**
  - Print cross-sections/BR
  - Print/save histograms

Saída

- Informações como a cadeia de decaimento, Id, status, momentos, energia…

- Diversos tipos de formato:
  - LHE
  - HepMC
  - ROOT
  - ...

Exemplo – Formato LHE

Referências

- http://home.thep.lu.se/~torbjorn/welcomeaux/talks.html

- http://home.thep.lu.se/~torbjorn/Pythia.html