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What ever happened to ARIADNE

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- Introduction
- The Original Dipole Shower — still unique
- CKKW-L
- Very old Fortran vs. new C++ version
- Outlook

The Original Dipole Cascade

- Describe gluon emissions in terms of radiation from colour dipoles
- Instead of one parton splitting into two, we have one dipole splitting into two, or two (colour-connected) partons into three.
- $g \to q\bar{q}$ is still treated as normal parton splitting
- Time-like dipole shower ordered in transverse momentum is equaivalent to normal (angular ordered) parton shower (recently disputed)
- Excellent description of LEP event shapes etc.

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Initial-state radiation

- All gluon radiation is treated as final-state emissions (Sic!)
- Also radiation from dipoles connecting the proton remnants
- Semi-classical model. If you kick out a quark from a proton in DIS, a dipole is formed between the struck quark and the proton remnant, giving a huge colour-antenna which can radiate gluons.
- For high-$p_\perp$ emissions, the proton-remnant part of the dipole must be considered being extended, which reduces the activity in this direction.
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- High $p_\perp$ gluons may be emitted in forward directions before softer emissions close to the hard sub-process.
- Corresponds to a resummation of large $\log 1/x$ terms, although not exactly BFKL or CCFM.
- Reasonable agreement with HERA data
- Why use it for LHC?
- The only(?) event generator able to reproduce HERA forward jets.
- Can any of the standard parton showers reproduce forward jets at the LHC?
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CKKW-L

CKKW-L merging with matrix elements was originally developed for ARIADNE. But CKKW-L is not ARIADNE with CKKW, it is a CKKW-like procedure which works with any parton shower with on-shell intermediate states.

Note that merging schemes implies that matrix elements are combined with a resummation corresponding to the parton cascade. If the parton cascade is DGLAP based, you will get a DGLAP resummation.

New dipole shower implementations are DGLAP based — ARIADNE also resums $\log 1/x$-terms.

NLO merging

CKKW-L has recently been extendet to also do multi-jet NLO merging (NL^3)

This precedure has been implemented for ARIADNE in e^+e^-.

The implementation for LHC processes will be done in PYTHIA, since there is a problem with ARIADNE:

Gluon emissions do not take into account standard parton densities, so the formal expansion of the shower in α_s is impossible.

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Recoil gluons

An emission of a high-$p_\perp$ gluon only resolves a small part of the proton remnant. Hence only that part will take transverse recoil in the emission.

In ARIADNE this is handled by an additional recoil gluon being emitted together with the normal one.

This makes normal CKKW-L difficult, and NL^3 merging becomes almost impossible.

The ARIADNE program

- Current version 4 has been around since 1992
- Not much has been improved the last 5 years
- CKKW(-L) possible but cumbersome
  (Gosselink has put W/Z+jets in the Atlas framwork)
- NL^3 not possible for LHC
- Heavily/successfully used by LEP and HERA
- Not used at all at the Tevatron
- Not suitable for Higgs production
  (no initial-state $q \to g$ splitting)

Current status of ARIADNE

- Completely rewritten in C++ using THEPEG (main work by Nils Lavesson)
- Almost all components are in place
- Simple CKKW(L) matching
- $q \longrightarrow g$ splitting included
- String fragmentation with PYTHIA8
- Validated for e^+e^-
- Modified model for initial-state radiation without recoil gluons needed.

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Recent progress for ARIADNE

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none

DIPSY

Together with the DIPSY implementation of Muellers dipole evolution (in impact-parameter space) we have a new model for minimum bias and underlying events, which can even be applied to heavy ion collisions.

Outlook

A completely new and perfect C++ implementation of ARIADNE with automatic tree-level and NLO merging, which perfectly describes all data as it comes out of LHC, will be available and fully documented by the 30th of June 2011.