



Status of SHERPA

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Disclaimer: I am not an active Sherpa member

The Sherpa Project

[Gleisberg, Höche, Krauss, Schälicke, Schumann, Winter, JHEP 02 (2004) 056]

- **history in brief**

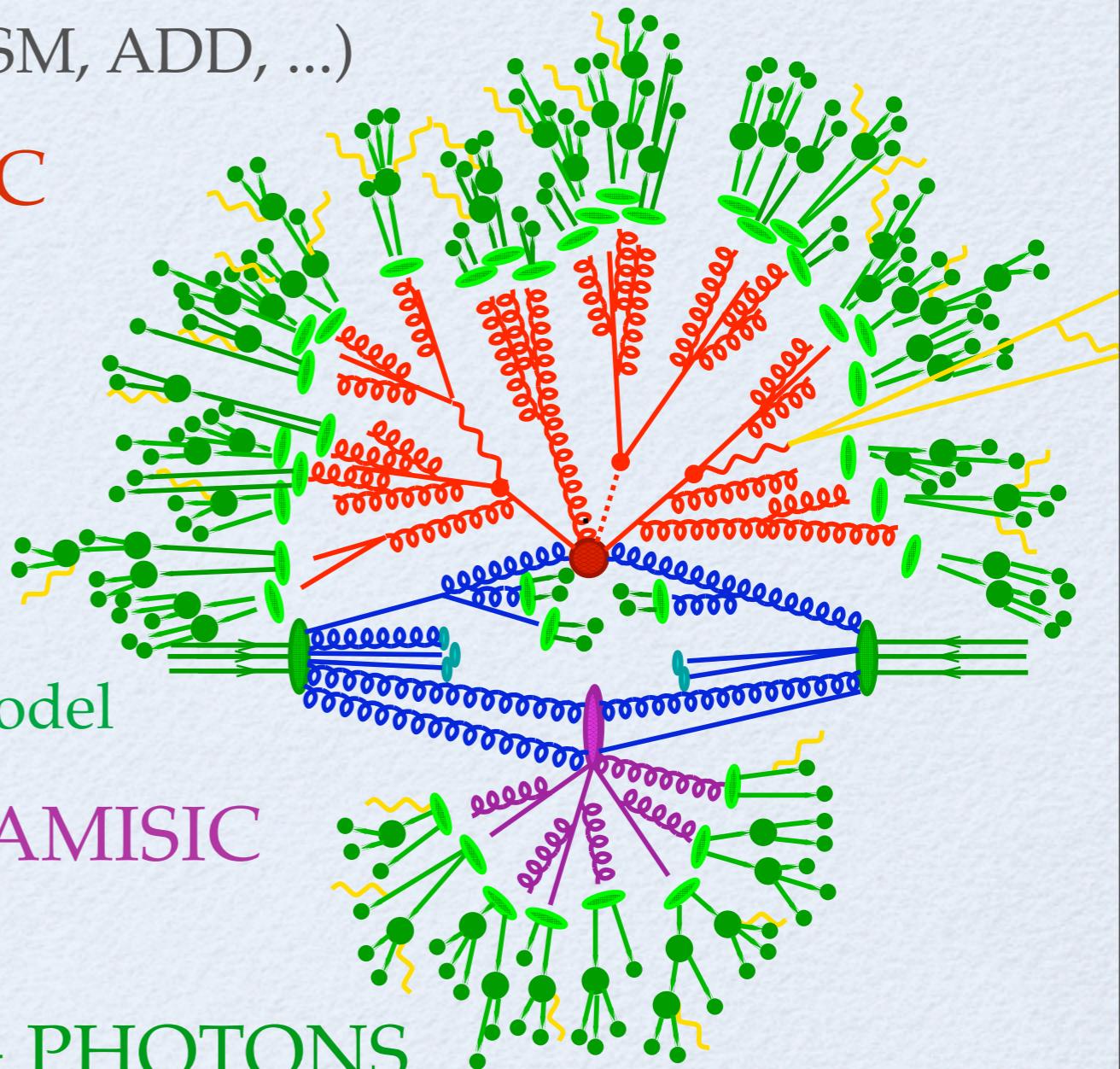
- Apacic++ 1.0 (1998), Amegic++ 1.0 (2000)
- first Sherpa version 1.0 α during MC4LHC workshop 2003
- release series 1.1.x -- complete physics (April 2008)

- **current development team**

- Frank Krauss, Frank Siegert (Durham)
- Tanju Gleisberg (SLAC)
- Stefan Höche (Zürich)
- Steffen Schumann (Edinburgh, on move to Heidelberg)
- Jan Winter (FNAL)
- Marek Schönherr (Dresden)

Physics of Sherpa

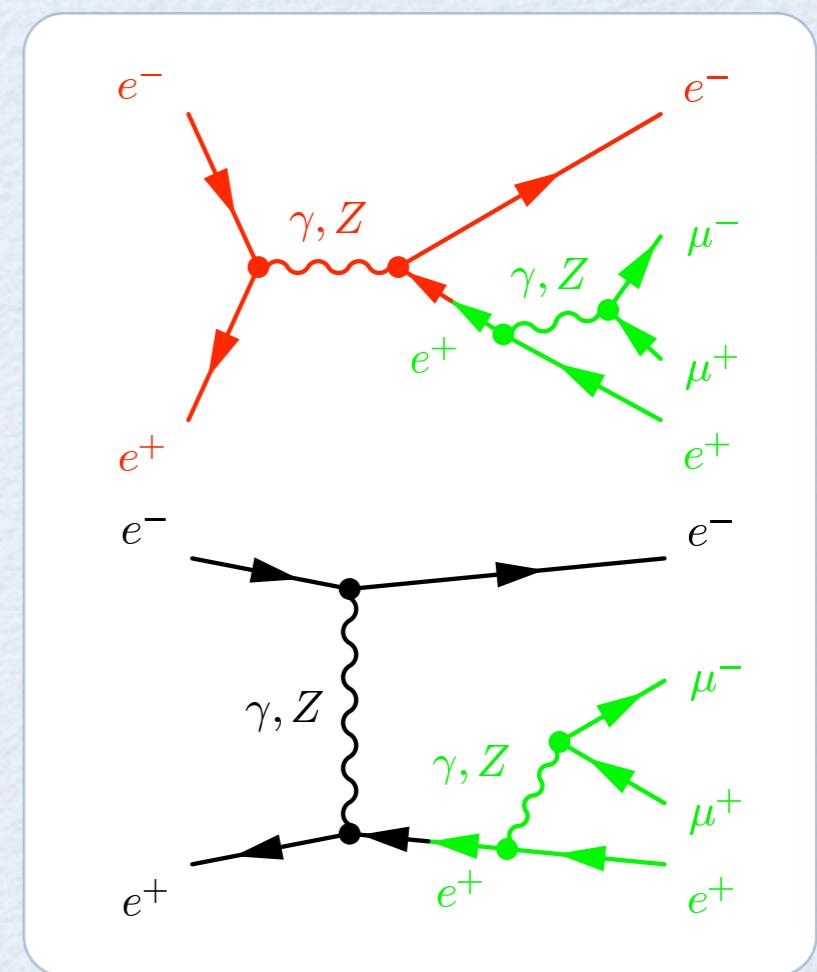
- Hard interactions: AMEGIC
 - tree-level ME generator (SM, MSSM, ADD, ...)
- QCD bremsstrahlung: APACIC
 - shower in initial and final state
- Merging of ME & PS
 - CKKW algorithm
- Hadronization AHADIC
 - non perturbative QCD: cluster model
- Multiple parton interactions: AMISIC
 - underlying event model
- Hadron decays: HADRONS + PHOTONS
 - matrix elements or phases space + YFS



ME part : Amegic

[Krauss, Kuhn, Soff, JHEP 02 (2002) 044]

- automatic tree-level matrix element generator
 - constructs Feynman diagrams
 - translate into helicity amplitudes
 - library with amplitudes and phase space mappings is compiled and loaded in run time
- available models:
 - SM + ggH + AGC + 4th family
 - MSSM (fully general)
 - ADD model of extra dimensions
 - addition scalar singlet
 - ... seamless user extension possible



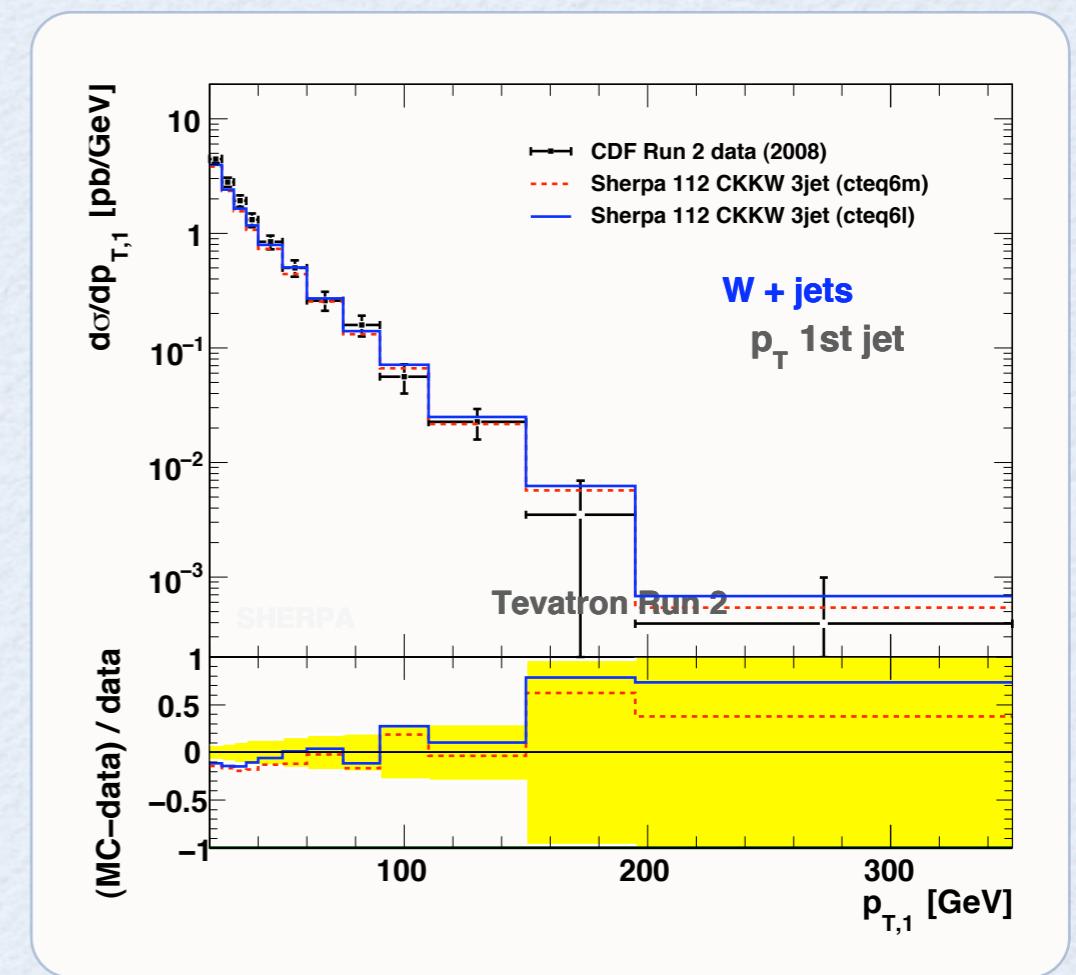
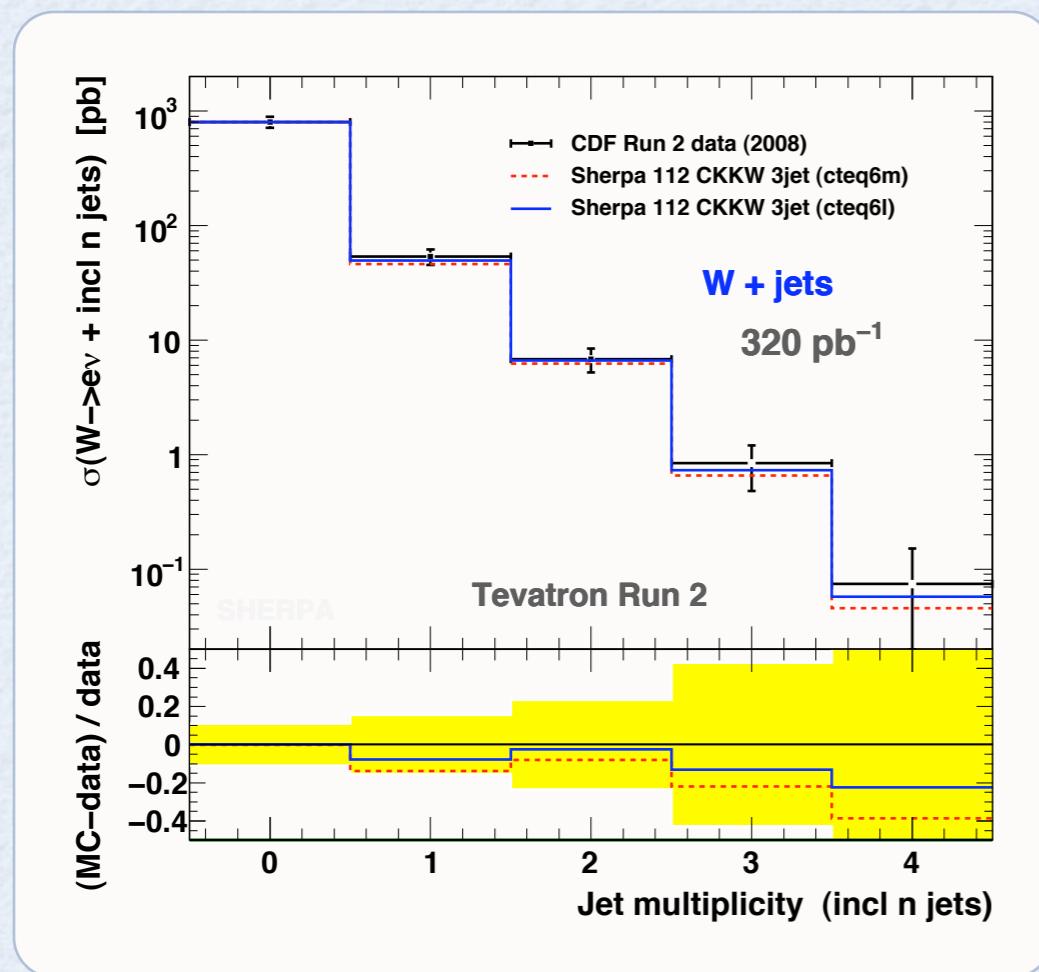
CKKW Merging

[Catani, Krauss, Kuhn, Webber, JHEP 11 (2001) 063]

- parton shower: Apacic [Krauss, JHEP 08 (2002) 015]
 - evolution parton virtuality
 - angular ordering by veto
- merging of multi-jet matrix elements with parton shower
 - hard emissions described by ME
 - soft and collinear emission covered by PS
 - CKKW: reweight ME and veto shower evolution
 - consistent description of soft and hard regions
- key feature of Sherpa

CKKW Merging

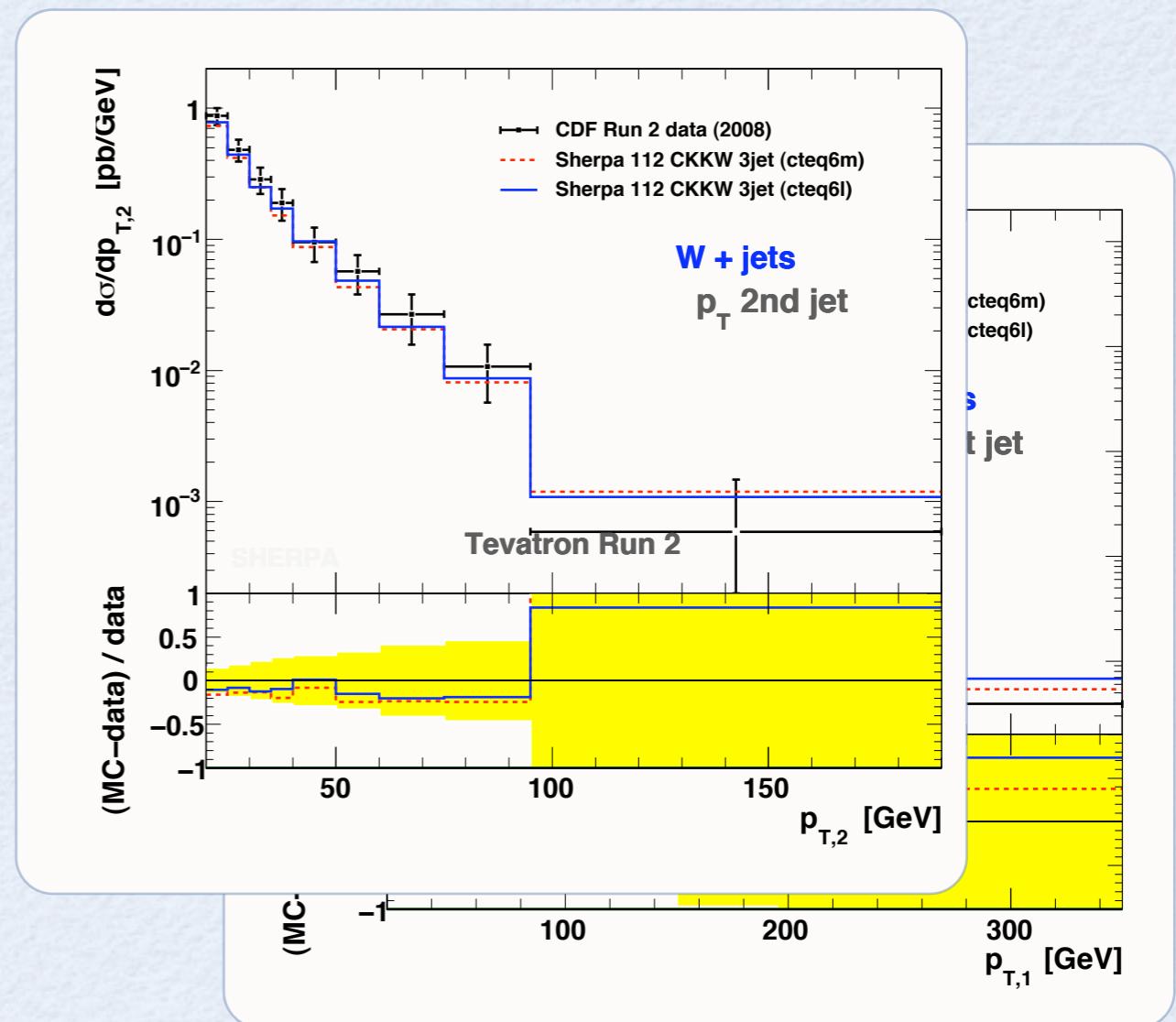
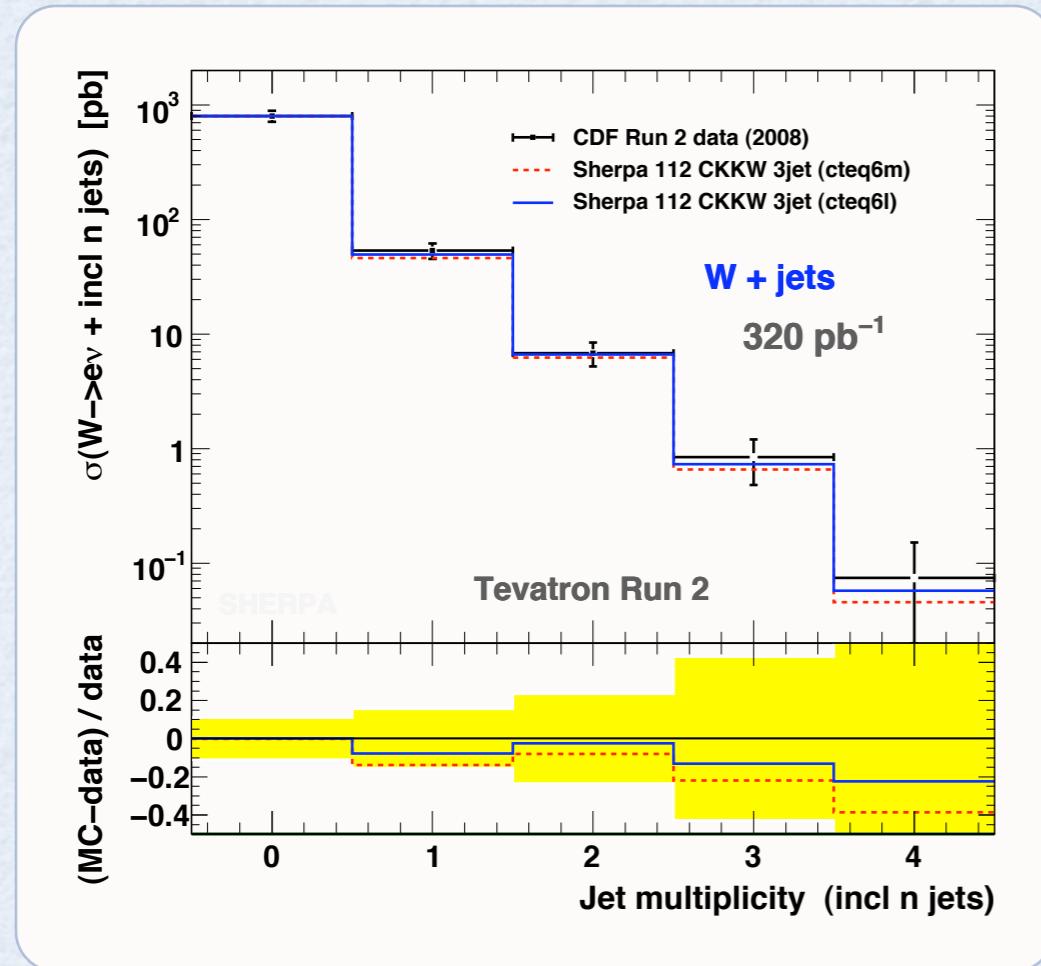
- Example: Tevatron Run II, $W + n$ jet



[T. Aaltonen et al., PRD 77 (2008) 011108]

CKKW Merging

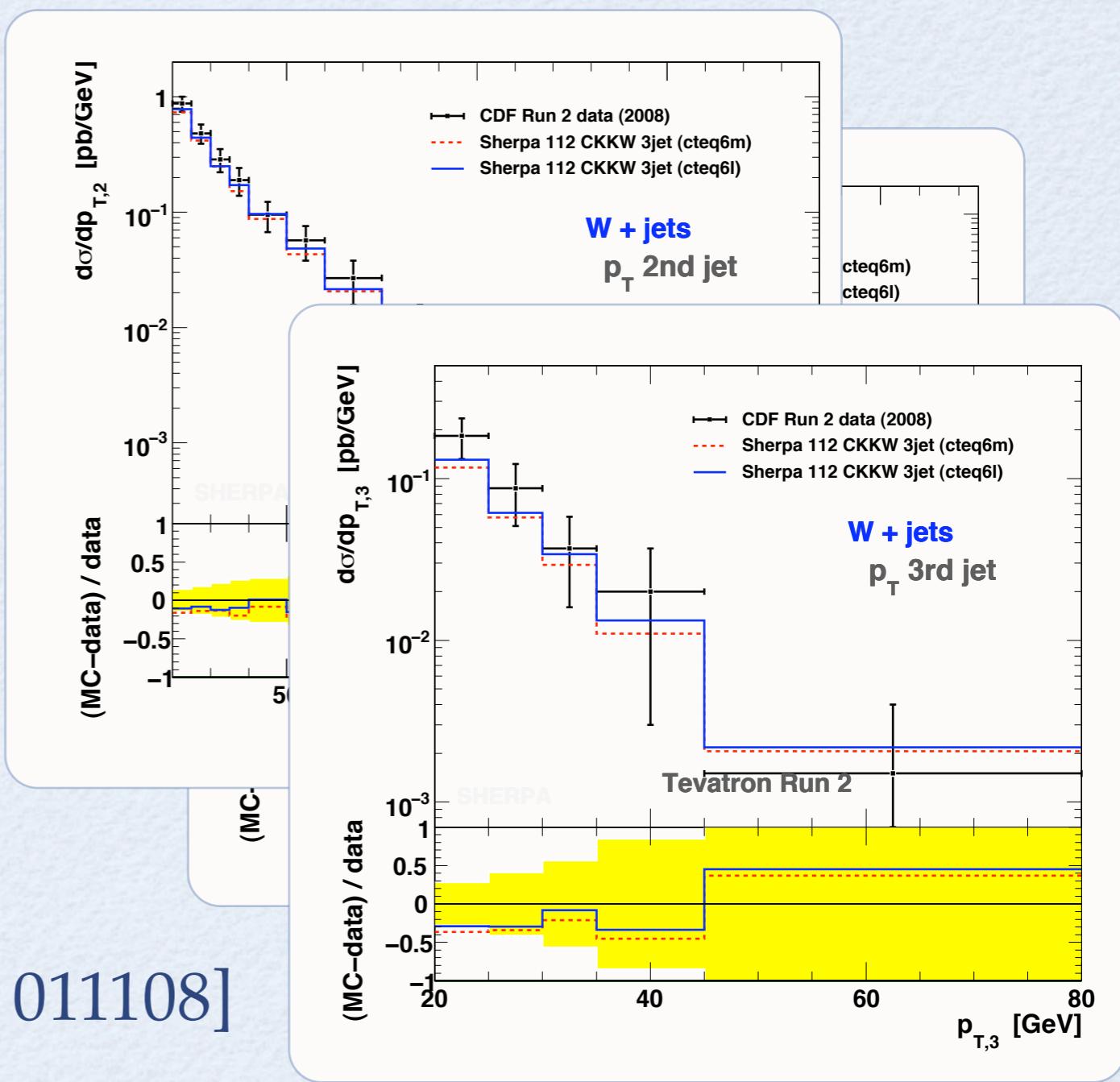
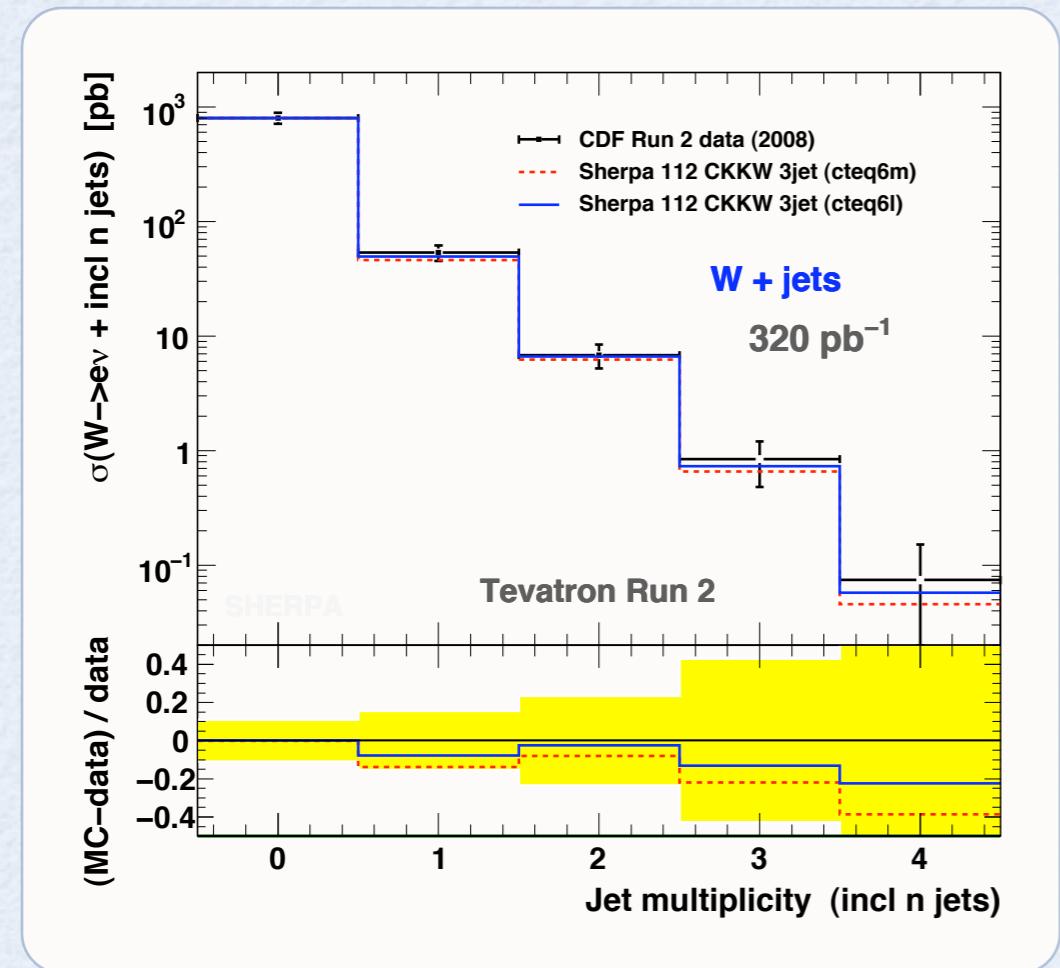
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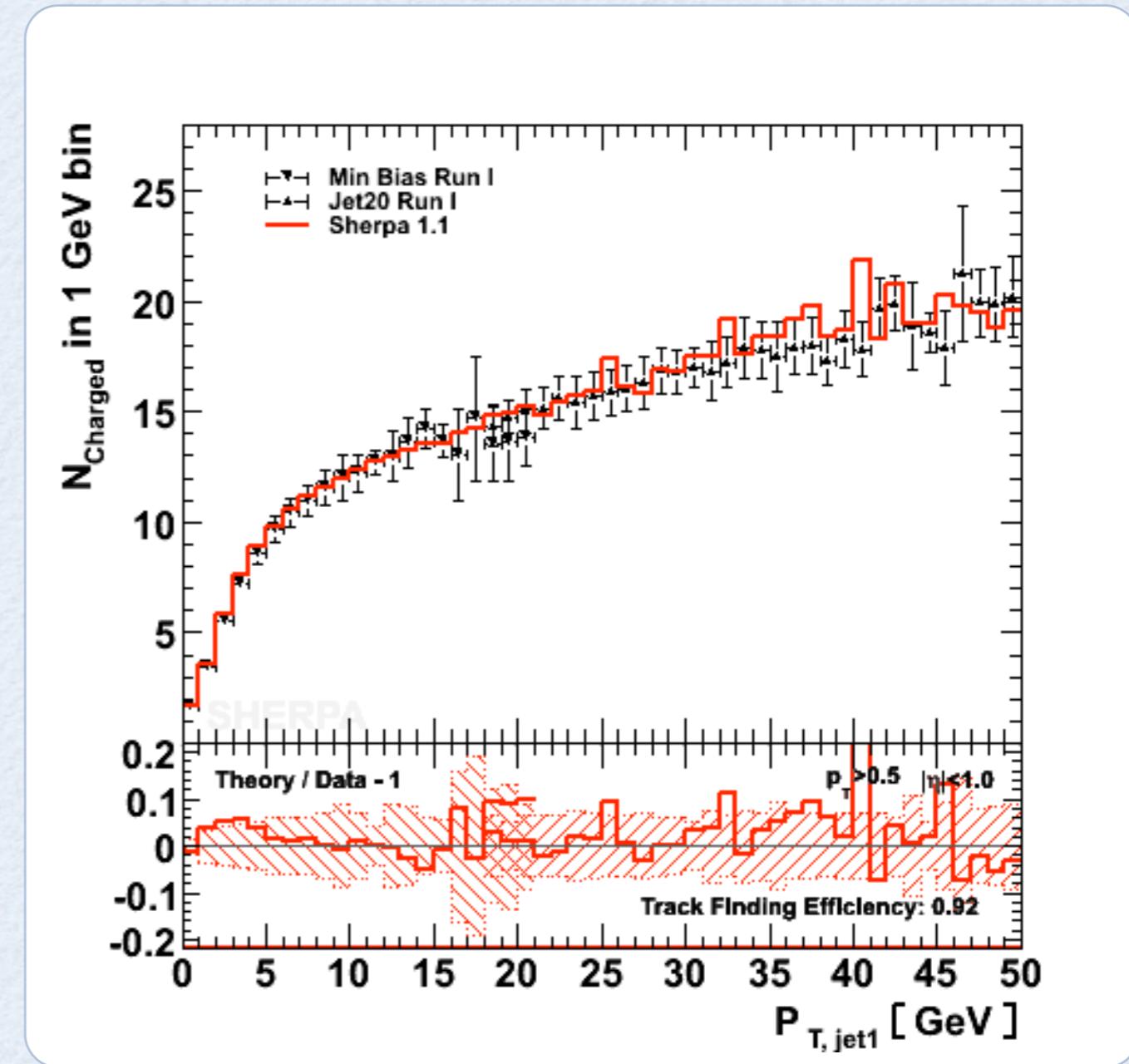
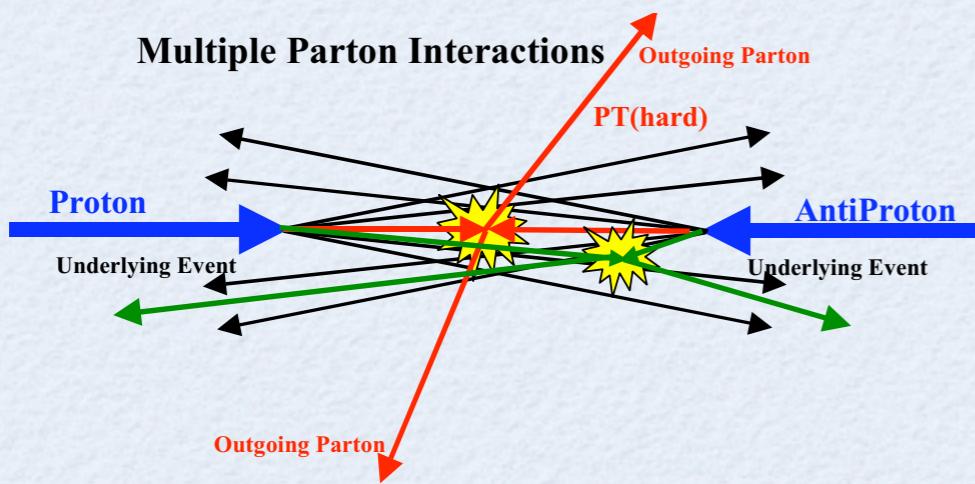
[T. Aaltonen et al., PRD 77 (2008) 011108]

Underlying Event: AMISIC

[in hep-ph/0601012]

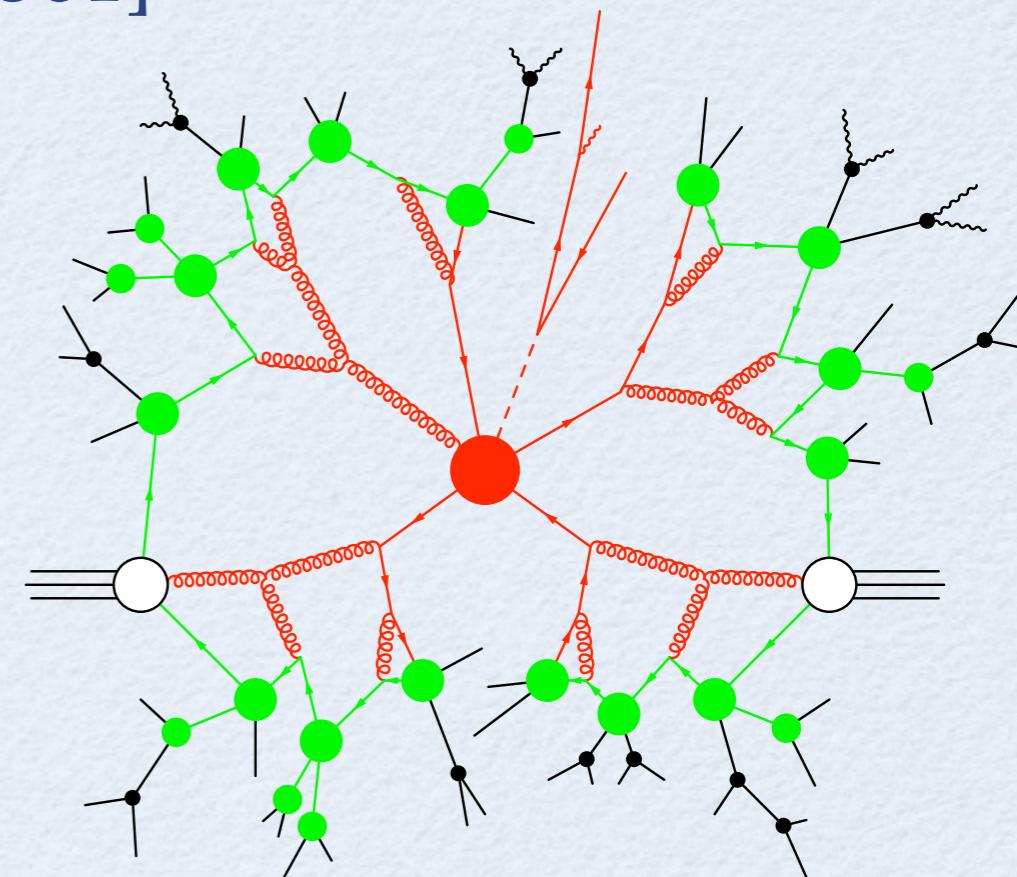
- Multiple interaction (MPI) module

- based on Pythia model
T.Sjöstrand & M. van Zijl
- Parton shower attached
- derive initial condition from CKKW matching of hard interaction



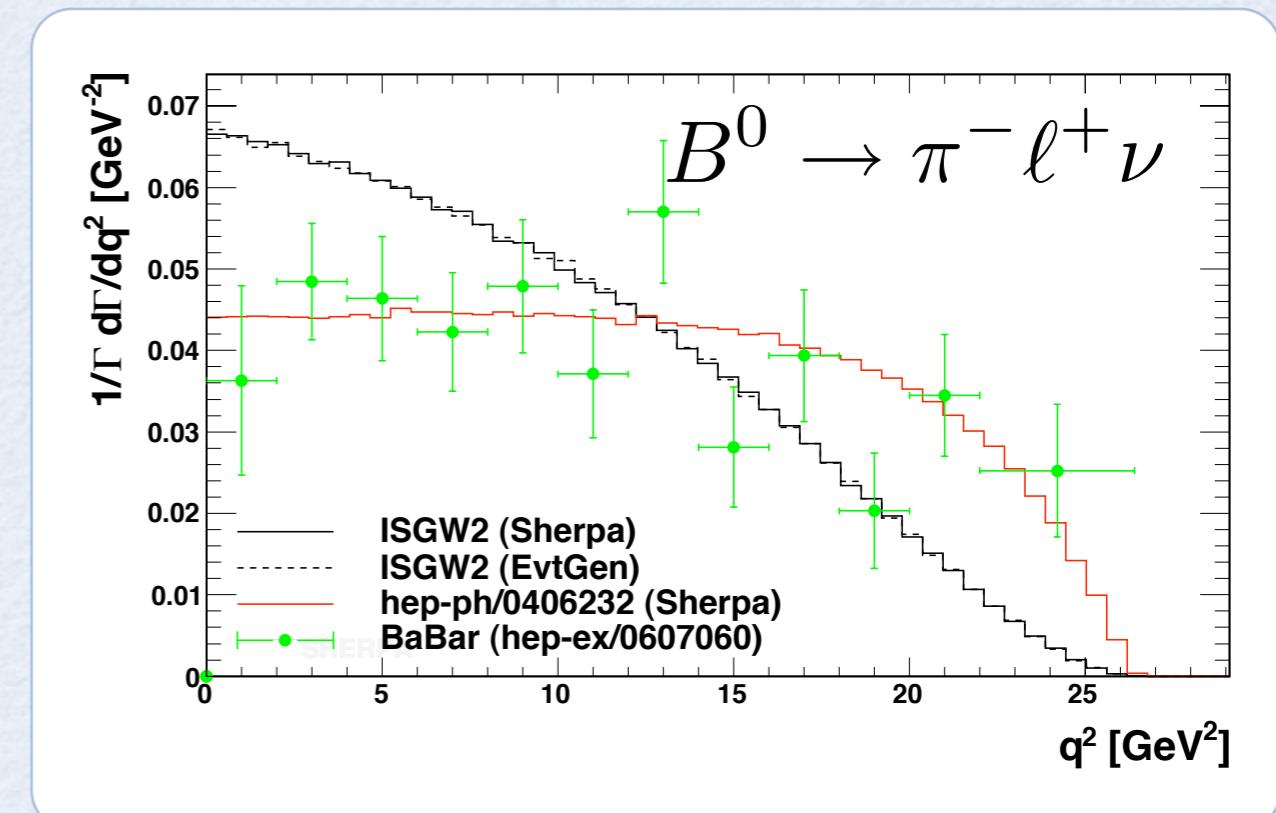
Hadronization: AHADIC

- Sherpa's new hadronization module (v1.1.x)
 - [Winter, Krauss, Soff, EPJC36 (2004) 381]
 - [Winter, Krauss, in prep.]
- large N_c limit
- split perturbative gluons non-perturbatively into $q\bar{q}$ (use dipole splitting)
- colour connected pairs form colourless clusters
- clusters decay into clusters or hadrons (C-H-transition defined by hadron wave function)



Hadron decays: HADRONS / PHOTONS

- hadron and tau decay package: HADRONS
 - branching ratios (e.g. PDG) as input for decay table
 - decay kinematics according to ME with form factor
 - correct spin correlations
 - neutral meson mixing, and related CP violation
[Siegert, Krauss, Laubrich]
- QED radiation in decays
PHOTONS
 - uses YFS approach
[Schönher, Krauss,
archiv:0810.5071]



Current activities

- COMIX: new ME generator
 - based on Berends-Giele recursion
[Gleisberg, Höche, arxiv:0808.3674]
- inclusive decays
 - e.g. SUSY decay chains with spin correlation
[Siegert, Krauss]
- Catani-Seymour shower
[Schumann, Krauss, JHEP 03 (2008) 038]
- Color dipole shower for hadronic collisions
[Winter, Krauss, JHEP 07 (2008) 040]
- new underlying event model
[Höche, Krauss, Teubner, arxiv:0705.4577]
- going to NLO for matrix elements
 - [Gleisberg, Krauss, EPJC 53 (2008) 501]
 - [Catani et al., JHEP 09 (2008) 065]

Sherpa Summary

- state of the art C++ Monte Carlo generator
 - ME generator for multi-leg processes (SM + BSM)
 - consistent merging of ME with parton shower (CKKW)
 - underlying event model
 - cluster hadronization model
 - comprehensive tau and hadron decay package incl. photon emission via YFS
- development ongoing
- Many thanks to the Sherpa team, esp. Steffen Schumann for help in the preparation of this talk