Event generators for eRHIC studies

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EIC at RHIC Meeting
Thursday 10th March 2011

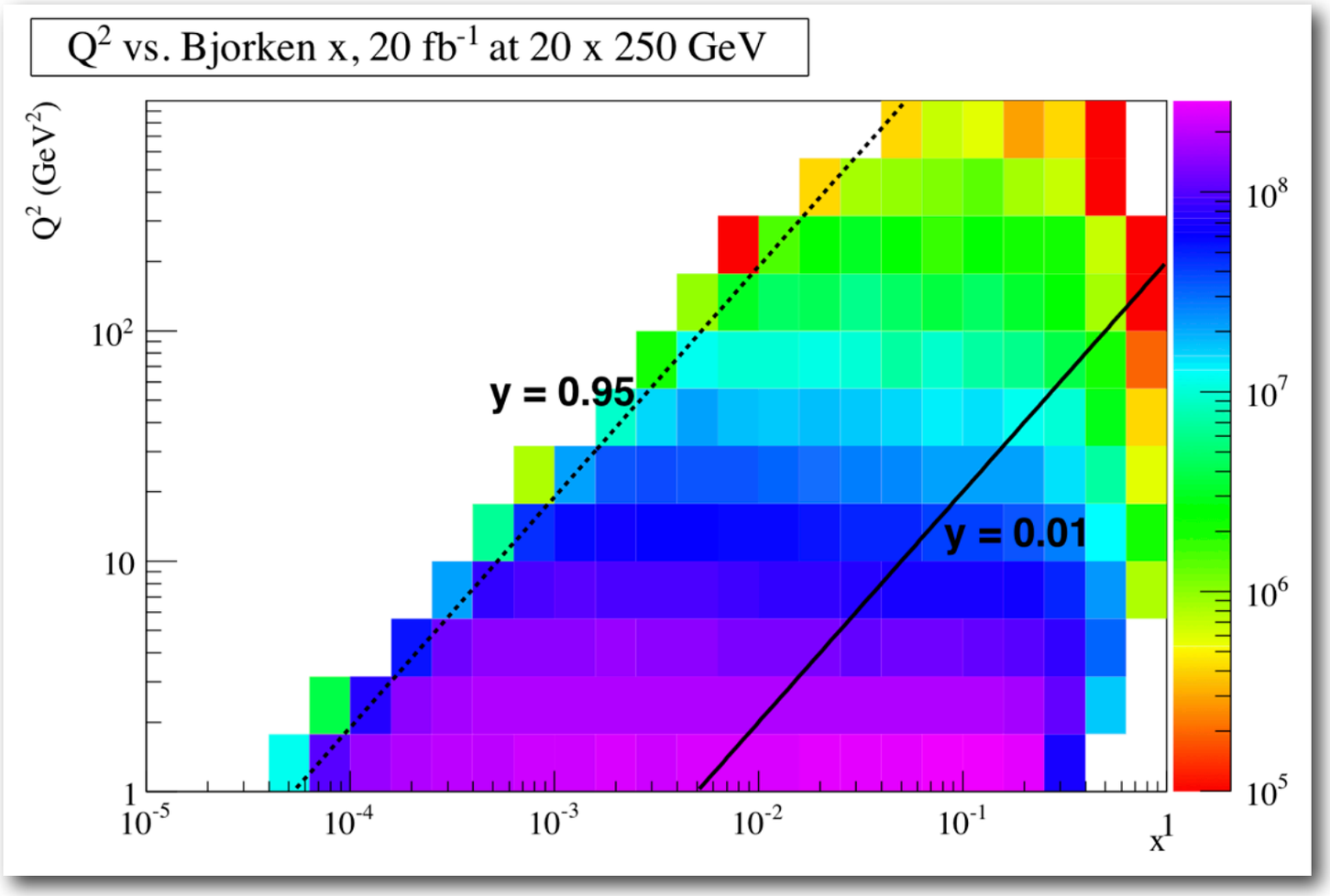
Getting started

- If you don't have an RCF account:
  - https://www.racf.bnl.gov/docs/getstart/newuserform
- Add EIC access to existing RCF account:
  - email John McCarthy & Elke
- AFS location of programmes:
  - /afs/rhic.bnl.gov/eic/PACKAGES
- Wiki pages with documentation:
  - https://wiki.bnl.gov/eic/index.php/Simulations_and_EIC_Computing_How-To

eRHIC generators

Name	Physics	Processes	Contact
PYTHIA 6	Multipurpose. Lund. DGLAP.	ep, pp	Elke
xdvmp	Dipole model. Vector meson diffraction. DVCS.	ep, eA	Tobias, Thomas
Milou	DVCS. GPDs @ NLO.	ep	Salvatore
PEPSI	LEPTO + longitudinally polarised PDFs.	ep	Elke
gmc_trans	Transverse polarisation. TMDs.	ep	Tom
RAPGAP 3	Diffractive. DGLAP.	ep, pp	Matt
HIJET	pQCD. Phenomenological fragmentation.	pA, AA	Matt
DJANGO	QED & QCD radiative effects. Lund.	ep, eA	Elke
MC@NLO	NLO matrix elements. HERWIG.	ep, pp	Tobias
LEPTO	Rapidity gap events. Lund. DGLAP.	ep	Elke
DPMJet-III	Dual parton model.	pp, pA, AA, eA, ee	Thomas
CASCADE	Unintegrated PDFs. k_T factorisation. CCFM evolution.	ep, pp	

PYTHIA v6.4



WHAT:

Multipurpose ep & pp generator

- Many physics processes
- DGLAP
- Lund fragmentation
- Initial- & final-state radiation

WHERE:

- https://wiki.bnl.gov/eic/index.php/PYTHIA
- /afs/rhic.bnl.gov/eic/PACKAGES/PYTHIA-RAD-CORR-64BIT
- /afs/rhic.bnl.gov/eic/PACKAGES/PYTHIA-RAD-CORR-32BIT

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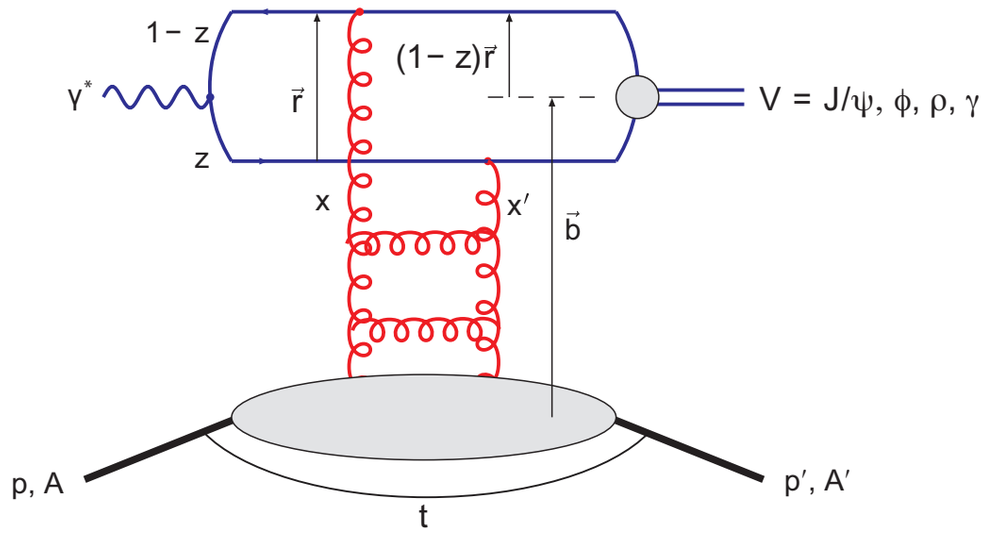
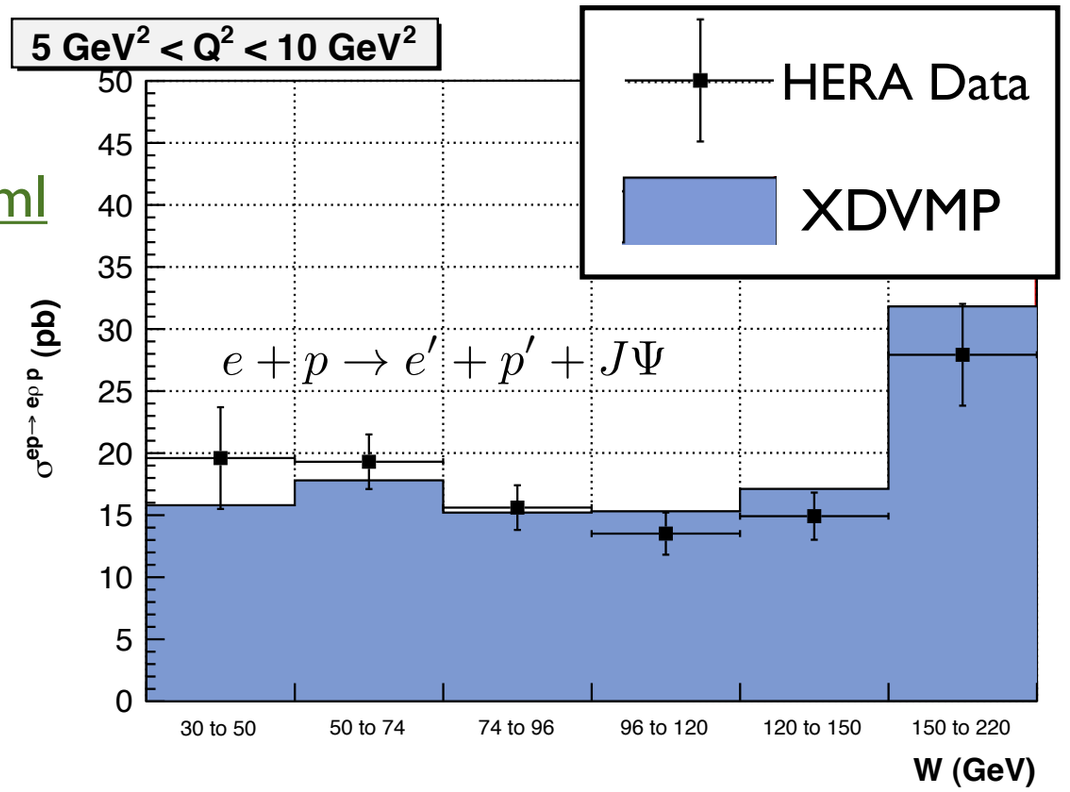
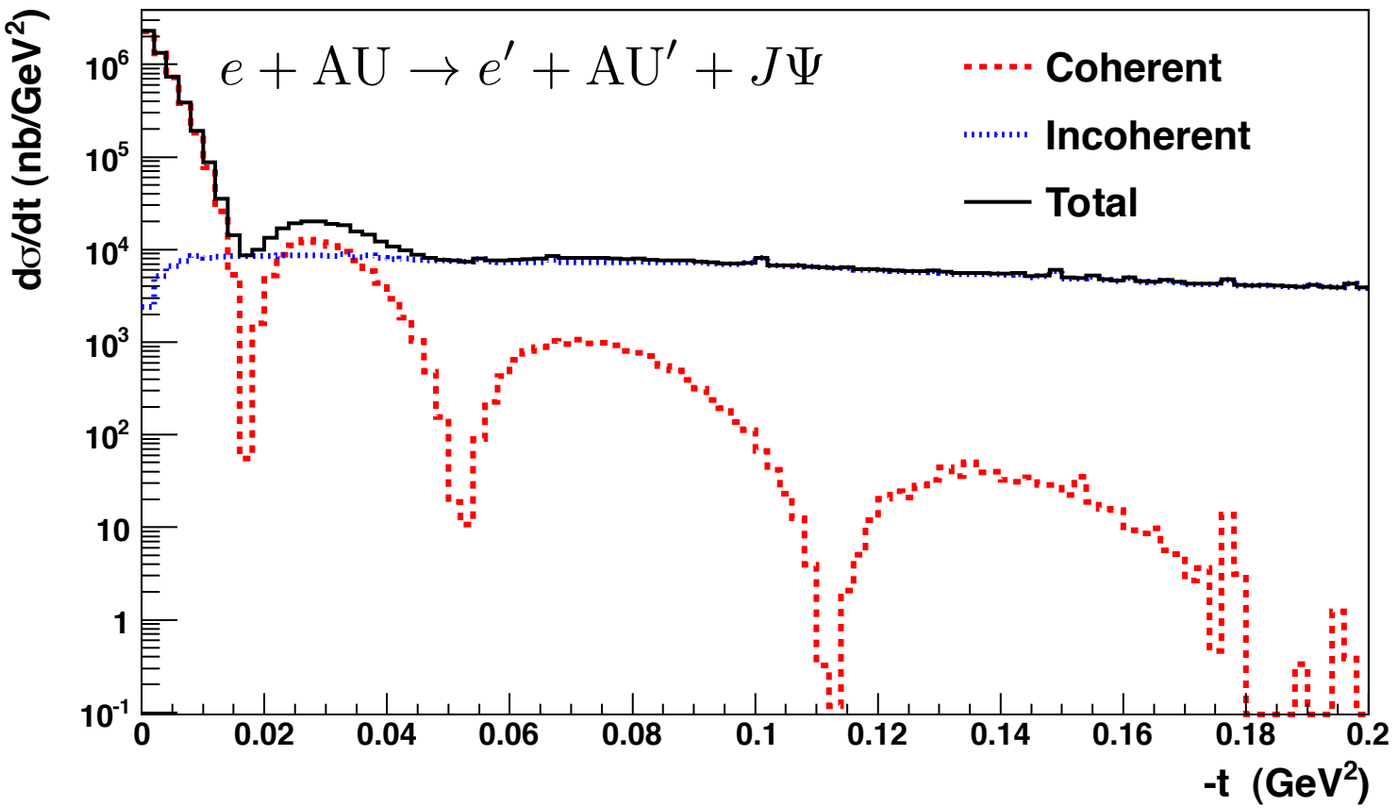
XDVMP
(name about to be changed)

- Exclusive Diffractive Vector Meson Production and DVCS
- Using the dipole model
- C++ code for ep here:
  http://rhig.physics.yale.edu/~ullrich/xdvmp/index.html
- Soon also in eA







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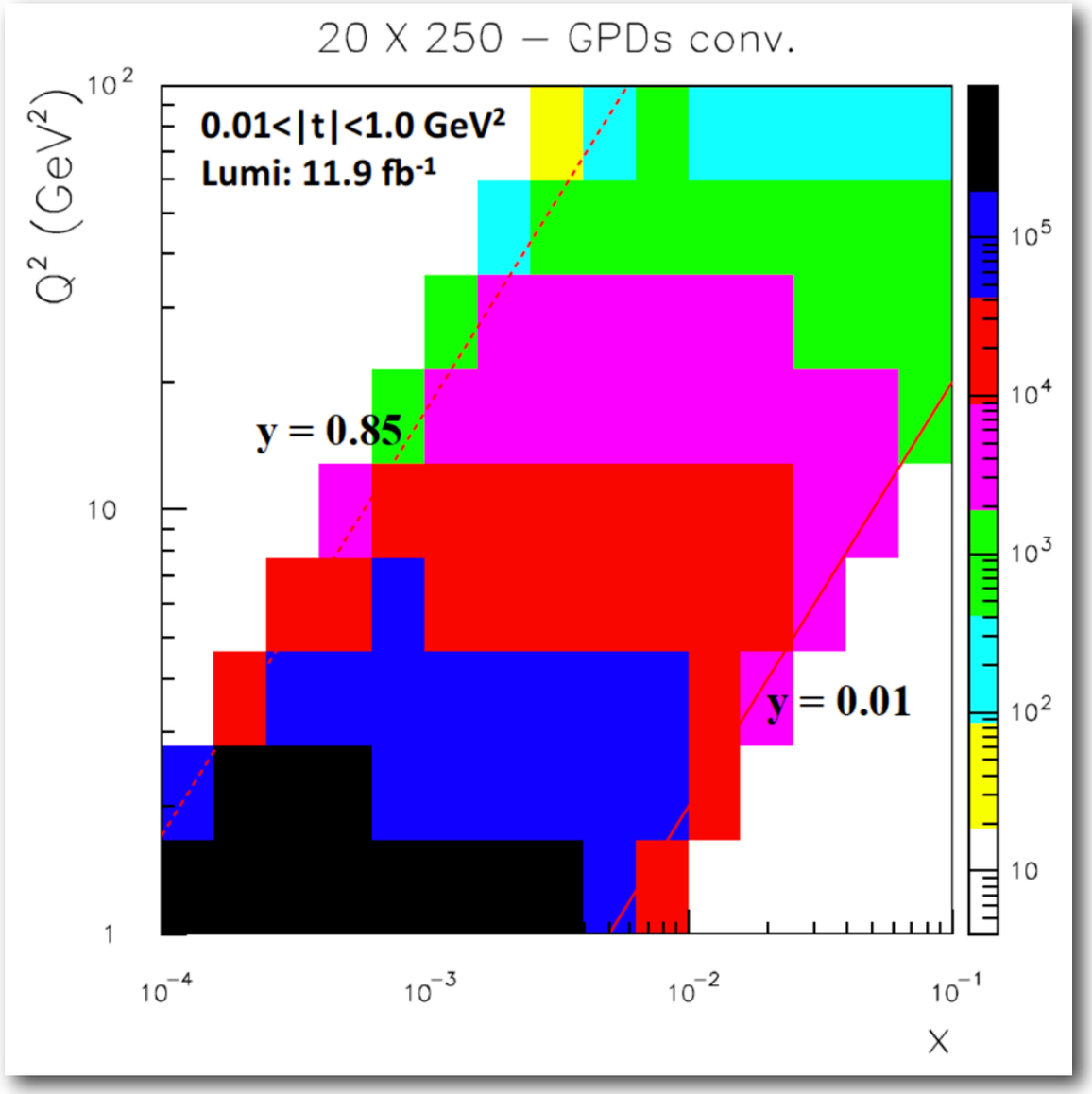
Milou



WHAT:

Deeply virtual Compton scattering generator

- GPD formalism at NLO
- DVCS, Bethe-Heitler & interference.
- Optionally include:
  - proton dissociation
  - initial-state QED radiative effects

WHERE:

- https://wiki.bnl.gov/eic/index.php/MILOU
- /afs/rhic.bnl.gov/eic/PACKAGES/milou32

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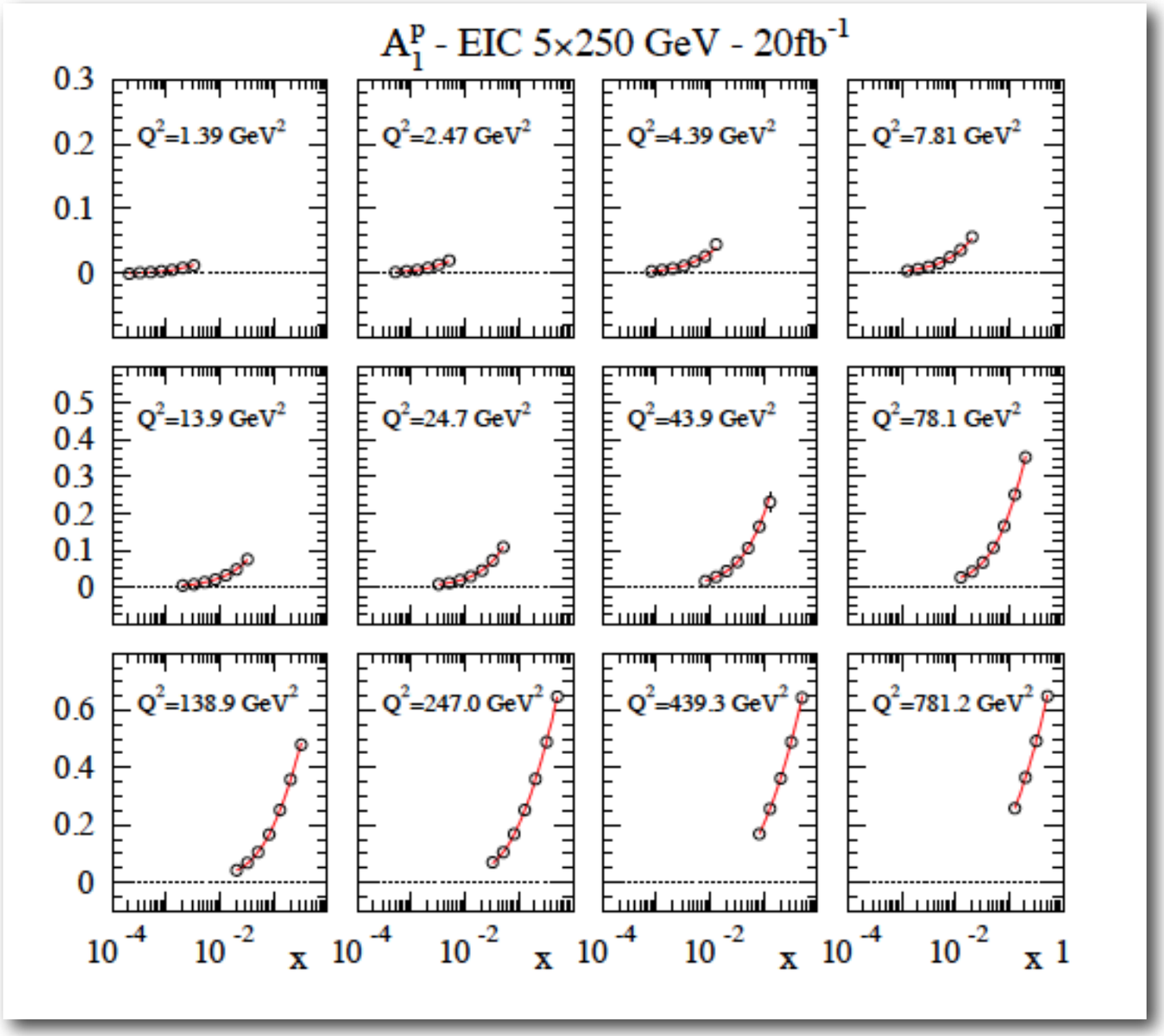

PEPSI

WHAT:

Polarised DIS ep generator

- Based on LEPTO 4.3
- Various parameterisations of $\Delta q(x,Q^2)$
- Radiative corrections via RADGEN
- Electro-weak interactions

WHERE:

- https://wiki.bnl.gov/eic/index.php/PEPSI
- /afs/rhic.bnl.gov/eic/PACKAGES/PEPSI

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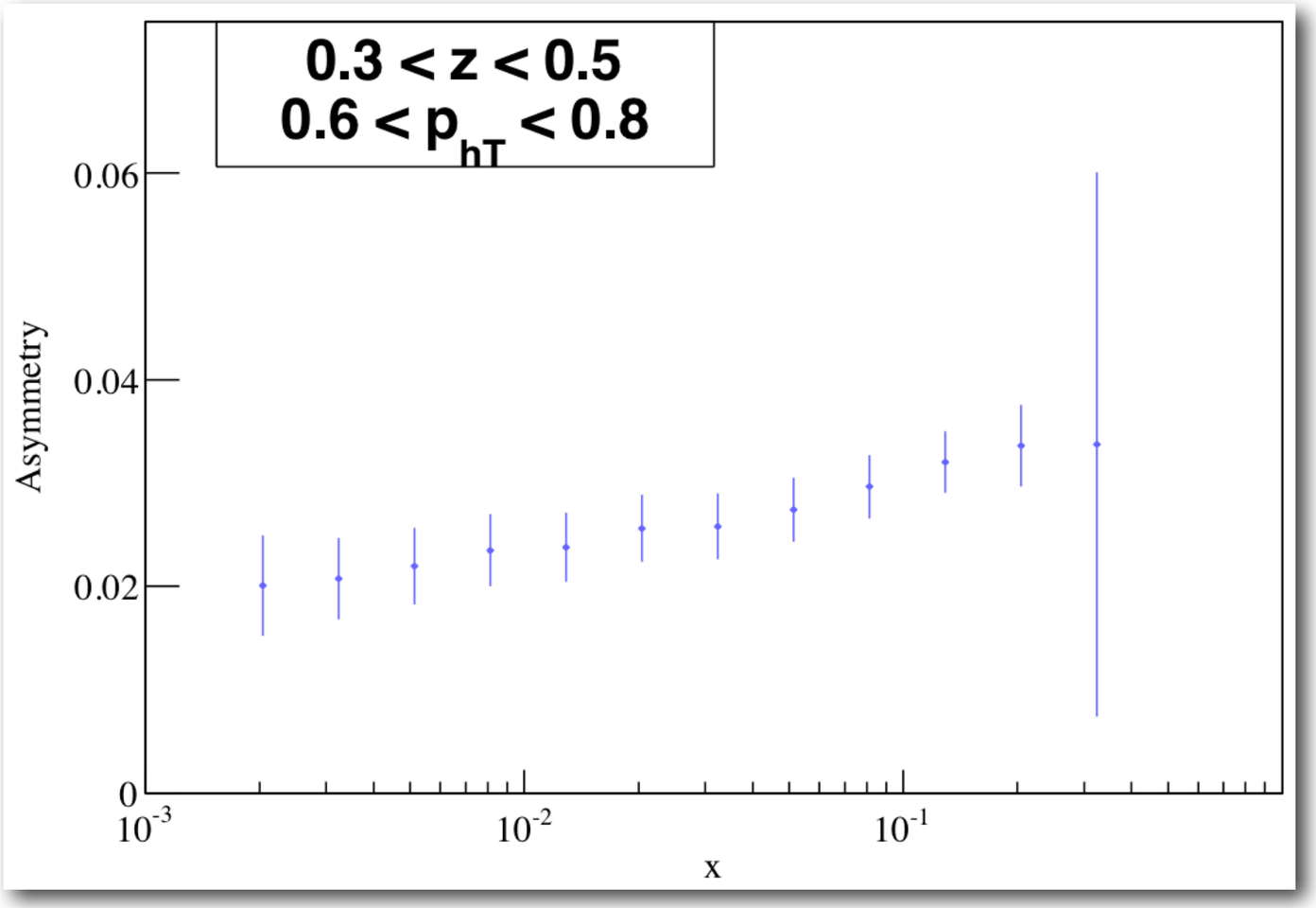
gmc_trans



WHAT:

SIDIS generator for $ep^{\Uparrow}$ with TMDs

- Choose TMD parameterisations
  - Sivers, Collins, Boer-Mulders
- Single hadron, not full event:
  - $e + p \rightarrow e + h$
  - $h = \pi^+, \pi^-, \pi^0, K^+, K^-$

WHERE:

- https://wiki.bnl.gov/eic/index.php/Gmc_trans
- /afs/rhic.bnl.gov/eic/PACKAGES/gmc_trans

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RAPGAP

- DGLAP evolution
- In ep: All inclusive and diffractive processes
- In pp: Single diffractive and a few inclusive processes
- Lund string fragmentation
- Fortran code available here: http://www.hepforge.org/downloads/rapgap

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HIJET

WHAT:

Ultrarelativistic pp, pA, AA generator.

- Uniform nucleus
- Leading baryon alone interacts in nucleus

WHERE:

- /afs/rhic.bnl.gov/eic/PACKAGES/HIJET

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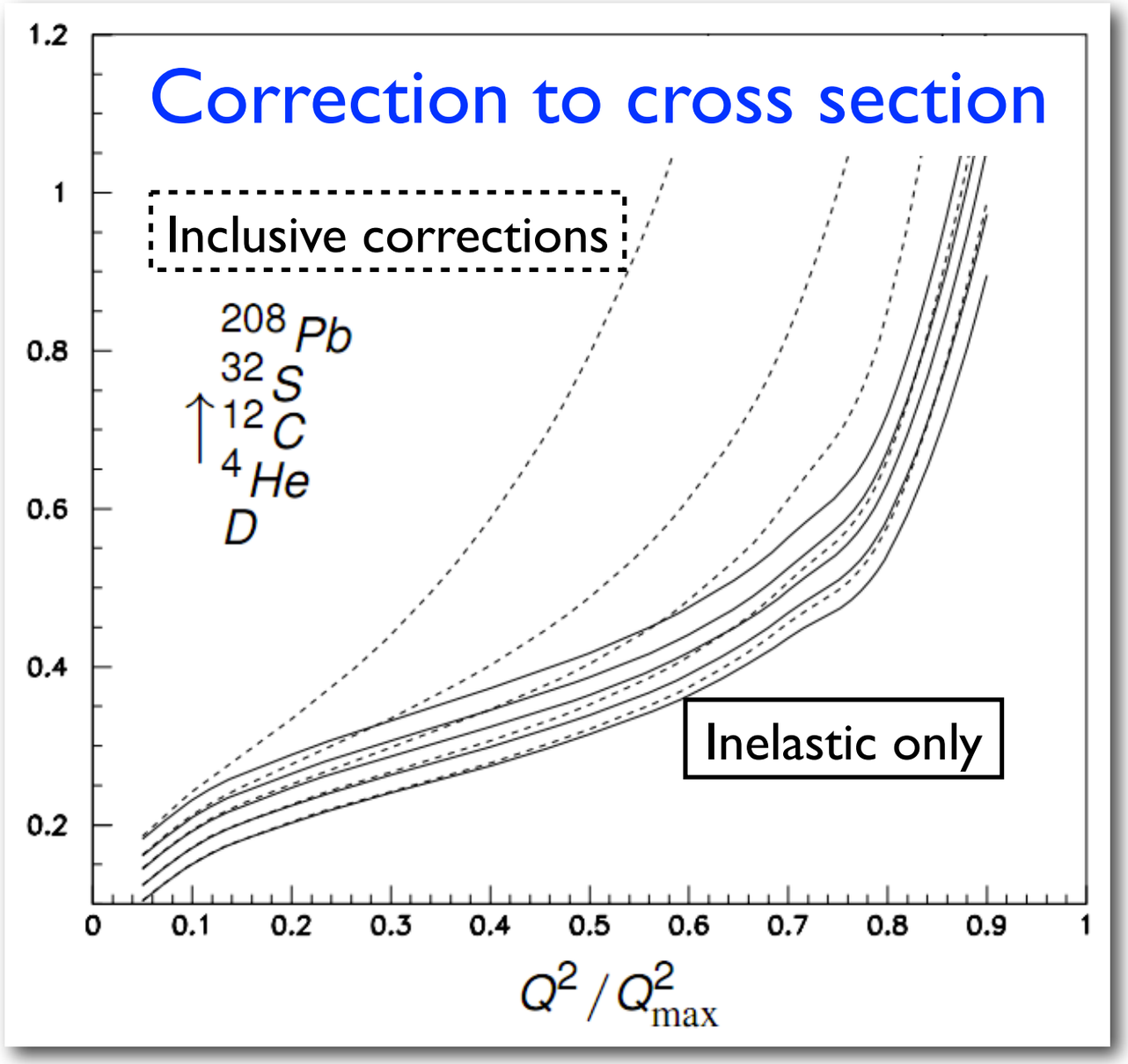

DJANGO

WHAT:

DIS generator with QED and QCD radiative effects

- Contains HERACLES MC
  - ➡ QED corrections
- Lund fragmentation
  - via interface to LEPTO
- eA included

- http://wwwthep.physik.uni-mainz.de/~hspiesb/djangoh/djangoh.html
- /afs/rhic.bnl.gov/eic/PACKAGES/DJANGO

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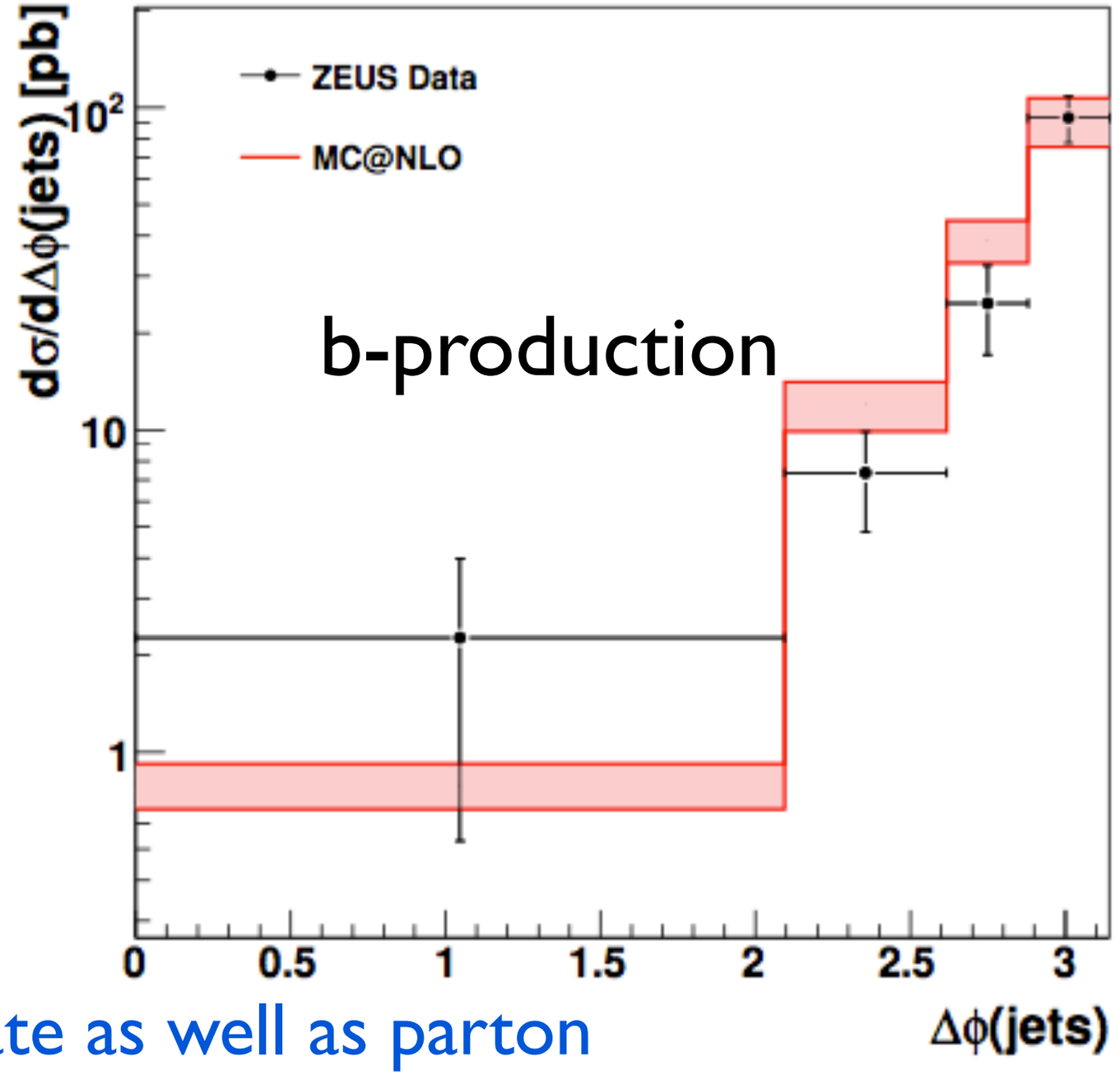
MC@NLO

- Using DGLAP Matrix Elements at NLO
- Matched HERWIG parton showers and hadronization
- In ep includes heavy quark production



- Get the correct NLO rate as well as parton correlations
- Fortran code available here:
  /afs/rhic.bnl.gov/eic/PACKAGES/mcatnlo_hadr
  /afs/rhic.bnl.gov/eic/PACKAGES/mcatnlo_point

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LEPTO

- Using DGLAP evolution
- Rapidity gaps with a model based on soft colour interactions.
- Lund string fragmentation
- Multi Purpose in ep
- Fortran code available here: /afs/rhic.bnl.gov/eic/PACKAGES/LEPTO-32BIT

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DPMJet-III

- Using the Dual Parton Model, i.e.
  soft and perturbative pomeron exchanges + AGK cutting rules
- Can do ee, ep, pp, eA, AA...
- Only fully developed generator to do eA!
- Interaction with one or many individual nucleons in a nucleus, not coherently (like XDVMP)
- Has a mechanism for breaking up the nucleus
- Lund string fragmentation
- C++ code can be found here:
  /afs/rhic.bnl.gov/eic/PACKAGES/DPMJet

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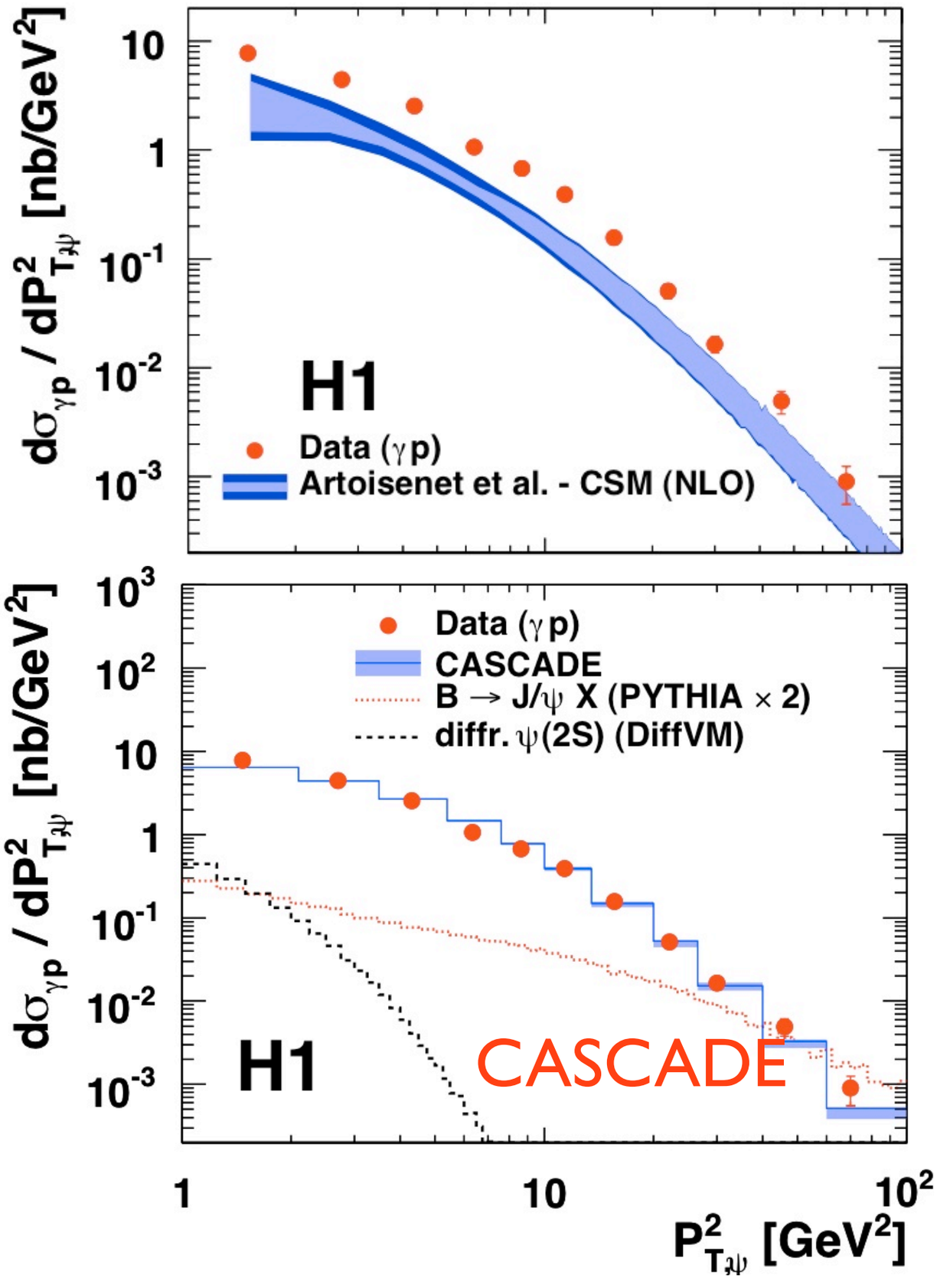
CASCADE

- Using k_t factorized matrix elements with
- Unintegrated PDFs and
- CCFM parton evolution, which is strictly ordered in angle
- gives a natural transition between DGLAP and BFKL kinematics, i.e. small and large x
- Lund string fragmentation
- No sea-quarks in evolution
- Fortran code available here: /afs/rhic.bnl.gov/eic/PACKAGES/CASCADE



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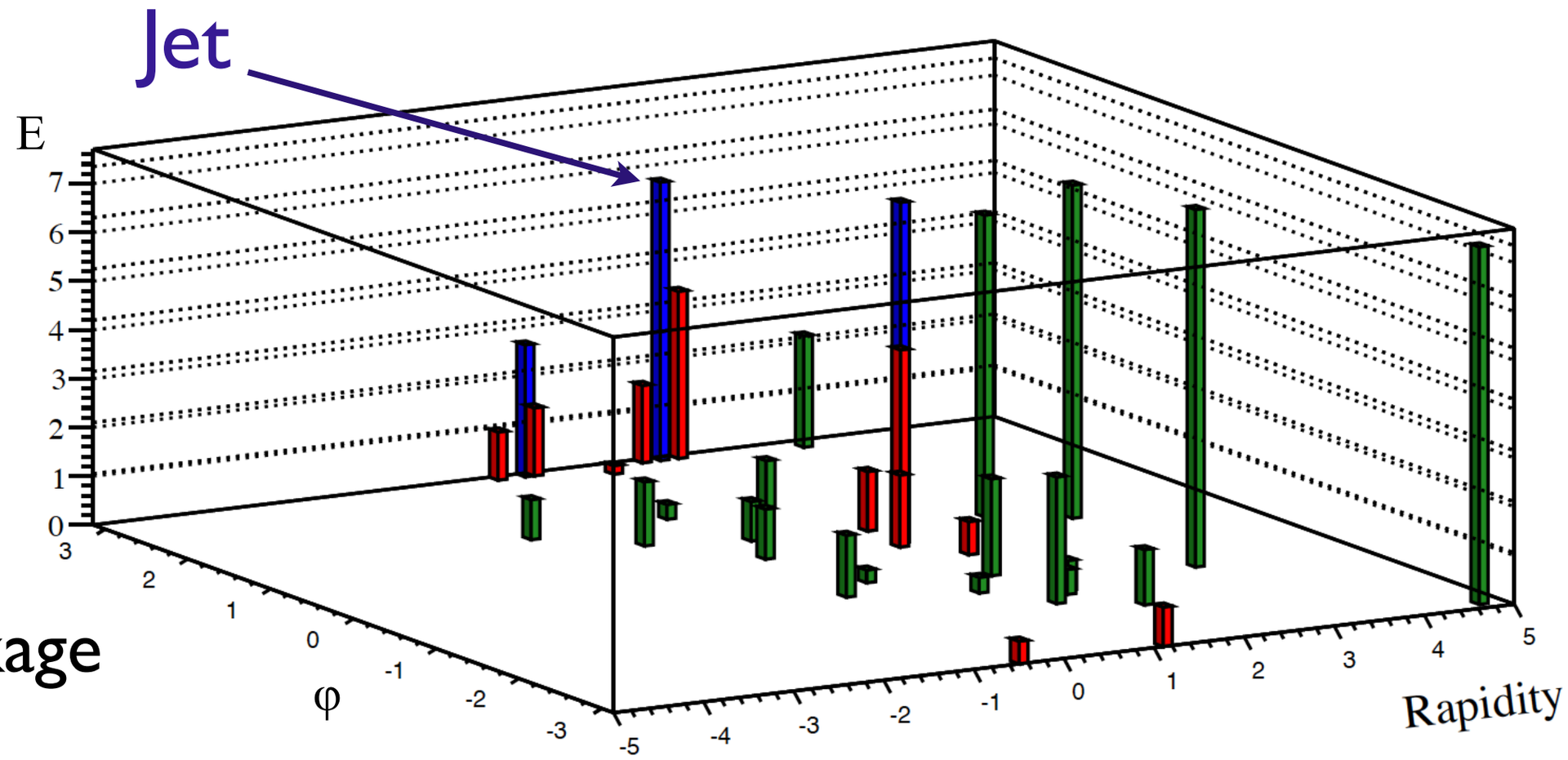
Other resources

FASTJET



WHAT:

Jet-finding package

- Implements
  - longitudinally invariant k_T
  - Cambridge/Aachen
  - Anti-k_T
- Interface to external jet-finders
- Background subtraction

WHERE:

- www.lpthe.jussieu.fr/~salam/fastjet/
- /afs/rhic.bnl.gov/eic/PACKAGES/FASTJET

Libraries/Utilities

CLHEP - CERN C++ library for high-energy physics

- /afs/rhic.bnl.gov/eic/PACKAGES/CLHEP
- http://proj-clhep.web.cern.ch/proj-clhep/

LHAPDF - Interface to PDFs

- /afs/rhic.bnl.gov/eic/PACKAGES/LHAPDF-5.8.4
- http://projects.hepforge.org/lhapdf/

GSL - C++ numerical library

- /afs/rhic.bnl.gov/eic/PACKAGES/gsl-1.14
- http://www.gnu.org/software/gsl/

Boost - C++ libraries

- /afs/rhic.bnl.gov/eic/PACKAGES/FAIRROOT/fairsoft/basics/boost_1_39_0
- http://www.boost.org/

HZTool - library for reproducing experimental results

- /afs/rhic.bnl.gov/eic/PACKAGES/hztool-4.2
- http://projects.hepforge.org/hztool/