



(no) News in PYTHIA 6

Peter Skands

Tools Readiness Workshop, CERN, March 29 2010

Current Developments

- Tuning
 - Professor, Perugia, MC09, ...
 - Theory uncertainties + Color Reconnections
- Bug Fixes
 - Companion Quarks
 - External Interfaces (ALPGEN, LHEF, SLHA, BSM-LHEF)
- **No future physics developments**

Tuning

- New development: tools for (semi-) automated tuning
- New tunes to LEP data by Professor
 - Also used as starting point for Perugia tunes
- Powerful and (a priori) unbiased
 - And/but still long way from encoding full human experience / judgement?

See talk on Wednesday pm

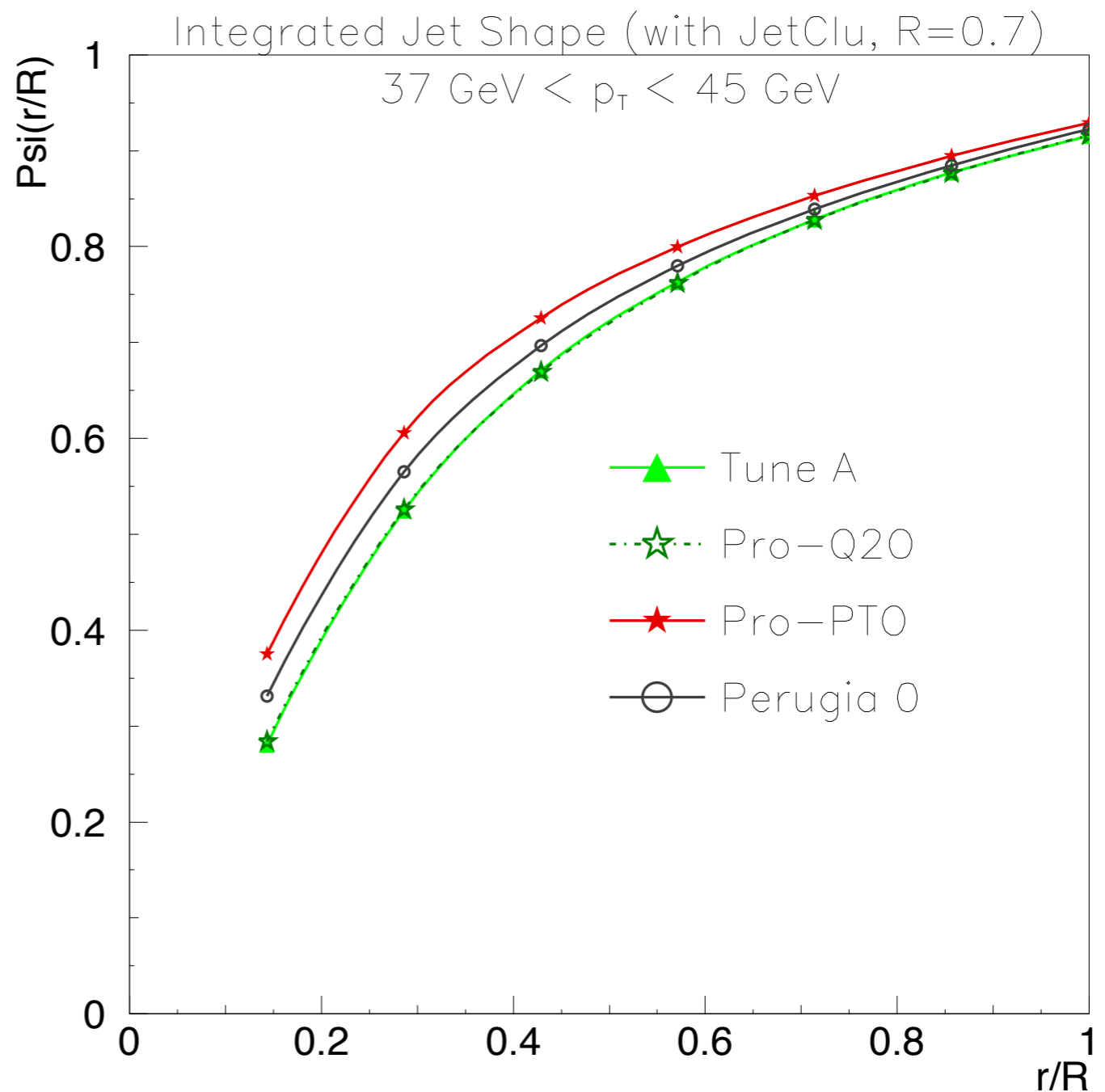
CDF Jet Shapes

- Current (pathological?) Example:
 - CDF Jet Shapes not used in LEP tunes
 - Only tails of LEP jet rates sensitive = low 'power' in automated fit
 - p_T -ordered tunes based on the Professor LEP parameters exhibit $O(10\%)$ worse jet shapes than Tune A
 - **Important** for jet calibrations & top mass!

See talk later today

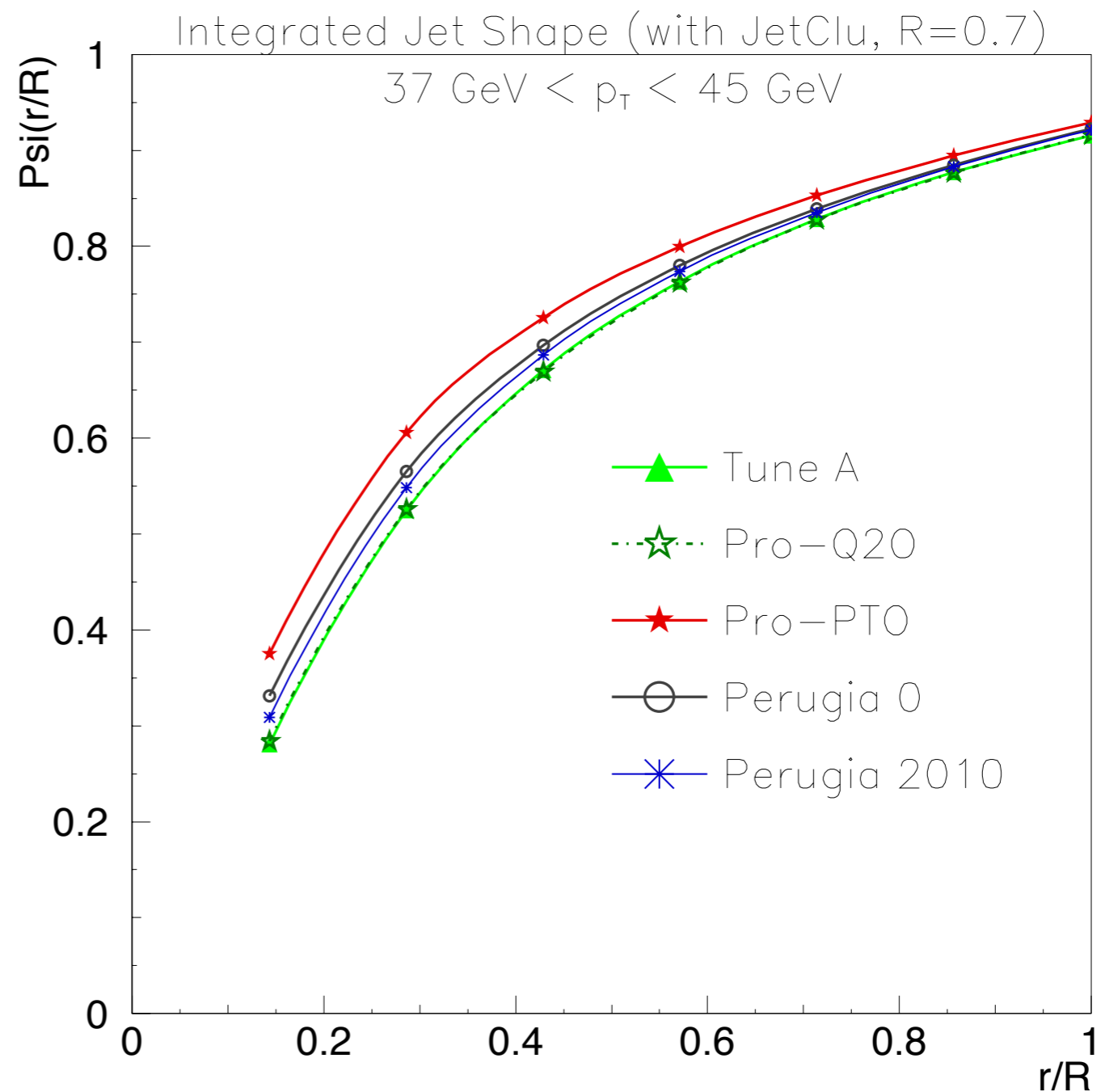
CDF Jet Shapes

- Could only get JetClu to run, but qualitative differences should be the same
- Pro-PTO far from Tune A
- Perugia 0 closer, but still significant (?) difference
- Owing in part to smaller Λ_{QCD}



CDF Jet Shapes

- Few tens of MeV changes to Lambda and fragment. p_T
- 10-20% changes in other N.P. pars
- Absorbed up to $\sim 5\%$ for (I-T), x spectrum (*improved at high z*), ...
- N_{ch} , N_{ID} , and Min-bias also fine
- **Perugia 2010** will be in 6.4.23

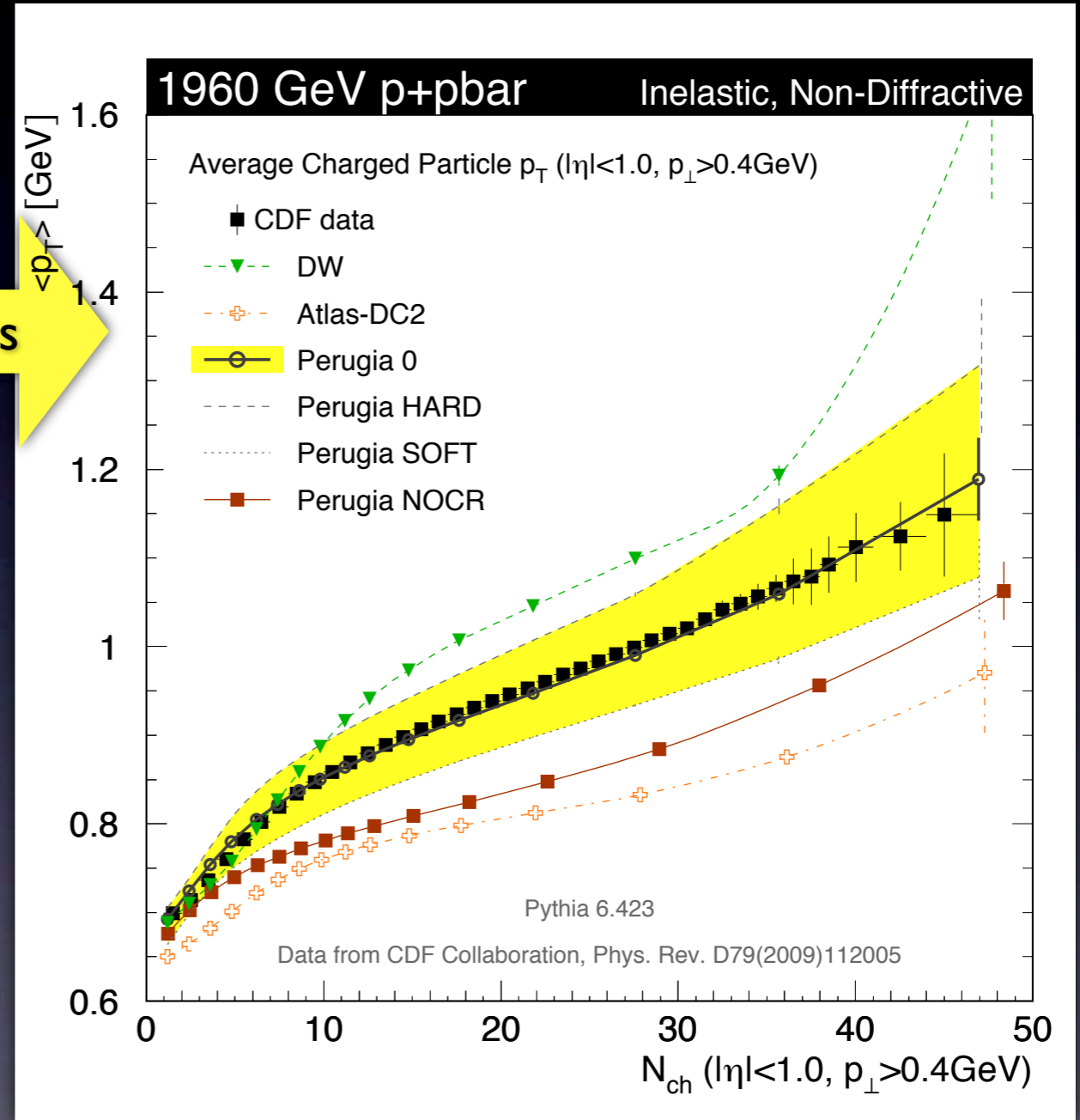


PYTUNE / MSTP(5)

6.4.20+

- 129: Pro-Q20
- 320: Perugia 0
- 321: Perugia HARD
- 322: Perugia SOFT
- 323: Perugia 3
- 324: Perugia NOCR
- 325: Perugia LO*
- 326: Perugia 6
- 329: Pro-PTO

variations



PYTUNE / MSTP(5)

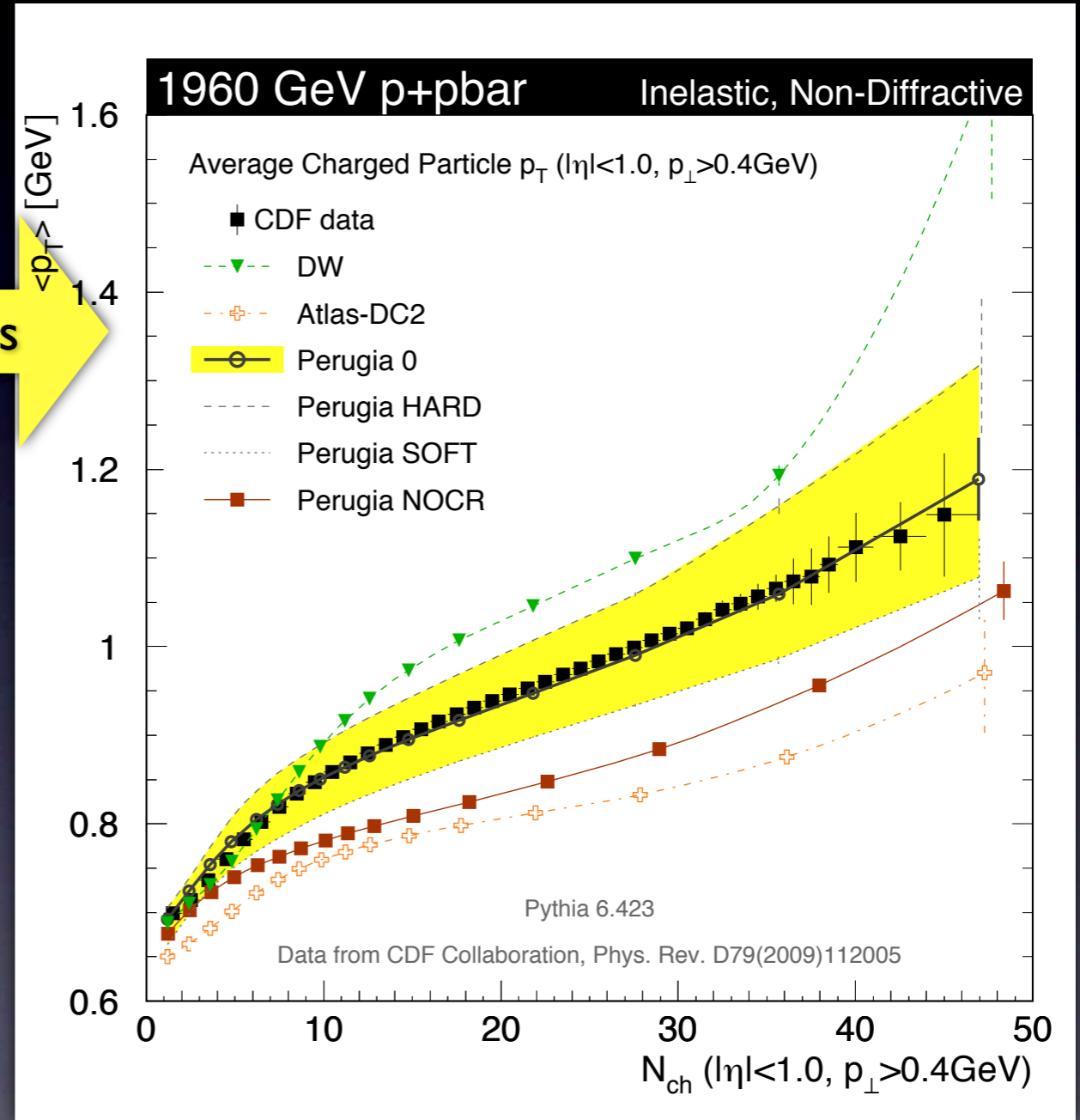
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variations

6.4.23+

- 327: Perugia 2010
- 328: Perugia "K"
- 330: ATLAS MC09
- 335: Pro-PT*
- 336: Pro-PT6
- 339: Pro-PT**



PYTUNE / MSTP(5)

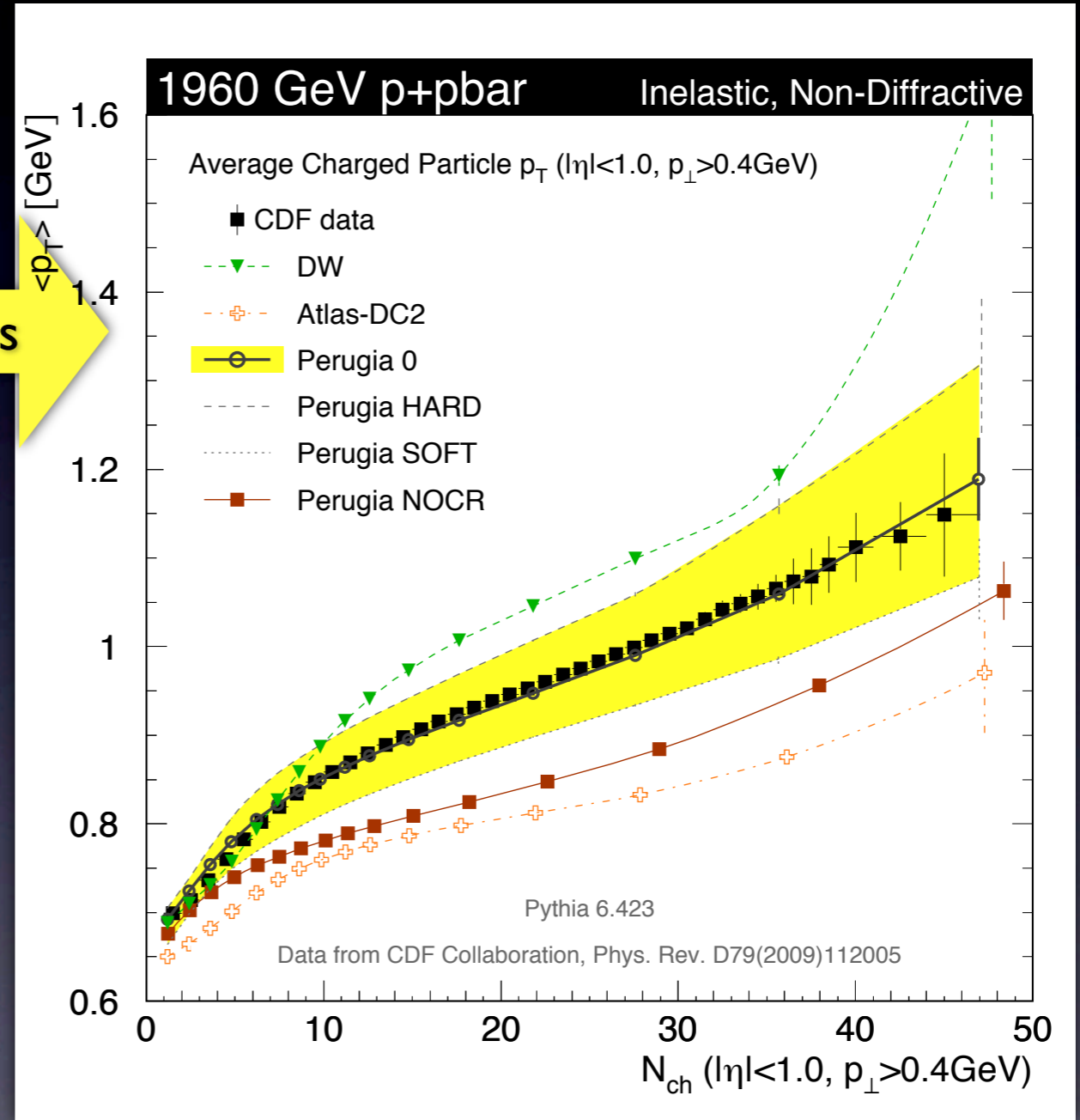
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6.4.23+

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+ Long writeup of Perugia tunes ready to go

Tuning

- Focus in PYTHIA 6 has really changed from one of **developing the model** to
- **Exploring** what happens if you let this or that distribution dominate, tails or bulks of distributions, manual tuning vs automated, ...
- **More** to be done with ‘finished product’:
 - Tuning in the presence of matching: surface still barely scratched: **Important for precision studies!**

Tuning Plots

- **Enter early LHC** data + more RHIC/Tevatron/... data + more models (other MC's) + more tunes
- Increasingly important to have a good overview & reference
- **Comprehensive web site** to be established in collaboration with W. Pokorski (GENSER) in context of LHC Physics Center UE/MB working group
- **Modeled on:**
<http://home.fnal.gov/~skands/leshouches-plots/>
- Combined resource for Physics, Tuning, Validation

Bug Fixes

Companion Quarks

- **Recent study by** Gaunt and Stirling on double-parton distributions derived from perturbative evolution framework Gaunt, Stirling, JHEP 1003:005,2010.
- **Includes, e.g.,** s_1 - $s_{\bar{2}}$ correlation (called '*companion quarks*' in p_T -ordered Pythia model) T. Sjöstrand, PS, JHEP 0403:053,2004.
- Comparison by D. Bandurin (DØ) revealed **no enhancement** in Pythia 6.4!
- Correlations tracked by shower evolution, but not in selection of hard scatterings! Bug fixed in 6.4.23.

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Subtle effect, checked no major impact on tunes

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Interface to External Processes (LHEF)

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- **Important bug** fixes up through 6.4.21 for
 - ALPGEN and LHEF interfaces
 - BSM-LHEF and SLHA interfaces
 - Please see **update notes** for details
- 6.4.22: mostly fixes of compiler-dependent issues and an issue with particle mothers
- 6.4.23 (imminent): more tunes, companion quarks

Summary

- No news is (mostly) good news
- Tendency to believe tuning = precision?
 - Order 10% changes **ARE** beyond the theoretical precision
- **Beyond** this level, treat MC as a physics-driven fit function
 - **Vital** to check sidebands etc against **data**
 - *Dedicated MC tunes as physics-driven fit functions?*
 - *Fast best-fit return with new data = incremental lessons?*
 - *More systematic understanding of theoretical uncertainties?*
- **To me, this** is where the real power of automated tuning lies

CDF Jet Shapes

Backup
comparison
including S0 and
S0(A)-Pro

