

Goals for the week

Pythia week 2025, goals for the week

Christian Bierlich:

1. Common understanding of, and implementation plan for, forced B fragmentation.
2. Decision about how to go on (or not) with the common tuning project.
3. A way forward for the fragmentation interface.
4. Discuss ML-based model(s) for colour reconnection.

Riley Henderson:

1. Common understanding of, and implementation plan for, forced B fragmentation.
2. Learn and discuss implementation of event weight framework.
3. Integrate forced $g \rightarrow b\bar{b}$ splittings with force b fragmentation.
4. Learn about ongoing projects and discuss opportunities for future projects, hadronisation related or otherwise.

Steve Mrenna:

1. forced hadronization
2. aExtra bug resolution
3. common or uncommon tuning effort
4. reweighting for MPI – is it attainable
5. fixed target behavior – resolving kinematics with Leif and Ilkka
6. general issue resolution (random number generator, tau timing, etc)
7. be able to answer the question: how low in mass can one go and “trust” the string model and string model parameters (when is mini-string fragmentation used and the impact of finalTwo): need expert input
8. what Phil says

Philip Ilten:

- Thermal strings.
- Forced B fragmentation.
- CI.
- Learn about spin in hadronization.
- Discuss tutorials.
- Future of Python interface?
- Julia interface?
- Forced style?
- aExtra bug and tuning.
- Variations vs. biasing and good documentation for this.
- Plugin interface and contrib.
- Clean up weights (from TS).
- Get vincia-prepare in (from PS).
- Work on LiveDisplays (from PS).

Manuel Szewc:

1. Explore useful observables / useful applications of ML-based hadronization models
2. Understand forced b fragmentation applications
3. Explore uncertainties in tuning / applications of SBI to tuning
4. Follow-up on the fragmentation interface and use it for MLHad plugin.
5. Ask about polarized PDFs

Leif Lönnblad

1. Finalize the new hadronisation scheme
2. Agreement on what is a “tune” and how to make them reproducible
3. Discuss management structure
4. Help Ilkka to fix DIS kinematics
5. Figure out the future of (CKKW-like) Matching and Merging in Pythia.
6. Cosmic ray update

Ilkka Helenius

1. Fix DIS kinematics
2. Make a plan for the new default tune
 - a. Also DIS and photoproduction
3. Discuss meeting practices and iterate management structure
4. Reduce the number of open Issues in service desk down to a small number
5. Discuss improved hard-process generation with Angantyr
6. Streamline MG5 interface(s) [Question from Peter: I am also interested in MG5 interfacing; would like to know more / discuss informally / chat via Mattermost/Slack?]
7. Discuss future funding. [Note from Peter: I am interested in looking at possibilities for an ERC synergy grant which is the only option for direct funding to go to a non-EU country.]

Torbjörn S

1. Hadronization structure - how handle switching to thermal fragmentation, whether to break out ropes/shove/reweighting/forcing/...
2. Cosmic ray updates
3. Clean up weights in simple showers

Naomi Cooke

- 1) Double counting
- 2) Tuning quarkonia
- 3) Bc mesons and double heavy baryon in quarkonia shower

Peter Skands

1. Copied from CTP: future of parton showers *and* future of matching/merging and support for same?
2. Forced fragmentation
3. Ensure there are no blockers for forced $g \rightarrow b\bar{b}$ splittings (Jack Helliwell)

4. Ensure there are no blockers for excited & hot strings (with Javira)
5. Obtain mandate to continue with tuning project; who wants to do what?
6. Discuss status of vincia-prepare
7. VinciaQED for PanScales (and as interleaved option for Pythia?)
8. VinciaQED for hadron decays (+ interleaved decays, with Giacomo Morgante)
9. LiveDisplays as contrib?
10. Colour reconnections: early/late resonance decays vs interleaving. Intermediate option: resonances above a certain width are decayed, resonances below it are not.

Christian Preuss

1. Discuss future of parton showers (default, Vincia, Dire, Apollo?)
2. Discuss future of matching and merging, perturbative physics in Pythia generally (interfaces? internal schemes?, continue working with MG5_aMC, closer interaction with Sherpa?)
3. more independent shower models (split up between ISR, FSR, resonance decays, QED, onia, ...)
4. Common funding schemes
5. learn about fragmentation! especially fragmentation interfaces (e.g. Sherpa cluster), role of junctions, ...

Breakout meetings

The future of M&M

Ilkka Helenius (should one discuss this and the next one at the same go)

Leif Lönnblad

Christian Preuss

(Peter S)

The future of showers

Christian Preuss

Leif Lönnblad

Peter Skands (if ok with time zone) (CTP: you should be part of the discussion, so we have to make it work time wise :)) (PZS: presume this also includes allowing for interleaving of QED showers separate from QCD etc ones.)

Ilkka Helenius

Torbjörn S

Forced fragmentation:

Christian Bierlich

Riley Henderson

Manuel Szewc

Philip Ilten

(Peter S but Riley can speak for me)

- Steve/Phil's branch not working currently $\Rightarrow$ fix weight calculation/application
- Riley's branch is working, but trial fragmentation method may not be desirable.
 - Final two filter efficiencies are averaged over all string configurations, this may lead to biases if one looks at subsets of events with a preference for certain string configurations.
 - Overhead from trial fragmentation?
- Need to confirm whether stochastic weight prescription works in the forcing case.
 - Write down proof similar to flavour variation case.
 - Get implementation working and validate.

Weight Interface:

Philip Ilten

Riley Henderson

(Torbjörn S)

(Peter S)

Potentially address also: <https://gitlab.com/Pythia8/releases/-/issues/562>

DIS kinematics:

Ilkka Helenius

Christian Preuss

Leif Lönnblad

Hadronization structure

Peter Skands (if possible)

Torbjörn S
Phil
Manuel Szewc
Riley

Moving to vincia-prepare

Peter S

Colour Reconnections: (Intermediate option between early and late resonance decays?
Resonances above a certain width are decayed, resonances below it are not. CR done
in-between.)

Peter S

Junctions

Leif
Torbjorn
Peter
Phil
Peter

CKKW-L #556

Steve, Leif, Christian P

aExtraDiquark

Proton--proton cross checks on aExtraDiquark bug

900 GeV:

- ALICE_2011_I881474 (Λ/K vs p_T)
- LHCb_2011_I917009 ($\Lambda_{\bar{b}}/\Lambda$ and Λ/K_s vs p_T and y)

7 TeV:

- ALICE_2016_I1507157 (Same-sign/opposite sign baryon correlations)
- LHCb_2011_I917009 ($\Lambda_{\bar{b}}/\Lambda$ and Λ/K_s vs p_T and y)
- LHCb_2014_I1298273 (Λ_b fraction vs p_T and y)
- LHCb_2016_I1391317 (Λ_b and B vs p_T and y at 7 and 8 TeV)
- LHCb_2021_I1888216 ($\Lambda_b/\Lambda_{\bar{b}}$ ratio)
- ALICE_2018_I1642729 (Ξ_c vs p_T)
- ALICE_2017_I1645239 (Λ_c vs p_T)

13 TeV:

- ALICE_2021_I1891391 (Λ - $\Lambda_{\bar{b}}$ correlations)

Tuning Groups

LEP Fragmentation

Deliverables:

- a minimal “Monash update” tune (set of numbers)
- a maximal, more ambitious tune, including matching issues (set of numbers with uncertainties + variant for NLO)
- Both Pythia & Vincia showers

Coordination: Peter

Group: Steve, Manuel, Adil, Leif

“Monash-inspired WG” (not limited geographically) focusing on obtaining a few tunes (+ uncertainties) with currently existing tools (or minor modifications of them): **PZS** + **Adil** have been using **Professor** with **Rivet** analyses based on the **Monash** distributions + ones from our **dark-matter fragmentation** studies. Like in Monash, we add a baseline 5% “theory uncertainty” but are exploring varying that to end up with an overall reduced $\chi^2 \sim 1$, to drive the fit (and its uncertainties). We divide the parameters into manageable 4-5 dimensional groups, and study the cross correlations at the best-fit points. We are also exploring adding **explicit higher-order terms** to the splitting kernels to complement the “magic trick”. We intend to use **MCplots** for cross checks. We would very much like to bring in any ee distributions we may be missing, like the **baryon correlations** mentioned by **Steve**. Related to that, we have not explored **popcorn parameters** yet but that really ought to be done. (**Anyone** interested in helping with that?) We intend to produce both a minimal retune, and a “maximal” one, and probably also ones with different assumptions about colour reconnections, and maybe more aspects. The maximal retune would explore use of parameters that were left inert in the original Monash tune, like **aExtraSQuark** (which should be more reliable now after the bug fix) and the possibility to give strange quarks higher pT kicks. As discussed during Pythia week, we should probably aim to produce a prescription that, ideally, anyone else could follow, and obtain the same results. Would be happy to work with **someone** (**Leif L?**) to explicitly test this? We aim to apply the methodology both to **Pythia** and to **Vincia**. **CTP**, could/should we look at Apollo too?

Other LEP fragmentation WGs?

Proposal: Adil, Peter, Steve perform a common study cross checking Prof vs Appr, including weighting and errors+error-on-errors

Concrete: Adil/Steve select a small number of parameters and data for LEP. They agree on what to use or not use or make different choices and compare the implications. They both report back on a relatively short time scale and work to understand the differences. As much as possible, we write up our technical steps so that each other's efforts are reproducible by the other part of the team. This is an iterative process, but will set the tone for future studies.

Steve: short term, writing code that replicates Pythia yoda files using parameter variations. Should work for aLund, bLund and TimeShower alphaStrong choices. (flavor reweighting still needs for us to address popcorn)

Steve: longer term, testing results from Harrison Prosper and student on Bayesian optimization which might give a posterior that can be used for “uncertainty tunes.”

ep (DIS and photoproduction) tuning

Deliverables:

- Fragmentation and MPI parameters (values with uncertainties)
- Both Pythia + Vincia showers for DIS part
- Identify external collaborators (Butterworth, Wing + students)

Lead: Jyväskylä group Ilkka.

Deliverables:

1. Fragmentation parameters for dipole recoil -shower option for DIS
2. MPI parameters for photon-proton collisions

Tools: Rivet and Professor

Coordinator: Ilkka

Group: Joni, (+ possible external involvement), Christian P

LHC pp tuning

Deliverables:

- wrapping up pilot projects, physics models to be proposed for tuning consolidated
- suggestion for a set of physics models (+ datasets) to be tuned.
- Identification of external collaborators to include or not

Trieste group (Valentina + Lorenzo) have been doing (limited) tunes of colour reconnections + ropes / close packing. This would probably be valuable to continue and build on.

Oxford group (Chris Hayes + Baris Tuncay) have been exploring Drell-Yan tunes with Pythia and Vincia, aiming towards an NNLO tune for ATLAS. This may or may not be useful to inform the global effort.

Base retuning to incorporate new PDFs, Vincia & Pythia.

Coordination: Christian P

Group: Christian B, Peter, Manuel, Riley

“Small x”-physics

- Identify datasets to be used
- Initial mapping of dependencies. What needs to be opened up from previous categories? Example: redoing parts of fragmentation
- Which cross section parametrization to use?
- Impact of bugfix on fragmentation region
- Identification of external collaborators to include or not

New aspects we should aim to bring in, that were not (very) directly addressed in Monash: Diffraction. Beam-remnant fragmentation. Forward physics (CORSIKA). Total / Elastic / Inelastic cross sections (Christian B happy to take this). Low-energy collisions (Detroit tune) / fixed-target energies. Cosmic-ray aspects. Input from Chloé.

Coordination: Torbjörn

Group: Naomi, Christian B, Ilkka,

Practical tools and implementations for tuning

Tony, Manuel, Steve, **Phil**,

Procedural tunes and tuning philosophy

This group will provide public code that can be used to reproduce tunes.

Phil Ilten (note, requires software and seeds for runs, surrogate building, AND optimization)

Christian Bierlich

Leif Lönnblad

Christian P

Manuel

Weighting for Uncertainty

Weighting for Speed

Tony

PZS thinks it would be very interesting to replace (parts of) Professor grids / interpolations by distributions obtained by reweighting from a sparser Professor grid. This would speed up the overall tuning process (e.g., if the grid could be made an order of magnitude or more sparser?), and would be an interesting approach to demonstrate if no one else have beat us to it? If such a technology was developed, it could go right into the fragmentation tuning project(s) and be exploited there.

Procedural Tunes

Surrogate model uncertainty

Define a prescription to handle the uncertainty for any interpolation methods used (Professor / Apprentice / ...) – one obvious thing is to compare tune results with surrogates to explicit parameter runs

Fragmentation Models

Collect fragmentation models here, and possible inheritance structure.