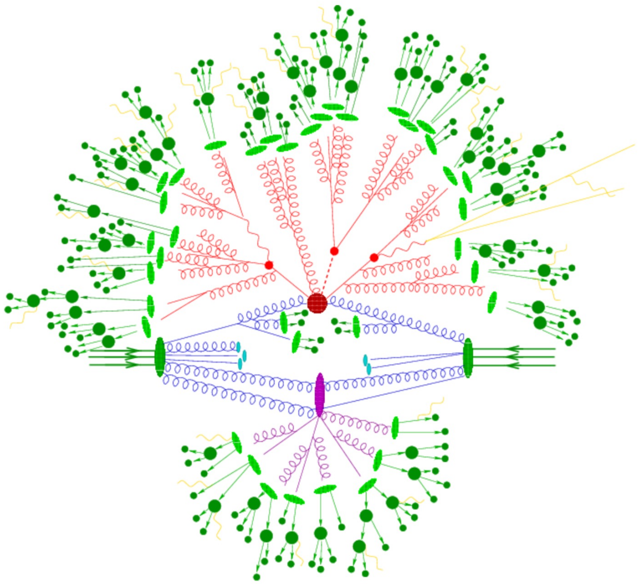
Theory Collider Phenomenology

Theory collider phenomenology:

- Provide theoretical calculations to make possible / improve precision of / that are relevant for (potential) experimental analyses at colliders
  → fixed-order pert. theory, resummation, factorization for dedicated processes
  → non-perturbative effects
  → multi-purposed simulation tools (MC)
- Connection / applicability to actual /potential analyses
- Precision in the context of realistic assumptions
- LHC the only current major high-energy collider experiment



Theory Collider Phenomenology

Austrian connections and situation:

- University of Vienna -- University of Graz – HEPHY (small Austrian community)
- Research interests focused, no coverage of the entire field of phenomenology
- Emphasis: (1) outstanding expertise at the international level
  (2) quantum field theory and solid theoretical foundation as guiding principle
  (3) maintain/expand possibilities on Austrian networking (→ “critical mass”)
  (4) (new physics search through) precision physics and novel methods
  (5) Funding

Current and mid-term research interests:

Ordering of topics is random!

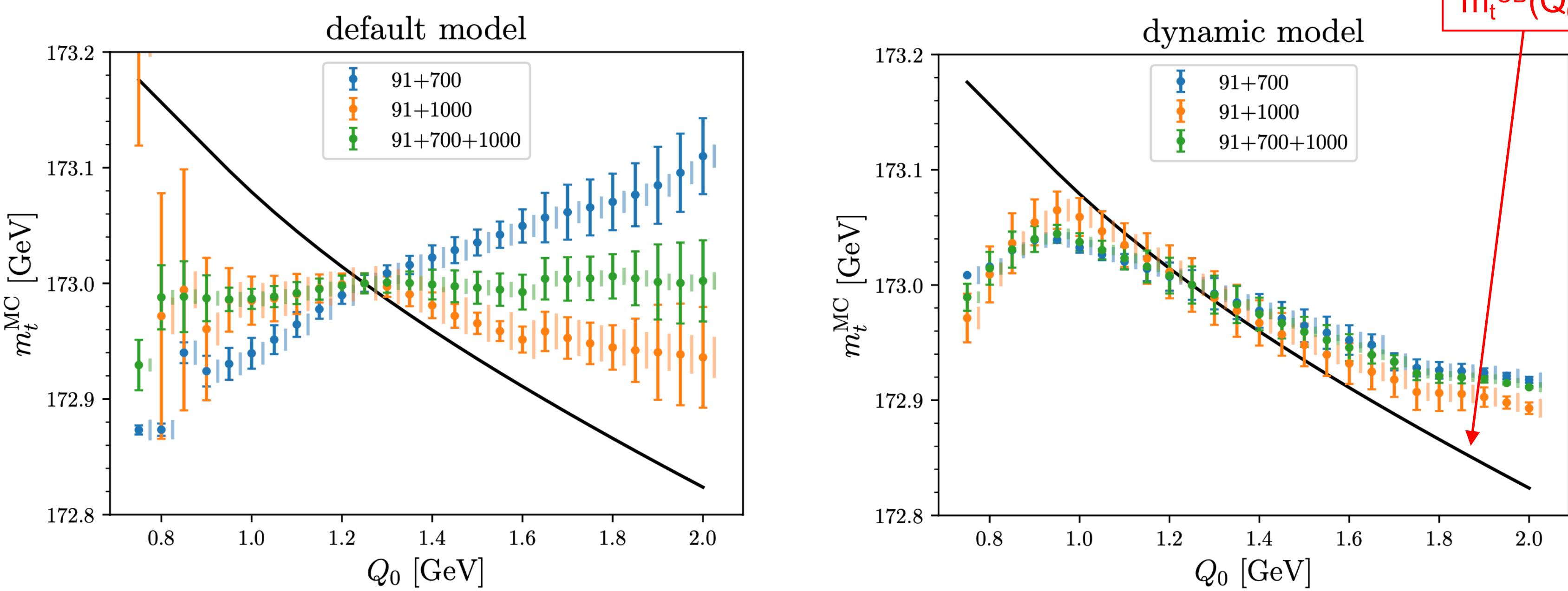
- Top and heavy quark physics, jets and jet substructure
- Simulations (MC event generators) and higher order resummations (QCD + electroweak)
- Perturbation theory ↔ hadronization effects
- Field theoretic systematics (IR structures, EFT’s, factorization, OPE, renormalons,..)
- Nonperturbative aspects of electroweak physics (→ lattice)
- Precise SM/SMEFT parameter determinations
- Direct contact to experimental groups and analyses
- Low-energy precision observables (g-2, hadron and heavy lepton decays)
- Novel approaches and concepts (ML, gauge-gravity, holography, …)

One recent collaborative highlight …

AHH, Jin (UV). Plätzer (UG), Samitz (SMI) to appear

Precise control over the meaning of m_t^{MC} for HERWIG for 2-jettiness for boosted top quark production in e^+e^- collisions

Q_0 dependence expected from $m_t^{CB}(Q_0)$



$$m_t^{CB}(Q_0) = m_t^{pole} - \frac{2}{3} Q_0 \alpha_s(Q_0) + \mathcal{O}(\alpha_s(Q_0)^2)$$

$$m_t^{CB}(Q_0) = m_t^{MSR}(Q_0) - \frac{2}{3}\left(1 - \frac{2}{\pi}\right) Q_0 \alpha_s(Q_0) + \mathcal{O}(\alpha_s^2(Q_0))$$

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Long term research interests (→ ~ 2034):

- Towards: Monte Carlo event generators as QFT tools (amplitude evolution, QCD+EW)
- Top quark physics in the boosted regime
- Multi-variable jet distributions and substructure
- Novel aspects (e.g. ML, non-global logs, MPI, gauge-gravity, unstable particles)
- Electron-positron physics (future lepton collider physics)
- Indirect searches for new physics through precision and intensity

Priorities

- HL-LHC with highest priority
  → plenty of opportunities for relevant phenomenological work
  → maximum data yield not be compromised
- Future lepton collider
  → a realistic prospect (incl. approval) most relevant considerations

- Direct CERN support for LHC-relevant theoretical work (travel support, fellowships,..)