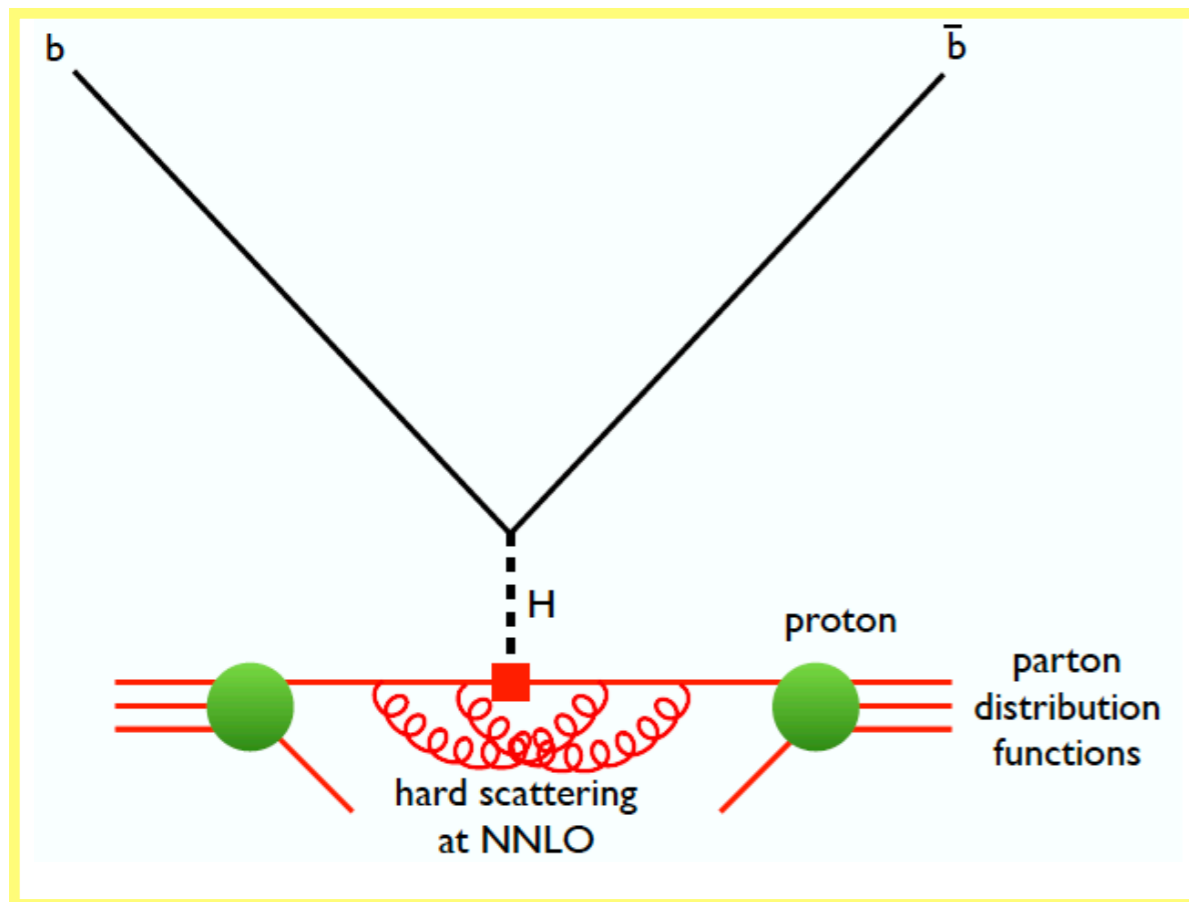# Event generators for NNLO/ NLL and beyond

NNLO: the frontier

good perturbative accuracy, accurate inclusive cross-sections, but limited to low multiplicity and parton level only

Parton showers: indispensable

less accurate, but realistic description, including multi-parton interactions, resummation, hadronization effects
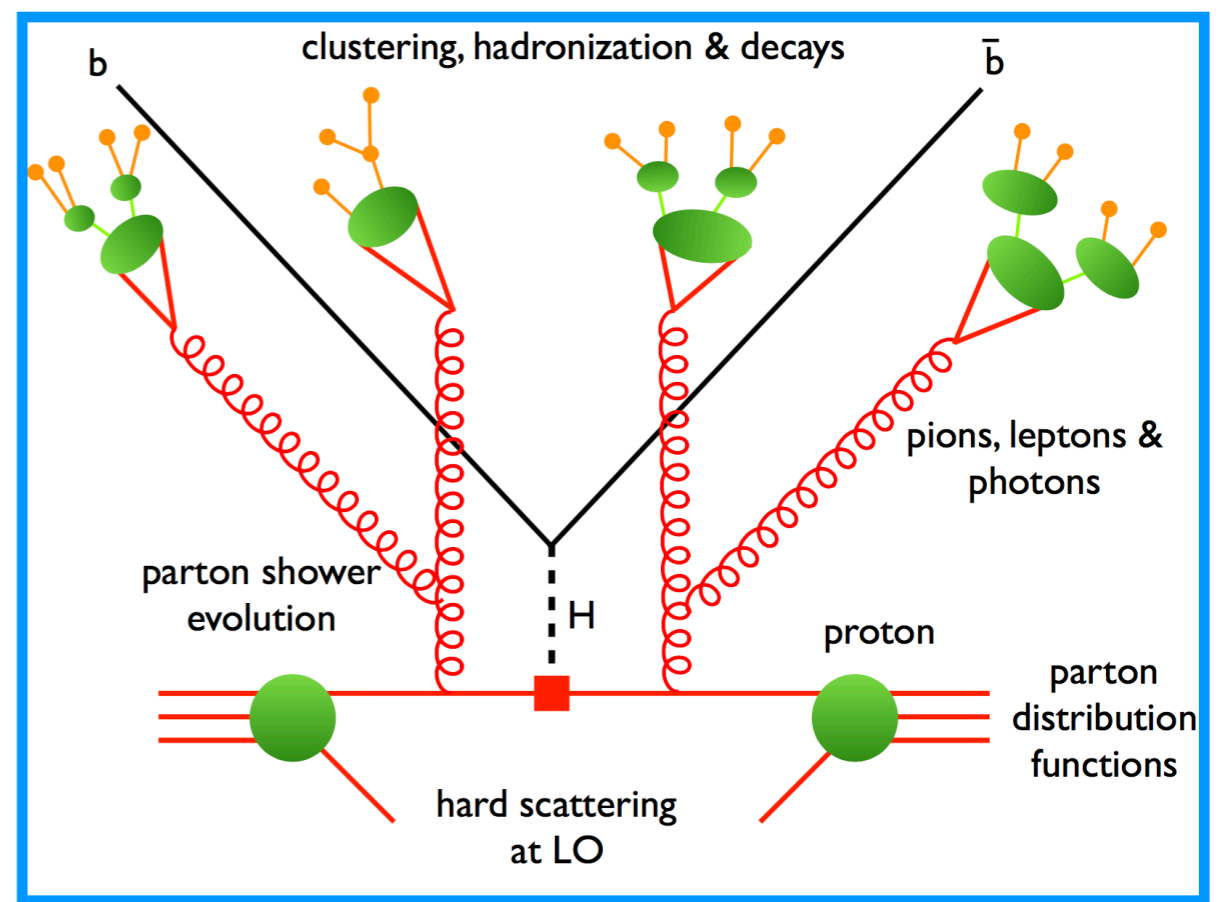
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clustering, hadronization & decays
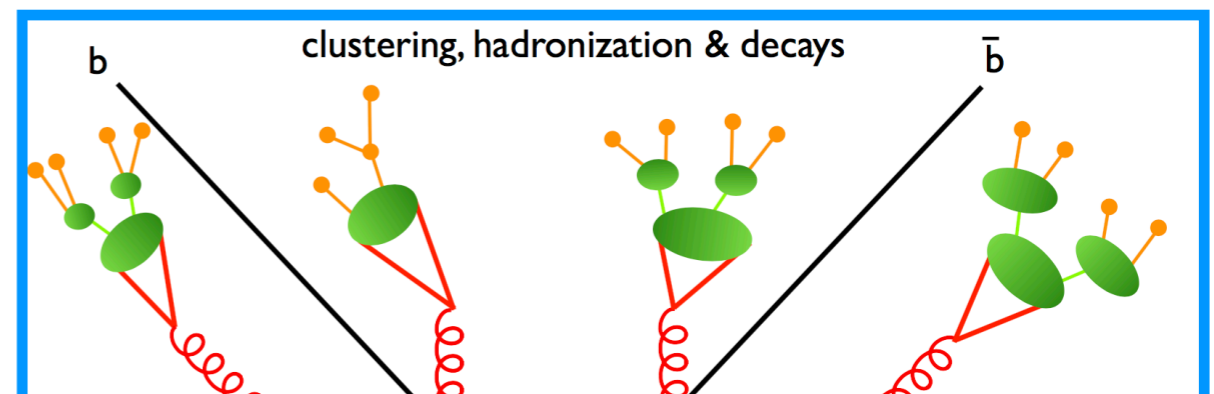
Matching of NLO & parton shower achieved in seminal papers about 15y ago

Nason hep-ph/0409146; Frixione & Webber hep-ph/0204244 (see also Jadach et al 1503.06849)

Today: NLO+PS codes (MC@NLO, POWHEG, Sherpa …) well-established and used in all advanced LHC analyses

NNLO+PS

Merging NNLO and parton shower (NNLOPS) is a must to have the best perturbative accuracy with a realistic description of final state
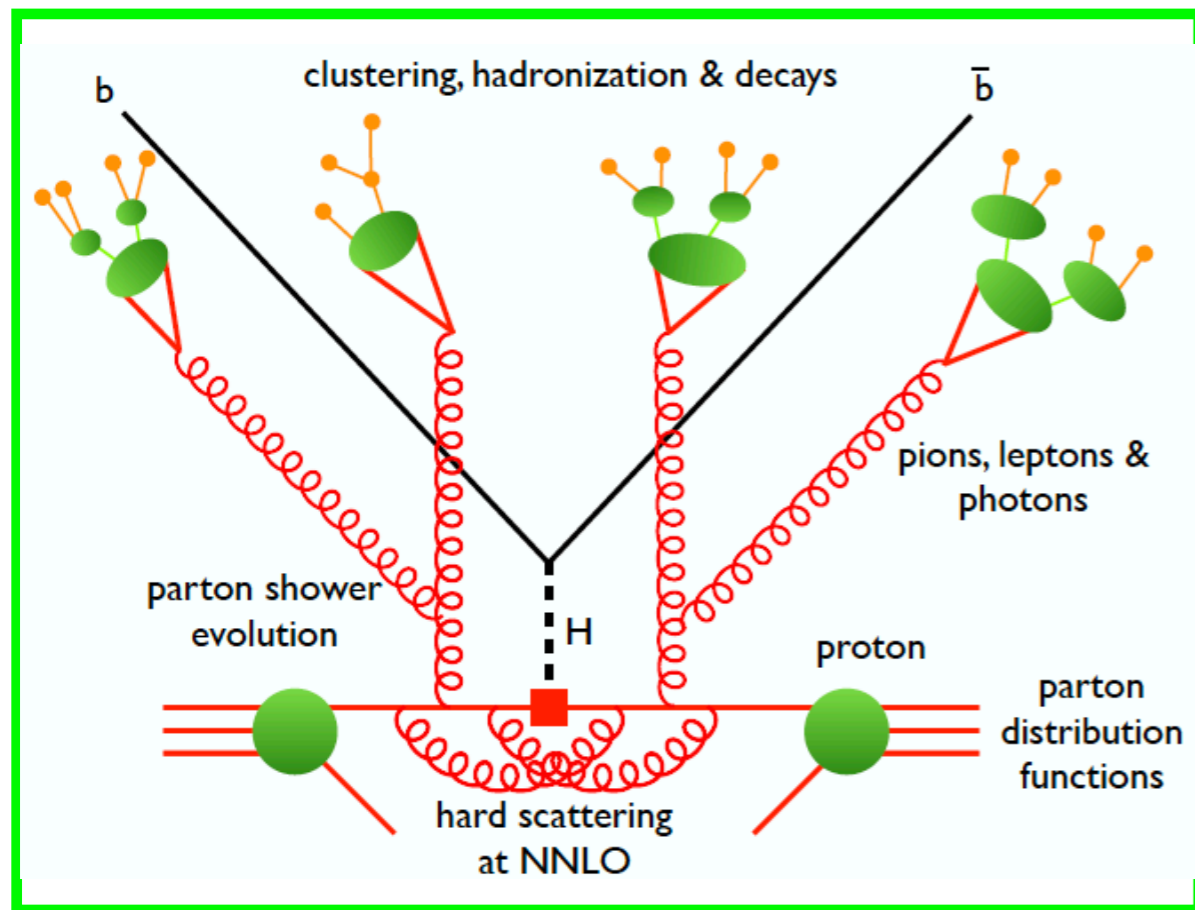
- Few methods exists: UNNLOPS, Geneva, MiNNLOPS

  Hamilton et al 1212.4504
  Alioli et al 1211.7049
  Höche & Prestel 1405.3607
  Monni et al 1908.06987

- So far NNLOPS applied to relatively simple processes only: Higgs, Drell-Yan, associated Higgs production, WW

A challenge to extend NNLOPS to more generic processes beyond colour singlet final states (e.g. processes involving tops or jets)

Event generators at NLL

NNLOPS aims at improving the fixed-order accuracy of the parton shower, while preserving the all-order accuracy

Recent work on

- Quantifying the all-order accuracy of the shower (using analytic all-order results): NLL criteria + validation framework

- Improving the all-order accuracy of the shower

More work needed towards logarithmically accurate Parton showers, and their matching to N(N)LO (arguably more subtle than current methods)

Dasgupta et al 2002.11114