NLM Theory summary

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Les Houches, 19 June 2019

Projects

- PDF benchmarking (Josh)

- Photon isolation (Daniel)

- NNLO nTuples

- NNLO subtraction prospects for $2 \to 3$
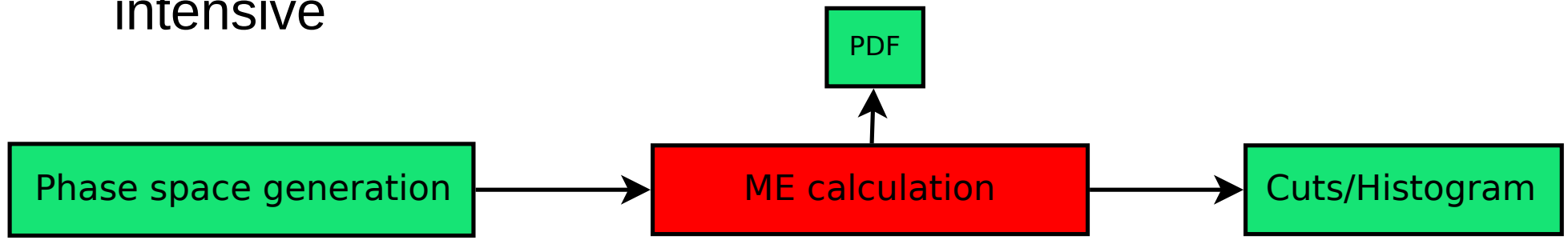
- Wish list update
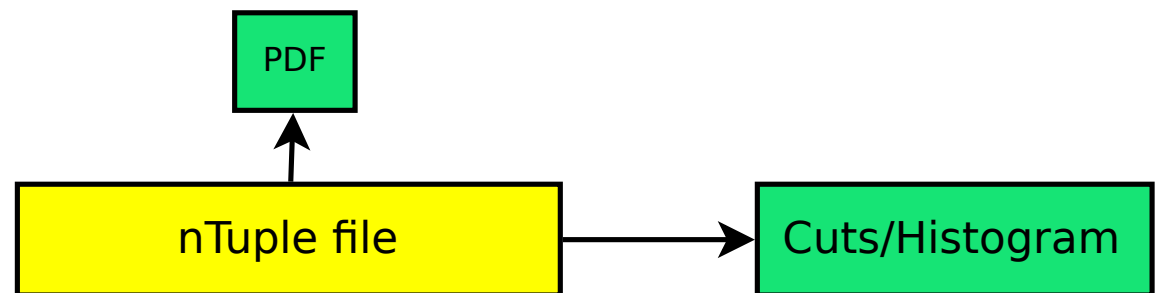
- Analytical reconstruction

- Slack: leshouches2019nlm

NNLO nTuples

nTuple files

- High multiplicity NLO calculations are computationally intensive

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                        │ PDF │
                        └──▲──┘
                           │
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│Phase space generation│─▶│  ME calculation  │─▶│  Cuts/Histogram  │
└──────────────────────┘  └──────────────────┘  └──────────────────┘
```

- Matrix elements are expensive

- Jet clustering, observables, PDF evaluation are relatively cheap

- Store matrix element, PS point and the information necessary to change scales

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                    ┌─────┐
                    │ PDF │
                    └──▲──┘
                       │
        ┌──────────────────┐  ┌──────────────────┐
        │   nTuple file    │─▶│  Cuts/Histogram  │
        └──────────────────┘  └──────────────────┘
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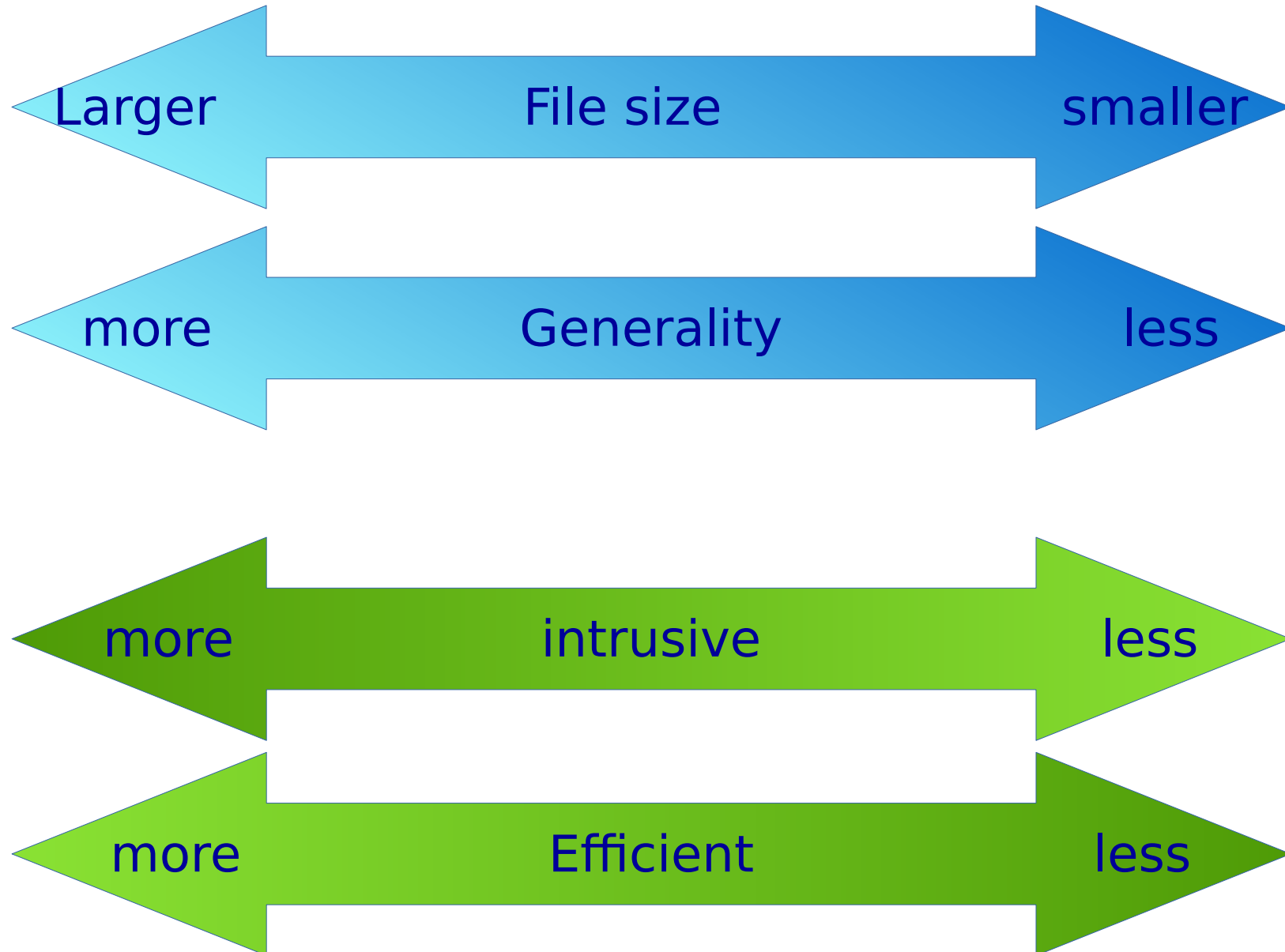
nTuple files

- Advantages
  - One can change the analysis cuts, add observables
  - Cheap scale variation and PDF errors (otherwise extremely expensive)
  - Easy communication between theorists and experimenters
  - No need for specific know-how of the tool which produced the NLO/NNLO calculation
  - Easier to "endorse" an event file than a program
- Disadvantage
  - Large files
  - Generation cuts need to be loose enough to accommodate many analysis $\rightarrow$ efficiency cost

- Trade offs

nTuples for NNLO

- nTuples have proven useful for NLO

- Can they be as useful for NNLO?

- Same advantages and same disadvantages but amplified:

    – Programs are more complex

    – Larger files:

        - Many more pieces in the calculation

        - More logarithm coefficients

- Main question: is the size reasonable?

Minimum invasive

NNLO nTuples project

- Aim: investigate feasibility of nTuple files for processes @ NNLO

    – Use Drell-Yan as a benchmark (between existing $e^+e^- \rightarrow 3$ jets and dijet benchmarks)

    – Can be used to compare different codes in terms of the number of subtractions, number of PS points to reach convergence, ...

      - NNLOjet
      - CaMeRo program
      - **Join the fun here!**

- #nnlo-ntuples on slack

Analytical formulae from numerical programs

Analytical expressions from numerical

- Method is described in arXiv:1904.04067

- Use large floating point arithmetic to probe an expression in singular limits to get the poles in the denominator

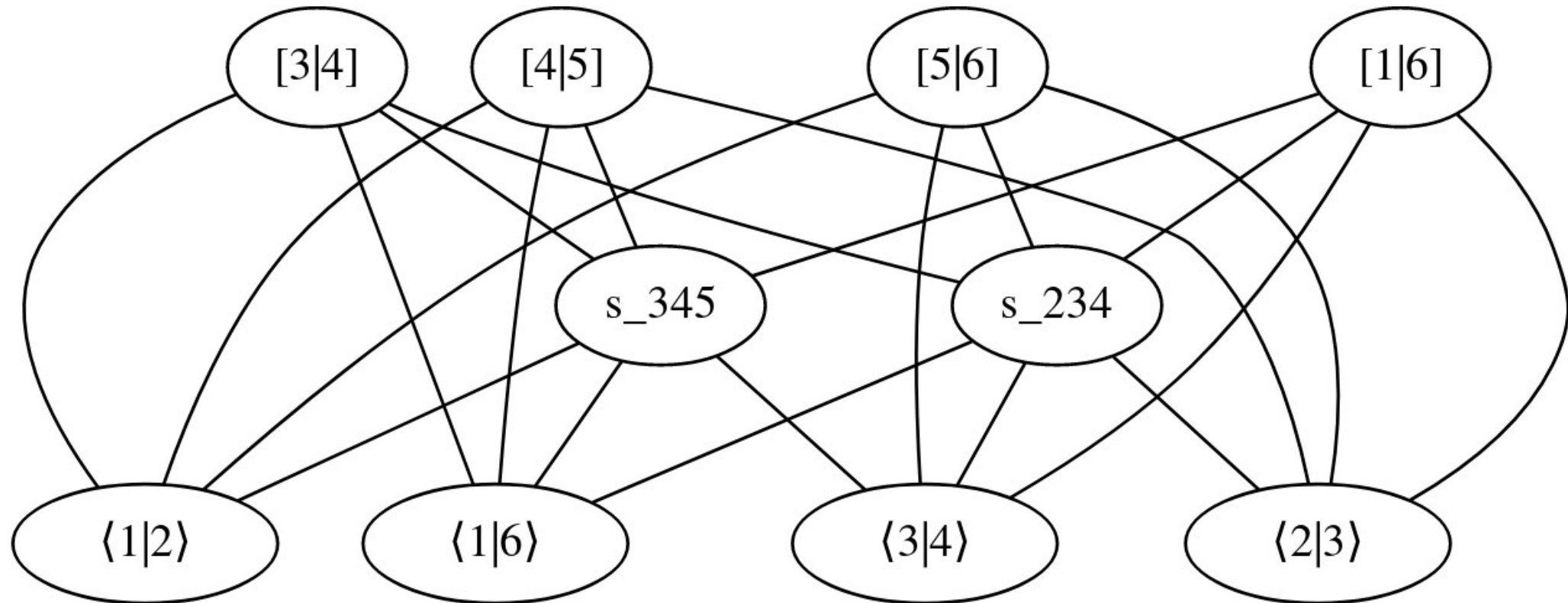$$\mathcal{A}(1^-, 2^-, 3^-, 4^+, 5^+, 6^+)$$

- Find poles using singular limits

$$\langle 1|2 \rangle, \langle 1|6 \rangle, \langle 2|3 \rangle, \langle 3|4 \rangle, [3|4], [4|5], [5|6], [1|6], s_{234}, s_{345}$$

- Investigate which poles belong together using double singular limits

$$\mathcal{A}(1^-, 2^-, 3^-, 4^+, 5^+, 6^+)$$

Analytical expressions from numerical

- Build ansatz for the numerator

- Solve for coefficents

- Extract subset of terms in a specific limit

    - Automatic Taylor expansion?

Analytical formulae

- Possible aim:
  - Identify amplitudes/processes for which is would be useful to have analytical formulae instead of numerical methods
  - Study numerical stability of analytical formulae in collinear regions of PS (RV part of NNLO calculations)
  - Volunteers needed!
  - #analytical on slack

Les Houches wish list update

Wish list update

- Update list with new calculation

- Would like to add state of validation

  – Agreement for total cross section

  – Agreement for distributions

- List of changes will be maintained on the wiki

  – Add your calculations (since 2017) on the wiki page

    https://phystev.cnrs.fr/wiki/2019:groups:sm:wishlist_update

Ex.: Edge list [(1,2),(2,3),(2,3),(3,4)] or 1 2 2 3 2 3 3 4 — Nickel index e11|e|

Enter your graph by its edge list (adjacency list) or Nickel index

or browse:

Loops [= ▾] [any ▾]   Legs [= ▾] [any ▾]   Scales [= ▾] [any ▾]

Fulltext must contain: [_____]   must not contain: [_____]

[Search]   [Reset]

If you wish to add a new integral to the database, start by searching for its graph first.

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