$\mu\mu\gamma$ discussion starting points

- Can we expand the differential equations for the MIs in certain problematic PS regions?
- Massification: wider use in fixed-order? Also beyond fixed order?
- How to evaluate theoretical uncertainties on fixed-order and resummed calculations
- MC authors/experimentalists: any requirements on (NNLO) amplitudes which you want to discuss further
- Collinear terms in YFS? Differences between parton shower/YFS?
- Bhabha more challenging for MCs, but precision requirements more stringent...

$\mu\mu\gamma$ discussion outcomes

Q. Can we expand the differential equations for the MIs in certain problematic PS regions?

A. Potentially yes, should be looked into when needed.

Q. Massification: wider use in fixed-order? Also beyond fixed order?

A. Yannick advocates for wider use, to make the most of the loop calculations we have. Need to be very careful beyond FO due to possible conflicting approximations.

Q. How to evaluate theoretical uncertainties on fixed-order and resummed calculations

A. Compare different methods/orders, take some measure of spread as uncertainty. e.g. NLO vs NNLO vs NLO+YFS. Best to do this on the histogram/observable level rather than integrated quantities. Need to be careful to combine with uncertainties on hadronic quantities.

$\mu\mu\gamma$ discussion outcomes

Q. MC authors/experimentalists: any requirements on (NNLO) amplitudes which you want to discuss further

A. N/A

Q. Collinear terms in YFS? Differences between parton shower/YFS?

A. There exists a formalism for collinear terms resummed in YFS, but never implemented/tested. Jérémy and Lois will do, but more urgent work first. In the meantime, include via β's – Lois to find out status of these. BABAYAGA authors keen to compare against YFS.

Q. Bhabha more challenging for MCs, but precision requirements more stringent...

A. MCMULE not planning to go beyond NNLO imminently (on average, Bhabha is easier than $\mu\mu$ numerically). BABAYAGA focusing on radiative processes for now. SHERPA YFS cannot do Bhabha but CEEX should be able to. PHOKHARA not planning any developments here, though Jérémy's CEEX could do Bhabha eventually.