

Two main technical themes

◆ aMC@NLO

◆ NNLO

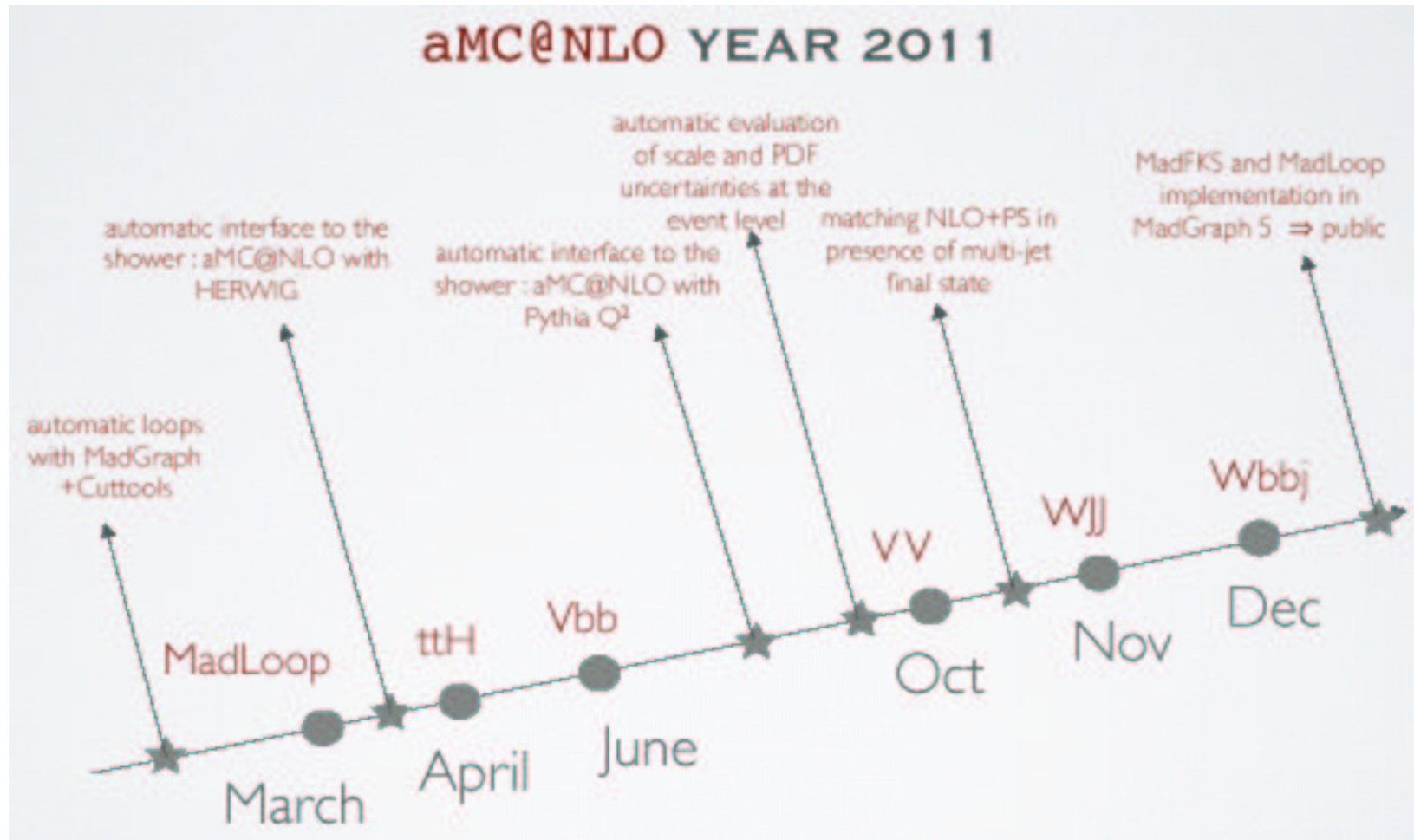
and extensive phenomenology

aMC@NLO

Is a catch-all name for the following independent components
(embedded in a single code)

- ◆ MadFKS: implements FKS subtraction. In general, treats all aspects of an NLO computation, except for one-loop matrix elements
- ◆ MadLoop: one-loop matrix element calculations, with OPP. Uses CutTools.
- ◆ aMC@NLO: interface with MC parton shower according to the MC@NLO formalism

Tree-level matrix elements are ubiquitous. Provided by MadGraph



plot: F. Maltoni

Each of the processes listed here would have cost *years* of work with traditional methods

aMC@NLO: status and limitations

- ◆ MadFKS: QCD corrections to any process in any theory implemented in MadGraph
- ◆ MadLoop: QCD corrections to SM processes that do not feature a four-gluon vertex at the Born level
- ◆ aMC@NLO: interface to Herwig6 and Pythia6 (Q^2)

Future directions are driven by phenomenology

If you've got a pet project, please speak up!

Some key issues in the next couple of years

- ▶ Treatment of unstable particles (top, W , Z finite widths)
- ▶ Top mass measurements (corrections to decay, interference)
- ▶ Jet veto (eg $VBF+1j$)
- ▶ Impact of EW HO effects on standard candles
- ▶ Multijets with NLO+PS ($VBF+$, $W+$, $t\bar{t}+$; an SM and BSM hot topic)
- ▶ Systematic use of NLO+PS in PDF fits
- ▶ Impact of NLO+PS techniques on non-SM processes
- ▶ Impact of non-QCD, non-EW HO corrections

In general: complete analyses at the NLO. Help sought

At the level of matrix elements, most of these issues will be solved by moving MadFKS/MadLoop to MadGraph5. This is now basically done, and we are in the testing phase

- ▶ Double perturbative expansion (QCD, EW)
- ▶ Complex-mass scheme

Contributions can be given mostly to phenomenology (with or without showers), by exploiting these newly-developed tool

A possible exception is the automation of the computation of UV and R_2 building blocks for an arbitrary theory. Work ongoing, possibility to explore alternative solutions

aMC@NLO will be interfaced to Herwig++ and Pythia8 – ongoing work.

Contributions are welcome to:

- ▶ Matching EW effects in matrix elements and shower
- ▶ Automation of POWHEG (any n ?)
- ▶ CKKW-NLO and/or MLM-NLO
- ▶ Pheno studies of urgent SM issues (top physics)
- ▶ Pheno studies of BSM (now limited to tH^\pm . Model-independent, signature-based, heavy top partners, ...)

Ongoing activity towards PDF fitting open to new technical solutions
(and raises non-trivial physics questions)

NNLO

Phenomenology should be seen as a (possible) spinoff here, the emphasis being in trying to understand a bit better the IR structure of QCD

- ▶ Formulate the problem (subtraction) in a way that does not depend on the perturbative order
- ▶ Are dual amplitudes a better way to tackle the problem?
(btw, a systematic $1/N_C$ expansion in aMC@NLO is desirable)
- ▶ Where is the simplicity (Gardi, Magnea; Becher, Neubert) lost?
- ▶ Is a fully-numerical approach conceivable (or desirable)?