

LHC - RELATED ACTIVITIES
at LAPTH (Annecy)

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F. Boudjema, J.-P. Guillet, E.P.
+ students & external collabs.

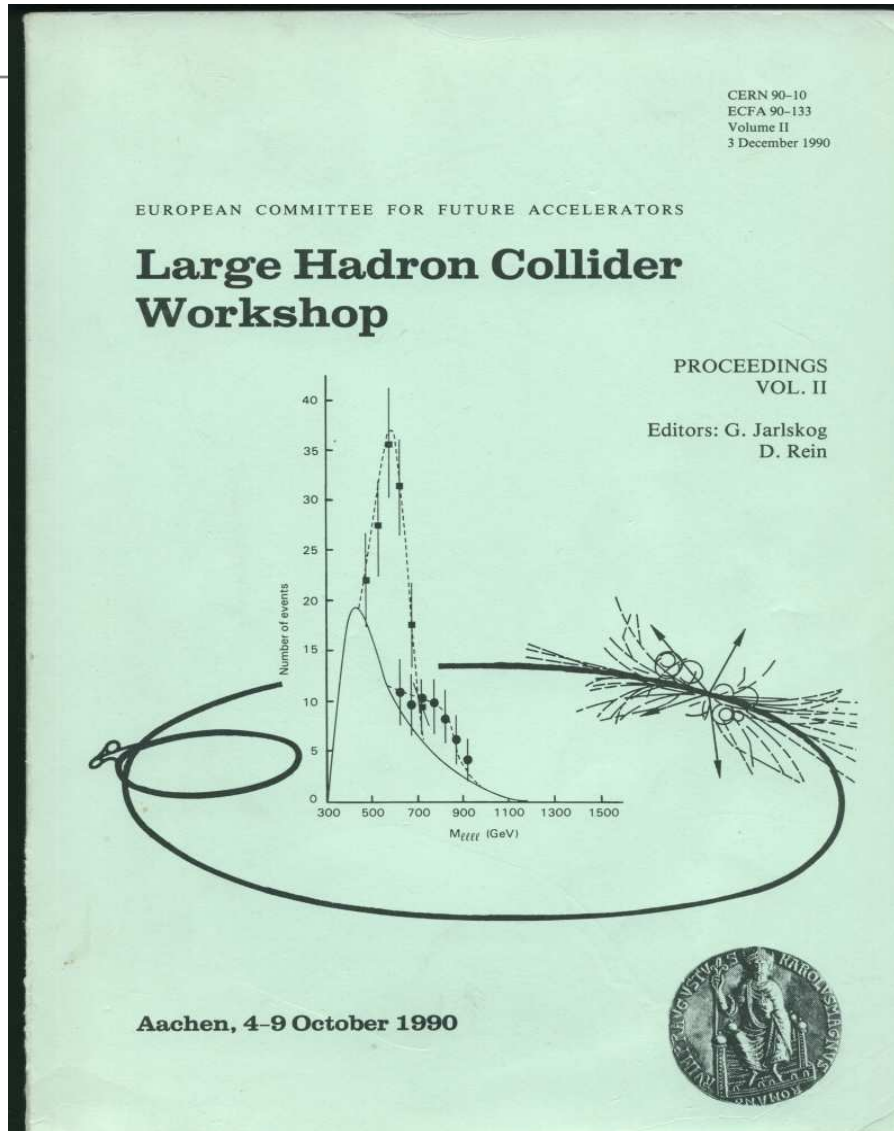
THEMES & TEAMS:

- * NEW PHYSICS & DARK MATTER
- * AUTOMATED 1-LOOP MULTILEGS ($N \leq 6$)
- * TOWARDS DIPHOX-SMC...
- * **QCD** IN HOT/DENSE MATTER
- * WORKSHOPS

NEW PHYSICS & DARK MATTER

(G. Bélanger, F. Boudjema + students & external collabs.)

Aim 1: LHC Dark Matter Connection, the new paradigm: weighing the Universe at LHC



no mention of a connection, despite a SUSY WG

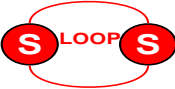
There is a mention of LSP to be stable/neutral because of cosmo reason, but no attempt at identifying it or **weighing the universe at the LHC**

LHC till 2000: Symmetry breaking and Higgs

New Paradigm, Dark Matter is New Physics. Dark Matter is being looked for everywhere

New Paradigm, Particle Physics to match the precision of recent cosmological measurements

New Physics at LHC, E_T miss, spin and model reconstruction

- Cosmology in the era of precision measurements, Dark Matter is **New Physics**. Can LHC match the precision of the upcoming cosmo/astro experiments and indirectly probe the history of the early universe?
 - Spin determination (eg. proposal for new helicity bases), Model reconstruction, E_T miss physics
 - Effects of backgrounds, collaborations with MC developers
 - Fits and reconstruction must be carried beyond naive tree-level analyses especially for SUSY
- Impact and role of Indirect and Direct detection, work with astrophysicists (e.g astro uncertainties, propagation models,...)
- – Need for efficient cross border tools
 - **micrOMEGAs** powerful tool for relic, direct and indirect detections, LHC cross sections and decays of NP particles. Any model can be implemented very easily and quickly, **many models already included**. modules for flavour physics **interface** MCMC (MC Markov chain)
 - MSSM** as prototype, beyond tree-level  fits need to be done beyond tree-level. Need for such tools. SloopS already operative (scheme dependence of cross sections, gauge invariance issues, modularity,..)

AUTOMATED 1-LOOP MULTILEGS ($N \leq 6$)

SLOOPS

(F. Boudjema + students & external collabs)

Automated calculator of “1 loop, up to 6 legs” processes in (MS)SM for Colliders and for DM (relic dsty at 1 loop)

- **non-linear** gauge fixings (num. checks of g.f. indepce)
- **automated** renormalization,
several possible “-inos” OS-schemes
- QED IR regul. / photon mass ($\rightarrow 0$)
- **improved Passarino-Veltman** recursive reduction of diagrams

relies on existing libraries for N-pnt fcts,
extended when needed (instable internal part.)

Effective;

already applied to practical 1-loop, 5 & 6-legged processes

- Planned improvements:
 - IR & colln. in **QCD** sector;
 - alternative libraries (e.g. golem95 cf. below)
- Applications to new physics searches & their backgrounds: MSSM & DM; e^- weak corr. to WW scatt.

GOLEM

(J.-P. Guillet, E.P. + external collabs.)

Towards automated calculation of QCD initiated “1 loop, up to 6 legs” processes

- **dedicated** reduction of diagrams
making subtract. of IR & coll. **systematic**
- **golem95 = non standard** (non minimal) library
to **avoid** fictitious $(1/\det \text{Gram})^p$

golem95 Fortran 95 library = publicly available at:
<http://lappweb.in2p3.fr/lapth/Golem/golem95.html>

- On-going improvements:
 - completion of library with internal/cx masses;
 - automation
- Applications to bkgd processes to new physics:
 $q\bar{q} \rightarrow b\bar{b}b\bar{b}$, $q\bar{q} \rightarrow VVjet$ at NLO

TOWARDS DIPHOX-SMC...

(F. Arléo, J.-P. Guillet, E.P.)

PHOX family codes = parton level MC programs computing inclusive Xsections of processes involving photons, at NLO accuracy:

DIPHOX \leftrightarrow photon pairs + X

JETPHOX \leftrightarrow photon + jet + X

Fortran codes publicly available at:

http://lappweb.in2p3.fr/lapth/PHOX_FAMILY/main.html

+ widely used by collider collabs.(ATLAS and CMS; CDF and D0 at the Tevatron; PHOENIX at RHIC);

- yet are stand alone tools w/o parton showers, ignoring underlying event, etc. ...

D. Fournier complained at first TH/LHC-F meeting:

“On veut un DIPHOX qui marche” ... :-)

\Rightarrow Project: combine

NLO accuracy of DIPHOX (aka Diphoton X sections)
with

versatility of shower MC event generators

in progress...

Aim: in particular, a better understanding of isolation

QCD IN HOT/DENSE MATTER

(F. Arléo, P. Aurenche)

Interest in the production of **hard processes** in $pp \rightarrow pA$ and $pp \rightarrow AA$ collisions + correlations, investigating **effects of medium**, either nuclear matter or quark-gluon plasma

- prompt photons
- jets
- large- p_{\perp} hadrons
- heavy-quarkonia and Drell-Yan

Emphasis is put in particular on :

- (medium-modified) fragmentation processes
- nuclear parton distribution functions

Active exchanges with ALICE and CMS collaborations so far

WORKSHOPS

LES HOUCHES WORKSHOPS “PHYSICS at TeV COLLIDERS”

(G. Bélanger, F. Boudjema, J.-P. Guillet, E.P. + external collabs.)

Series of **workshops** happening every odd year since '99.

Goal: unravel

- the EWSB mechanism at TeV Colliders
- accompanying new physics + corresponding bkgds + MC implementation

Format:

- bring **together** during 3 week th + exp, seniors + jounng guns, of both Newphysics and SM & bkgds on = footing,
- **informal** discussions e.g. leading to fruitful “**Les Houches Accords**” (examples: LHAPDF, SLHA) to solve practical issues
- work on various **selected** research **projects on site** and develop new collaborations within WG.
- Research activities carried through during the whole year. Results gathered and published on arXiv.

more at:

<http://wwwlapp.in2p3.fr/conferences/LesHouches/Houches2009/>

TOOLS FOR SUSY AND THE NEW PHYSICS

(G. Bélanger, F. Boudjema + external collabs.)

Series of **workshops** more specifically dedicated to the computational **tools for new physics and its bkgds**, accords for MC and implementation of models

Organised every **even** year in alternance with LH.
Initiated in Annecy (till '06), then in Munich ('08);
next in Southampton (in '10)