

Searches for New Physics:

Les Houches Recommendations for the Presentation of LHC Results

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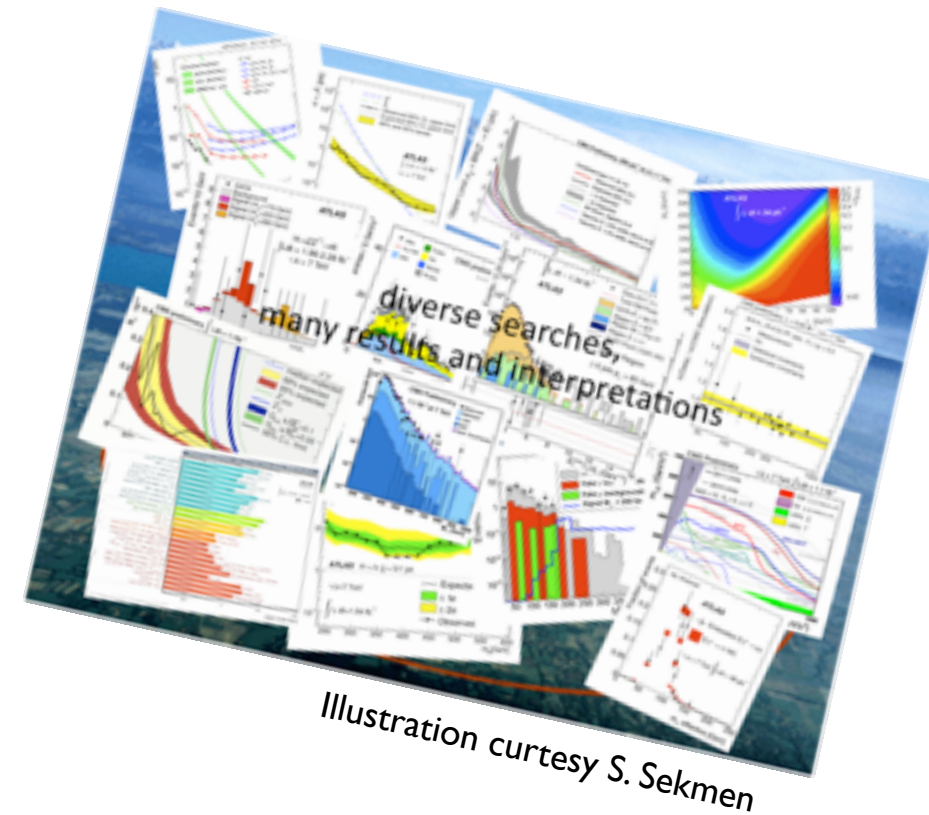
[arXiv:1203.2489](https://arxiv.org/abs/1203.2489)

eds. S. Kraml, B.C.Allanach, M. Mangano, H.B. Prosper, S. Sekmen,
EPJC, Vol. 72, number 4 (2012), 1976

see also the Les Houches 2011 BSM working group report, arXiv:1203:1488

Motivation

- LHC is **the** high energy frontier machine to explore the TeV scale and provide answers to many key questions in particle physics.
- **Need to interpret LHC results in the contexts of all kinds of models of new physics**; crucial if we are to unravel the correct theory and determine its parameters.
- The complexity of a) the experimental analyses and b) the possible new physics models **requires active collaboration of experimentalists and theorists** —the whole HEP community— **to fully exploit the LHC potential**.
- A **common standard** for the information to provide **would immensely help this task**. (it would actually help not only the interpretation of results but also comparisons within/across experiments, data preservation efforts, etc, etc)
- Besides our own (physics) interest in making the most out of the LHC data, we may soon be seriously mandated by the funding agencies to work much more openly towards this aim ...



Les Houches Recommendations

- At the PhysTev2011 workshop, we started to discuss a set of recommendations for **presenting the LHC results in a form that would be most useful to the community at large**, and that would help to **maximize the scientific return** of the LHC.
- Initial recommendations were thoroughly discussed and refined with input from ATLAS and CMS collaborations in a dedicated LPCC miniworkshop

13 Feb 2012

→ **final document arXiv:1203.2489** (33 authors)



Searches for New Physics: Les Houches Recommendations for the Presentation of LHC Results

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Abstract

We present a set of recommendations for the presentation of LHC results on searches for new physics, which are aimed at providing a more efficient flow of scientific information between the experimental collaborations and the rest of the high energy physics community, and at facilitating the interpretation of the results in a wide class of models. Implementing these recommendations would aid the full exploitation of the physics potential of the LHC.

LH recommendations - some remarks

- In the Recommendations, we think it useful to clearly distinguish between
 - ★ **experimental result** — whatever is actually observed, i.e. the outcome of an analysis, such as event count or the measurement of a physical observable,
 - ★ and **interpretation** — the comparison of the experimental results to particular theoretical models
- Many of the experimental publications already implement several of the basic recommendations ⇒ work towards an agreement on a **common standard**.
- The sum of our recommendations goes substantially beyond current practice.
- Useful not only for non-collaboration groups or individuals performing (re-)interpretation studies; a common standard will also greatly facilitate the comparison and combination of analyses within and across the LHC collaborations, and help long-term data preservation efforts.
- Recommendations focus on **what** information should be provided, **not how** this should be done!

Nature and categories

- Analysis description

- a. Clear, explicit & complete description of the analysis
- b. Common analysis database (analysis codes)

a. “mandatory”
b. “desirable”

- Detector modeling

- a. Efficiency maps
- b. Public fast detector simulator



- Analysis dissemination

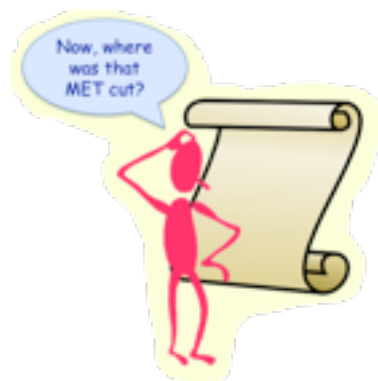
- a. Crucial numbers of results
- b. Full likelihood function (analytic and/or numerical form)



- Interpretation of BSM search results confidence levels, etc

- Higgs searches channel-by-channel information

- Analysis design disjoint sets of events



I. Analysis description

Recommendation Ia: Provide a **clear, explicit description of the analysis** in publications. In particular, the most crucial information such as **basic object definitions** and **event selection** should be clearly displayed in the publications, preferably **in tabular form**, and **kinematic variables** utilised should be **unambiguously defined**. *Further information necessary to reproduce the analysis should be provided, as soon as it becomes available for release, on a suitable common platform.*

Rivet, HEPdata, ...

Recommendation Ib: The community should **identify, develop and adopt a** common platform to store **analysis databases**, collecting object definitions, cuts, and all other information, including well-encapsulated functions, necessary to reproduce or use the results of the analyses, and as required by other recommendations.



I. Analysis description

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Comments:

- The analysis database should also be capable of storing any **analysis-related software** that may be provided alongside the analysis.
- **Rivet and HEPdata** provide examples of such a platform, possibly supported by the **inSPIRE** indexing and searching infrastructure. Their **functionality could be adapted to accommodate further needs**.
- **Phenomenologists'** approach towards Ib: common platform of analysis codes by users of experimental results.



2. Detector modeling

Recommendation 2a: Provide histograms or functional forms of efficiency maps wherever possible in the auxiliary information, along with precise definitions of the efficiencies, and preferably provide them in standard electronic forms that can easily be interfaced with simulation or analysis software.

Recommendation 2b: The community should take responsibility for providing, validating and maintaining a simplified simulation code for public use, reproducing the basic response of the LHC detectors. The validation and tuning of this tool should be based on comparisons with actual performance plots, and/or other inputs, made available by the experiments along the lines of Recommendation 2a. Limits of validity should be investigated and clearly documented.

3. Analysis dissemination

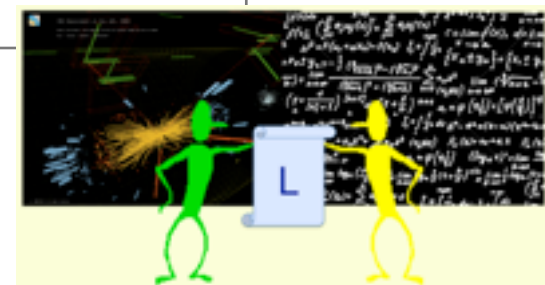
Recommendation 3a: Provide all crucial numbers regarding the results of the analysis, preferably in tabulated form in the publication itself. Further relevant information, like fit functions or distributions, should be provided as auxiliary material.

Addendum: [...] Results should be quoted without inclusion of systematic/theoretical uncertainties external to the experiment.

Towards publishing likelihoods

Recommendation 3b: When feasible, provide a mathematical description of the final likelihood function in which experimental data and parameters are clearly distinguished, either in the publication or the auxiliary information. Limits of validity should always be clearly specified.

Recommendation 3c: Additionally provide a digitized implementation of the likelihood that is consistent with the mathematical description.



4. Interpretation of results

So far our recommendations concern generally the presentation of experimental results, irrespective of whether they report a signal or are used to set exclusion limits.

Let us now turn to the interpretation of these results, the presentation of confidence intervals, parameter inference and limit setting in particular models:

Recommendation 4: *In the interpretation of experimental results, preferably provide the final likelihood function (following Recommendations 3b/3c). When this is not possible or desirable, provide a **grid of confidence levels** over the parameter space. The **expected constraints should be given in addition to the observed ones**, and whatever **sensitivity measure** is applied must be precisely defined. **Modeling of the acceptance** needs to be precisely described.*

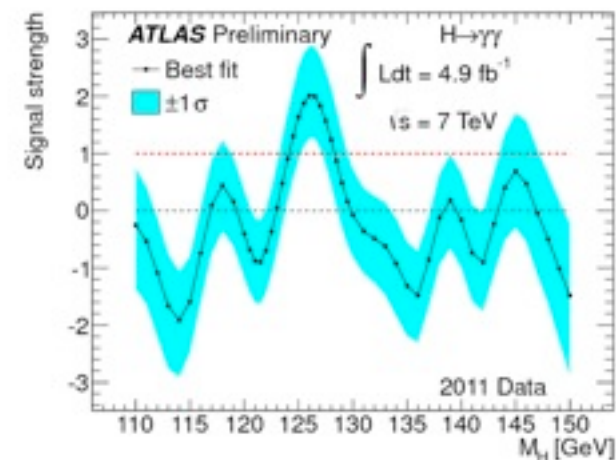
NB this applies equally to phenomenologists' interpretation studies as to interpretations of results in experimental papers.

5. Higgs searches

Recommendation 5: For **Higgs searches**, provide all relevant information on a **channel-by-channel** basis for both production and decay processes.

NB this is **crucial** in the context of multiple or composite Higgs boson models! Indeed, different Higgs models weight various possible production mechanism and decay distributions differently.

It is moreover very instructive to give the **best-fit signal strengths** as function of the SM Higgs boson mass **for all available channels**, along with error bands, as this facilitates testing deviations from SM couplings.



6. Analysis design

Recommendation 6: When relevant, design analyses and signal regions that are based on disjoint sets of events.

Conclusions

- We presented a set of **recommendations** for the presentation of LHC results on searches for new physics, which are aimed at **facilitating the interpretation of the results in wide classes of models**. (or even making such interpretations possible)
- Our wish is to stimulate discussions among the whole community and **work towards a common standard** for the presentation of results.
- Added value for the experiments, and the community as a whole:
 - ✓ **faster and more precise feedback on the implications** of the LHC results for a broad range of theoretical scenarios.
 - ✓ greatly **facilitate the comparison and combination of analyses** within and across the LHC collaborations, as well as the **assessment of the physics potential of future facilities**.
 - ✓ a further step towards a more comprehensive approach to the **storage, persistence and future use** of LHC results.
- The **tools** needed to provide extended experimental information **will require some dedicated efforts** in terms of resources and manpower, to be supported by both the experimental and the theory communities.

Next step:
practical solutions

Discussion of extended inSPIRE services



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have questions, comments or concerns, please email us at f

HEP :: HEPNAMES :: INSTITUTIONS :: CONFERENCES :: JOBS :: HEL

Add-on's

- functions, code snippets, etc
- citable via DOI's
- permanent like the publication

Information References (39) Citations (0) Files Plots

Search for physics beyond the standard model in events with a Z boson, jets, and missing transverse energy in pp collisions at $\sqrt{s} = 7$ TeV.

CMS Collaboration (Serguei Chatrchyan et al.) [Show all 2212 authors.](#)

Apr 17, 2012

CMS-SUS-11-021, CERN-PH-EP-2012-029
e-Print: [arXiv:1204.3774 \[hep-ex\]](#)

Abstract: A search is presented for physics beyond the standard model (BSM) in events with a Z boson, jets, and missing transverse energy (MET). This signature is motivated by BSM physics scenarios, including supersymmetry. The study is performed using a sample of proton-proton collision data collected at $\sqrt{s} = 7$ TeV with the CMS experiment at the LHC, corresponding to an integrated luminosity of 4.98 inverse femtobarns. The contributions from the dominant standard model backgrounds are estimated from data using two complementary strategies, the jet-Z balance technique and a method based on modeling MET with data control samples. In the absence of evidence for BSM physics, we set limits on the non-standard-model contributions to event yields in the signal regions and interpret the results in the context of simplified model spectra. Additional information is provided to facilitate tests of other BSM physics models.

Note: Submitted to Physics Letters B

Contacts: Till Eifert (ATLAS), Sezen Sekmen (CMS),
Salvatore Mele (inSPIRE), M. Mangano and I

Fast Simulators for the LHC

11-12 June 2012 *CERN*
Europe/Zurich timezone

Search

Overview

Timetable

Registration

... Registration Form

List of registrants

LH Recommendations

Dates: from 11 June 2012 09:00 to 12 June 2012 18:00

Timezone: Europe/Zurich

Location: *CERN*
Room: [TH Conference Room](#)

Chairs: [Mangano, Michelangelo](#)
[Kraml, Sabine](#)
[Sekmen, Sezen](#)

Additional info: This workshop has been motivated by the recently published "Les Houches Recommendations for the presentation of LHC results", [arXiv:1203.2489](#), which emphasize the important role of public fast detector simulators in maximizing the use of LHC results, and suggest the HEP community to take responsibility for providing, validating and maintaining tools for fast simulation.

June 11-12

The workshop aims to bring together the developers of the existing and upcoming tools, the experts from experiments, and the current and potential users in order to thoroughly discuss fast simulators, and address topics such as:

- current status and shortcomings
- object implementation, difficult topologies
- validation
- input/output formats, common analysis tools

Please contribute.