Proposal for the LEP2 MC workshop

Dear Colleagues,

an informal workshop took place at Cern with the goal of reviewing the progress made in Monte Carlo generators since the LEP2 Yellow report. Organizers have been M. Mangano and R. Pittau.

A decision has been taken to continue the activity of the workshop and here we present the official formulation of the proposal. At the moment, the following persons have accepted to act as general contact persons:

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Goals to be achieved in the Workshop:

a) Describe the new calculations, the improvements and the upgrading in the theoretical understanding and in the MC implementations.

b) Indicate where new contributions have changed previous predictions in the MCs adopted by the collaborations. Why, how, how much.

c) In those cases where a substantial discrepancy has been registered and the physical origin has been understood, we should be able to make recommendations on what to use.

d) In those cases where we have found incompleteness of the existing MCs, but no complete improvement is available we should be able to indicate a possible time scale for the solution and a sound estimate of the theoretical uncertainty.

Time schedule:

Regarding the time-scale of the effort, one could identify two classes of problems with 2 different time-scales: a reliable estimate of the Standard Model background to searches, for which, in a finite set of cases, we crucially need some initial answers very soon (within 1999), even if the final treatments and/or estimates of theoretical precision are not ready by then, and then the measurements, which naturally have a longer time-scale (18 months). The problem of the SM background to searches should have high priority, so we should aim for a 9 months time-table with the understanding that some preliminary answers have to be produced on what matters most for the searches on that time-scale. However, what is produced is not necessarily all that will be produced, and new issues and questions may very well come up, also in 2000, when the full statistics is available. If everything works as it is expected, already this year LEP is going to run at the maximum energy and with enough luminosity to clearly specify the problematic areas from the experimental side. This workshop does not want to act like a group to respond, on-line, to possible difficulties found in the year 2000. If anything happens in the year 2000 that has not been seen before and has not been predicted by the work done this year, then there will be a lot of new activities.

Therefore we propose that

a) Within the end of this year a full document will be written, summarizing the conclusions.

b) We do not fade away after step a), but re-discuss the whole project in view of new issues and questions that may very well come up.

We have identified the following topics to be discussed in restricted sub-groups.

Sub-groups:

1. 2F:
   a) extension from LEP 1 to LEP 2 energies of TOPAZ0-ZFITTER
   b) QED I/F interference.
   c) exponentiation and missing higher orders.
   d) (Initial state) Pair production corrections to 2f production.
   e) Photons with p_t.

2. Hard 4F:
   a) WW.
   b) ZZ.
   c) Zγ^*.
   d) High mass single-W$^*/Z^*/\gamma^*$ (high mass QCD).

e) $\gamma - \gamma$ collision with leptonic final states.

f) Gauge invariance.

g) Photons with p_t.

h) 2F-4F interplay, eg. separation issues of qq and $qqqq$, etc.

i) Anomalous couplings.

3. Photonic final states:

   a) $e^+e^- \to \gamma - \gamma(\gamma)$.

   b) $e^+e^- \to \nu - \bar{\nu} - \gamma(\gamma)$.

   c) Additional photons.

4. $\gamma - \gamma$ collisions as a background for searches:

   a) $\gamma - \gamma$ collision with hadronic final states.

   b) Low-mass single-W*/Z*/g* (low mass QCD).

   Leptonic gg collisions with ISR should be handled within the sub-group 2). For this sub-group we feel it is important that a clear distinction be made between gamma-gamma studies for gamma-gamma physics and gamma-gamma as a background to searches. In general, we would propose that the two gg aims be clearly separated. In fact, there is already an actively collaborating LEP WG on gg physics and, therefore, the real aim of this sub-group is 'issues in gg physics as background for searches'.

5. QCD modeling as a background for searches and for WW systematics:

   a) Tuning of existing programs to LEP2 energies.

   b) Colour reconnection effects.

   c) Bose-Einstein effects.

   d) Study of fragmentation uncertainties in the W mass measurement.

   Also here there is a LEP WG on QCD. The reason why we are interested in QCD is really as a background for searches and also to some extent for the WW systematics. Of course final state interaction aspects such as CR and BE can be considered in this group as well.

The sub-group 2) will probably split further, since it covers too many topics. It will be done in a second step. The sub-groups should remain in close contact. That can be achieved via, for example, a common web page (one has already been opened: http://www.to.infn.it/ giampier/lep2.html).

Structure of the workshop:

We feel that, in order to obtain maximal efficiency, there must be only one experimentalist taking the full responsibility of running the experimental part for each sub-group.

We ask the four collaborations to name one contact per experiment per sub-group, and these four contacts agree on the one experimental coordinator of the respective sub-groups. This procedure should be relatively fast. Since the experimental coordinator will have to keep contact to four experimental groups, it would be a good idea to select a person based at CERN. However, this criterion should not prevent anybody, available for the task, to be selected.

Therefore we formulate the following proposal proposal:

a) 1 th. + 1 exp. coordinator per sub-group,

b) possibly, additional (1 for each of the remaining 3 experiments) experimental contact persons per sub-group.

Coordinator for each sub-group:

sub-group	*Coordinator*	
1)	Was	?
2)	Passarino	?
3)	Jadach	?
4)	(Schuler)	?
5)	?	?

We have a contact for theo 4 and we are waiting for a reply. An obvious candidate for th-5 is T. Sjostrand, but apparently he is, at the moment, overloaded with work for other workshops, and cannot contribute. This is, in our opinion, a serious problem. The question marks in the second column will be replaced once the collaborations have produced physical names.

As for the theory part, it would preferable that general contact persons do not get directly involved in the organization of any specific sub-group. This is because a time consuming general coordination of the whole workshop is also necessary. However, as already mentioned, sub-group 2 will have to select few additional splittings and G. Passarino has accepted to act as th. coordinator of sub-group 2) with the only goal of guiding this splitting. In any case, is is our intention and our duty to fill up the above scheme asap!

The strategy

We strongly recommend to take into proper account physical issues. Therefore, the key question will be that the experimental community has to make very clear, process by process, the level of the requested theoretical accuracy and a statement has to be issued, process by process, on the impact of any new theoretical input.

Action is needed if the accuracy will appear to be worse than some requested value. Furthermore, some experiments care a lot more about differential distributions and an overall statement may not be sufficient. We need to discuss and understand the requirements together with people doing the analyses. Hopefully, such discussions can start rapidly in small groups once the sub-groups have been set up.

It is important to weight each specific problem with its experimental impact. In this sense, it is very important that experimentalist give the correct weights to each of the difficulties we are facing, and we do not start working for one year in a problem that has no impact on the physics output from the LEP2 data. Therefore, we would strongly recommend that problems are not treated in an equal foot, but they are treated as a function of the experimental impact (defined by the luminosity expected at the end of LEP2, and detector's resolution and acceptance).

Clearly, we look at and measure lots of different processes, so we'll have to manage with lots of different sets of cuts. It should be stressed that for efficient work the experimentalists must come up as much as possible with one set of quasi-realistic cuts for each process.

Schematically:

a) Experimenters point out processes and/or phase space regions (agreeing among them on a set of quasi-realistic cuts) where better theoretical predictions would be desirable. They should also provide a weight to the problems, according to their relevance/urgency.

b) Theorists improve, when possible, their predictions for these processes and/or phase space regions, and give at least a definite value for the theoretical uncertainty.

c) More urgent problems should be treated first.

d) The final output of the whole operation should not be a collection of comparison tables (that are probably unavoidable, but will be produced for internal use only), but a solid value for the theoretical uncertainty to be associated to any specific process.

Of course we want to reach a general consensus on the theoretical accuracy and not only some vague statement on overall agreement among different generators. Naturally, if differences are found, we want to be sure that they are due to physics, and not some different input, so we must have first a technical benchmark. Once trivial bugs are found we have to assign physics uncertainties.

So, we do not skip technical benchmarks, but this should be a rather quick operation and then we move immediately to physics uncertainties.

We urge the experimental collaborations to quickly start the procedure for selecting coordinators and contact persons. In practice, each experiment should quickly provide a contact person for each topic and they should nominate a single name as overall experimental coordinator. At this point we will have one th. + one exp. contact per sub-group, each gathering and summarizing the information:

a) the theory person taking a global view, co-ordinating the theoretical activity in each sub-group, and serving when needed as central contact for the experimenters,

b) the experimenter taking a global view, co-ordinating the experimental activity, collecting the input from the 4 experiments in each sub-group, and serving when needed as central contact for the theorists (plus any additional experimental contact, that the experiments want to name, to strengthen their representation on specific items).

It is extremely urgent that discussions can start rapidly once the sub-groups have been set-up. We will keep you informed as soon as all coordinators have been selected.

Best regards,

- Philip Bambade
- Brigitte Bloch-Devaux
- Alvise Favara
- Paolo Giacomelli
- Martin Gruenewald
- Maria Kienzle
- Michael Kobel
- Robert Mcpherson
- Giampiero Passarino
- Hywel Phillips
- Roberto Pittau
- Frederic Teubert