Detailed plan for MC systematics
Two processes: gg → H → {WW, ZZ} → leptons (muons)

Aim of exercise:

1. Compare Powheg-type implementations with analytic results (from Grazzini).
2. Differences should not be interpreted as some "final uncertainty" to be obtained with event generators.
3. Maybe learn how to re-weight generators with Grazzini results (w.r.t. pt of the Higgs)

Comparison at/with fixed order (ME level):

1. Tools to compare:
   - **Grazzini NNLO+Resummation** (+sanity check: NLO – if possible),
   - **Powheg-Box** (+Pythia – I guess not needed there),
   - **Sherpa**
   - Ask **Herwig++** → **action item Frank Krauss**
2. PDFs: NNLO PDF(s) for Grazzini (**MSTW, CTEQ-NNLO& NNPDF-NNLO** at some point later), standard NLO ones for the other two (**MSTW 2008, CTEQ6, NNPDF**) – take envelope of the three PDFs.
3. Observables: Total xsec, Higgs-y, Higgs pt=jet pt, jet-eta, Delta y of Higgs and jet, (pt of leptons, eta of leptons, Delta R of leptons, Etmiss/DeltaPhi of planes of 4 leptons)
   - Higgs boson mass: 160 GeV & 170 GeV
   - Make plots without lepton cuts as well.
   - Lepton acceptance cuts: ptmin = 20 GeV (WW); 10,10,5,5 GeV (ZZ), |eta| < 2.5
   - Jets: anti-kt, ptmin = 30GeV, R = 0.4, 0.5, 0.6
   - MET: METmin = 20 GeV (for WW channel)
   - check Higgs mass cuts: → **action item Chiara Mariotti and Reisaburo Tanaka**
4. Technology:
   - Stop Powheg-Box/Sherpa after 1st emission with different set-ups (PDFs + alphaS + scale – keep default functional dependence but multiply/divide with/by factor of 2.
   - Draw error bands with scale variation around central set-up.
   - Draw 2nd set of error bands for different PDFs, taking their default alphaS, but NO scale variation, add scale variation for 3rd error band
   - I would like to do this with Rivet, so outside the collaborations software structures – this would make our analysis efforts very durable and accessible for the theorists as well. Is this acceptable for everyone? If we do it with Rivet, can we get the Grazzini code to output in the right format or can we convert – we may want to add a Rivet-knowldgeable person.
   - Check ways of producing central analyses → **action item experimental colleagues**

   So, all together 4 sets of plots for
   4 (yH, ptH, etajet, Deltay(jet-H)) +
   4 (ptlepton, Etmiss,Deltaphi(planes), DeltaR(leptons), etalepton)
   observables in each of the two processes.

Comparison after showering:

1. Add **MC@NLO (+Herwig)** to the game.

2. We must decide if and if yes how we include QED FSR into the comparison. Different codes will have different accuracy → **No QED FSR, leptons = muons.**
3. Same PDFs, alphaS ideas
4. Add some more observables like: HT, Njets, pt(jets), eta(jets), delta(phi) of first two jets, delta(phi) of H and 1st jet, jet-veto efficiency for two values of pt (25 and 50?), beam thrust
5. Technology: Shower the stuff, but do not hadronize and do not add underlying event, apply jet finders etc. on the parton shower level.

   → **Action item: Which shower (or both?) to use with Powheg-Box: Paolo Nason**

   The following issues to be addressed after baseline has been attached:

   - Try to change scales/PDFs everywhere – at least the scale variation should be possible in the shower. I do not know how to do this in Pythia.
   - To check dependence on shower, we can compare Powheg-Box with Sherpa, if the ME-level result is sufficiently close – if this is not the case I suggest we also run Powheg-Box + Herwig (I'd like to avoid this, if any possible)
   - Potential pitfalls:
     - Using Pythia, must take a version/tune without interleaved UE/showering, i.e. with UE switched off completely. Which tune should we try?
     - Pythia's shower is typically tuned with various alphaS values/scales – so the scale variation may prove tricky and the PDF may be impossible. I seem to recall that there are some tunes of Pythia8 which are more consistent – this is a place, where we should investigate. I suspect we must just take different tunes like the Atlas tune, two old Perugia tunes used in Atlas/CMS, and two of the more consistent Perugia 2011 ones. This should allow for enough variation, and we may be able to quantify the difference of "consistent set-up" vs. "parton-shower-fixed set-ups".

   So this is a bit more tricky, and we have to figure out what and how we can deal with issues related to Pythia's tunes and showering. I do not think that just forcing Pythia to have the same alphaS etc. is a very good idea – the shower may misbehave – so a bit of the uncertainty is then related to different tunes rather than to explicit global changes like in the case of Sherpa. I also do not know, how this works for MC@NLO. I suspect we should ask for guidance from the shower authors.

Underlying event:

1. We now add hadronization and UE, for the same tools and observables as in the shower case above – I do not expect big effects, but I guess we must check..
2. For Powheg-box, take different UE tunes, possibly with different PDFs and alphaS – input from Skands to get a sufficiently varied set.
   For Sherpa, take different PDFs and alphaS – we do have some tunes for that.
   For MC@NLO I do not know the situation …. I guess, there's only one Jimmy-tune so we can play internal UE vs. Jimmy. Or go to Herwig++.

People:

CMS: Nicola De Filippis et al.: Powheg vs. HqT, Marek Schonherr to join.

ATLAS: → **Action iterm: Identify people (Jae & Reisaburo)**

Next meeting:

Tentatively week of 11/4/11 → Doodle to follow

→ **action item Frank Krauss**