LHC Discovery Story

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Imagine a future for which there is …

A Discovery at 300/fb

- Both ATLAS and CMS have between 3.5-4σ excess in each of all hadronic and 1-lepton final state.
  - Both experiments furthermore see a hint of events with >=3 btags, but not sufficient to be unambiguous.
  - There is evidence also from hadronic top reconstruction that the excess is in the 2 top + MET final state.
  - A few events appear to have low pT leptons as well, but not enough to say anything significant above bkg.
- No other significant excesses in any other final states.

Further Discoveries at HL-LHC

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- Both experiments now have in addition to a whopping 2 top + MET signal:
  - 3-4σ each also in 4 top + MET indicating pair production of ~2TeV particles.
    - Final states of >= 3 btags, same-sign dileptons, 1-lepton plus btags, trilepton + btags.
  - The 2 top + MET excess prefers an interpretation as two spin-0 resonances with ~100GeV or so mass difference, and below about 1TeV of mass.
    - Evidence based on cross sections and kinematic distributions of the excess.
  - Both the 2 top and 4 top excesses include events with additional low pT leptons. Events with one and two soft leptons are seen at rates indicative of a low mass splitting triplet of states, X_{10}, $X_{1\pm}$, X_{20} that include the particle that's the source of MET.
  - Each experiment sees evidence of some of WW, WZ, Wh, ZZ, and hh + MET events. The statistics is not significant in each experiment for each final states, but in combination, it is obvious that something is there at a mass scale of several hundreds of GeV but less than 1TeV.