A few slides to prime the discussion

Start simple (1)

- This is a <u>mock-up</u> exercise
  - to learn how we exchange information
  - to understands assumptions used by each collaboration
  - correlate assumptions
  - etc., etc.

- No intention to produce "official" projection

Start simple (2)

- pick one analysis, cut-and-count for now
  - e.g. $H \rightarrow WW \rightarrow 2l2\nu$ + 0-jets (3 sub-channels)
    - all numbers are made up
- factorize:
  1) event counts for signal and all backgrounds
  2) systematic list of systematic error sources with their pdf's and correlations across all…
  3) statistical machinery converting the above input into limits and significances

Why H→WW

- H→WW is good testing ground
  - many observables involved: leptons, jets, MET
  - variety of methods used (MC-driven, data-driven detector performance measurements, data-driven control samples for assessing some backgrounds)
  - role of systematic errors is rather large

- H→WW is a forerunner Higgs publication

Input information (1)

- Conceptually, for each channel, we track event counts for signal and a few backgrounds:

$$b = N \cdot w \cdot \prod \varepsilon_i$$

  - N is some integer (number of MC events, number of events in a control sample in data); it gives a statistical uncertainty
  - w is some scale factor, e.g., MC event weight $w = \sigma \cdot L$, or scale factor for $N_{\text{SignalRegion}} = w \cdot N_{\text{ControlRegion}}$. A slew of systematic errors may affect it.
  - ε_i's are efficiencies associated with reconstruction and subsequent cuts; they all come with some systematic errors

Input information (2)

- For signal and all bkgd's in each channel, we need:
  - N
  - $\alpha = w \cdot \prod \varepsilon_i$
  - systematic errors on α (pdf and its parameters), broken down by all <u>independent</u> contributions

Then systematic errors can be treated as

- 100% correlated across channels, signals, backgrounds
- 0% correlated from one source to another

Input information (3)

- Conceptual table of input information:

	Bin 1 (channel 1)				Bin i (channel i)			
events observed in experiment ==>	**n_1**				**n_i**			
	Signal	**Bkgd 1**	**…**	**Bkgd j**	**Signal**	**Bkgd 1**	**…**	**Bkgd j**
MC or DataControlSample events ==>	N(0,1)	N(1,1)		N(j,1)	N(0,i)	N(1,i)		N(j,i)
overall scale factor ==>	α(0,1)	α(1,1)		α(j,1)	α(0,i)	α(1,i)		α(j,i)

Systematic Error Sources and Parameters

No.	Uncertainty Source description	pdf typ	Parameters															
			parameters		parameters		parameters		parameters		parameters		parameters		parameters		parameters	
1	Luminosity	lnN	1.05		1.05		1.05		-		1.05		1.05		1.05		-	
2	Signal cross section x acceptance	lnN	1.10								1.10							
3	Bkgd 1 cross section	lnN			1.30								1.30					
..	…	lnN																
..	Bkgd j (ch1) data-driven from control region: dw/w	lnN							1.10									
..	Bkgd j (ch2) data-driven from control region: dw/w	lnN															1.20	
..	…																	
..	muon Reconstruction Efficiency (2%)	lnN	1.04		1.04		1.04		1.04		1.02		1.02		1.02		1.02	
..	electron Reconstruction Efficiency (2%)	lnN									1.04		1.04		1.04		1.04	
..	…																	

pdf's

$$b = N \cdot \alpha$$

- e.g., lognormal for α (general purpose?)
- e.g., gamma distribution (stat contribution from N)
- use convolution when both are comparable

- any other favorites?

- truncated normal (avoid in general, but may be needed for comparisons with other tools)

Statistical Machinery

- RooStats and all tools available to crosscheck and compare (when possible)

- De-facto recent “standards”:
  - CL_s, CL_{bs}, CL_b with marginalization and profiling of errors
  - Bayesian with a flat prior on signal strength

- New approaches? To be discussed…