Higgs Hunting 2015 session: *ATLAS CMS run 2* discussion

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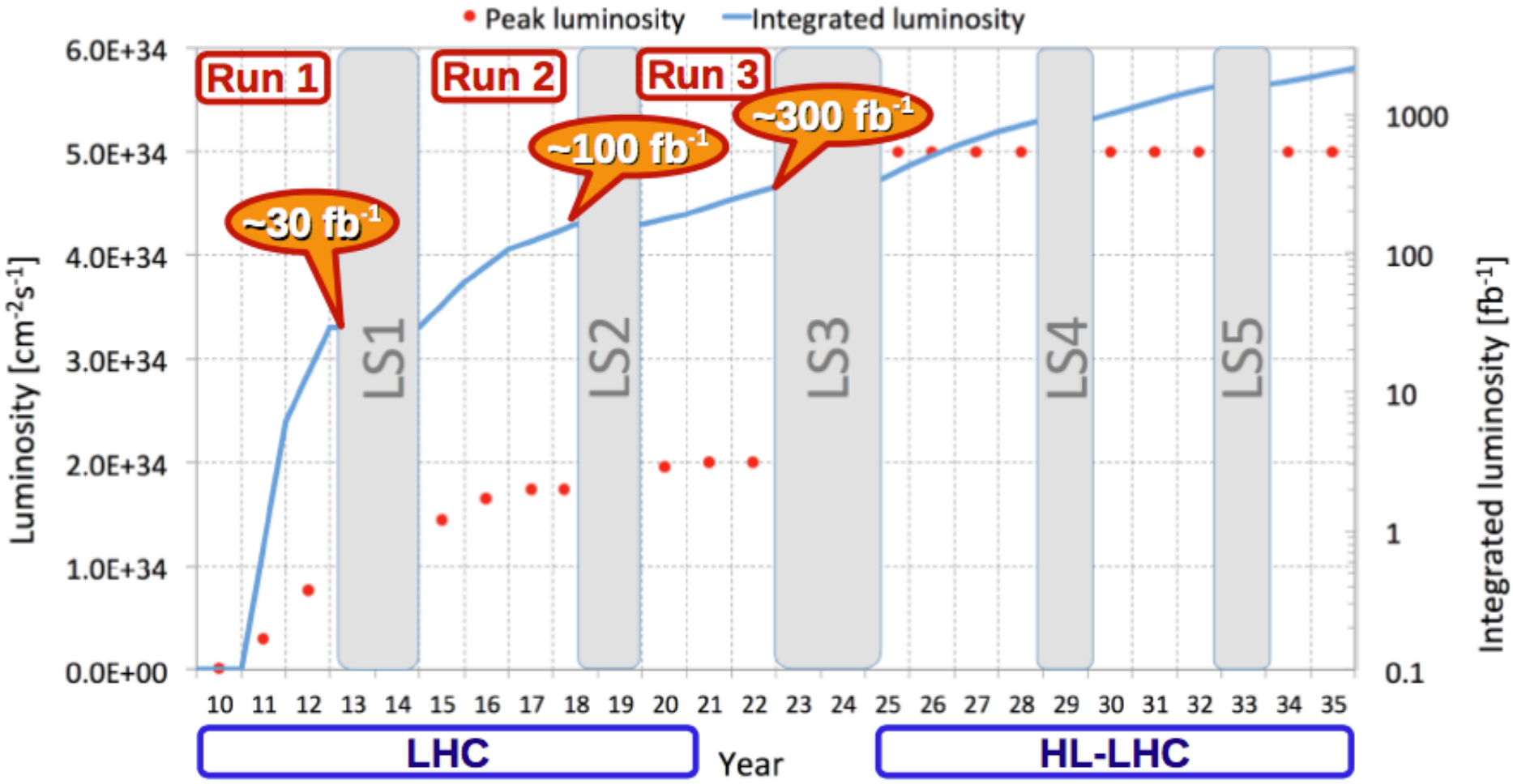
LHC Run 2 planning



Outlook

- LHC Run2- 100 fb^{-1}:
  - observation of H→ττ, bb;
  - Evidence for ttH
  - Differential cross sections
  - Search for BSM Higgs boson partners
- LHC Run2- 300 fb^{-1}:
  - Probably observation of ttH
  - Evidence H→μμ
  - Precision measurement of Higgs couplings at the level of 10 %
  - Search for BSM Higgs boson partners
- HL-LHC 3000 fb^{-1}:
  - Observation ttH
  - Observation of H→μμ and H→Zγ
  - Precision measurement of Higgs couplings at the level of few %
  - Search for BSM Higgs boson partners
  - **Evidence for HH production**

Need to reduce theory uncertainties

- Example: N^3LO ggF production cross section

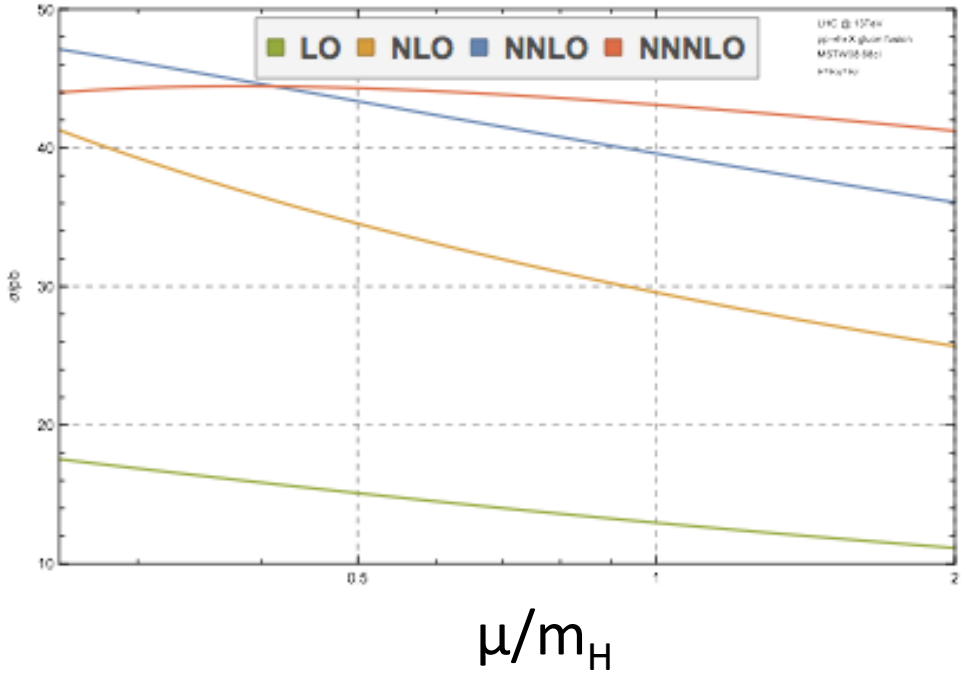


FIG. 2: Scale variation of the gluon fusion cross-section at all perturbative orders through N^3LO.

C. Anastasiou et al.:
http://arxiv.org/abs/1107.0683 ,
http://arxiv.org/abs/1403.4616 ,
http://arxiv.org/abs/1411.3584 ,
http://arxiv.org/abs/1503.06056

The total scale variation at N^3LO is 3%, reducing the uncertainty due to missing higher order QCD corrections by a factor of 3

Precision on signal strength

channel	Prec. (%) 100 fb^{-1}	Prec. (%) 300 fb^{-1}		Prec. (%) 3000 fb^{-1}	
ttH H→γγ	~65	38	36	17	12
ttH H→ZZ*→4l	~85	49	48	20	16
VBF H→γγ	~80	47	43	22	15
VBF H→ZZ*→4l	~60	36	33	21	16
H→μμ	~70	39	38	16	12
H→ττ	~18	14	8	8	5
H→bb	~20	14	11	7	5
H→γγ	~15	12	6	8	4
H→4l	~15	11	7	9	4
H→4l	~15	11	7	7	4

ATLAS: experimental & theory uncertianties; only exp. uncertainty
CMS: current exp.l & theory uncertianties; exp. uncertainty $\propto 1/\sqrt{L}$ and ½ theory unc.

Assumed luminosity uncertainty: 3%

backup

Coupling fit with L=300 and 3000 fb^{-1}

per experiment!

Coupling modifier	300 fb^{-1}	3000 fb^{-1}	
$k_{W,Z}$, $k_{\gamma,}$	6%	3%	
k_b	12%	5%	down-quark type
k_t	15%	7%	Top Yukawa coup.
k_τ	10%	5%	lepton coupling
k_μ	22%	8%	2^{nd} generation

(based on best estimate today)