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Illuminating Standard candles at the LHC : V+jets

at Imperial College London, April 25th/26th 2017

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IP3

Scope of workshop

Focus on the Standard Model measurements of vector boson + jets processes that we can perform in Run 2 of the LHC to improve our understanding of the high transverse momentum phase space and constrain higher order QCD and electroweak corrections

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Agenda - Tuesday 25th

10:00	**Tea/Coffee** *Blackett building, room 539, Imperial College London*		10:00 - 10:30
	Introduction *Blackett building, room 539, Imperial College London*		10:30 - 11:00
11:00	**Experimental overview of V+jet measurements from CMS** *Blackett building, room 539, Imperial College London*	*Sarah Malik*	11:00 - 11:30
	Experimental overview of V+jet measurements from ATLAS *Blackett building, room 539, Imperial College London*	*Chiara Debenedetti*	11:30 - 12:00
12:00	**Lunch** *Blackett building, room 539, Imperial College London*		12:00 - 13:30
13:00			
	Theory overview of higher order QCD corrections *Blackett building, room 539, Imperial College London*	*Nigel Glover*	13:30 - 14:00
14:00	**Theory overview of higher order EWK corrections** *Blackett building, room 539, Imperial College London*	*Jonas Lindert*	14:00 - 14:30
	Discussion *Blackett building, room 539, Imperial College London*		14:30 - 15:00
15:00	**Tea/coffee** *Blackett building, room 539, Imperial College London*		15:00 - 15:30
	Theory overview of status of MC generators: Sherpa *Blackett building, room 539, Imperial College London*	*Marek Schoenherr et al.*	15:30 - 16:00
16:00	**Theory overview of status of MC generators: MadGraph_aMC@NLO** *Blackett building, room 539, Imperial College London*	*Paolo Torrielli et al.*	16:00 - 16:30
	PDF constraints from V+jets *Blackett building, room 539, Imperial College London*	*Maria Ubiali*	16:30 - 17:00
17:00			

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Agenda - Wednesday 26th

10:00	**V+jets in Herwig and jet scaling patterns**	*Peter Schichtel*	
	Blackett building, room 539, Imperial College London		10:00 - 10:30
	Experimental overview of estimation of V+jets backgrounds to BSM searches at CMS	*Nicholas Wardle*	
	Blackett building, room 539, Imperial College London		10:30 - 11:00
11:00	**Tea/Coffee**		
	Blackett building, room 539, Imperial College London		11:00 - 11:30
	Experimental overview of estimation of V+jets backgrounds to BSM searches at ATLAS	*Darren Price*	
	Blackett building, room 539, Imperial College London		11:30 - 12:00
12:00	**Discussion: Prospects for V+jets measurements in at HL-LHC/future colliders**		
	Blackett building, room 539, Imperial College London		12:00 - 13:00
13:00	**Lunch**		
	Blackett building, room 539, Imperial College London		13:00 - 14:00
14:00			

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- What V+jets measurements are being undertaken at CMS and ATLAS and how does the data compare with theoretical predictions? (Sarah, Chiara)
- What is the status of calculation of higher order QCD and electroweak corrections? (Jonas, Nigel)
- What is the status of MC generators for these processes? (Marek, Peter, Paolo)
- What are the constraints on PDFs from V+jets? (Maria)
- How are we estimating the V+jets processes that are backgrounds to new physics searches? (Nick, Darren)
- What measurements are we missing? What could we do with full data-set in Run2? (All)

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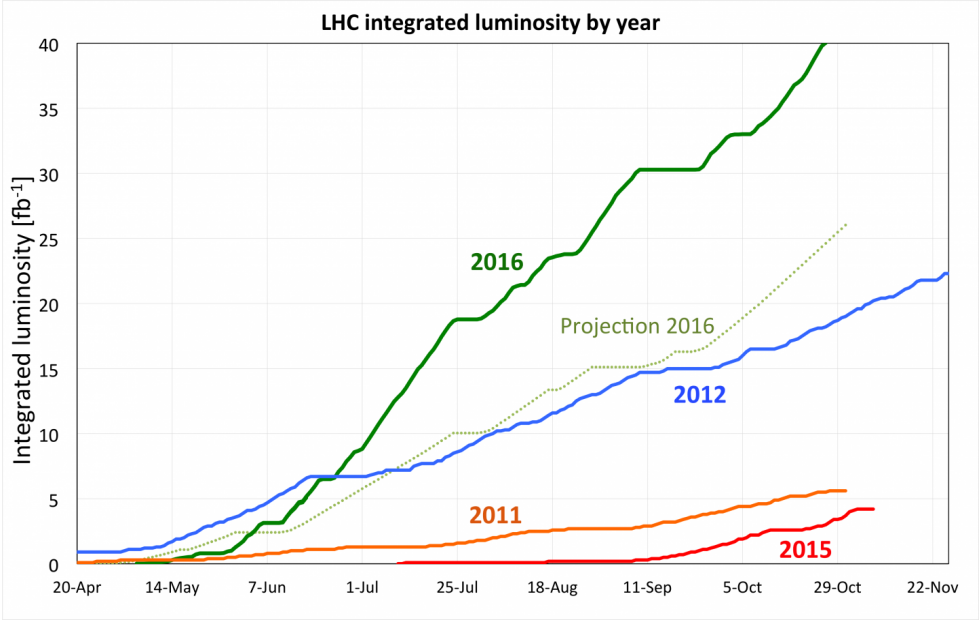
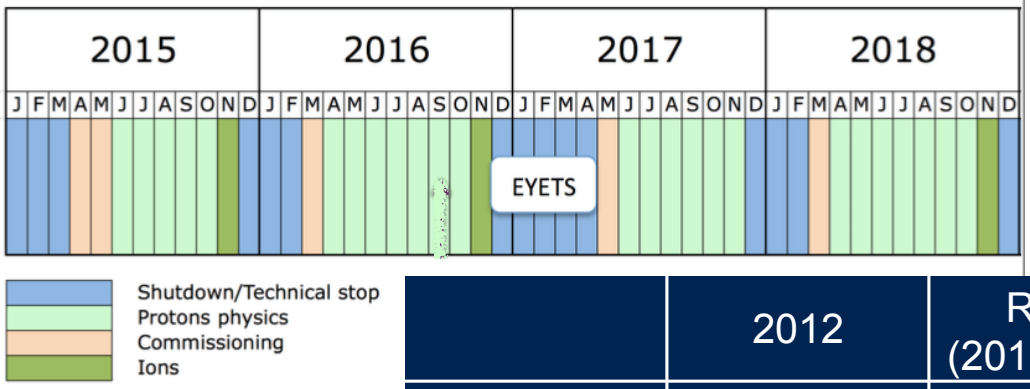
- In 2016 run, the final integrated luminosity ~40 fb^{-1} in ATLAS and CMS
- The target for the whole year was 25 fb^{-1}!





	2012	Run 2 (2015-2018)	Run 3 (2021-2024)	HL-LHC (2024-2035)
Energy	8 TeV	13 TeV	13 TeV	13/14 TeV
Integrated luminosity	20 fb^{-1}	100 fb^{-1}	300 fb^{-1}	3000 fb^{-1}

- Expect ~40-50 fb^{-1}/year in 2017 and 2018 - **total of ~ 130 fb^{-1} by end of 2018**

Higher center of mass energy of 13 TeV and order of magnitude more data expected in Run 2, LHC will be in precision regime.

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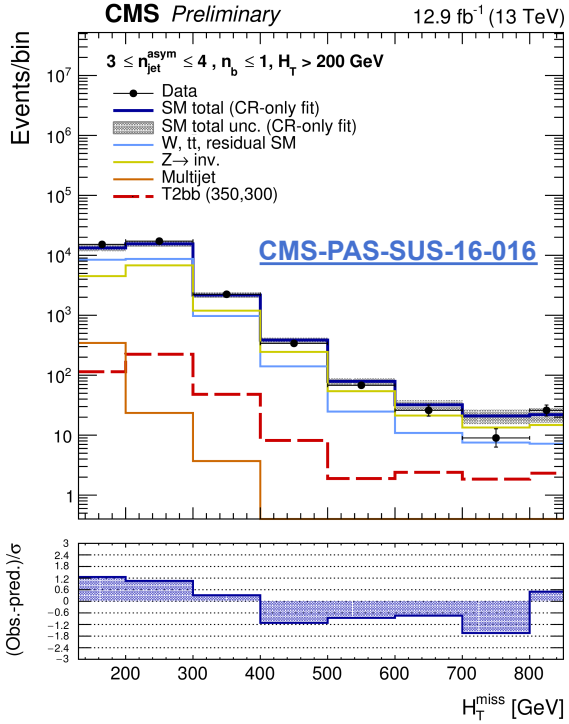
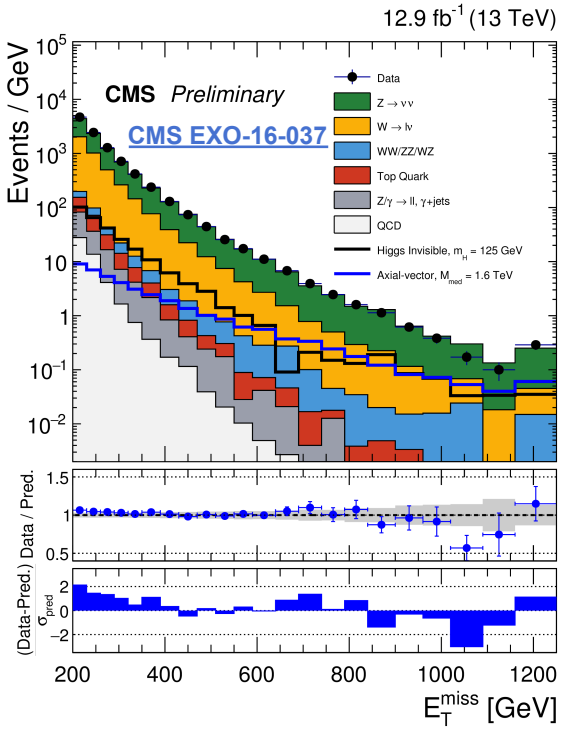
- Tremendous opportunity to conduct SM measurements that study regions of phase space previously limited by statistics, for instance the high pT region

  - **Many searches involve production of new particles that can only be inferred from missing transverse energy (SUSY, Extra dimensions, WIMPs, Higgs to invisible etc)**
  - **V+jets (especially Z→ ν ν + jets) is dominant background in many searches that involve jets and missing transverse energy.**





Up to 90% of background in jets+MET searches from V+jets processes

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- Tremendous opportunity to conduct SM measurements that study regions of phase space previously limited by statistics, for instance the high pT region

- In the scenario of e.g observation of an excess of events in the tail of MET distribution, critical to understand modeling of V+jets background before can claim discovery.

- Searches (e.g CMS monojet) have shown that now sensitive to higher order QCD and electroweak effects, accounting for these corrections. Increasing sensitivity of these searches will require accurate estimation of V+jets backgrounds.

- Active theoretical developments in providing automated NLO EW+QCD MCs, will need data measurements to validate these predictions

- In case of no new physics signal in direct searches, discrepancies in data and MC in precision measurements may provide evidence BSM physics (provided theoretical uncertainty smaller than statistical uncertainty).

Plenty of motivation to pursue precision physics in V+jets