LHC 2009 - 2010 luminosity performance - estimate for 3.5 TeV plus move to higher energy

A path to the total integrated luminosity quoted at Chamonix 2009 while keeping the total intensity to a reasonable level. Necessarily approximate. Preliminary.

Month	Comment	Turn around time	Energy [TeV]	Max number bunches	Protons/Bunch	% nom. intensity	Min beta *	Peak Luminosity $cm^{-2}s^{-1}$	Integrated Luminosity	events/X
1	Beam commissioning								First collisions	
2	Pilot physics, partial squeeze, gentle increase in bunch intensity, avaialbility low	Long	3.5	43	3×10^{10}		4 m	8.6×10^{29}	100 - 200 nb^{-1}	
3		5	3.5	43	5×10^{10}		4 m	2.4×10^{30}	~ 1 pb^{-1}	
4		5	3.5	156	5×10^{10}	2.5	2 m	1.7×10^{31}	~9 pb^{-1}	
5a	No crossing angle - could at this stage push intensity see 5b	5	3.5	156	7×10^{10}	3.4	2 m	3.4×10^{31}	~18 pb^{-1}	0.8
5b	No crossing angle - squeezing to beta* = 1m at this stage would double these lumi numbers (and the pile-up)	5	3.5	156	10×10^{10}	4.8	2 m	6.9×10^{31}	~36 pb^{-1}	1.6
6	Possible shift to higher energy - would anticipate ~4 weeks to reestablish physics follow by a fairly gentle increase back up in intensity.	Would aim to first provide a period of physics at the higher energy (4.5 TeV, say) without crossing angle, this could be followed by a move to 50 ns with a limited number of bunches. Note that the total intensity limit will go down with the move to higher energy.								
7	4 - 5 TeV (5 TeV luminosity quoted - doesn't make too much difference). No crossing angle.	5	4 -5	156	7×10^{10}	3.4	2 m	4.9×10^{31}	~26 pb^{-1}	
8	50 ns - nominal crossing angle - aperture restricts squeezing further - note limited complement of bunches.	5	4 -5	144	7×10^{10}	3.1	2 m	4.4×10^{31}	~23 pb^{-1}	
9	50 ns	5	4 -5	288	7×10^{10}	6.2	2 m	8.8×10^{31}	~46 pb^{-1}	
10	50 ns*	5	4 -5	432	7×10^{10}	9.4	2 m	1.3×10^{32}	~69 pb^{-1}	
(11)	50 ns*	5	4 -5	432	9×10^{10}	11.5*	2 m	2.1×10^{32}	~110 pb^{-1}	

To Do List on the Real Data Analysis
Inclusive $b \to J/\psi X$, $J/\psi \to \mu \ \mu$

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Aug. 28 , 2009

Outline On the List

- Low pT J/Psi trig
- Acceptance*
  - Plat spetrum: pT &eta
  - J/Psi polarization(from b hadron part)
- Tracking performance from data
  - tracking efficiency
  - momentum scale/resolution
  - vertex efficiency/resolution
  - I.P. resolution
  - muon efficiency/trig efficiency: Tag&probe*
- Mass& lifetime fit*
  - Candidate selection
  - Pdl efficiency
  - Resolution from data
  - Fit strategy

Improved low pT J/Psi events in trig

- 1.SigleMu3+pt(2.mu from a track)>1 GeV/c: J/psi ~ 2.7 GeV/c
- 2. d_phi<100, d_eta<1

Tag&probe

- tag muon
  - matched to L3 muon; isolation cone 0.3; track quality: d_xy<0.2, n_hits in silicon>10, norm chi2<5

- tracking efficiency
  - passing probe: data driven track embedding technique vs. M.C. truth matching

- muon id efficiency
  - bins in eta: (0,1.2],[1.2,2.1)

Tracking(Muon) performance I

- tracking resolution
  - CRAFT data, split reconstructed track in half: D(d_xy),D(1/pT)
- tracking efficiency: inside-out recon(CTF)
  - Track on one side is tag, search for reconed track on opposite side

- T&P on tracking efficiency:
  - STA muons, poor resolution/low pT
  - CRAFT: close to Center of CMS; lower occupancy
  - track embedding(for low PT, non-isolated hadrons):

Mix (at digi level) a single track from data or MC with higher occupany event from data and reconstruct from scratch

Tracking(Muon) performance II

- Momentum scale: 2 group
  - MIT(as CDF's):
    - Study reconstructed resonance masses vs PT or other kinematic variables and correct for any shape with improved energy loss corrections
  - MuScleFit(Padova, Torino):
    - 1. Muon momentum scale calibration and momentum resolution fit
    - 2. Likelihood-based approach to extract scale correction
- I.P. resolution: reconed resonance or prompt J/psi
- Vertex reolution: P.V.: split tracks in 2 sets and fit

run-average beamline vs. an event-by-event primary vertex:
the beamline effectively adds to the uncertainty on P.V. However, decay length resolution is likely dominated by the S.V. resolution; avoids a potential bias in the reconstructed primary vertex due to the inclusion of tracks from heavy flavor decays in the primary vertex fit

J/Psi mass & lifetime Fit

Mario Pelliccioni (Torino/INFN)
Roberto Covarelli CERN

- Candidate selection:
  - first global-global pair
  - otherwise, look for global-tracker
    1. if one pair, n_hits>10, TM2DCompatibilityLoose || TMLastStationOptimizedLowPtLoose
    2. if more than one pair, use highest pT tracker muon
  - otherwise,look for global-calo
    1. if one pair, n_hits>12, chi2<3 & calocompat.>0.8
    2. if more than one pair, use highest pt calomuon

- PAT muon so J/Psi candidates

Fit on lifetime (Combined with mass)

- have three components:
  - Prompt signal is a delta function
  - Non-prompt signal is an exponential (see later)
  - Background is a sum of a zero lifetime +positive/negative tails + symmetric tail

- Resolution function: need further investigation
  - extracted from data in the same fit as shape parameters
  - from QCD, Y->mumu data?

- Non-prompt lifetime parametrization
  - CDF used templated distributions from MC
- strategy
  - Fit the MC distribution of non-prompt lifetime with a simple exponential + resolution
  - Fix the resolution from the“nominal” fit

31X Data pp@10TeV

SIGNAL

Filter: 2 muons with |eta| < 2.5, >= 1 having pT > 2.5 GeV/c (this is a new filter proposal)

- 10M -- prompt J/psi -- 8.7/pb (was 2M in summer2008)
- 0.5M -- Psi(2S) -- 32/pb (same as summer2008)
- 1M -- Upsilon(1S) -- 54/pb (was 0.5M)
- 0.3M -- Upsilon(2S) -- 38/pb (was 0.2M)
- 0.2M -- Upsilon(3S) -- 88/pb (was 0.1M)
- 5M -- non-prompt J/psi "loose" -- 18/pb (new request)

IHEP's SE

BACKGROUND

- 10M -- ppMuX -- 0.075/pb

"Loose" Filter: >= 1 muon passing eta-dependent pT cuts (new filter!)

0 < |eta| < 1.2 -- pT > 1.5 GeV

1.2 < |eta| < 1.7 -- pT > 1.0 GeV

1.7 < |eta| < 2.5 -- pT > 0.6 GeV

- 10M -- "ppMuXLoose" -- 0.004/pb (new request) (filter eff is from Zongchang Yang with r < 2m, z < 3m)