Short summary and comments on the machine session

Mike Lamont

Thanks to Massi, Helmut and Alick for their input

Beam instrumentation

- DCCT
  - Superb – close to full potential (Colin, Gabriel and team)
  - < 1%
  - 24 bit ADC under commissioning "really promising" – to be used in VdMs this year. Clear support for support for development/deployment/calibration
  - Continuation of 12-bit ADC DCCT calibration monitoring
- FBCT
  - Relative 2 per mil level during VdM
  - Monitor itself – (beam position, bunch length dependence etc.)
  - Assessing new type of monitor (ICT)

Beam instrumentation

- WCM
  - Hope to achieve relative accuracy of < 1%
  - Support for developments of WCM as bunch population measuring device
- Beam current from sync light
  - Challenging
- Beam current from LDM
  - Disagreement between LDM and FBCT on main bunch populations usually < 2%
  - deployment/test/validation of diffuser on both LDMs asap – already there for B1 – next TS for B2 if good

$$\sum FBCT = DCCT$$

$$\sum FBCT + \sum Ghost\ charge + \sum Debunched\ beam = DCCT$$

- Emittance via BSRT
  - Aiming for corrected sigmas +/- 10% at injection and top energy
- Emittance from WS
  - Reference for 2012
- BPMSW
  - Wrestling with B1/B2 cross-talk
  - Use synchronous orbit mode on well placed bunches
  - Noise < 10 microns but still temperature effects...

Beam instrumentation

- Acknowledge significant effort made by beam instrumentation group in understanding their instruments and reducing the associated uncertainties

- Thanks for the: trust, patience, help, demanding requirements, gentle pressure

- "We learnt a lot!"

- Tension between ''Rest in Peace" and ''keep current momentum"

Jean-Jacques Gras

BRAN – Energy

- BRAN
  - Performing well and some very nice operational tools in place
  - Essential for debugging and as back-up to experiments' signals
  - The team would like be around for VdMs
- Energy
  - Magnet model does a good job – abs ~0.1%
  - RF/revolution frequency in conjunction with p-PB offers an interesting possibility
  - Might be able to get error down to per mil level at 4 TeV
  - "operational development" time for Jorg

2012 operations

Parameter	Value at 450 GeV	Value at top energy
Energy [GeV]	450	**4000**
$\beta^{*}_{IP1/5}$ [m]	11.0	**0.6**
β^{*}_{IP2} [m]	10.0	**3.0**
β^{*}_{IP8} [m]	10.0	3.0
Parallel separation [mm]	2.0	**0.67**
Crossing angle IP1/5 [μrad]	170	**145**
Crossing angle IP2 [μrad]	170	**90+**
Crossing angle IP8 [μrad]	170 (H)	**100 (V)**

These changes require tight collimator settings: TCPs @ 4.3σ, TCTs @ 9σ

Alick's offering a 76% increase in luminosity and a max <mu> of around 34

8 fb^{-1}, 5 fb^{-1} by middle of June?   3 to 4 fb^{-1} would be good

2012 - Of note

- Luminosity leveling in Atlas and CMS
- Improved procedures for going into Stable Beams
- LHCb
  - horizontal to vertical external crossing angle
  - plus tilted leveling
- Improved lumi scan software
  - LHCb, leveling, status to DIP, pause/resume, loadable scan sequences, tilted leveling, parallel scans
  - Luminosity trims to experiments – eek?
- VdM for β*= 0.6m uses ~0.19σ @ TCT
  - Aperture budget is 0.2 σ
  - Van der Meer Scan: **6 σ**
  - Definitions of MP allowed scan ranges to take into account VDM & LSC as much as possible

Optics

- Two techniques:
  - Segment-by-segment via AC dipole/2k turns
  - K-modulation
- 90 m optics
  - global correction of beating and dispersion
    - Beating down to 10 – 15%
  - Measurement error ~8%
- Ly via segment-by-segment
  - Error around 3%

Ly via Monte Carlo (quads/phase error)

Error similar to s-b-s

IP5 could expect similar but not better…

Glenn Vanbavinckhove

Systematic uncertainties

- 90 m optics at IP1
  - Leff(y) uncertainities
    - Quad gradient errors – MAD versus machine ($\sim 10^{-5}$) - negligible impact on Leff
    - Quad misalignments – optics parameters change but negligible impact on Leff
    - Beam-beam – 0.3% - dominant effect
  - Leffy is very robust!
  - But an interesting discussion after the talk….

S. Cavalier

Roman pots

☑ Reviewed the strategy to **align LHC collimators** and **movable devices**
- *We can align very accurately the collimators around the beam with beam-based techniques - no other way to be accurate within a fraction of σ*
- *The setting validation relies on loss maps that ensure cleaning and MP role*

☑ Roman pot settings are **determined** by the collimator positions
- *In all cases, the settings must respect some collimator hierarchy*

☑ A **closest approach** for Roman pot settings in 2012 was proposed
- *Defined retractions from various collimator types: different strategies to cope with "standard" and "special" machine configurations*
- *Relies on achieving "tight" collimator settings in 2012*
- *Detailed settings will be followed up by panels of experts (collimation+MP)*

☑ Special **"dream" scenarios** can be attempted but cannot be guaranteed
- *Challenge to operate with full TCP gaps around 1 mm at top energy to take data with pots between 3-5σ for small emittance beams*

☑ Possibility to take data without alignment campaign being investigated
- *Proposal by R. Assmann under investigation*
- *Clearly, will have to sacrifice accuracy of settings: could be a good startup strategy*

Requests

- CMS:
  - "assuming 15 fb-1 in 2012 at 8 TeV" – the clear priority
  - EOF scans (2 sigma, 10 points..)
  - Dedicated VdM run with nominal optics
  - Precision VdM at 11 m (set-up required)
  - VdM with p-Pb
- Atlas: two options but similar
- ALFA: "Coulomb scattering regime in 2012" (a few bunches)
  - "900 m with last year's beam conditions"
- TOTEM: diffractive physics at β*=90 m (156 bunches)
  - A mixed setup with 90m in IP5 and 500m in IP1
  - 6 shifts to commission, including some Stable beam running, is, as Alick says, optimistic
  - Note a total of 13 shifts for 90 m in 2011 – (**lessons learnt**)
  - Support for speeding-up of collimator alignment and loss validation procedures

Requests

- 1: Roman pots in standard physics fills at high intensity
    - Set-up and validation required
- 2.1: Low intensity special optics – single stage cleaning – pots to 4 – 6 sigma
    - Background…
- 2.2 Special optics – high intensity
    - Set-up and full validation
- Machine is not asking for long painful alignment
- Dreamin'…

Normalization is part of the program (~8 days in schedule – for VdM and RP/high beta) – need a rough schedule soon

High beta

- 90 m recommissioning before ICHEP?
  - At 4 TeV...

- Viable 500 m for 2012
  - Higher beta difficult...
  - Coulomb regime possibly within reach (1 micron etc.)
  - Valuable experience for beyond LS1
  - Commission in MD

- Extra quad return cables – decision before July 2012.

Helmut

Miscellaneous

- Watch beam induced heating of ALFA
- Clarify appropriate bunch intensities during special runs vis a vis BPN sensitivity ranges
- ATLAS BPTX data via DIP to be pushed as FBCT data into LDB
- ABP: Effort/collaboration needed to quantify and correct for beam-beam effects in VDM scans (model vs data, tune shift measurements in dedicated conditions ?)
- OP: operational procedures with sufficient flexibility , feed-backs not just locked to high intensity and many bunches, also working for fewer bunches and intensity