Wish list for wire MDs

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Outline

- List of MD studies for 2017
  - Commissioning (beyond HW tests), preparation (crossing angle scans) and compensation tests
    - Goals and procedures
    - Beam parameters
      - Intensity, emittance, train composition
    - Machine configuration
      - Energy, optics, crossing angle, orbit control, tune, chromaticity, octupole current
    - Wire settings
      - Position (alignment) and currents L/R of IP5
    - Observables and associated instrumentation
    - Further beam-beam wire related studies, including synergies with other MDs
    - Prioritization (following **1**, **2**, **3**, **4**)
  - MD time request and time-line
- Key simulation studies for preparing MDs

Wire impact on single beam - goal

- Priority **1**, **2**, **3**, **4**

- **Goal:** Test and calibrate the effect of the wires in a single beam
  - Need to measure impact of wires on beam **orbit**, **tune**, **beta-beating**, **chromaticity**, **tune-spread**, **coupling**, **RDTs**
  - **Calibrate wires** and estimate **orbit** and **tune feedback** functions during the compensation tests
  - **Align wires** with respect to the beam (vertical orbit, coupling)
  - Similar measurements for the **external wires** can be foreseen, but also for **negative polarity** and with vertical position at non-zero, e.g. @ **45º degrees**
  - Estimate impact in **lifetime** and **emittance** (tails, halo?) and compensate with other wire

See presentation of G.Sterbini

Wire impact on single beam – set-up

- Priority **1**, **2**, **3**, **4**

- **Energy**: All can be done at **450 GeV**
  - Qualification of tune and orbit feed-forward would be desirable at **6.5 TeV**
- **Beams** required: Only **beam 2**
  - Could be compatible with **parallel** studies using beam 1
- Beam **composition** and **intensity**: Single nominal bunches of 1.3 x 10^{11} ppb
  - ome tests can function already with probe
- **Emittances**: Nominal BCMS, i.e. ~1.5-2.0 µm.rad
- **Optics**: Nominal @ injection with nominal injection tunes, octupoles and chromaticity settings
  - More **exotic options** if testing compensation or lifetime impact can be foreseen (for example beam2 squeezed with beam1 nominal, equal β aspect ratio at the wire,…)

See presentation of G.Sterbini

Wire impact on single beam - procedure

- Procedure:
  - **Alignment**
    - Move the TCT collimators with 1 wire at a time and measure impact on **vertical orbit**, align the jaw to minimise this.
    - Measure **coupling**.
  - **Orbit**, **tune**
    - For fixed wire distance (jaw at **~6 σ_{col}**), measure impact of different currents to the beam orbit and tune
    - Do the same for **fixed current**, moving the collimator jaw.
    - Set-up orbit and tune **feed-forward**
  - **Chromaticity**: With corrected orbit and tunes, measure impact in chromaticity (maybe also **non-linear**) for different currents
  - **Beta-beating, tune-spread**, **RDTs:** Usual optics correction set-up
  - Repeat above for **external wires** and **negative polarity**
  - **Lifetime** and **emittance**: With corrected orbit and tunes, measure impact in lifetime and emittance evolution. **Compensate** with other wire (needs special optics)
- **Time** needed: **1.5 x 8 h**, **2 x 8 h**, **3 x 8 h**, **4 x 8 h**

- Priority **1**, **2**, **3**, **4**

See presentation of G.Sterbini

BBLR Compensation preparation - goal

- Priority **1**, **2**, **3**, **4**

- **Goal:** Measure the crossing angle reduction impact on lifetime
- Ideally, part of the **commissioning**
  - Synergy with crossing angle levelling setting-up
- Energy: **6.5 TeV**
- **Beam** composition: 2-3 colliding trains in beam1 and 2 (without/with IR8), a few single bunches in beam 2
  - With **full long-range, PACMAN-L/R**, **non-colliding**
- **Intensity**: Nominal @ 1.25 x 10^{11} ppb
- **Emittances**: Nominal for trains i.e. **2.5 µm.rad** for BCMS, some nominal single bunches and some blown up by ADT to **4-5µm**
  - Optics measurements can be done with pilot
- **Optics**: Nominal @ collision with nominal tunes, octupoles and chromaticity settings
  - β* of **40 cm**, but probably **33 cm** if commissioned

BBLR Compensation preparation - procedure

- **Procedure:**
  - **Reduce crossing angle** in steps
  - Measure impact on **lifetime** of different bunches, while keeping constant orbit and tune
  - Monitor impact in **emittances**, **luminosity**, **halo**, **losses**
  - **Measure optics,** e.g. **beta-beating**, **coupling**, **chromaticity**, **tune spread**, **RDTs**
- Time needed: **1.5 x 8 h**, **2 x 8 h**, **3 x 8 h**

- Priority **1**, **2**, **3**, **4**

BBLR Compensation goal

- **Goal:** Prove **BBLR compensation** with powering wire when crossing angle reduction impacts beam lifetime
  - Leading order octupole effect compensation possible with present hardware
- **Energy**: **6.5 TeV**
  - **Partial squeezed optics** @ injection could be envisaged
  - Simulation work to be done and optics commissioning overhead
- **Beam composition**
  - A **few single bunches** (around 3-4) in beam 2 (weak beam) spaced by > 15x25 ns for machine protection (abort gap kicker rise time)
  - With **full long-range, 1 non-colliding**
  - As many trains in beam 1
- **Intensity**: Nominal of 1.25 x 10^{11} ppb for strong (or highest possible from SPS)
- **Emittances**: Nominal for trains i.e. **2.5 µm.rad** for BCMS, some nominal single bunches and some blown up by ADT to **4-5µm**
  - Small enough to guarantee that long range kick identical to 1/r field corrected by wire for all LRs
- **Optics**: Nominal @ collision Nominal @ collision with nominal tunes, octupoles and chromaticity settings
  - β* of **40 cm**, but probably **33 cm** if commissioned
  - Un-squeezed optics in IR1, only if synergy with IR compensation MD
- **Crossing angle:**
  - Nominal in both IR1 and 5, no collisions in IR2 and 8
  - Moving only one IR crossing angle could be **envisaged**

- Priority **1**, **2**, **3**, **4**

BBLR Compensation procedure

- **Procedure:**
  - Priority **1**, **2**, **3**, **4**
  - Inject and ramp up a few bunches in beam 2 to commission **orbit** and **tune** feed-forward with wire (ideally during calibration phase) and **blow-up** effect of ADT
    - Compatible with parallel tests in beam 1
  - Inject, ramp-up and collide strong (beam 1) and weak beam (beam 2)
  - Set **internal TCT/L jaw** at **5-6σ_{col}** (including other collimation adjustments enabling this)
  - **Reduce crossing angle** in steps, while keeping orbit and tune constant
  - Observe **lifetime reduction** and ramp-up the current of each wire in steps, observing lifetime **recovery** in colliding weak beam
    - Note that if collimator distance in mm is equal L/R from the IR, wire current should be the same, whereas if distance is equal in σ, L/R current should be adjusted independently
  - Monitor **emittance**, **luminosity**, **halo**, **losses**
  - Repeat the test with different weak beam flavours (**Pacman-L**, **Pacman-R**, **without HO** and **non-colliding**)
  - **Measure optics,** e.g. **beta-beating**, **coupling**, **chromaticity**, **tune spread**, **RDTs,** with wire compensation
  - Repeat the test with **IR1 crossing angle fixed** and/or separated in IR1
  - Repeat the test using the wires in **external jaw**
- Time needed: **3 x 8 h, 3.5 x 8 h, 4 x 8 h, 5 x 8 h**

Observables and instrumentation

- Priority **1**, **2**, **3**, **4**

- **Observables → instrument**
  - **Lifetime → FBCT**
  - **Losses → (D)BLMs**
  - **Halo → coronograph**
  - **Emittance → BSRT**
  - **Orbit, crossing angle → BPMs, DOROS**
  - **Tune, chromaticity → BBQ, Schottky**
  - **Tune-spread → BPMs, BBQ, BTF**
  - **RDTs → BPMs, BBQ**

See presentations of B.Salvachua, G.Trad, T.Levens, R.Tomas, X.Buffat

Other compensation studies and spin-offs

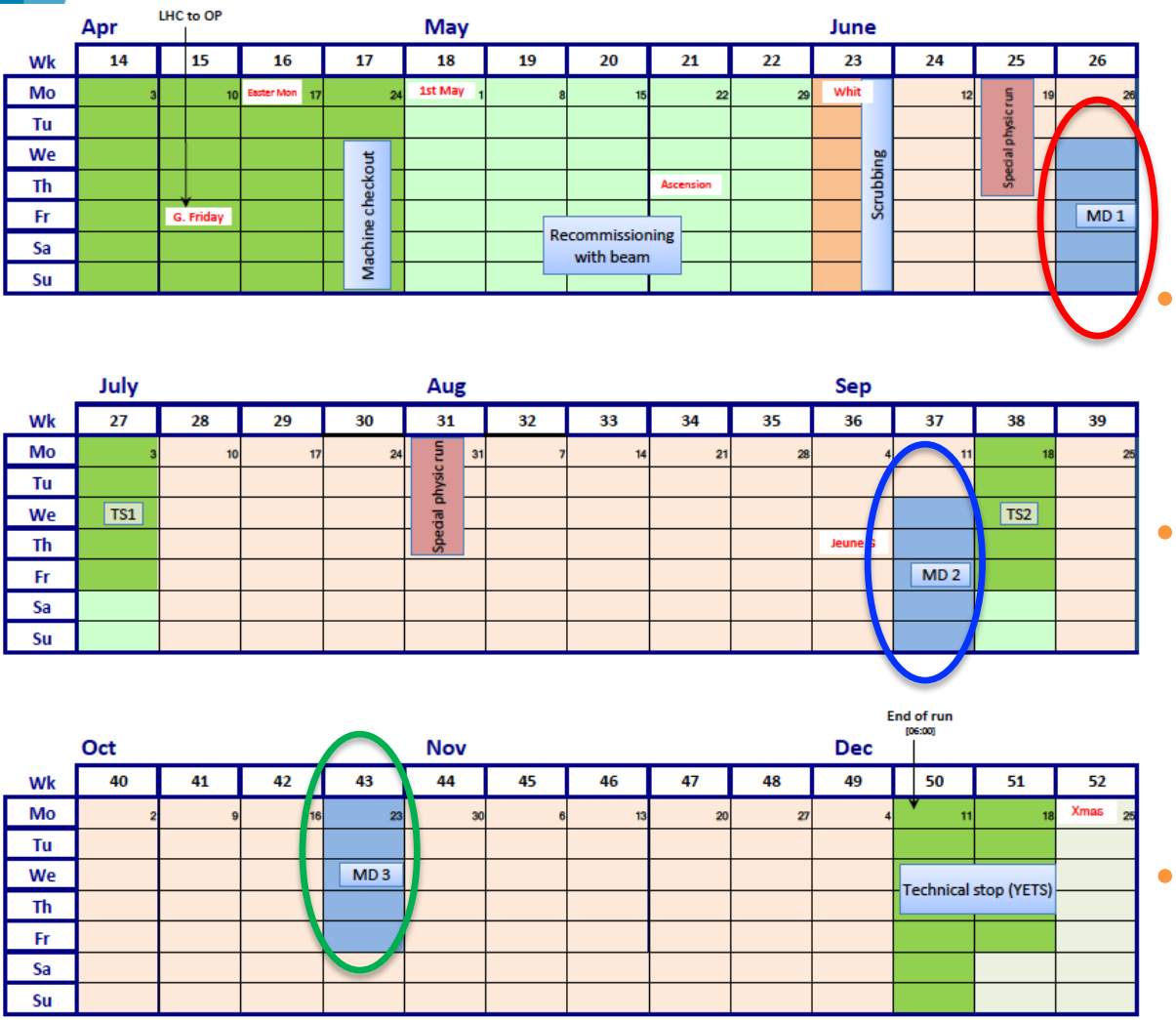
- BBLR Compensation with octupoles (arc, IR)
- Flat optics

See presentation of S.Fartoukh

- Wires are powerful enough to be used for linear and non-linear optics studies but also collective effects
- Measuring tune-spread, RDT, instability studies, halo cleaning

See presentation of M.Fitterer, X.Buffat and R.Tomas

MD schedule and time-line



- Only 15 MD block days
  - Possibility for additional days after TS2 if LHC lumi goal reached
- Wire MD requests **48 h** for strict minimum (**96 h** for more complete studies)
- Ideally wire calibration and crossing angle scanning should profit from **recommissioning** time in May (~16h)
- Would like to profit already from the **1st MD block** for most of the studies

See presentation of R.Tomas

Outlook

- Devise a **strict minimum commissioning** and **MD plan** that demonstrates BBLR compensation already in 2017
- Continue **simulations studies** for consolidate experiment
- Start discussing **configuration for 2018** and possible optics options (injection, flat optics, etc.) still using the **present H/W solution**
- Start a **reflection** for the **optimal configuration** and **hardware** to put in operation for (HL-)LHC

Thanks for your attention