“Top-up” Operation at the Swiss Light Source

Top-up Operation - Preservation of Bunch Pattern

- Preservation of bunch pattern
- Splitter
- Mixer
- LPF
- Phase
- 90° Phase shifter
- Adjustable Phase shifter
- Storage ring BPM
- 500 MHz Main RF
- Network
- Oscilloscope
- GPIB Gateway
- Waveform Readout
- Triggered by Revolution Event
- Global Timing Events from event generator
- VME
- IOC
- EVR
- Pre Injection Event
- For Bucket in bucket-index-waveform
  - Set timing to inject to selected Bucket
  - Current < low-limit + dead band?
    - No
    - Yes
  - Last Bucket of waveform?
    - No
    - Select next Bucket
    - Yes
- Compress waveform to 480 buckets
- Calculate bucket-index-waveform
- Sorted by charge in bucket
- Wait
- Current < low-limit?
  - No
  - Yes
- Read waveform of beam current

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Top-up Operation - Injection Oscillations

BPM in single turn mode:

**Horizontal Plane:**
- 800 μm peak-peak over 6 μs
- Decoherence time ≈ 600 μs

**Vertical Plane:**
- Excitation < 15 μm BPM noise
Scintillator count rates @ ID U24 →

I heard that you do not use the system of gate-signal delivery to experimental users during top-up injections. We would like to know how experimental users know (or don’t care about) the timing of series of injections, and also how to exclude its negative contamination to their experimental data due to possible fluctuation of X-ray beam.

We don’t do anything ... We plan to do a fast (ms resolution) measurement of the beam intensity during injection to get a feeling for the distortions.

(C. Schulze-Briese, PX beamline responsible)

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Top-up Operation - Losses @ U24

... May be you even have some plots which illustrate the positive and negative influences of Top-up operation on your various experimental setups.

We don’t have plots but it can be said that the effect of Top-up on the data quality is rather positive than negative. It is believed that a small and periodic distortion is better than a continuous drift / change during the data collection. We are able to measure at least as good quality data as ESRF and a particular difficult case that was not solvable at ESRF was solved here during Top-up operation.

Some users told me that in SLS so far there is no experiment which requires very severe beam stability. I doubt this opinion. So please make clear what kind of experiment performed in SLS. There I ask you to explicitly clarify the requirement of each experiment to beam quality. The beam stability of $< 1 \, \mu\text{m rms}$ and $< 1 \, \mu\text{rad rms}$ is more than sufficient for Protein Crystallography. Another nice aspect of SLS is the reproducibility of the beam position after shutdown. Typically the beam comes back to few microns and the intensity is the same as before.

(C. Schulze-Briese, PX beamline responsible)
Top-up Operation - Temperature and Pressure

Temperature
12 * 6 = 48 sensors
26 deg C

Pressure
34 gauges
3HC
arc flange
injection
4e−8 mbar
4.5e−8 mbar
2e−8 mbar

100 deg C = Maximum Temperature
1e−7 = Maximum Pressure
## Top-up Operation - Gap Control and Interlocks

**Gap Control:**
- Set Operator/Experiment
- Status

**Kicker/Septum Control:**
- Set Disarm/Rearm
- Status

**Orbit Autodump:**
- Set Parameters
- Status

**Sources Autodump:**
- Orbit
- Temperature
- RF
- 3HC

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Top-up Operation - Controls

- Bunch Charge
- Gap Control
- Orbit Autodump Params
- Sources Autodump
- Orbit
- RF
- Sources
- Inhibit active flag
- Kicker/Septum Control
- Tuneshifts
- Chromaticities
- Nominal Tunes & Chromaticities
- Bunch Pattern
- Top-up Control
- SR Current

ICT 1: +00.513 nC
ICT 2: +00.487 nC
ICT 3: +00.330 nC
SR Current: 300-301 mA
DCT: +0.0355 mA/s
DCT: +0.1515 mA/min
Lifetime: +09.93 h
Top-up Operation - Beam Time and Faults

Jan.-Jun. 2002 (4344 h)
- User 44.2% = 1920 h
- Shutdown 36.6%
- Beamlines 6.4%
- Machine 12.7%

Jan.-Jun. 2002: 93.5% Availability

Jul.-Dec. 2002 (4416 h)
- User 57.8% = 2552 h
- Shutdown 25.5%
- Machine 10.0%
- Beamlines 6.7%

Jul.-Dec. 2002: 94% Availability

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**Slow Orbit Feedback - Golden Orbit**

- **Horizontal difference orbit**
  - ~1 μm
  - $v_x = 20.42$

- **Vertical difference orbit**
  - ~1 μm
  - $v_y = 8.17$

- **Golden orbit**
- **BBA offsets**

- **72 BPMs**
- **72 corrs**
- **0.5 Hz (3 Hz) refresh rate**
- **~0.3 μm precision of BPMs**

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