



SPS aspects and new location

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Layout

- SPS operational considerations
- Phase 1 : resonance finding
- Phase 2 : photon flux optimization
- Phase 3 : cooling demonstration
- Accurate resonant energy measurement
- Conclusion

Operational considerations

- The SPS may run in two different modes
 - Coasting mode where the beam is injected, accelerated and maintained for any length of time
 - A cycled mode where the beam is maintained for up to 10/20s
- Details tomorrow, by F. Velotti

Phase 1, resonance finding

- Multiple dimension overlap required to achieve excitation
 - Horizontal & vertical positions matching is no longer considered. Decided during the March CERN meeting that the cavity will be equipped with 1 or 2 BPMs.
 - Energy matching (see Synchronisation talk, this afternoon)
 - Time matching (see Synchronisation talk, this afternoon)
- All dimensions need simultaneous overlap to induce ion excitation and observe the emitted photons
 - Ion-laser interaction off the resonance cannot be observed
- The observable to detect and quantify the excitation of the PSI is the photons emitted in their relaxation
 - A major goal of the LAL meeting is to identify the choice(s) of detector placement and technologies

Phase 1, resonance finding : procedure

- Use a cycled SPS
 - Relaxed time constraints as it is operated in parallel with other users
 - SPS systems functions are preloaded
Beam shape (optics) and position cannot be changed during the cycle based on observations (feedback)
- Systematic scanning in 2 dimensions of the parameters space
 - Fully automatized, from parameter set to beam and instrumentation recording.
Intrinsically possible to be done with the SPS control but requires development time
 - Coupling between energy and position due to the non zero dispersion at the IR. See synchronization talk this afternoon.

Phase 1, resonance finding : Energy and timing

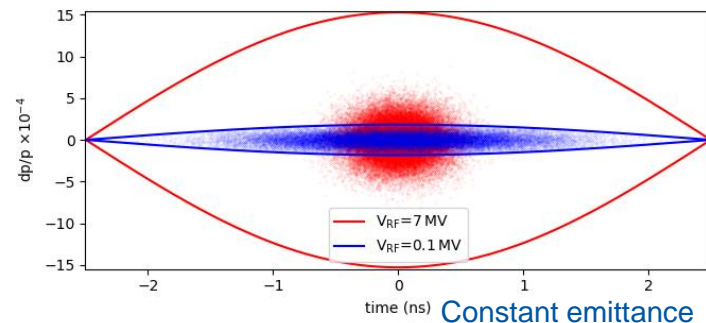
- Beam energy variations between cycles and over longer times discussed tomorrow by F. Velotti.
- Timing is discussed this afternoon during the synchronization talk

Phase 1, resonance finding : scanning plan

- Scanning if 2 dimension
 - Considering 10 steps per dimension results in 100 sets
 - If each setting can be tested within 100ms the total procedure takes 10s
- Cycled operation would be favored
 - Will require a full automation of the machine setting generation and clean recorded data storage
 - Photon detection system capable of measuring $\sim 0.1\%$ of maximum flux within 100ms

Phase 1, resonance finding : dilution plan

- In addition or instead of systematic scanning one could consider beam dilution to achieve the first ion excitation
 - In the transverse plane the existing damper could be used to increase the transverse beam size up to the machine acceptance of $\sim 42 \times 18 \text{ mm}$ at the IR
 - In the time dimension, the voltage could be reduced to increase the bunch length up to the bucket length of 5 ns
- This technique is limited by the instrumentation, in particular the photon detection system
 - Details and limits will can only be discussed once the photon detection system will have been decided



Phase 2 : optimizing the photon flux

- Phase 2 aims at optimizing the ion beam excitation and photon production
 - To maintain resonant conditions for arbitrary long times
 - To reliably reproduce optimum resonant conditions
 - To reliably target specific parts of the beam in energy
- In practice phase 1 will produce one set of optimum machine settings
 - Systematic scanning near this set will provide the optimum machine setting
 - Continuous measurement will provide information on stability and reproducibility
- Switch to coasting SPS operation
 - Do we expect more stability and reproducibility issues ?
 - Do we need to consider a live feedback system (on ion momentum, timing and position) to maintain the resonant condition?

Phase 3 : cooling demonstration

- Using coasting operation and long flat-top times (~ 100 s)
- We could consider using the existing wall current monitor to observe the longitudinal cooling. It has a resolution of 5ps and enough sensitivity to detect the ion beam
- Can we consider observing cooling with cycled SPS operation and up to 20/30s flat-top?

Accurate transition energy measurement

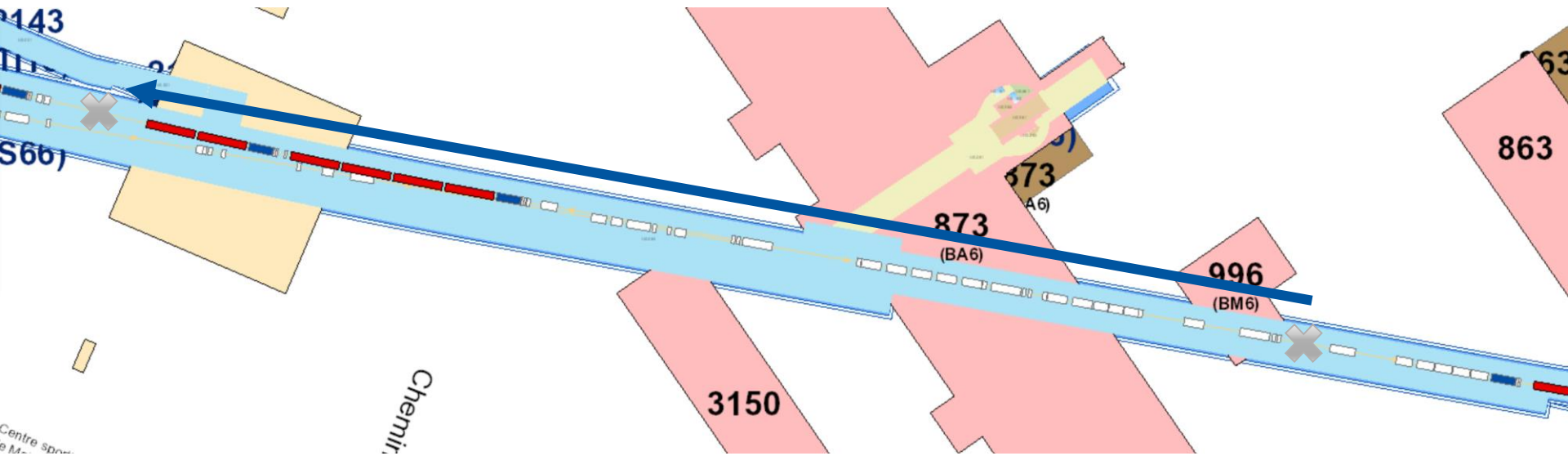
- The accurate measurement of the resonant energy mainly depend on the understanding of all the systematics influencing the ion beam energy
- No specific steps is foreseen but much of the work will be carried on in parallel such as energy calibration using two different partially striped ion species.
- Possible plan for SPS absolute energy measurement in Run3 discussed by F. Velotti

New location

- Outcome from the CERN March meeting on radiation effects
 - SPS environment is very radioactive
 - Prediction of radiation effects on electronics is very uncertain
 - Placing the laser electronics in the tunnel would be a major risk
- Visit of the SPS tunnel at the end of the CERN March meeting. Aurelien & Kevin found a new location of the PoP where the electronics could be housed in a side tunnel

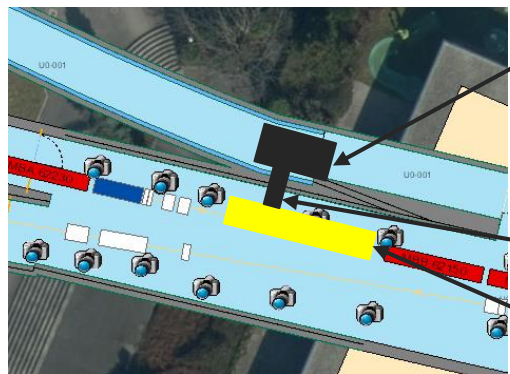
New Location : LSS621

- Located ~100m downstream the position initially considered, at the end of the SPS long straight section 6 and after the extraction



New Location : LSS621

- Side tunnel was used for lepton transfer during the LEP era.
- Now empty and closed.
- Tunnel walls offers shielding from radiation coming from the ring
- Space seems enough for the laser electronics and eventually additional shielding



Laser electronics in side tunnel
Used for electron transfer
during LEP time

Optical transport line
on the ceiling

Cavity

The cavity is foreseen immediately downstream the dipole MBB.62150 and the interaction point 3m downstream.

Total space available of ~12m.

New location : LSS621

- SPS arc and dipoles immediately downstream make considering extracting highest energy photons complex
- No showstoppers to consider this location after consulting with SPS experts
- Required apertures discussed by Francesco this afternoon

Conclusion

- 3-steps experimental procedure
- New location allowing to shield electronics

- Questions remaining
 - Laser cannot be switched on-off quickly and will have to remain active for every user in cycled operation.
 - Radiation levels and additional shielding needed in the side tunnel to use classical laser electronics is unknown. This requires a comprehensive simulation of the environment, particularly with PSI beams.
- Major goal of the LAL meeting is to identified and agree on detector specifications (location, technology and sensitivity).

Thank you

