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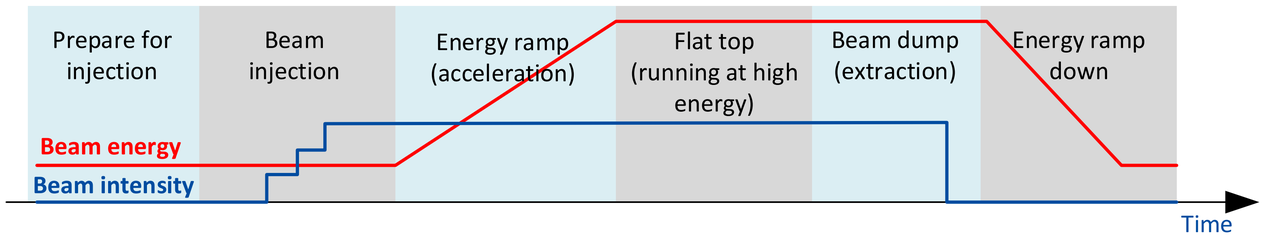
SUPER PLASTIC SYNCHROTRON
Operating instructions

CERN

Typical operating cycle of a particle accelerator



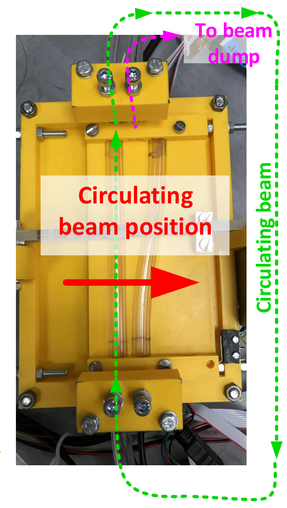
Full operating sequence

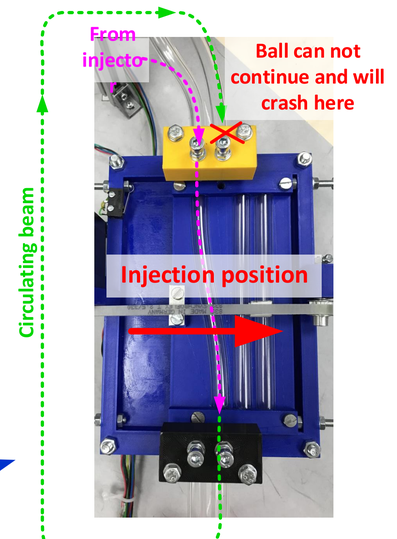
Prepare for injection checklist:

1. Check the machine is in Manual mode (**"Accelerator operation mode" key**)
2. Check the machine is at low energy (**"Energy control knob"** is set to 0)
3. Check the source is filled with particles
4. Check the machine is empty, no beam is circulating
5. Check the Extractor is in the closed orbit position

Beam injection. Read before doing! The process is very fast. The order of actions is critical.

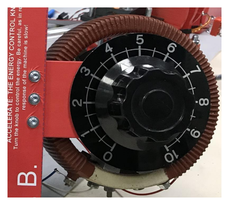
6. Move Injector to Injection position by pressing the **Button 1 "Move injector"**
7. Release one particle (ball) by pressing the **Button 2 "Drop one ball from vertical LINAC"**. The ball will pass through the Injector.
8. Immediately after the ball leaves the Injector return the Injector into the closed orbit position (**Button 1 "Move injector"**). This is a time critical operation, you have about one second to do it.
9. The ball should circulate at low energy now

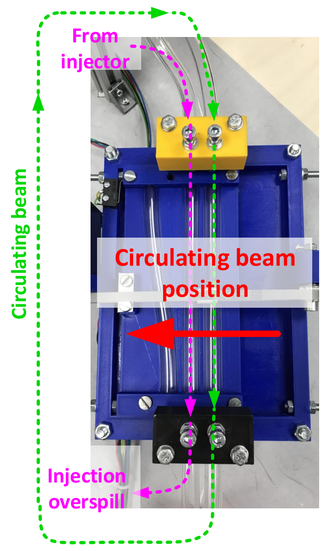




Energy ramp:

10. Turn the **"Energy control knob"** to gradually increase the ball (beam) energy. Note it takes the ball about 2 seconds to make one turn (the revolution frequency is quite low). Therefore accelerate very slowly, try to increase the energy knob not faster than in 30-60 seconds.





Flat top:

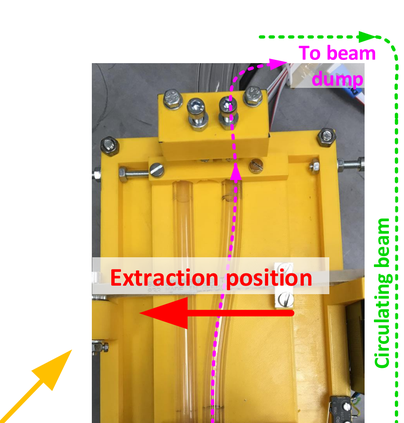
11. The beam circulates at high energy without operator interventions.

Checklist to start the extraction (beam dump) process:

12. Check the machine is in Manual mode
13. Check there is circulating beam in the machine

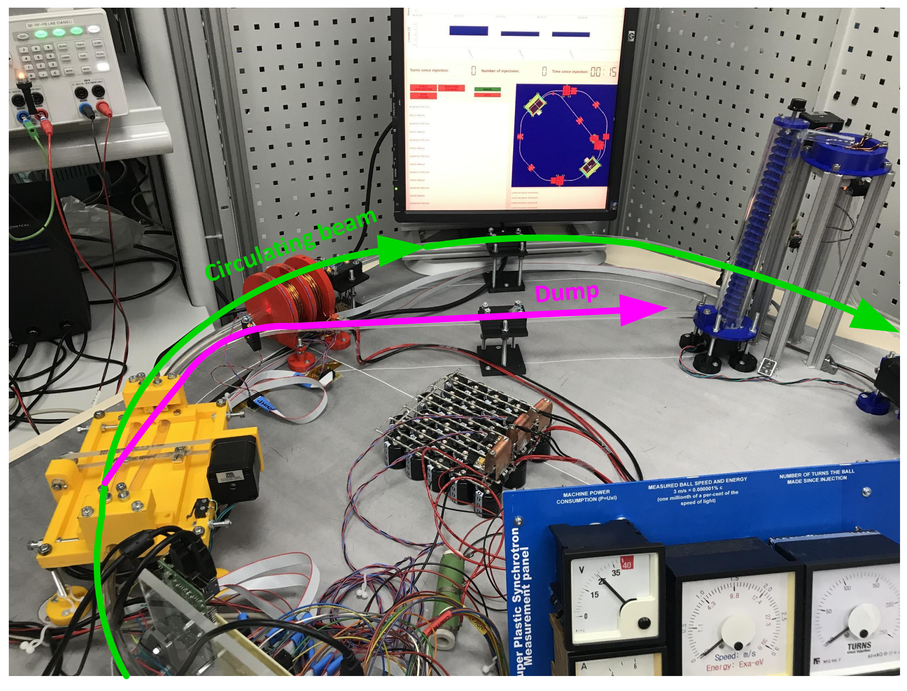
Extraction (beam dump). Read before doing! The process is very fast.

15. The Extractor needs about 1 second to move and it must be secured in the final extraction position before the ball arrives. **Synchronization with beam is critical!**
16. Observe the ball circulating in the machine. Start moving the Extractor by pressing the **Button 3 "Move extractor"** immediately after the ball had passed through the extractor
17. The ball will be extracted on the next turn.
18. When the machine is empty, move the Extractor back to the closed orbit position by pressing **Button 3 "Move extractor"** again



Energy ramp down

19. Refill the Vertical LINAC source. Press **Button 4 "Refill the source"** to start the Archimedes' screw. Wait until the ball drops back to the source
20. Ramp down the accelerator energy by turning the "Energy control knob" towards zero



Semi-automatic operating sequence

I. Run the checklist (steps 1 to 5) by yourself

II. Press the **Button A "Injection request"** to run the steps 6 to 9 automatically

III. Ramp the energy (steps 10 to 13)

IV. Press the **Button B "Beam dump request"** to run the steps 15 to 19 (Beam dump) automatically

V. Ramp down the accelerator (step 20) and start over

Fully automatic operating sequence

A. Turn the **"Accelerator operation mode" key** to Automatic. The control computer will run a full accelerator operating sequence for you (injection, acceleration, beam dump, refill, ramp down). Observe the process.