Startup of the Polarizer

The Polarizer neutralizes a fraction of the ion beam at the Na cell neutralizer, polarizes the resulting neutral beam with laser optical pumping, and then re-ionizes a fraction of the neutral beam at the He cell re-ionizer. The ion beam *not* neutralized at the Na cell cannot be polarized, and is therefore dumped by the deflector plate ILE2:DEF15C onto Faraday cup ILE2:FC15. The fraction of neutral beam not re-ionized at the He cell goes straight through the bender ILE2:B21 into the neutral beam monitor. The Helmholtz coils controlled by ILE2:SOL15A are essential to producing polarization. Preserving polarization to the neutral beam monitor also requires that ILE2:SOL15B is on.

Tuning procedure:

1. Make sure that the polarizer is completely off i.e. beam line components ILE2:
   BIAS15
   RESEVR
   DEF15C
   SOL15A
   SOL15B
   are all off, the Na cell reservoir temperature is below 250 deg C, and ILE2:FG16 (helium flow) setpoint is zero.

2. Tune stable pilot ion beam through the Polarizer to the experimental target. The smallest restriction in the Polarizer is a nominal 8 mm diameter aperture (variable) at the entrance to the He cell chamber. Because of that restriction, the best transmission through the Polarizer of a 30 keV ion beam is about 82%. The aperture can be seen through the viewport on the He cell. A manual knob to control the aperture size is on the other side of the chamber. The calibration has been lost, so the aperture size is best estimated visually while shining the laser beam through it.

3. Turn on the helium flow (typically 1.0 ccm). This will increase the emittance of the ion beam. Slight retuning of elements downstream of the He cell may be required.

4. Turn on ILE2:SOL15A (nominal 5 amps). This should have no effect on the beam tune, since the magnetic field is small (~10 gauss) and along the beam axis. If required by the experimenters, turn on SOL15B as well (nominal 10 amps). This will move the beam slightly in the vertical direction at the bender ILE2:B21 and will probably need correcting downstream of that. **You have then finished tuning the unpolarized ion beam.**

5. Now turn on the deflector ILE2:DEF15C. Nominal value for deflecting 28.0 keV ion beam into the fixed, off-axis Faraday cup ILE2:FC15 is 1762 V. The value should scale linearly with the ion beam energy and be independent of the isotope mass, although for unknown reasons this has not always been true in practice (perhaps the Faraday cup has been moved inadvertently closer to the beam axis).. Tune the

deflector voltage to get all the ion beam on FC15. **CAUTION: Oversteering the beam can lead to high radiation fields when running radioactive beam.**

6. Turn on the Na cell by ensuring that the air shut off valve by the Na cell is open and air cooling is on (check for the sound of air flow at the Na cell) and gradually raise the reservoir temperature (initially in 100 deg steps, then less as the final temperature is approached) to 420 deg C. *NOTE: The nozzle heater has been removed, so that only temperature readback is left on that*. The trap and collector, ILE2:TRAP and :COLL, are passively air-cooled and only read back temperature *(a previous closed loop control has been removed)*. As the Na cell heats up, one sees a decrease in the ion beam current at ILE2:FC15 and an increase in ion beam current after the He cell. **It will not be possible to measure the neutralization efficiency of the Na cell using radioactive beam, so do it now**, by measuring the drop in the ratio of currents ILE2:FC15 / ILE2:FC11 as the Na heats up. The drop is due to the ion beam at FC15 decreasing due to increased neutralization in the Na cell. The neutralization efficiency = 1 – FC15 / FC11, and should be around 40%.

7. Turn on the Na cell bias ILE2:BIAS15. The experimenters should know the approximate setting. The ion beam energy to the experimenters is decreased by that amount. This requires decreasing the voltage on all electrostatic elements downstream of the He cell by a percentage equal to the percentage decrease in beam energy. *NOTE: the bias only reduces the energy of beam that is neutralized within the Na cell.*

8. Switch over to radioactive beam.

Notes regarding Na cell: The PID settings are optimized for keeping the reservoir temperature stable under operating conditions. They are not optimized for raising the temperature quickly to the setpoint. If the reservoir heater trips off, it saves a great deal of recovery time if the setpoint is frequently adjusted to keep the PID output near the operational value. **Run a strip tool of the Na cell parameters, including reservoir PID output, to aid in diagnosing and recovering from Na cell trips or outages**. If the Na cell tripped due to high temperature, the options are to lower the heating or (maybe) to increase the cooling.

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