GTS Ion Production, Measurement, Ghost Beam (3/7/19)

Ion Diagnostic #1: Electrostatic Precipitator

Calculations & Simulations

- Build E-field model of collector plates for precipitator installed at GTS
- Generate E-field map and insert into PGUN/TGUN GPT model (or test standalone)
- Make best estimate of ion/secondary distributions (HV, #, spatial, velocity)
- Run GPT w/ E-field precipitator to estimate ion/secondary collection rate at plates
- Compute secondary electron yield, include corrections to ion/secondary collection, i.e. current vs. precipitator voltage.

Experimental

- Identify useful range and resolution of precipitator bias voltage (mV, V) to study collection, e.g. sufficient for collection but w/ resolution to measure energy
- Build and install power supply and ammeter, w/ ability to precisely set plate voltage and precise readback of precipitator current.

Ion Diagnostic #2 : Magnetic Ion Trap

Calculations & Simulations

- Build B-field model w/ magnetizing coil + solenoids, compare w/ Jay's TOSCA model
- Add steel plates to shape magnetizing solenoid field to make a new trap around spool; consider range of magnetizing solenoid current (range of trap conditions)
- Calculate ion/secondary trapping condition, reasonable?
- Generate B-field map and insert into TGUN GPT model
- Run a test case w/ "artificial" distribution to verify works expectedly
- Make best estimate of ion/secondary distributions (HV, anode, #, spatial, velocities)
- Run GPT w/ B-field trap to estimate ion/secondary collection rate
- Make best estimate of recombination light rate (#, color, solid angle)
- Calculate transmission of light through vacuum window to detector (#, color)

Experimental

- Leak check spool, attach vacuum windows, ready to install
- Design and fabricate steel plates from the B-field model that can be added/removed
- Identify suitable detector for predicted recombination light, sensitive to the light (#, color) and practical to implement (position, B-field, controls)
- Build or procure detector, assemble and bench test, ready to install

PGUN Measurements (now – TGUN, late summer?)

1. Commission the precipitator diagnostic, i.e. for some gun voltage, beam current and bias voltage, can you measure a detectable current, either ions or secondaries?
2. IF yes, perform systematic study (be sure to record ion pump currents, RGA scan), to develop the precipitator as a useful diagnostic for electron impact ion generation:

#	Measurement	Gun Voltage	Current	Precipitator Bias
1	Ion energy distribution	Fixed	Fixed	Vary for ions
2	Secondary energy distribution	Fixed	Fixed	Vary for secondaries
3	Ion yield/linearity	Fixed	Vary	Fixed for ions
4	Secondary yield/linearity	Fixed	Vary	Fixed for secondaries
5	Ion yield vs. beam energy	Vary	Fixed	Fixed for ions
6	Secondary yield vs. beam energy	Vary	Fixed	Fixed for secondaries

TGUN Measurements (April – Summer)

1. Before implementing ion trap, repeat previous PGUN conditions but with TGUN to determine if a Ghost beam can be produced on the viewers.
2. IF PGUN precipitator test was UNSUCCESSFUL then explore precipitator again, but w/ TGUN; where there is possibly worse vacuum, lower beam voltage, high beam current.
3. IF PGUN precipitator test was SUCCESSFUL perform comparative measurements with TGUN to reproduce PGUN result, and then extend to higher current (note differences).
4. Characterize the observed light through the anode and trap ports when the TGUN is operational (intensity, color), evaluate with ambient light or a light source the effect of the magnetizing solenoid on the light detector (if one exists, mitigate)
5. Configure the magnetic trap w/ light detector at spool, and reproduce PGUN-like beam run conditions (beam current * duration), monitor precipitator (ion/sec) concurrently:

#	TGUN Spool Light Measurements	Mag Solenoid	Anode Bias	Beam Current
1	Any light during beam operation	Fixed	Fixed	ON
2	Any light after beam operation	Fixed	Fixed	OFF
3	Trap efficiency vs. mag solenoid	Vary	Fixed	Always ON, then OFF
4	Trap efficiency vs. mag solenoid	Vary	Fixed	Initially ON, then OFF
5	Trap efficiency vs. anode voltage	Fixed	Vary	Initially ON, then OFF
6	Trap charge limit	Fixed	Fixed	v. (current * time)

6. Adjust the magnetic trap w/ light detector at anode, but retain magnetic steel plates, to explore if one can distinguish collection OR transfer of ions between anode & trap:

#	TGUN Anode Light Measurements	Mag Solenoid	Anode Bias	Beam Current
1	Trap efficiency vs. mag solenoid	Vary	Fixed	Always ON, then OFF
2	Trap efficiency vs. mag solenoid	Vary	Fixed	Initially ON, then OFF
3	Trap efficiency vs. anode voltage	Fixed	Vary	Initially ON, then OFF
4	Trap charge limit	Fixed	Fixed	v. (current * time)