

Tests with the Plasma Dummy Cell

Main purpose: check the stability of the thin electron window foils

Matthias Gross

Tests with the Plasma Dummy cell
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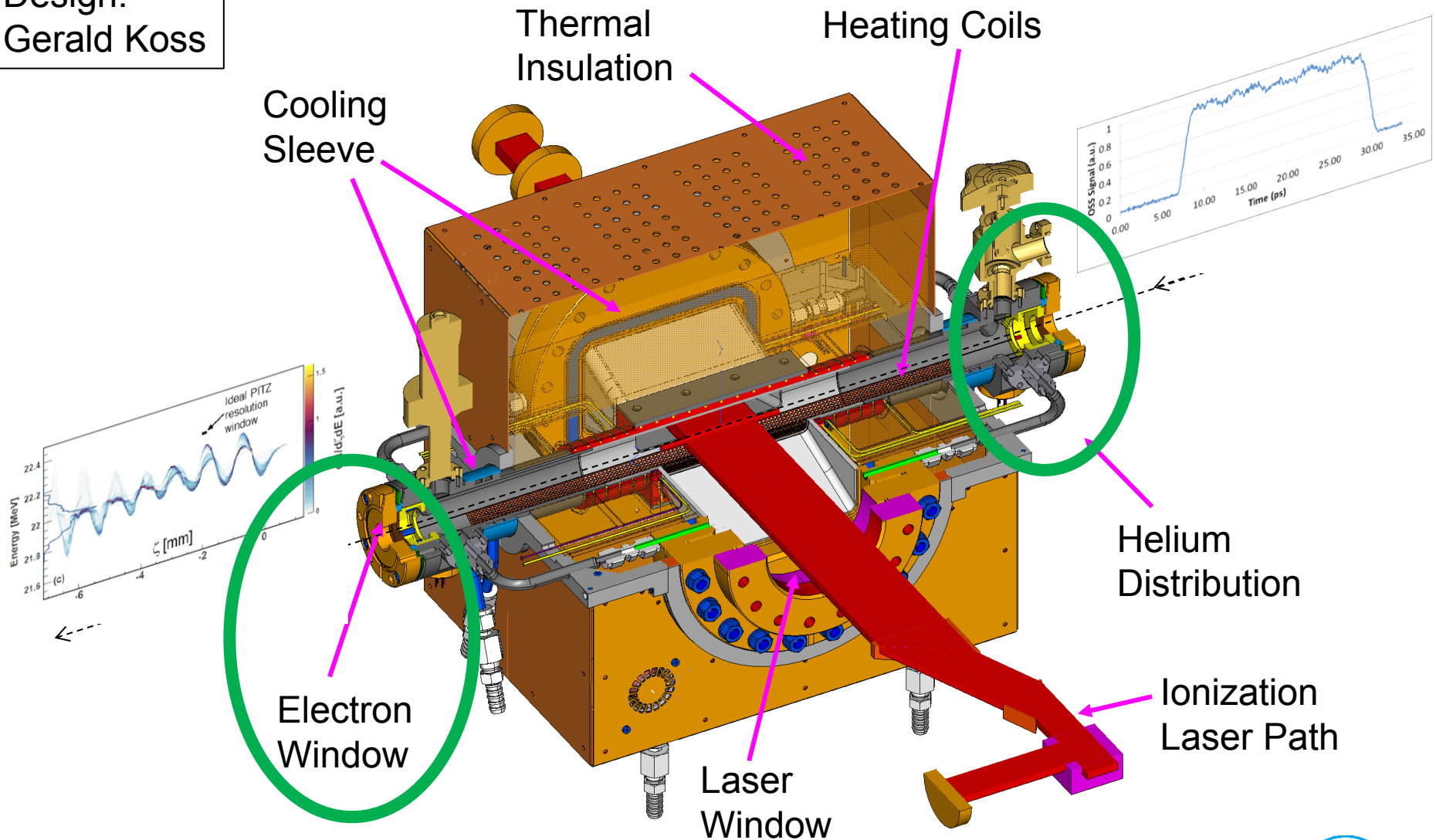
Background

- > A plasma acceleration experiment is in preparation at PITZ
 - Self-modulation of a long (several plasma wavelengths) electron bunch
- > A plasma cell was constructed for that purpose
- > One critical component: the electron windows
 - Separate the plasma cell atmosphere (≈ 1 mbar Argon) from PITZ vacuum
 - Need to be thin (a few μm) to minimize electron scattering
- > To be tested here: Does the heating caused by the energy deposition of the electron beam inflict damage to the foil?
 - DUT: 8 μm Kapton foil
 - Dummy plasma cell filled with ≈ 1 mbar Argon
 - „Detector“: vacuum activity around plasma cell; visual inspection after extraction

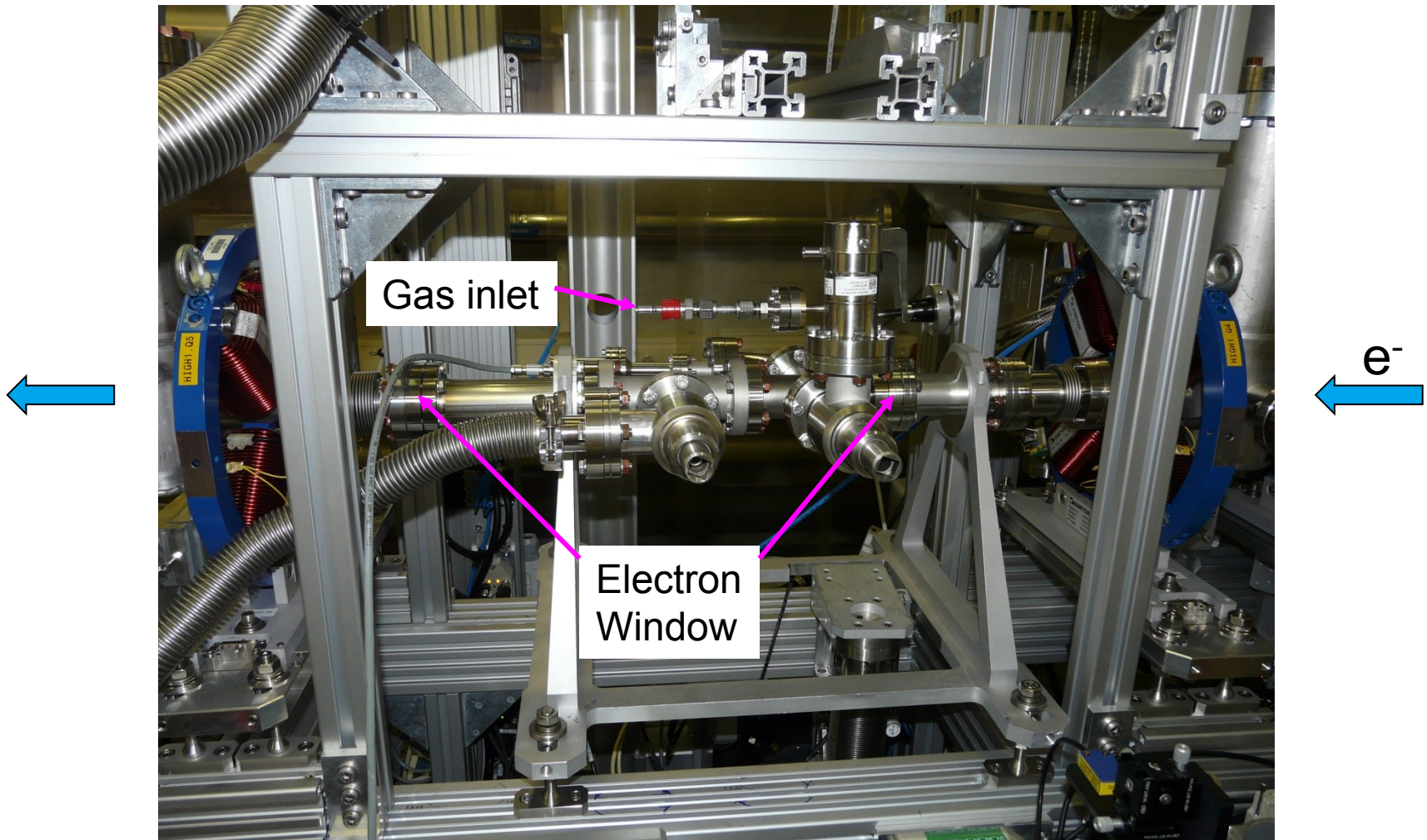


Plasma Cell Design

Design:
Gerald Koss



Experimental Setup



Experimental conditions

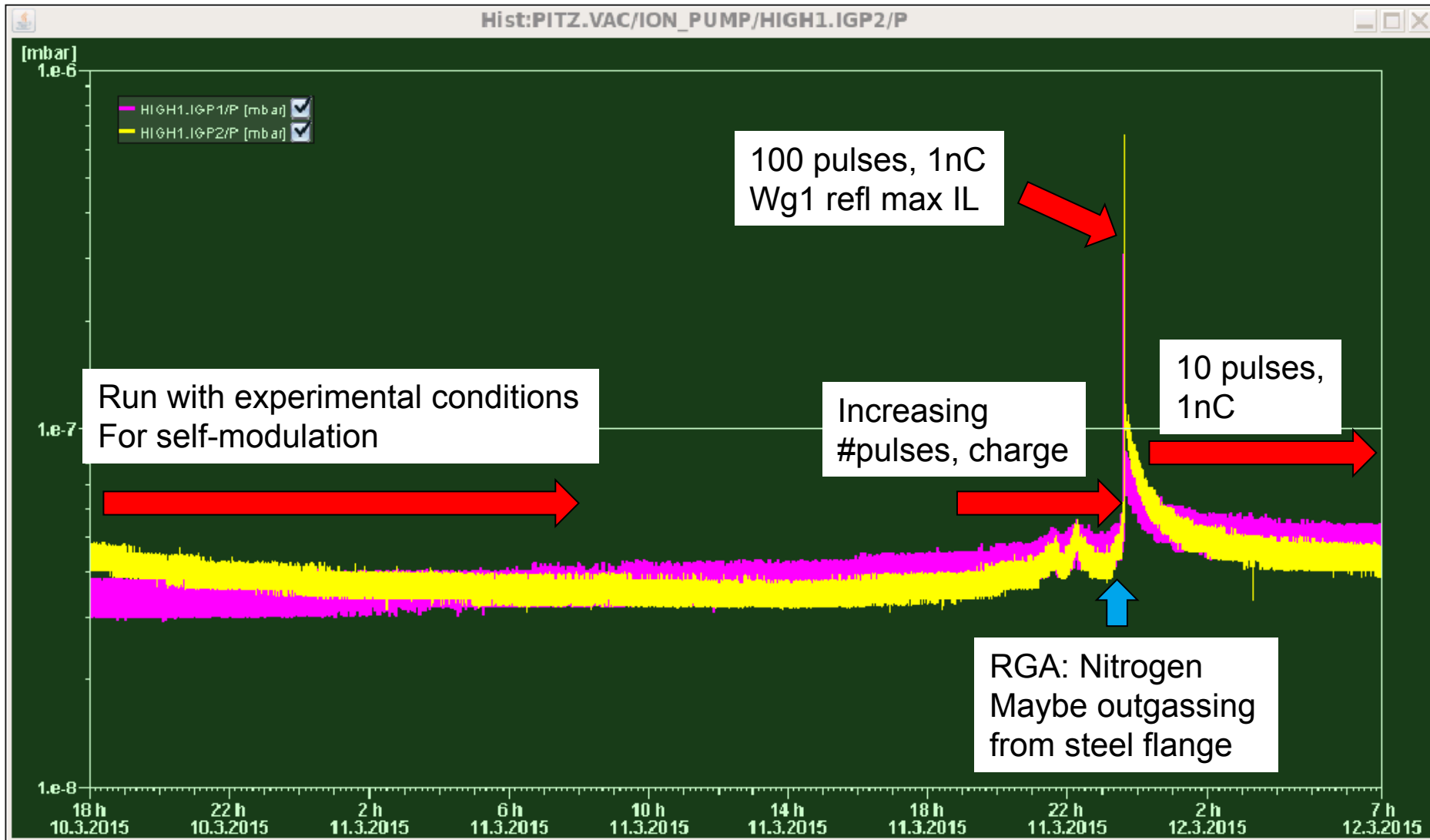
- > Gun: 6MWg; on-crest; 400 μ s pulse length
- > Booster: 3.1MWb; on-crest; 200 μ s pulse length
- > Beam transport as for emittance measurements
- > Solenoid and Quadrupoles High1.Q1...4 for tight focusing into plasma cell (see preceding PPS talk by Yves Renier)
- > Beam conditions
 - **13h, 1 laser pulse, 100pC bunch charge**
 - 15min; 5 pulses; 100pC charge
 - 15min; 10 pulses; 100pC charge
 - 1h; 50 pulses; 100pC charge
 - 1h; 100 pulses; 100pC charge
 - 1h; 100 pulses; 250pC charge
 - 1h; 100 pulses; 500pC charge
 - 20min; 100 pulses; 1nC charge
 - 7h; 10 pulses; 1 nC charge



Experimental conditions for self-modulation experiment



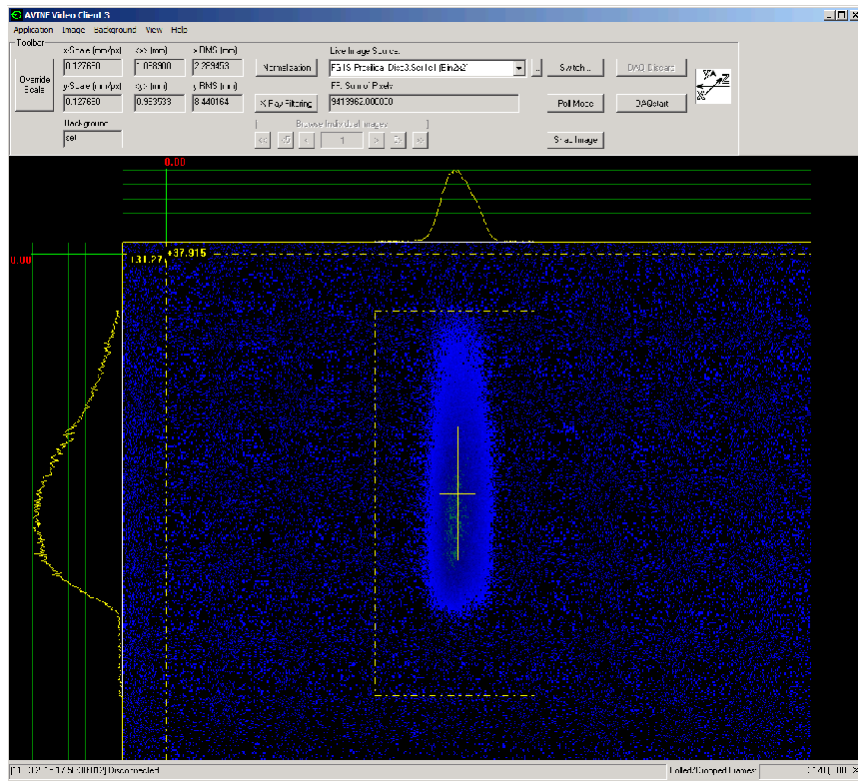
Vacuum History



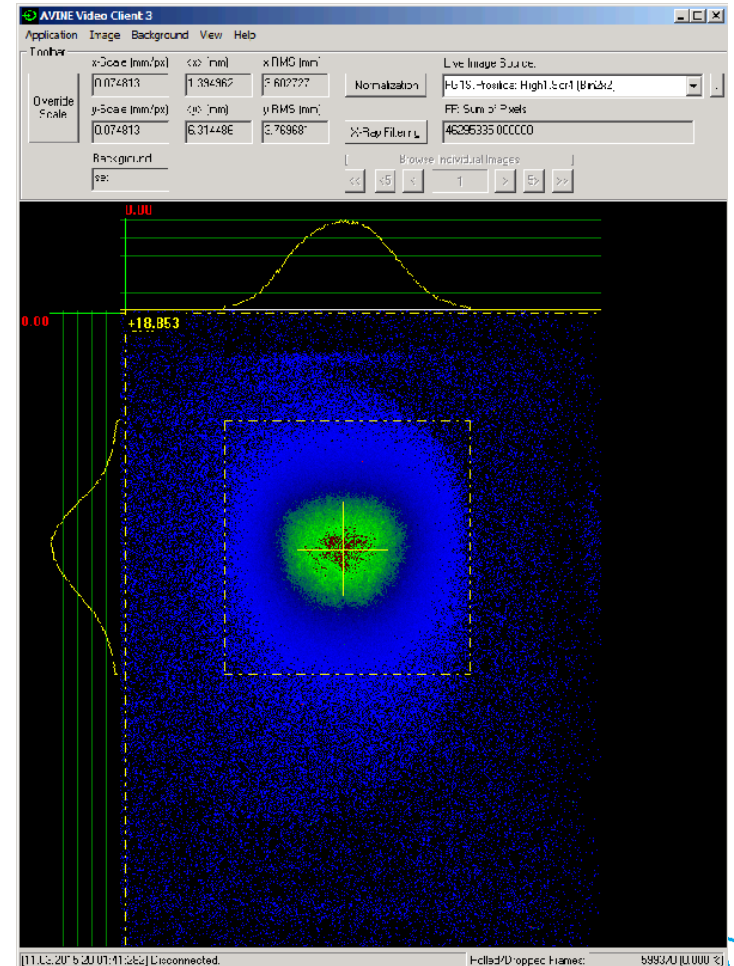
Other achievements

- Transport of beam through plasma cell to HEDA2

Beam at Disp3.Scr1



- Capturing of tightly focused beam with High1.Q5/6 to **High1.Scr4**



Summary

- > Stress test of electron window foils (8 μ m Kapton) was conducted
- > **Window passed test** for nominal experimental conditions (1 pulse; 100pC bunch charge, several hours continuous run)
 - Note: plasma cell will be heated to $\approx 700^\circ\text{C}$ in experiment, but area of electron windows is water cooled to ambient temperature
- > No problems seen for 100x heat load (10 pulses, 1nC) after 7h
- > Beam passed plasma cell intact

