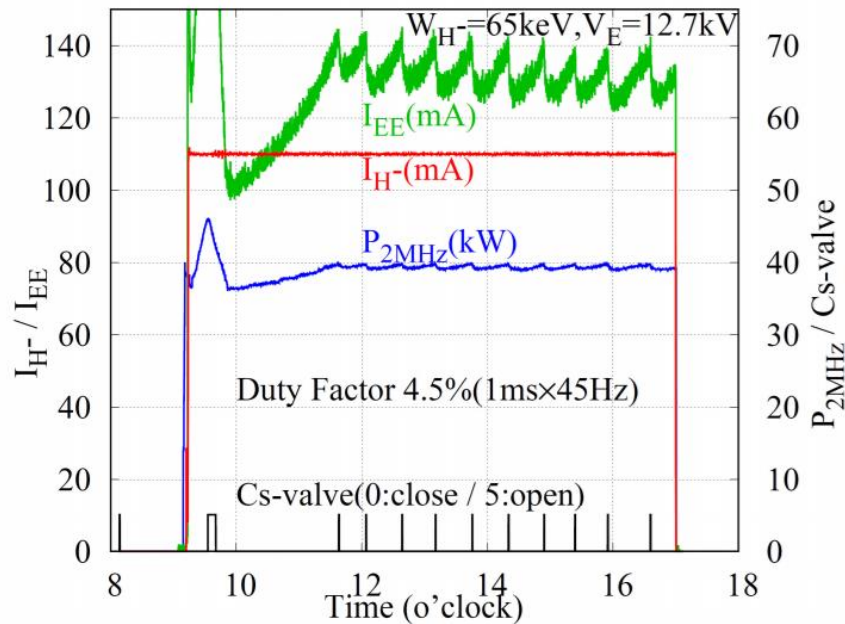


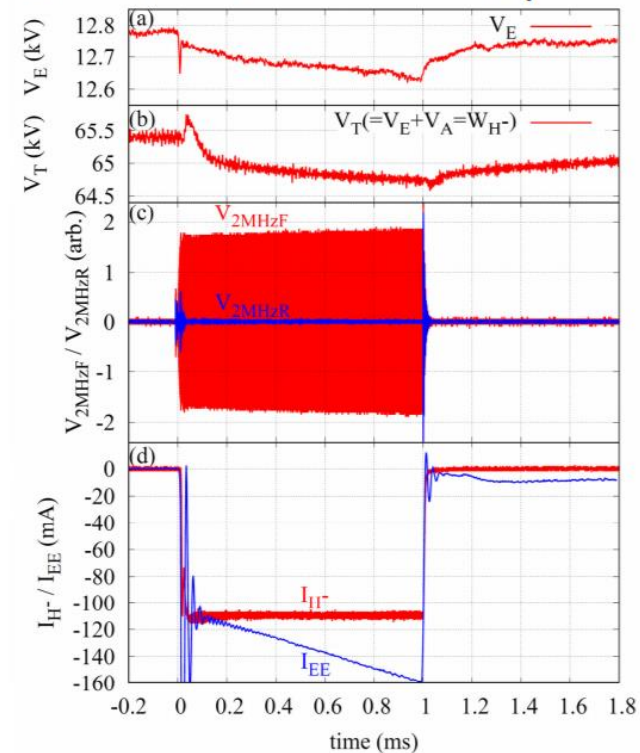


NIBS2020 Negative Ion Sources for Accelerators - Highlights

8 hours 110 mA operation & waveforms of one beam pulse



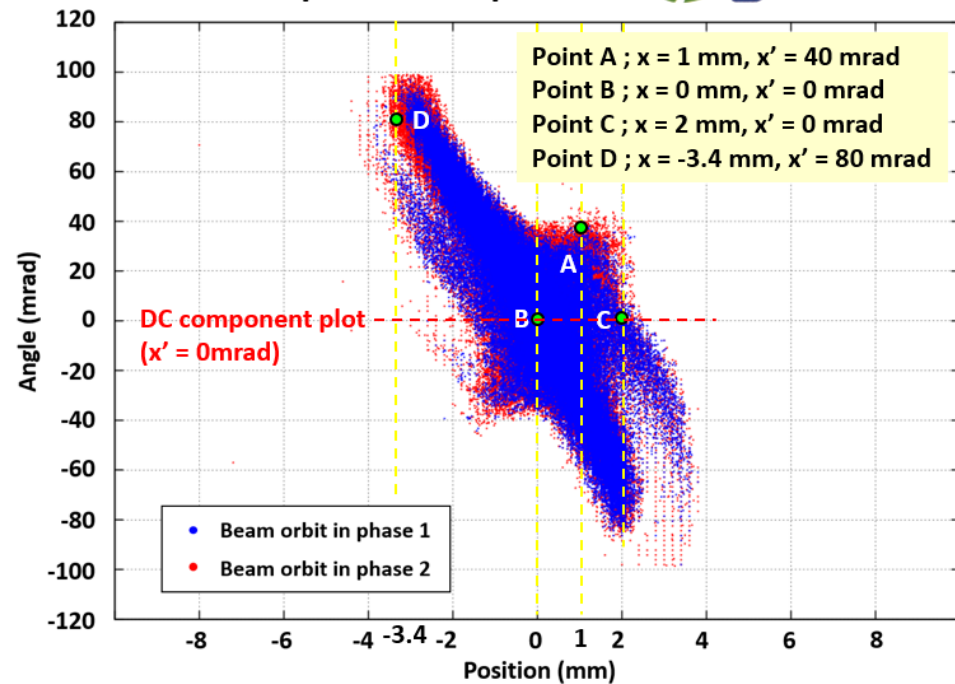
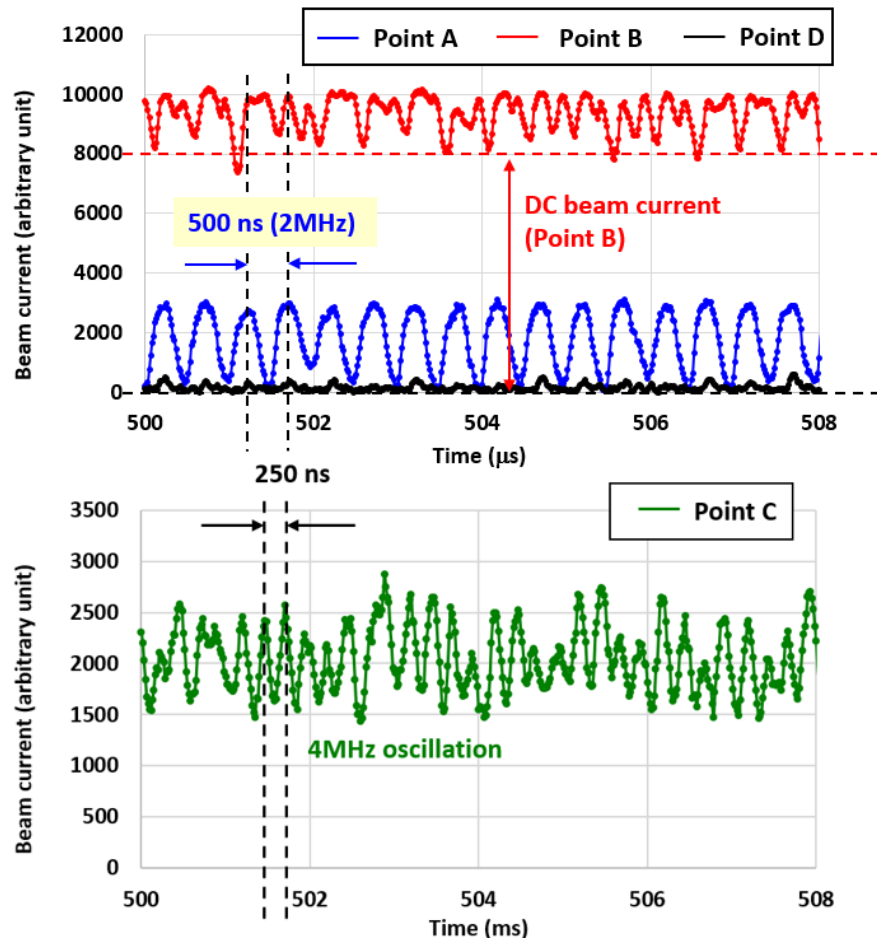
Trend graph of I_{H⁻}, I_{EE}, P_{2MHz} and Cs-valve close/open during 8 hours operation of well-conditioned IS after 88 hours shutdown, in which I_{H⁻}, was feedbacked to 110 ± 1 mA by P_{2MHz}, for W_{H⁻} and V_E of 65 keV and 12.7 kV, respectively. In station. state, Cs inject. rate = 35.8 μg/hour.



Waveforms of V_E(a), V_T(b), V_{2MHzF} and V_{2MHzR}(c) and I_{H⁻} and I_{EE} (d) of one beam pulse. *Flat I_{H⁻} by tilting up P_{2MHz} by 4% to comp. V_E&V_T droops.⁶

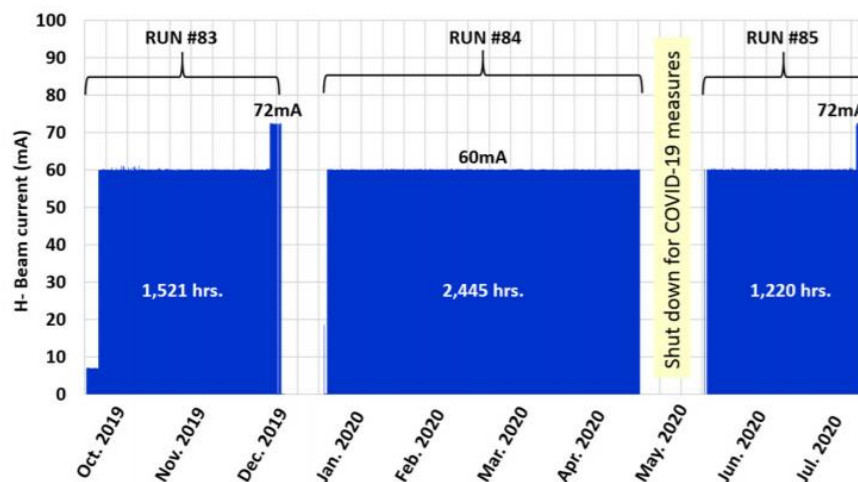
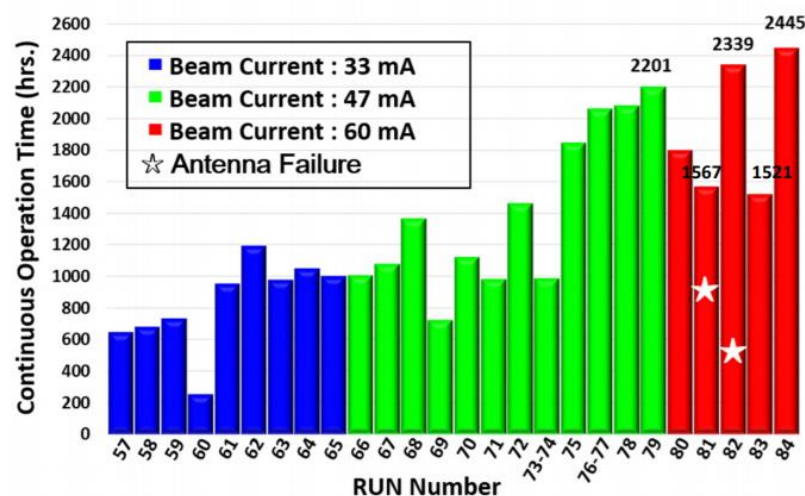
> 100 mA RFQ will need a higher injection energy 50 kV → 80 keV.

Main current WFs at each phase space point



- **Point A (diverging halo) : strong 2MHz oscillation**
- **Point B (beam core) : strong DC current component**
- **Point C (converging halo) : small 4MHz oscillation**
- **Point D (asymmetric halo) : very small 2MHz oscillation**

Progress of J-PARC RF H⁻ ion source

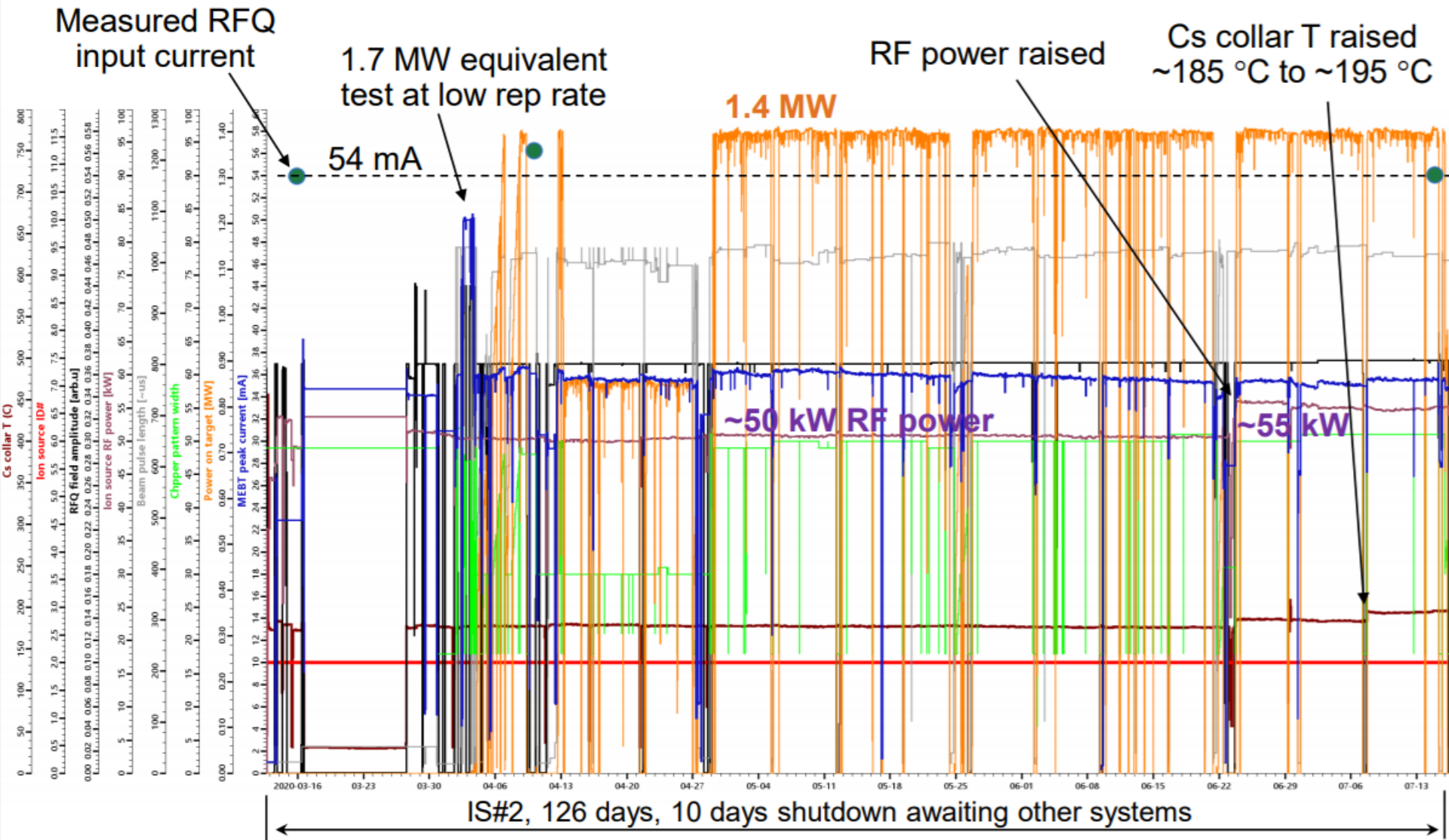


Continuous operation time prolonged :

~1.5 months → 2.5 months (Run#75)

→ 3 months (2017 Autumn~) → **3.5 months (2020 Jan.- Apr.)**

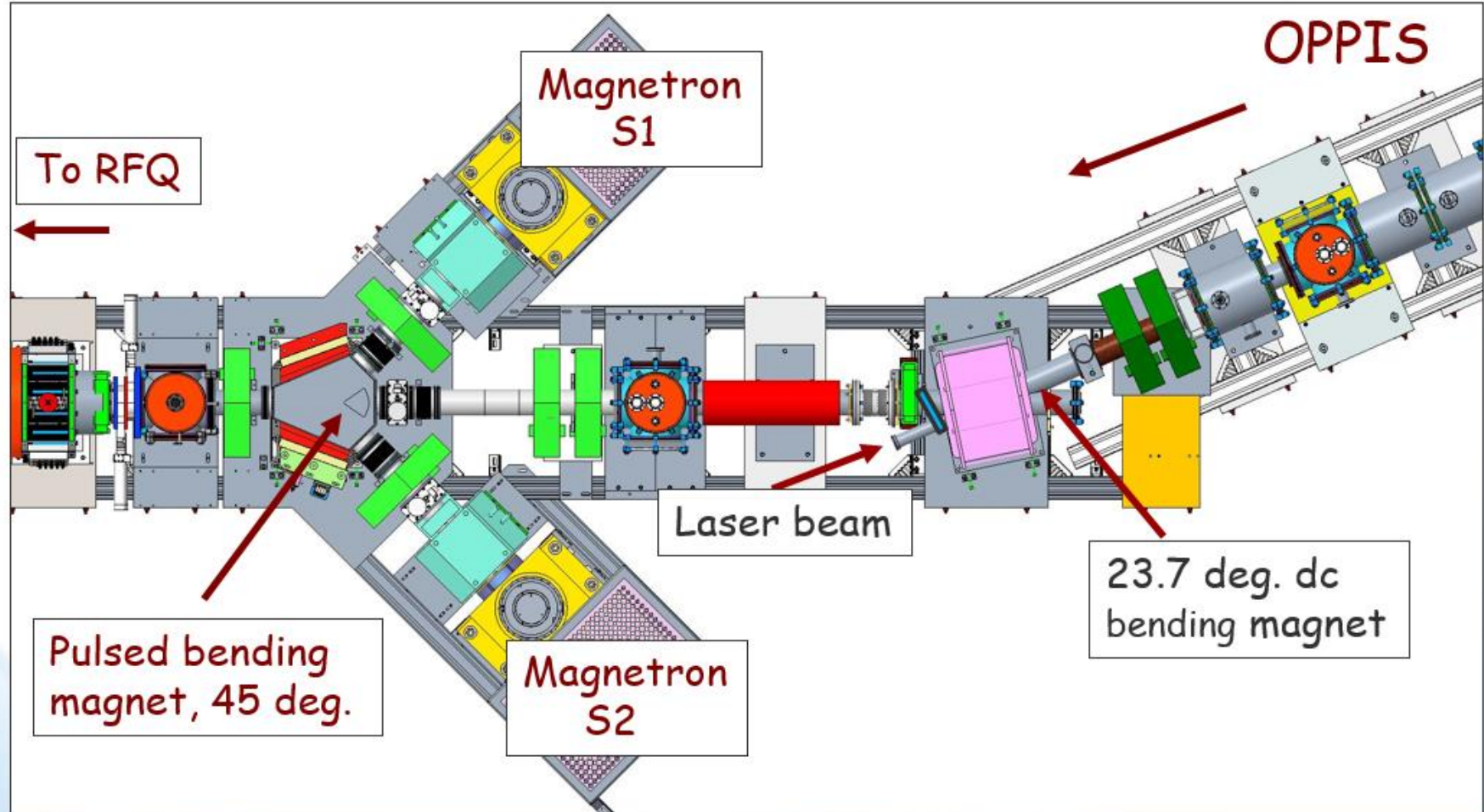
Longest run of the SNS H⁻ ion source



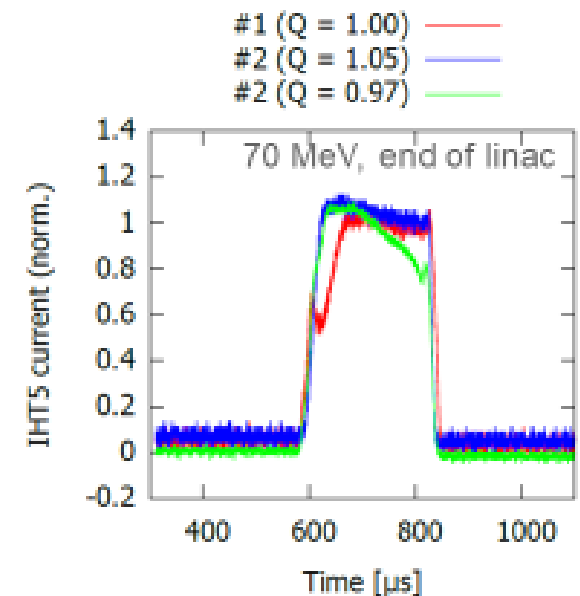
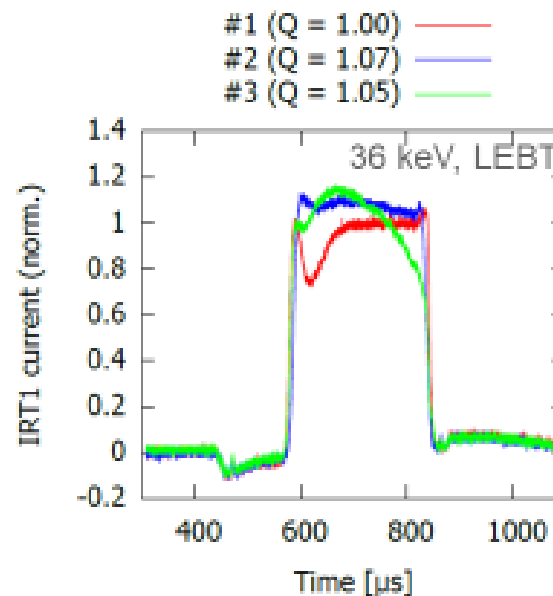
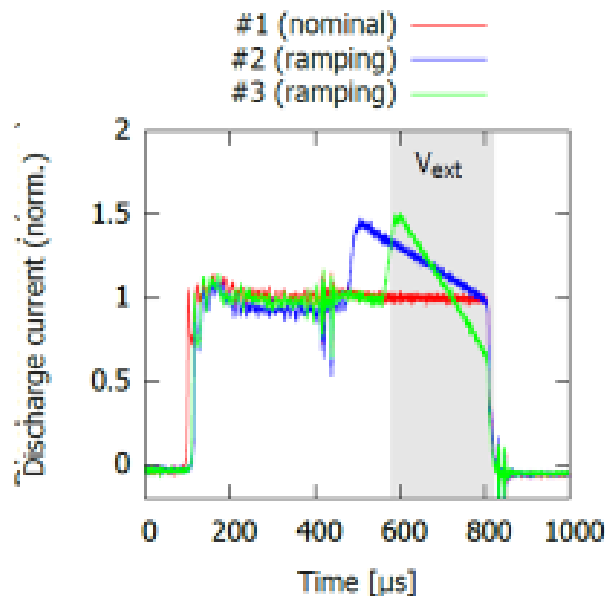
- IS#2 was operated for ~4 months with an availability of >99.5%
- A single dose of cesiation in the ion source startup yielded ~54 mA for the entire run
- After service inspections did not see significant wear or damage that would have limited further operation of the source.

35 keV LEBT upgrade with three sources for Run-2020

Prototype of H^- injector for high-energy accelerators, with high cost downtime



Through the linac

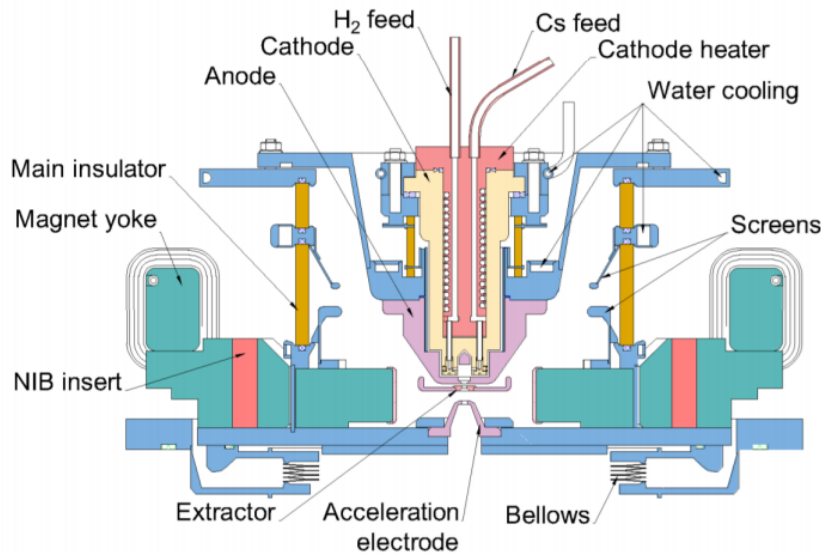


Dip due to space charge compensation increases required pulse length

Can square the beam
Or make it ramped



DC Penning Negative Ion Source Upgrade (2015)



- NdFeB magnet insert for field increase up to 0.1 T
- Upgraded acceleration voltage power supply
- Detachable cathode heater
- Replaceable high voltage insulators
- Replaceable extraction electrode insert

Year	Days	Hours
2006-2014	358	1693
2015	53	265
2016	70	341
2017	121	658
2018	92	516
2019	77	431
2020*	49	377
Total	820	4281

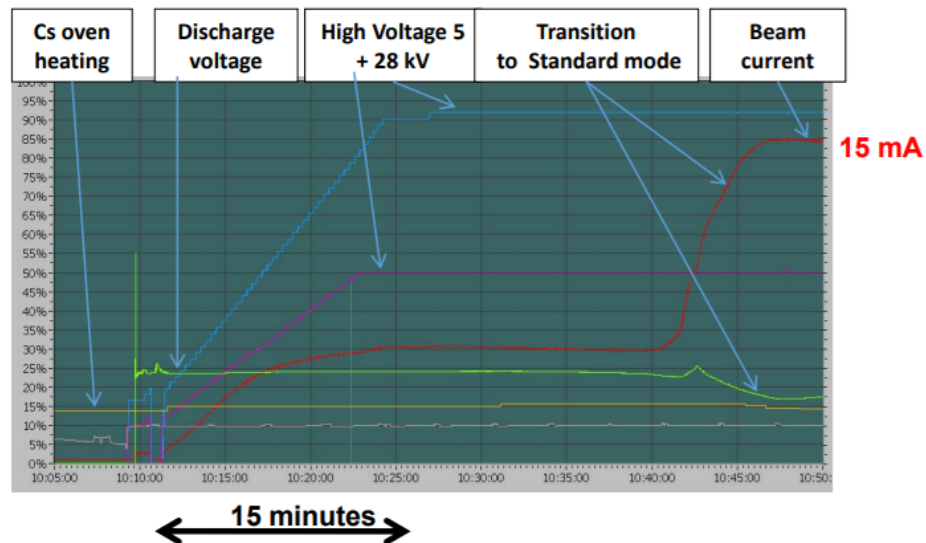
* in operation

Source Operation Statistics at the Tandem

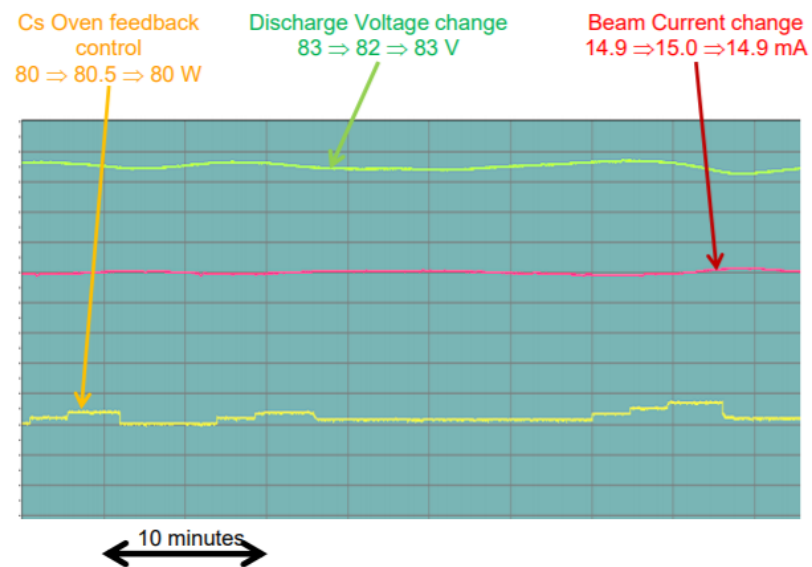
- Both source modifications have operated for 1693 + 2588 = 4281 hours with average daily run ~ 5 hours.
- Source start time ~ 50 minutes



Unattended Control of Source Operation



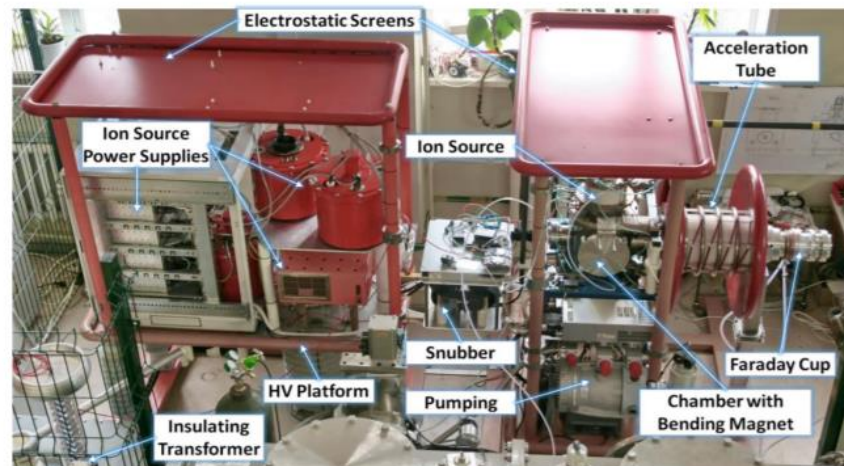
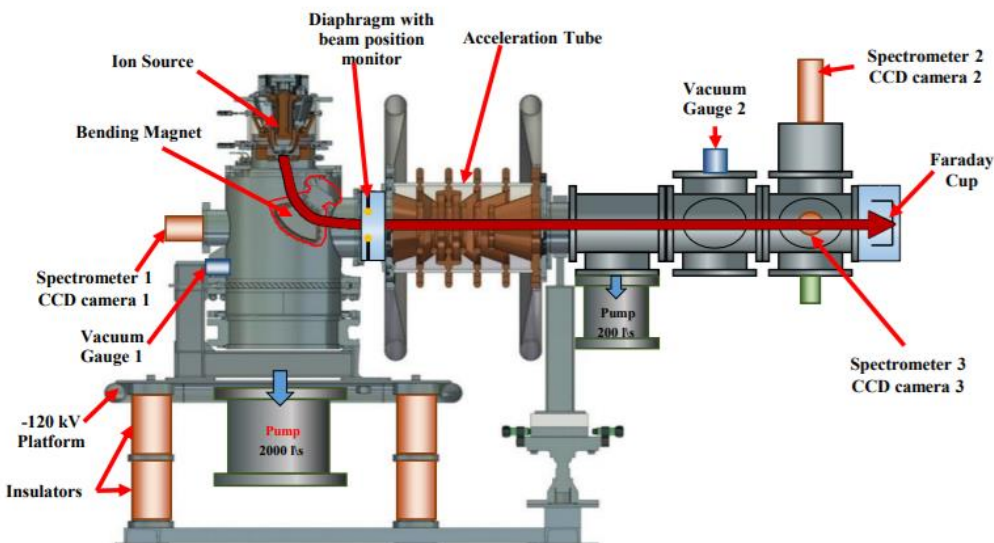
Source start by computer



Cs seed control by PC during the run



Injector with Beam Pre-acceleration to 130 keV



- Penning SPS with DC output H- current up to 15 mA
- Bending chamber with beam 90° turn for separation of secondary particles
- Preliminary beam acceleration to 130 keV for improving the beam transport through tandem
- Beam diagnostics using Faraday cup and beam position monitor
- Optical diagnostics for beam profile and position in the transport chamber

Other new results to look out for in NIBS2022:

- 10 mA charge exchange RF source -BINP
- Ignition gun for the external antenna RF source – SNS
- Cs measurement in LANSCE source by laser absorption - LANL
- Laser Assisted H⁻ production – Jyväskylä/ISIS
- 30 mA external antenna RF volume source -ISIS