High-Brightness RFQ Injector for LANSCE Multi-Beam Operation

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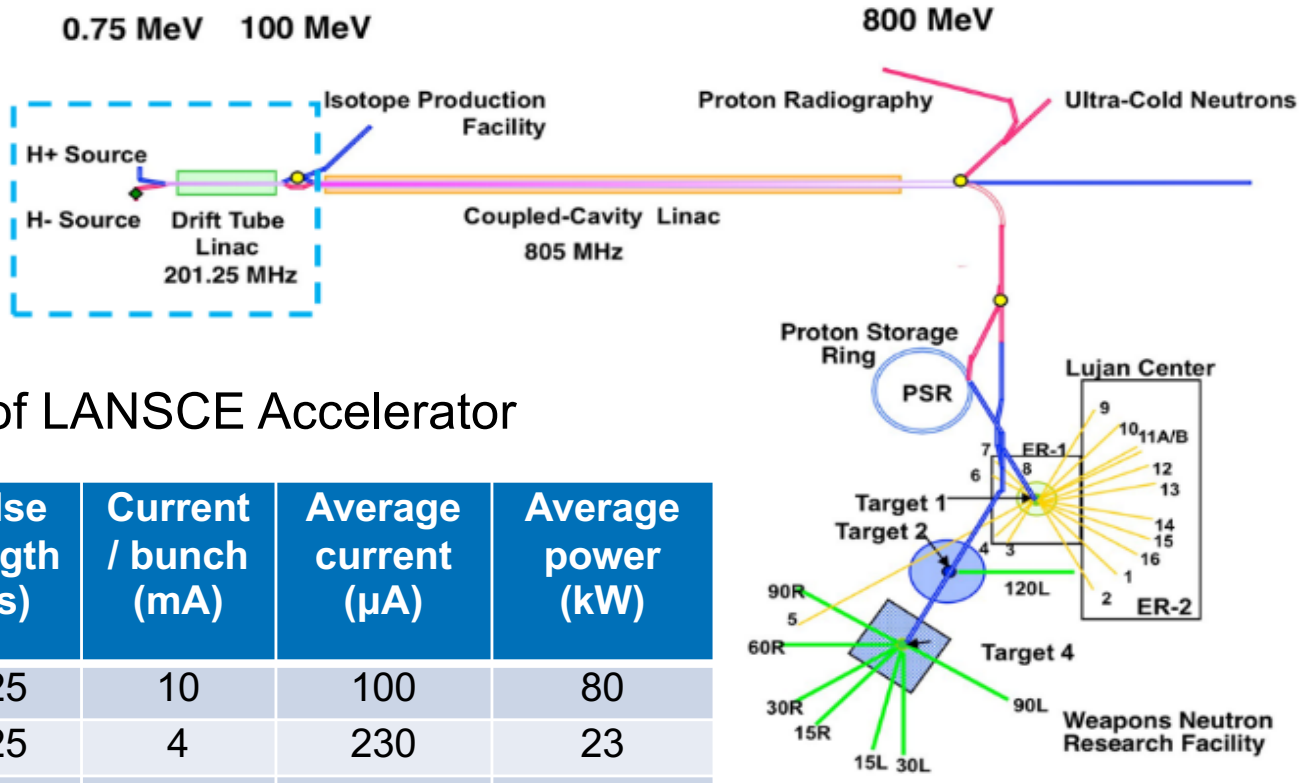
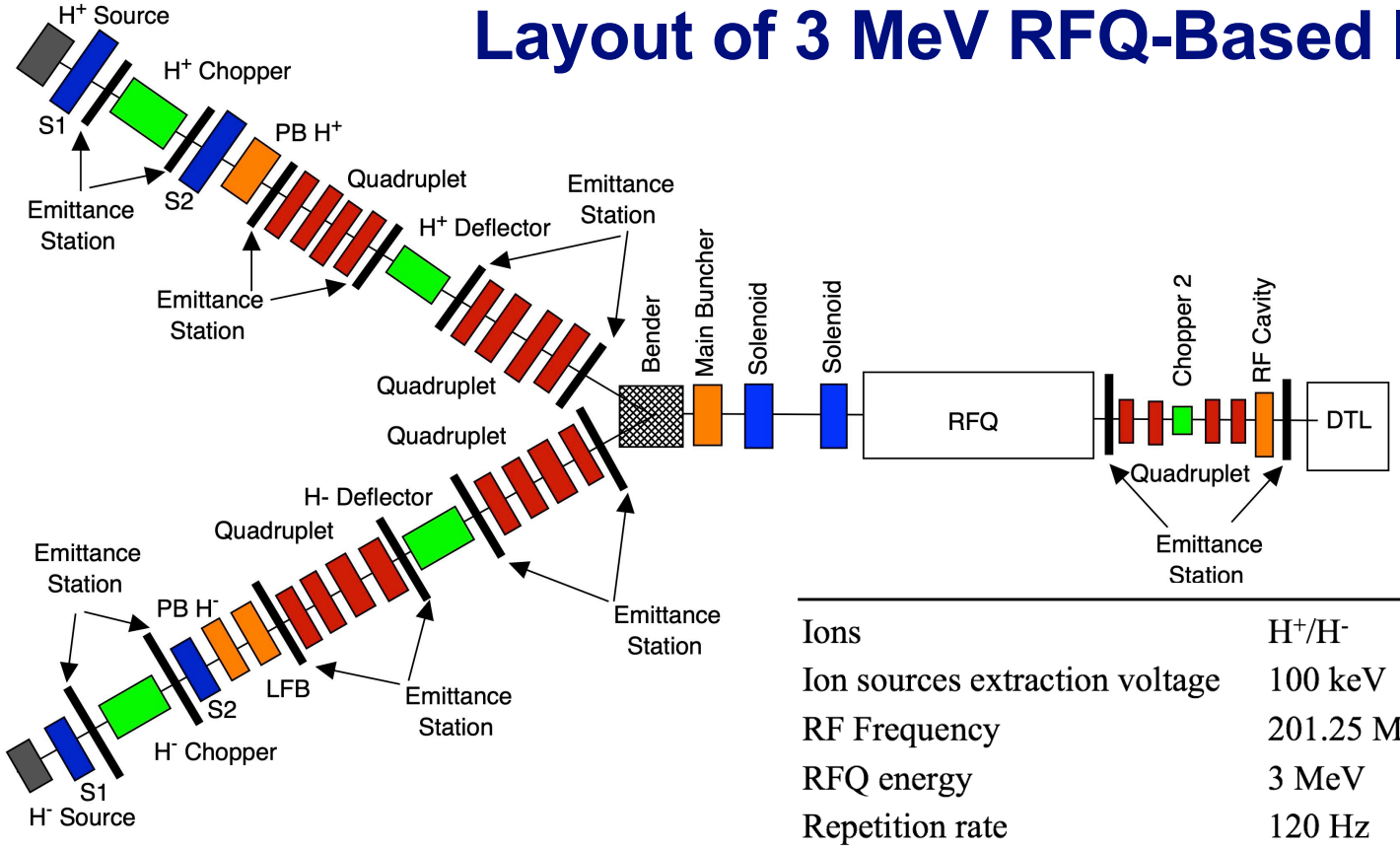
LANSCE Accelerator Facility



Beam Parameters of LANSCE Accelerator

Area	Rep. Rate (Hz)	Pulse Length (μs)	Current / bunch (mA)	Average current (μA)	Average power (kW)
Lujan	20	625	10	100	80
IPF	100	625	4	230	23
WNR	100	625	25	4.5	3.6
pRad	1	625	10	<1	<1
UCN	20	625	10	10	8

Layout of 3 MeV RFQ-Based Injector



Parameters of the proposed LANSCE injector

Ions	H^+/H^-
Ion sources extraction voltage	100 keV
RF Frequency	201.25 MHz
RFQ energy	3 MeV
Repetition rate	120 Hz
Max beam peak current	32 mA
Average current	1 mA
Beam pulse	625-1000 μs
Number of RFQ cells	187
RFQ Length	4.2 m

Time Structure of LANSCE Beams

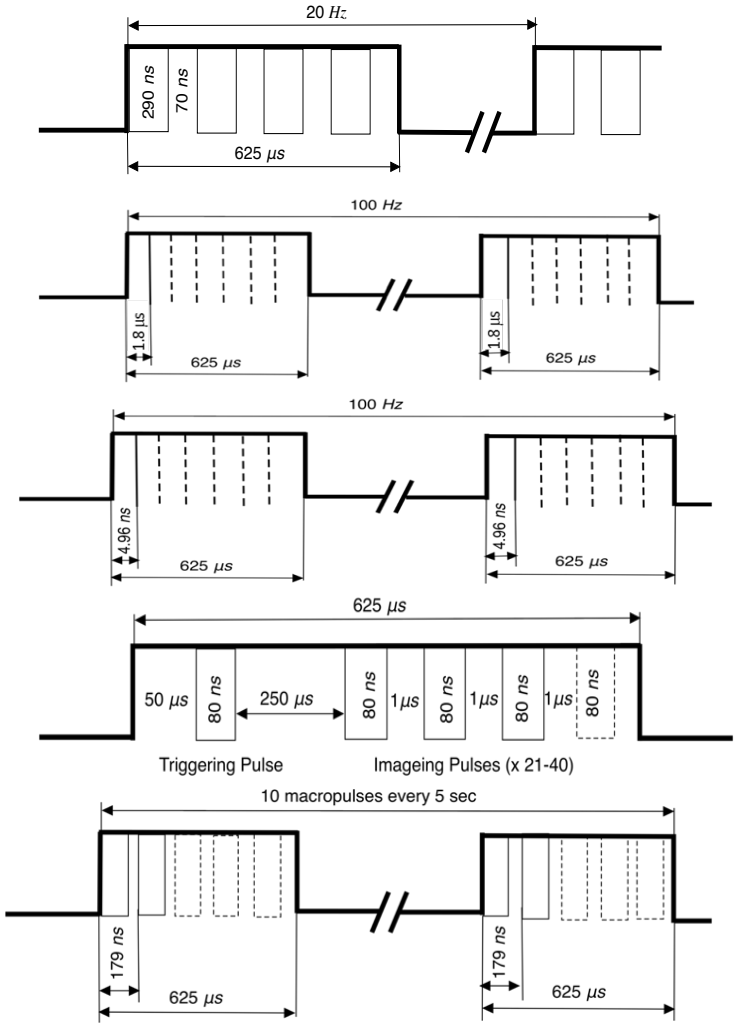
Lujan

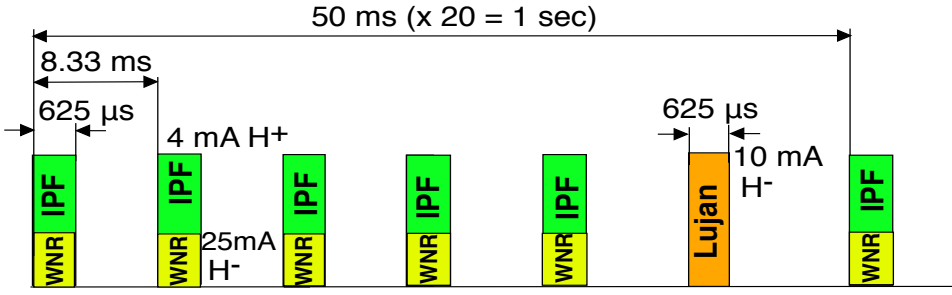
WNR

IPF

pRad

UCN

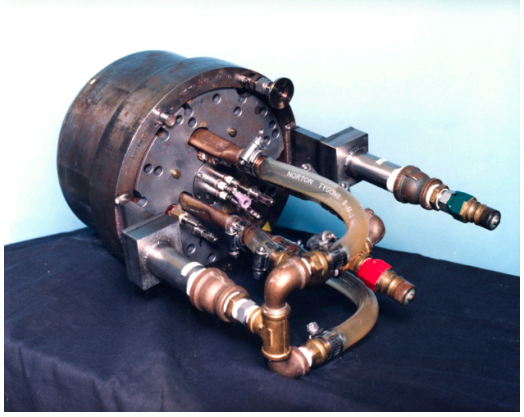




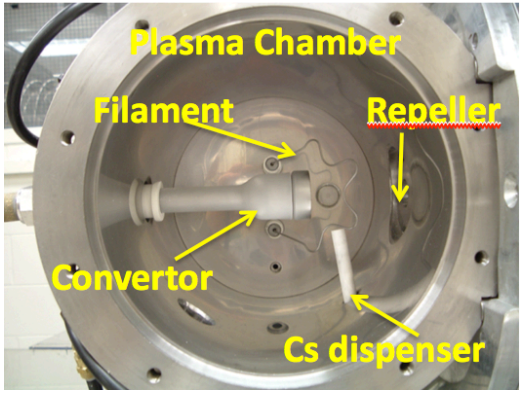
Layout of Lujan/WNR/IPF beams. Beams delivered to pRad or UCN facilities “steal” their time cycles from WNR beam.

LANSCE slow-wave chopper

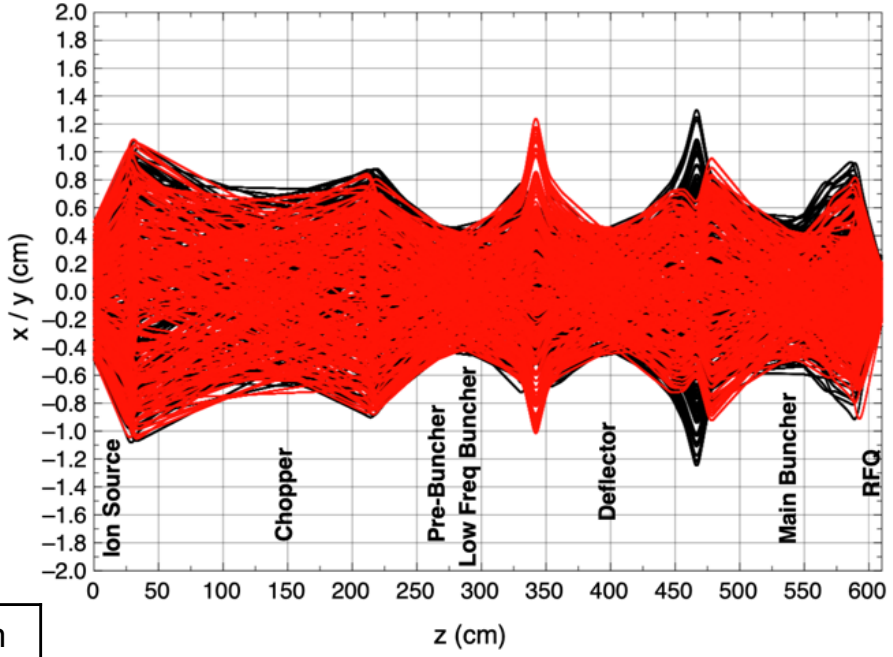
High-Brightness Ion Sources and LEBT



Side view of assembled LANSCE duoplasmatron proton ion source.



Caesiated, multicusp-field, surface-production H^- ion source

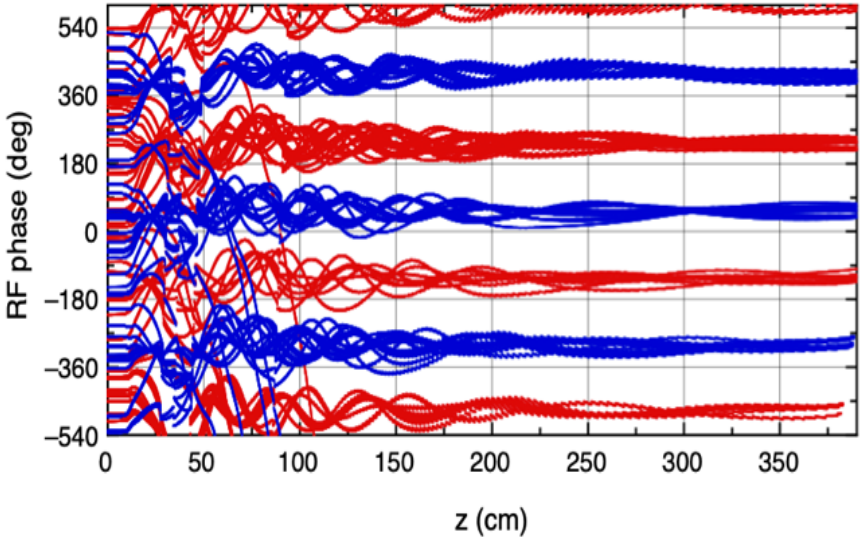


Particle trajectories in the Low-Energy Beam Transport: (red) horizontal, (black) vertical.

Beam	Current, I (mA)	Normalized rms Emittance, ε_{rms} (π cm mrad)	Normalized Beam Brightness, $B = I / (8\,\pi^2 \varepsilon^2_{rms})$ A/(π m mrad)^2
H^+	10 - 30	0.003 - 0.004	20
H^-	14 - 20	0.016 - 0.018	0.6

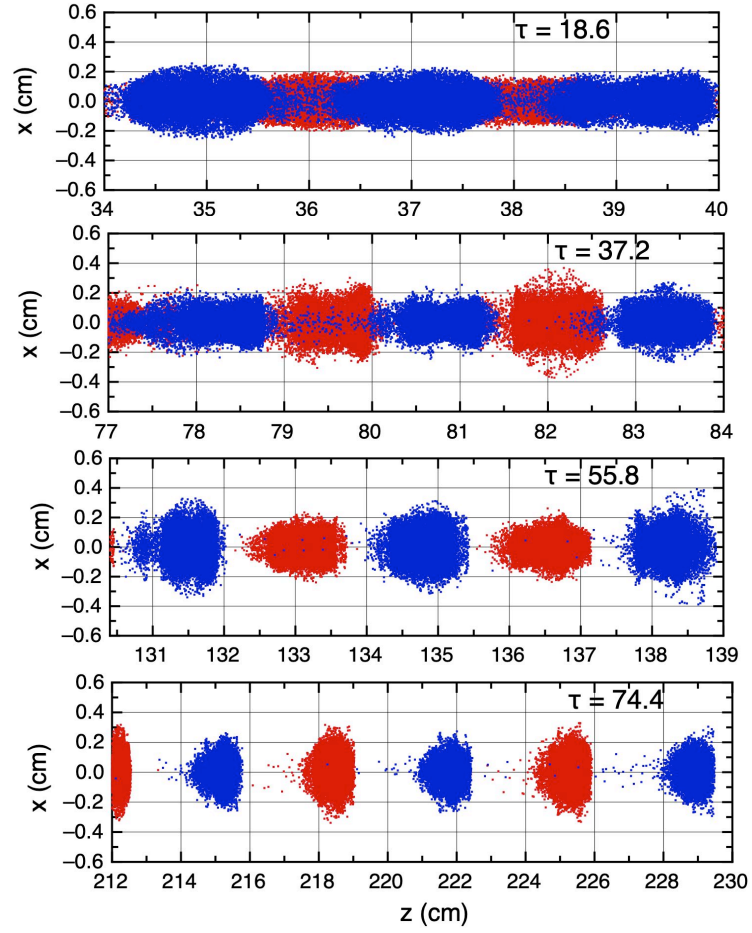
Multi-Beam RFQ

Phase trajectories in RFQ:
(red) H^+ beam,
(blue) H^- beam.



Normalized rms emittance (π cm mrad), beam capture (in parenthesis), and charge per bunch (pC).

Beam (Facility)		Ion Source	100 keV	3 MeV	Charge /bunch
H^- (Lujan/pRad/UCN)	unbunched	0.02	0.021	0.022 (0.84)	50
H^- (Lujan/pRad/UCN)	bunched	0.02	0.021	0.022 (0.96)	50
H^- (WNR)	bunched	0.02	0.024	0.028 (0.96)	240
H^+ (IPF)	unbunched	0.003	0.004	0.006 (0.84)	50
H^+ (IPF)	bunched	0.003	0.004	0.008 (0.96)	50



Formation of the two-component beam in RFQ: (red) H^+ beam, (blue) H^- beam.

Summary

1. The new 3-MeV injector for future LANSCE operation is proposed.

2. The proposed injector will replace the existing LANSCE injector, which is based on old-style 750-keV Cockcroft-Walton accelerating columns.

3. The replacement will use a single Radio Frequency Quadrupole (RFQ) for simultaneous acceleration of high-brightness protons and H^- ions with multiple flavors of beams.

4. More details: Poster MOPOPA24.