LANSCE Overview

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Snowmass M6 Working Group

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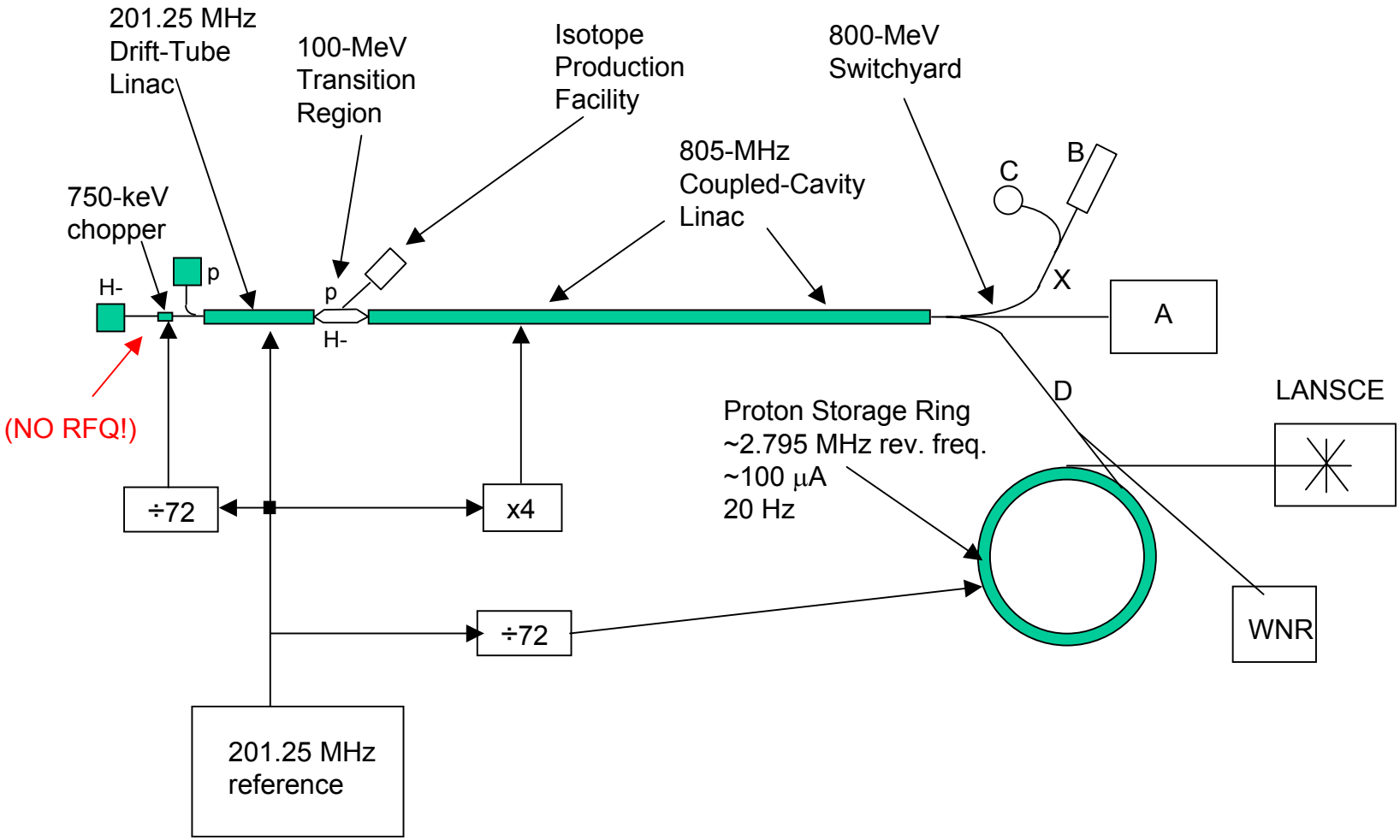
LANSCE Layout

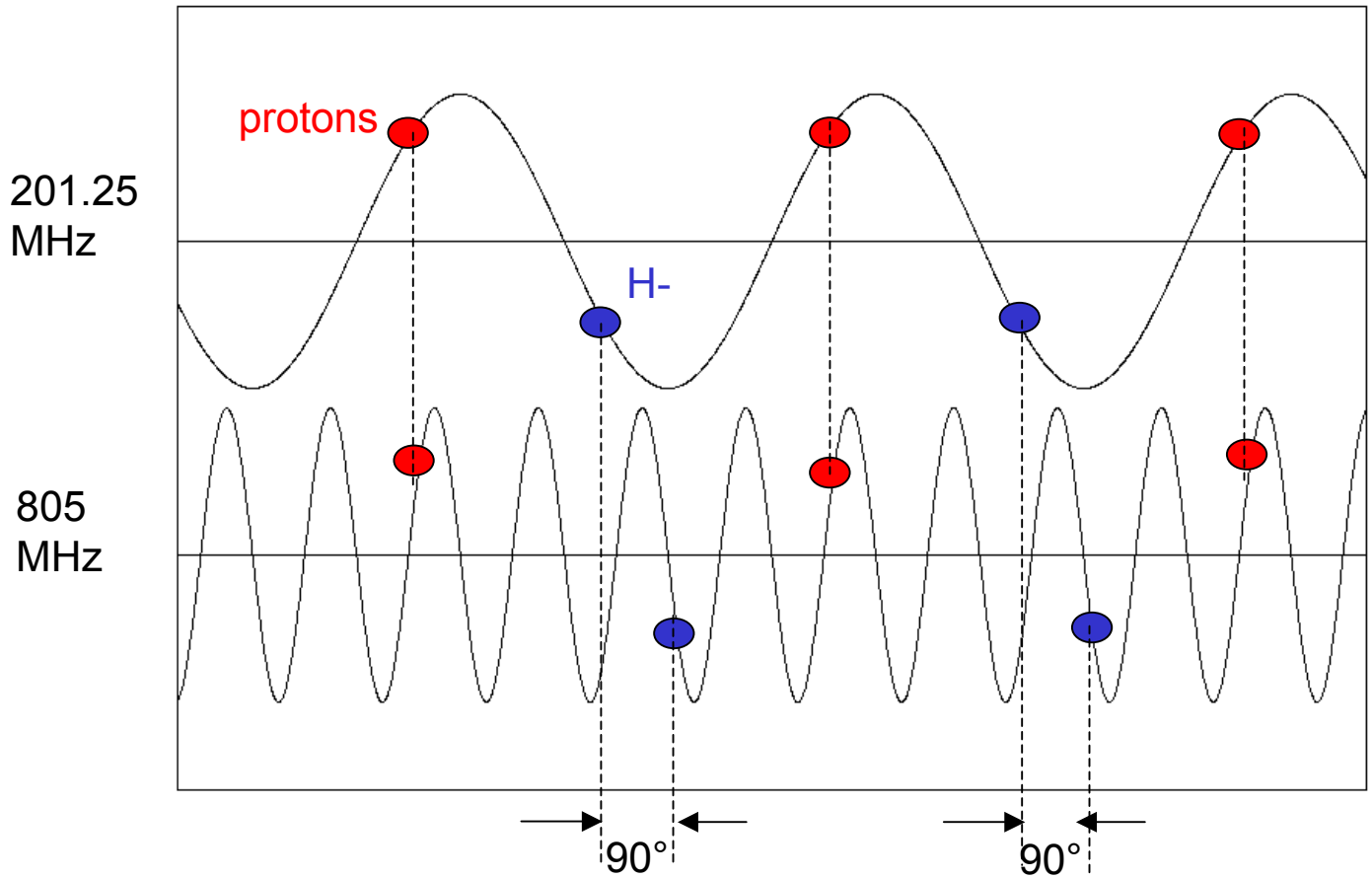


LANSCE 201.25-MHz Drift Tube Linac

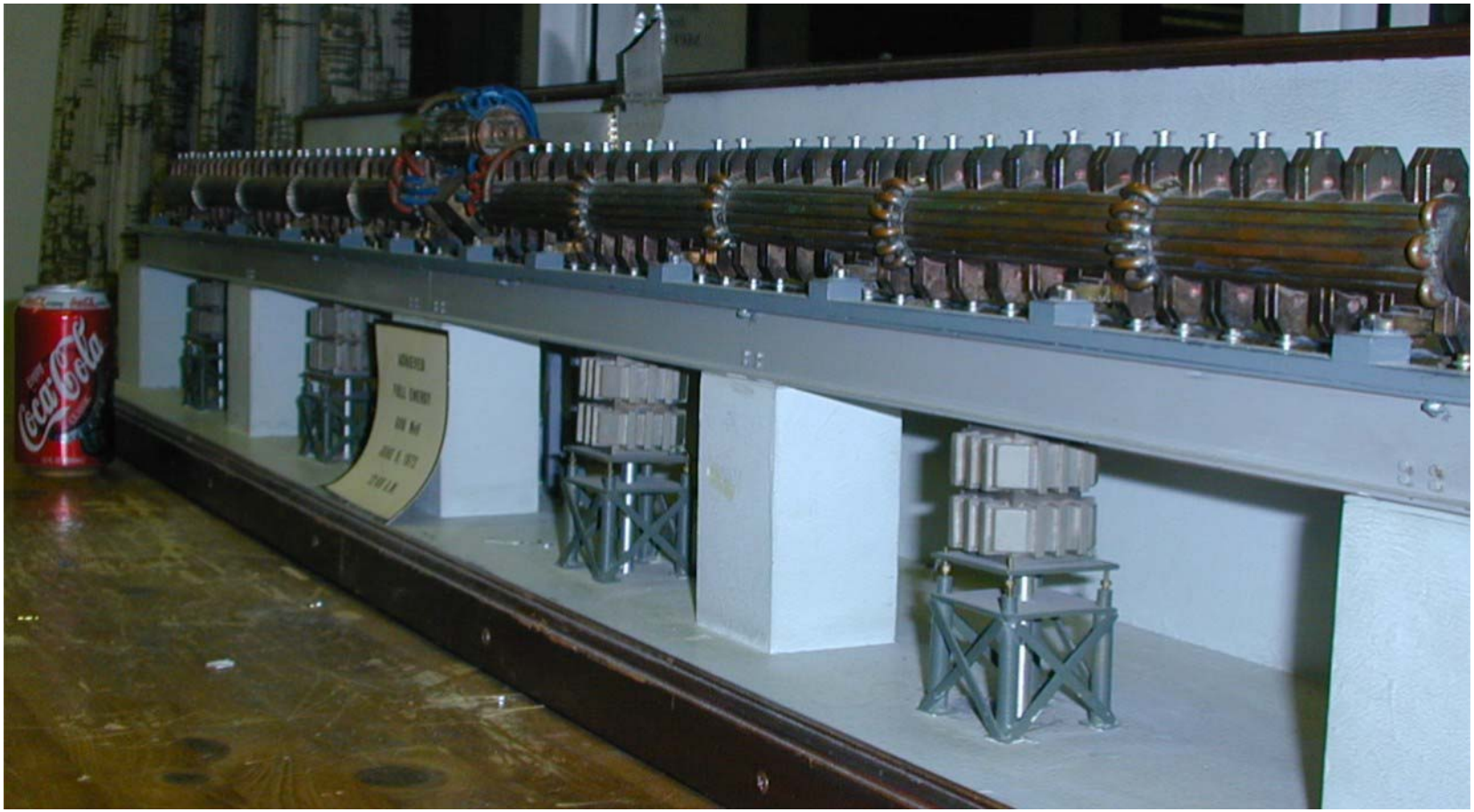
Four 201.25-MHz drift tube linac (DTL) tanks accelerate beam from 750 keV to 100 MeV.

100-MeV Transition Region

For simultaneous proton and H- acceleration in LAMPF, the path lengths in the 100-MeV transition region must differ by 90° of phase at 805 MHz (about 4 cm).



LANSCE 805-MHz Coupled Cavity Linac



Forty-four 805-MHz coupled cavity linac (CCL) modules accelerate beam from 100 MeV to 800 MeV.

LANSCE 805-MHz CCL

LANSCE Beam Properties

Proton beam operation

~800 MeV
~6% duty cycle
60-Hz pulse rep rate
~ 1000 μs pulses
~ 15 mA peak current
~ 1 mA avg. current
~ 0.8 MW avg. beam power

Proton beam rms emittances (normalized)

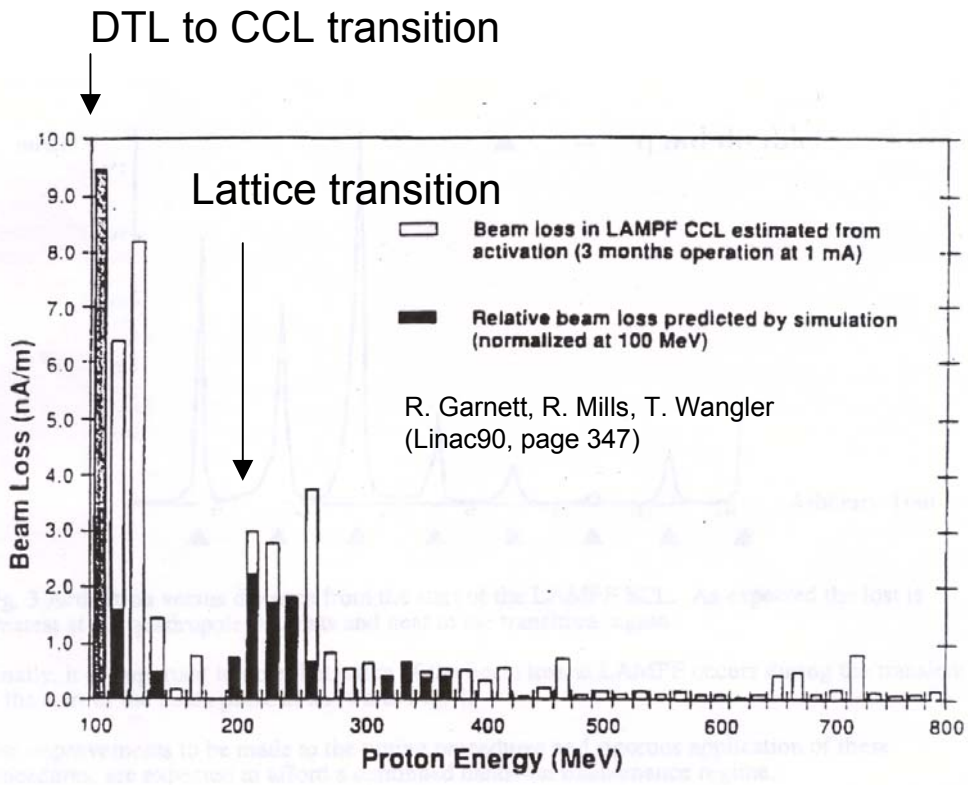
100 MeV: ~ 0.30 π mm-mrad
800 MeV: ~ 0.70 π mm-mrad
(very large emittance growth between 100 And 800 MeV)

See 1990 Linac Conf. Proc., pages 347-350 (Garnett, Mills, and Wangler)

H- typical operation (to Proton Storage Ring)

~797 MeV
20 Hz pulse rep rate.
~100 μA avg. current.
~ 10 mA peak H- (chopped @70% and at 2.795 MHz) .
~ 625 μs macropulse.
~ 1750 turns of accumulation.
~ 80 kW avg. beam power.
~ 3E13 protons in PSR per pulse.

LAMPF Beam Losses



Major sources of beam losses are caused by

1) DTL to CCL transition at 100 MeV, including a 15' drift w/o RF bunching cavities.
2) Abrupt change in doublet lattice period at about 180 MeV.

Lack of ability to steer beam may also contribute (simultaneous H- and proton acceleration).

LANSCE Uses

H- beam

Proton storage ring – LANSCE.

Weapons neutron research (WNR, individual micropulses).

Proton radiography development.

Proton beam

Neutrino physics (discontinued).

Isotope production (100 MeV, begins ~ 7/02).

Proton irradiation (discontinued).

LANSCE Reliability Improvement

During the years 1992-1995, the facility program emphasis changed from basic research and nuclear physics (LAMPF) to the neutron science program (LANSCE).

Because of the different type of users, with much shorter experiment durations (2-3 days instead of 2-3 months), the impact of availability and down time led to LRIP (LANSCE Reliability Upgrade Project).

Recent improvements have improved neutron availability from < 75% to >85%.

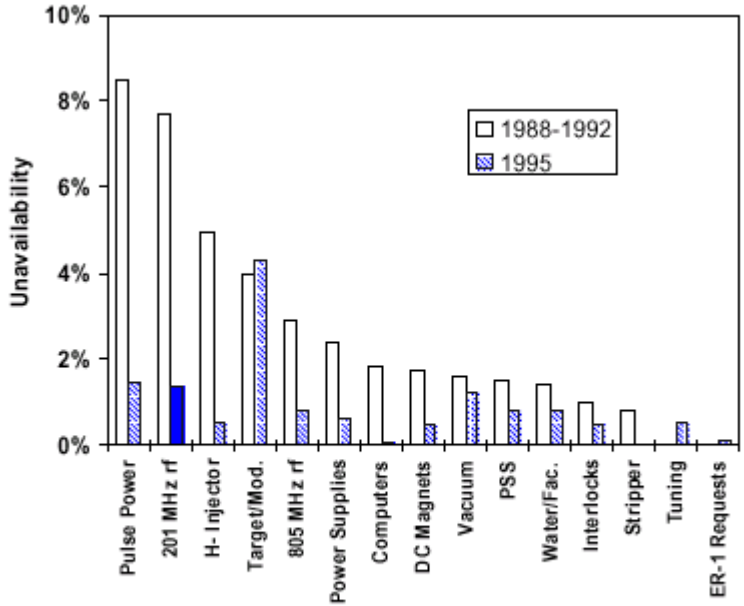


Figure 1. Main contributors to down time.

Proton Storage Ring

Some basic PSR properties

$2\pi R$	90.2 meters
Lattice	FODO, separated function, 10 periods
Tunes (x,y)	~3.19, ~2.18
γ_t	3.08
γ	1.85 (800 MeV)
Revolution frequency	2.795 MHz (synchronized to 201.25 MHz).
Beam chopping	~ 260 ns on, 100 ns off.
N	~ 3E13 per pulse
Avg. current	~100 μA
Pulse rate	20 Hz
Avg. beam power	~ 80 kW

Proton Storage Ring

Recent PSR upgrades

- New injection chicane.
- 2-stage stripping (magnetic + foil) replaced by direct H- injection.
- Better phase-space matching into ring.
- Vertical orbit bump – reduces foil hits during accumulation.
- Thicker stripper foil – less H^0 excited state production.
- More RF voltage + second harmonic cavity.
- Added longitudinal coupling inductance to offset space charge capacitance.
- Added multipole correction magnets and skew quad.
- Uncontrolled beam losses are now ~ 0.3 μA at 100 μA avg. current (~ 0.3%).

LANSCE Upgrade Possibilities

These are possible upgrades.

PSR goal 200 μA @ 30 Hz.

H- ion source upgrade to increase H- peak current.

New front end: 750-keV CW → 5-MeV RFQ? (requires new DTL front end).

Upgrade neutron target power handling capacity.

Increase linac energy (add superconducting RF “afterburner”) (LPSS?).

LANSCE as H- injector for AHF?