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Author
Kim, C.

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Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

Accelerator & Fusion Research Division

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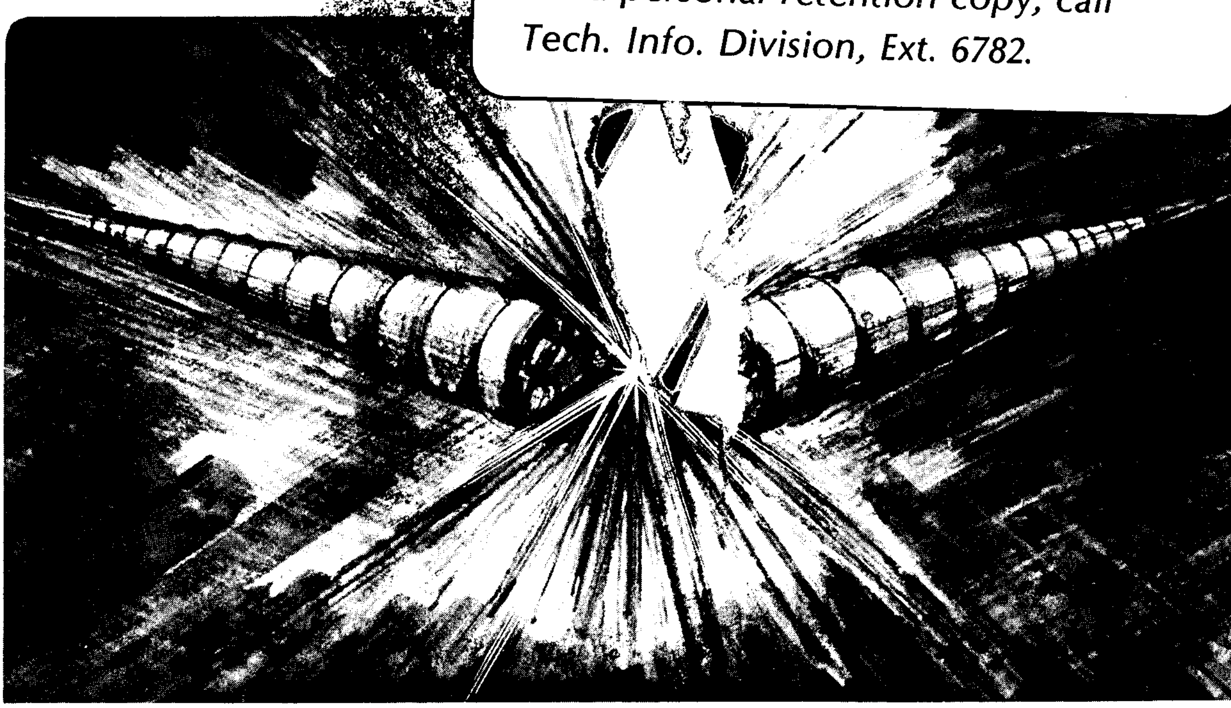

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Charles Kim

Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

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Charles Kim
Lawrence Berkeley Laboratory
University of California, Berkeley, California 94720

Three beam transport experiments have been or are being performed in the USA at Brookhaven National Laboratory (BNL)[(1)], Lawrence Berkeley Laboratory (LBL)[(2)], and the University of Maryland (UoM)[(3)]. The experimental configurations and the beam parameters are summarized in Table I.

Table 1 Experimental configuration and beam parameters of the three USA beam transport experiments

	BNL	LBL	UoM
Species	Ar^+, Xe^+	Cs^+	e^-
Kinetic Energy (keV)	1 - 2	80 - 160	0.5 - 5
Current (mA)	0.06	23	220
Pulse Duration (μs)	dc	~10	~5
Focussing Scheme	Electrostatic Quadrupole	Electrostatic Quadrupole	Interrupted Solenoid
Number of Lattice Periods	25	41	12[(a)]
Period Length (mm)	38.1	304.8	136
Aperture Radius (mm)	4.08	25.4	18.3
Minimum σ/σ_0	0.02[(b)]	0.1[(c)]	0.08[(d)]

(a) This value will be increased to 36.
(b) This value is estimated for a measured beam emittance after the publication of Ref. (1).
(c) This value is for the equivalent Kapchinskij-Vladimirskij beam (which has the same beam current, has twice the rms radius, and has four times the rms emittance) of the laboratory beam. Stable beam transport was observed for $\sigma_0=60^\circ$, $\sigma=8^\circ$.
(d) Emittance growth of 50 percent was reported for $\sigma_0=60^\circ$, $\sigma=5^\circ$. The final emittance was measured and compared with the theoretically estimated initial emittance.

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In the BNL experiment, a very bright beam was injected into the transport channel with the beam size as large as the available aperture. The matching is done by flooding the acceptance of the channel with the injected beam.[4] A continuous current loss was observed along the channel with the highest transmission occurring at $\sigma_0 \approx 85°$. At the end of the channel the beam filled about 80 percent of the aperture. The space charge nonlinearity, image efects, and the lens nonlinearities were listed as possible causes of the current loss.

In the LBL experiment, a beam with a variable brightness was matched to a periodic envelope in the matching section composed of five lenses and injected into the channel. The beam filled up to 80 percent of the available aperture. The beam current, emittance, and the beam size were measured at the beginning and at the end of the channel. Stable beam transport is inferred if there are no detectable changes in these parameters. They found stable beam transport in the region $\sigma_0 < 85°$, and $\sigma/\sigma_0 > 2.2 \times 10^{-3} \sigma_0$ (with σ_0 measured in degrees). They also reported that the semi-Gaussian distributions of the particles (flat in configuration space and Gaussian in velocity space) are approximately preserved through the channel. LBL is planning a multiple beam experiment (MBE) - a linear induction accelerator which accelerates and bunches high intensity multiple beams (16 beamlets planned) to about 7 MeV. The purpose of MBE is to demonstrate the necessary physics and accelerator technologies for the High Temperature Experiment (HTE).[5]

In the UoM experiment, the beam matching is accomplished with two interrupted solenoids. A 100 percent beam transmission is observed in the region bounded by $\sigma_0 > 40°$ (the matched beam is smaller than the channel aperture) and $\sigma_0 < 90°$ (the envelope instability does not occur). The UoM group is planning to increase the number of lattice periods from the present 12 to 36 in the near future.

In conclusion, it has been demonstrated that an intense beam with the space charge defocussing force as large as the average focussing forces of the channel can be transported over many lattice periods without losing either the current or the optical quality. This conclusion, which is consistent with the PIC code results[6], has an important implication in designing a linear induction accelerator driver for inertial confinement fusion.

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(4) This method of beam matching is good only when the space charge effect is negligible.

(5) See reports by D. Keefe and by A. Faltens in these Proceedings.

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