



Contribution ID: 28

Type: **not specified**

Research with intense, pulsed ion beams at Berkeley Lab

Wednesday, 21 June 2017 14:00 (30 minutes)

At Berkeley Lab, we currently operate two facilities for research with intense, pulse ion beams, NDCX-II (the neutralized drift compression experiment) and BELLA-i at the BELLA petawatt laser. In this talk we will report on the status of the two facilities and give examples of our research and re-search directions.

NDCX-II is an induction linear accelerator that produces pulses of 1 MeV Helium ions with peak currents of up to 2 A in a few ns long pulses (Figure 1) [1]. Beam spot sizes are in the range of 2 to 4 mm². The total charge per pulse in the main peak and tail is up to 16 nC (1011 ions) for an beam energy of fluence of 16 mJ or ~0.5 J/cm² at the given few mm² spot size. This ion intensity level enables studies of dose rate effects of radiation damage in materials and electronic devices and studies of phase-transitions in selected materials. We will report on studies of damage dose rate effects in transistors and of flux effects on ion energy loss in materials.

BELLA-i is an initiative for high energy density science at the BELLA petawatt laser facility. We have now commenced experiments with solid targets at BELLA, using the long focal length beam-line that is optimized for electron acceleration [2]. Here, the Ti:sapphire laser delivers up to 40 J in 32 fs (1.2 PW) to target foils for peak intensities in the low 10¹⁹ W/cm² range with a w₀=57 micron beam spot and a repetition rate of up to 1 Hz. We will present results from a first ion acceleration campaign in the TNSA regime where spectra and angular distributions of accelerated ion pulses have been measured from thin metal foils (sub-micron to a few micron thicknesses).

Acknowledgments

This work was supported by the U. S. Department of Energy under contracts DE-AC0205CH11231 (LBNL) and DE-AC52-07NA27344 (LLNL).

References

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- [2] W. P. Leemans, Phys. Rev. Lett. 113, 245002 (2014)

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Session Classification: Plasma physics research at other facilities