RF-BASED PLASMA DENSITY DIAGNOSTIC FOR INVESTIGATION OF WAKEFIELD OF THE BEAM IN PLASMA OF NEUTRALIZER.

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INTRODUCTION.

Inertial confinement fusion (ICF) is a process where nuclear fusion reactions are initiated by heating and compressing a fuel target to 100 keV and multiple Gbar respectively.

Many ICF driver options, including laser, z-pinches and particle beam, have been investigated because ICF requires fuel to be heated on a sub-ns time scale using aggressive longitudinal compression of an ion beam. The compression is initiated by imposing a linear head-to-tail velocity tilt to a drifting beam. The main issue of the compression is to avoid Coulomb repulsion; therefore, the ion beam neutralization is needed. Neutralization occurs by passing the ion beam through plasma, which should have greater electron density than the space charge of an ion beam.

The long-term goal of this project is to construct a mirror laboratory of ICF at our research center; therefore, we need highly qualified researchers who can use the accelerator effectively. This is a startup project aimed to enhance research capacity of Nazarbayev University (NU). It is planned to train the NU staff on the Neutralized Drift Compression Experiments-II accelerator (NDCX-II) at Berkeley.

MATERIALS AND METHODS.

The neutralization plasma is a critical component of NDCX-II. For reliable machine operation and for advanced computer simulations, the plasma electron density must be known. The plasma density is currently measured with a Langmuir probe which is an intrusive diagnostic tool with a fair level of accuracy. This proposal is focused on the development of a more accurate, in situ plasma density measurement method using an optical heterodyne interferometer.

The compact linear induction accelerator NDCX-II is a development platform for future heavy ion beam drive for inertial confinement fusion. The inertial fusion is an approach to a clean and sustainable energy generation. To achieve conditions for the thermonuclear fusion one needs to create very high temperature and pressure in a fuel assembly. One of the techniques to heat fuel to these conditions is to employ intense short-pulse ion beams.

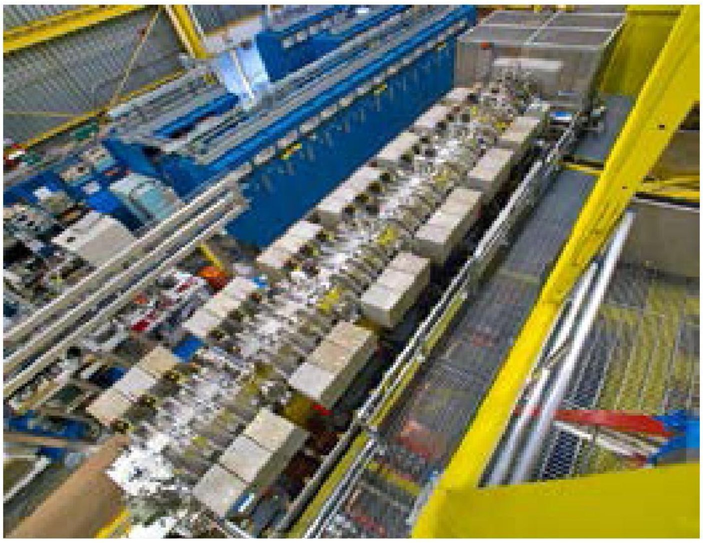

__Figure 1.__ NDCX-II linear accelerator

The original Neutralized Drift Compression Experiment (NDCX-I) has successfully demonstrated simultaneous radial and longitudinal compression. The neutralized drift compression region is approximately 1 m long and 30 cm in diameter. A ferroelectric plasma source (FEPS) is used for plasma generation. For efficient neutralization it is essential to know the electron density profile (EDP) of the plasma. NDCX-I did not have the plasma electron density diagnose setup. NDCX-II, is an improved version of the NDCX-I. NDCX-II has better compression beam characteristics. The electron plasma profile diagnostics is planned for NDCX-II accelerator.