In the scenario of inertial fusion with heavy ion beam, several storage and buncher rings are planned to accumulate a high current beam and to make a bunch shape so narrow as ∿ 50 nsec. The extracted beams from these rings will be transported to the target for the implosion of fuels. The key issues in this scenario among many accelerator beam dynamics problems, are ; first the suppression of coherent instabilities of high-current and short-bunch beams of relatively low energy ∿ 50 MeV/u. Secondly can we focus the beam uniformly on the small target through the long beam transport line with the chromatic aberration ? Thirdly in connection with the target physics, what structure and what materials should be selected to achieve the plasma temperature of several hundreds eV for the ignition of fuels ?

Presently the experimental works are urgently required to understand the basic mechanism regarding with three subjects. At GSI in West Germany and INS in our country, heavy ion storage rings are being constructed as the versatile instrument for nuclear and atomic physics as well as the fusion basic research. In these rings, beam cooling devices are installed for the improvement of beam emittance and momentum spread which assure the small focal spot of the extracted beam on the target. Stochastic and electron beam cooling are being prepared for the effective and fast cooling of the accumulated beam.

In the present paper, the status of cooling technique are reviewed and the problems in the application of cooling to the fusion are discussed.

Wednesday Morning, 24 May 1989
9:40 AM - Grand Ballroom G

Oral Session 5C: X-RAY LASERS-I
Chairperson: F.C. Young

5C1

RECENT DEVELOPMENTS IN X-RAY LASER RESEARCH AT LLE

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We present results and analysis of recent experiments using multiple-foil target designs for a collisional excitation x-ray laser in Ne-like nickel and germanium. These targets, which are designed to yield higher gains than single-exploding-foil targets, are irradiated by 600 ps pulses of 351 nm light in a single 18-mm line from GDL. The lasing lines at ~230 Å are observed with a 1-m grazing incidence grating spectrometer. We also discuss the relative merit of different pump-laser wavelengths and present experimental results for three wavelengths: 1.06 μm, 527 nm, and 351 nm. For recombination x-ray laser studies we have irradiated 1000–2000 Å foils with 100 ps pulses of 351 nm light and have recorded the spatially resolved x-ray spectra. These spectra show the extent to which the hydrogenic and helium-like species expand and recombine. We also present plans for the conversion of the GDL laser to a ~100 J – 10 ps laser (10 TW) which will be used for producing a recombinationally pumped laser in Al which is predicted to lase at 39 Å. We also will present the results of computer simulation of these proposed experiments.

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5C2

ANALYSIS OF MULTIPLE-FOIL XRL TARGETS USING X-RAY SPECTROSCOPY

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The multiple-foil collisional excitation x-ray laser targets proposed by LLE have been studied spectroscopically. Using spatially resolved 3d-2p x-ray spectra, we compare the temperatures and densities obtained in single- and double-foil geometries. We use the ratio of the dipole transitions to the electric quadrupole transitions in the Neon-like species as a density diagnostic. A non-LTE average-ion atomic physics model is used to describe the ionization process and a relativistic atomic physics code is used for calculation of the level energies, populations, and gain calculations. We support our claims that the double-foils provide higher densities and in some cases concave density profiles. The XUV spectra in the range of 20–300 Å show the effect of target geometry and incident laser intensity on the lasing lines and the ionization balance.

This work was supported by the Naval Research Laboratory under Contract N00014-86-C-2281.

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5C3

Application of Escape Probability to Line Transfer in Laser-Produced Plasmas

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Escape probability methods have been widely applied in the calculation of transfer of optically thick line in a plasma because of the simplicity of the methods. In these approaches, the line-transfer processes are characterized by a photon escape probability, which is defined to be the probability for a photon once emitted will travel directly in a single step without scattering to the surface of the plasma and escape. The effect of absorption on the ion level populations in a plasma is calculated by reducing the spontaneous emission rate by a factor equal to the escape probability.