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Vacuum Ultraviolet Radiation from Neon Implosions.+ B.L. WELCH,* F.C. YOUNG, H.R. GRIEM,* AND S.J. STEPHANAKIS, Plasma Physics Division, Naval Research Laboratory, Washington, DC 20375 — Neon implosions are being studied in order to produce a plasma which is suitable for photopumping with 11-Å NaX line radiation. The coincidence in wavelength of the NaX $1s^2$-1s2p ^1P (11.0027 Å) transition and the NeIX $1s^2$-1s4p ^1P (11.0003 Å) transition is being utilized in resonant photopumping experiments[1] directed toward the development of a soft x-ray laser. This investigation of neon gas-puff implosions is being carried out in support of the Na/Ne photopumping experiments.

A neon gas-puff Z-pinch, driven by a 5-kJ capacitor bank discharge, is being used to determine experimentally the conditions required to produce a neon plasma with ions predominately in the NeIX ground state. Theoretical calculations[2] for Na/Ne photopumping have indicated that neon temperatures of 50-100 eV and ion densities of 5×10^{17} cm^{-3} to 10^{19} cm^{-3} are required. A fast Z-pinch model used in the design of this experiment predicts that implosions with mass loadings of 3-9 μg/cm driven by currents of 120-240 kA should produce such a neon plasma. Previous experiments[3] with mass loadings and geometries similar to those used in experiments on the Gamble II generator at NRL have been carried out for driving currents of 160-280 kA. The results, based on K-shell radiation (0.9-1.2 keV) measurements, indicate that higher temperatures and densities than desired can be achieved. The present experiments use softer radiation (50-280 eV) to better determine the neon-plasma conditions.

A 1-meter grazing incidence spectrograph is being used to identify the radiation from various ionization states of neon in the pinch. Spectral lines from NeVI, NeVII and NeVIII have been observed. Spatially resolved pinhole-camera images (filtered for 160-280 eV) and time-resolved vacuum-diode measurements (filtered for 150-280 eV) are used to characterize the pinch. Effects of varying the neon mass loading and the driving-current waveshape are being investigated.

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Characterization of Aluminum X-pinch Plasmas Driven by the 0.5 TW Lion Accelerator*

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The x-pinch, obtained by crossing two fine wires at one or more points as the load for the 0.5 TW Lion accelerator, has been used as a bright x-ray source. High density and temperature hot spots are observed at the crossing point(s). From these hot spots, an intense, spatially confined burst of x-rays is emitted which can serve as a pump for resonant photo-pumping lasers. Here, we present experimental results concerning the radiation emission using Al x-pinches. The optimum mass loading for different ionization stages of Al ions and the total x-ray energy yields are examined. The density and temperature of the plasma and the size of the hot spots are measured.

Diagnostics used for these include pinhole photography, streak and framing photography, filtered XRDs, pin-diodes, and XUV and soft x-ray spectroscopy. The streak camera provides radial or axial spatially resolved continuous time information on the collapsing plasma, while the 5 ns single framing camera gives a spatially resolved image. The size of the hot spots is determined from pinhole photographs.

There is no strong *Al* line radiation for photon energy in the range from 300 to 1,500 eV. When the *He*-like or *H*-like ionization stage is reached, radiation is dominated by resonant K-shell line radiation ~ 1.6 keV in energy. Thus, at the higher hot spot temperatures, XRDs with filters suitable for the soft x-ray region are used to estimate the Al plasma temperature and to measure the soft x-ray radiation energy yield. The total K-shell line radiation of Al ions is monitored by a pin-diode.

The emission spectrum of the Al ions is recorded by using XUV and soft x-ray spectrographs. The ionization stage of the Al ions and the plasma density and temperature are obtained from the Al line intensities.

Based upon the results of these experiments, we will evaluate resonant photopumping schemes such as those involving *Be*-like ions,[1] using the Al x-pinch emission as the pump source.

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TIME RESOLVED XUV SPECTROSCOPY FROM HIGHLY IONIZED CAPILLARY DISCHARGES

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Pulsed capillary discharges can produce highly ionized plasmas and have been used as spectroscopic sources in the study of multiple ionized species and in the generation of X-ray radiation [1,2]. We have proposed the use of a fast capillary discharge plasma as a medium for the amplification of extreme ultraviolet radiation following electron ion recombination [3]. We have made time resolved measurements of the axial emission from capillary plasmas 500 µm in diameter and several cm in length excited by short (50-100 ns FWHM) discharge pulses. The use of a gated dual plate intensified array detector provides the sensitivity required to obtain extreme ultraviolet spectra with 5 ns resolution in a single discharge shot using a 1 m focal length vacuum spectrograph. Analysis of the axial spectra from a 500 µm diameter lithium hydride capillary shows simultaneous line emission from highly ionized (LiIII, OVI) and single ionized (OII) species. The data indicates the existence of a hot core plasma (Te > 25 eV) surrounded by a significantly cooler (< 5 eV)