X-ray Spectroscopy at NSTX*

M. Bitter, K. W. Hill, L. Roquemore,
Princeton Plasma Physics Laboratory, Princeton, NJ 08543
P. Beiersdorfer, D.Thorn,
Lawrence Livermore National Laboratory, Livermore, CA 94550
Ming Feng Gu,
Center for Space Research, MIT, NE80-6083
S. G. Lee
Korea Basic Science Institute, P.O. Box 41, Yusung, Taejeon, Korea

Two new X-ray spectrometers are presently installed at NSTX and will be operational during the next experimental campaign in 2003. The first spectrometer is the prototype of a new X-ray Imaging Crystal Spectrometer, which will record temporally and spatially resolved spectra of helium-like, lithium-like, and beryllium-like argon from an extended (80 cm high) area of the plasma with use of only one spherically bent quartz crystal and a large 2D position-sensitive detector. The obtained spectral data will be used for measurements of the radial profiles *(and gradients)* of the ion and electron temperatures and measurements of the argon ion charge state distribution, which is of interest for ion transport studies. - By providing both temporally and spatially resolved spectra this new spectrometer will solve a longstanding problem in the X-ray spectroscopy of tokamak plasmas. - The first proof-of-principle measurements at NSTX will be made with special 10 cm x 30 cm large 2D position-sensitive multi-wire proportional counters (MWPCs), which are presently fabricated at the Brookhaven and Lawrence Livermore National Laboratories and the Korean Basic Science Institute. MPWCs have the advantage that they can be manufactured in the large sizes based on proven technology. They also have a high signal-to-noise ratio, so that the obtained spectral data will be of high quality. However, they will not be the ultimate solution, since their count rate is limited to few hundred kHz. New large Gas Electron Multiplication (GEM) detectors with a multi-MHz count rate capability and a delay-line readout scheme are presently developed by Dr. Oswald Siegmund from Sensor Sciences in Pleasant Hill CA 94523 in a joint SBIR project with PPPL These new GEM detectors will be available in 2004. The second X-ray spectrometer consists of a spherically bent mica crystal and a Reticon array detector. This spectrometer will be dedicated to measurements of density-sensitive line ratios in the wavelength range from 2 to 20 Å, which are of astrophysical interest. The measurements will be conducted in collaboration with researchers from the Chandra and Newton X-ray observatories. The paper will describe the instrumental details and diagnostic capabilities of these two X-ray spectrometers.

* supported by the US Department of Energy, DOE contract: DOE-AC02-76CH03073