1. PROPOSAL AND MOTIVATION

We propose to test the feasibility of using channeling radiation as the source of radiation for microlithography. Channeling radiation is very intense, forward-directed, easily tunable, narrow-band radiation that is produced when an electron beam is directed along a major axis or plane in a single crystal. Because of these properties and especially because channeling radiation of a few keV (in the x-ray region) can be produced by electrons of only a few MeV, many important applications may be feasible. Among these are microlithography, angiography, molecular-structure analysis by x-ray diffraction, and elemental analysis by x-ray fluorescence. Since high-intensity electron accelerators of only a few MeV are inexpensive (relative to GeV synchrotrons, for example), and since electron accelerators with the very low emittance necessary for most of the electrons to be channeled in a crystal target now have been shown to be practical, widespread use of this kind of radiation source might be envisioned.

SFA, Inc. has proposed to test the feasibility of these possible applications of channeling radiation, and has been awarded a Phase II SBIR grant by the DOE to do so. After studying the electron beam properties at a conventional linac (at AFRRI, in Bethesda, MD), we concluded that such applications were best accomplished only with one of the new generation of low-emittance accelerators. The CEBAF injector is the best electron accelerator in the world in this energy range, it is in the United States so that we have control over technology-transfer issues, it is a DOE facility, and it is conveniently located for us so that we can make measurements here on short notice and hence with very little disruption of the CEBAF construction or operations schedule. Therefore, we propose to set up a beam line for producing channeling radiation at the 5-MeV stage of the CEBAF injector, and to carry out feasibility studies of applications of channeling radiation, the first of which would be for the lithography of silicon wafers on a submicron scale.