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Extractor for Heavy Ion Fusion Volume Source*

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Previously, surface-production ion sources have been used for heavy ion fusion (HIF) drivers because they deliver low ion temperature. A typical design, ELISE [1], specifies 0.8 A of K+ per beamlet; the required surface area is large, so it may not be easy to obtain uniform emission, especially over a long period of operation. In contrast, volume sources (e.g., 0.8 A of Ar+) should give good uniformity over long times, but they deliver warmer ion beams, several tenths of an eV or more. They can produce large current densities and thus could in principle equal or exceed the brightness of surface sources, but conventional extractor designs run into voltage breakdown limitations and cannot easily produce the required current rise time (about one microsecond). An improved two-stage extractor utilizing concentric ring preaccelerators, recently described for another application [2], can overcome these volume-extraction problems. Fast beam switching is done within the small ring grids and the use of preacceleration lowers the voltage gradient in the main acceleration column. The preaccelerators are tilted toward the axis, giving inward momentum that supplements the Pierce-type focusing. The concept allows beam aberrations to be essentially eliminated [2] and emittance growth from beam merging within the extractor to be minimized. It may also allow the design of an injector with compact, parallel ESQ matching channels, a possible improvement on the design in Ref. [3]. Simulation results for these various ideas will be presented.

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