

# RF power challenge for the linac of the U4 single pass RF driver for energy from inertial confinement fusion

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The U4 single pass rf driver (SPRFD) concept as developed overwhelms heavy ion beam requirements for pellet ignition to meet the need to be investment grade, commercial IFE, to justify building the first-of-a-kind, HIF IFE regional energy and water supply facility, with co-located heavy energy-use industries, from a coordinated set of computer models supported by empirical data including project-driven data acquisition. U4 uses the high gain cylindrical pellet approach with ion ranges up to  $\sim 10\text{g/cm}^2$  and fast ignition in  $100\text{g/cc DT}$  and extends charge balanced neutrality\* to the multiple ion species. With no storage rings, all U4's 20 species can focus to the required  $50\mu\text{m}$ . This paper characterizes the RF power challenge, specifically in the last highest frequency section, where an isotope's current from 64, 200mA sources [Staples et al., RF accel. for HEDP, 2006] is in a single beam (12.8A) due to zippering. 20 parallel linacs ( $\sim 100\text{km}$  total) accelerate  $\sim 40\text{MJ}$  in  $\sim 5\mu\text{sec}$ : 8TW.  $5\text{e-}5$  duty factor at 10Hz. U4's challenges are in the linac; beam manipulations are aggressive but simple [Burkes, The U4 SPRFD, Accel.Apps. 2024]. (+) and (-) ion sources, telescoping  $\sim 25\text{-}40\text{GeV}$  isotopes: Cd114, Ba136, Nd145, Gd155, Er166, Hf178, Ir190, Hg203, Th232.  $\sim 10\text{A}$  per beam,  $100\text{MW/m}$  to beam at  $10\text{MV/m}$ . A concept under study integrates the final amplifier stage and the RF cavity to 1) deliver the RF power, and 2) be mass-producible RF power and linac cavity LRUs to achieve a target cost of  $50\text{k}\$/\text{m}$ .

## Footnotes

Basko M. et al., *Prospects of heavy ion fusion in cylindrical geometry. Laser and particle beams.* 2003.\*Koshkarev DG, Charge-symmetric driver for heavy-ion fusion. *Il Nuovo Cimento A.* 1993.

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