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Heavy Ion Fusion: Ready for Reassessment?

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Research activities on heavy-ion fusion (HIF) were abandoned over a decade ago, and brought down to a crawl even earlier. It is easy to forget that in the 90's HIF was considered to be the top contender for developing inertial fusion energy (IFE). This is not surprising: accelerator technology is well-established, and the conversion efficiency from a wall plug to accelerated particles is hard to match, especially at the repetition rates required for IFE powerplants. Moreover, unlike most laser fusion schemes, HIF does not require any damageable optics. One of the often-cited reasons for abandoning HIF is its non-modular nature: testing even the most basic IFE components requires multi-km long induction accelerators. Compact high-gradient collective ion acceleration has the potential for drastic reduction of the driver size – an important step towards modularity and compactness. I will describe the historical context for such schemes and describe the latest efforts in my group to improve them. In addition to driving future fusion power-plants, compact ion accelerators have many other exciting applications that I will describe. Those range from promising carbon ion radiation therapy in the short-bunch (FLASH) regime to testing space-bound electronics for deleterious effects from impinging high-energy ions.

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