Contribution ID: **76** Type: **Invited talk**

The Single Pass RF Driver

Tuesday, 14 August 2012 11:20 (20 minutes)

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In the closing summary of the 4th international HIF workshop in 1979, Burton Richter declared the RF driver fatally flawed because of the "black cloud"problem in storage rings. The Single Pass RF Driver (SPRFD) concept arose in part from the need to dispel that cloud. Eliminating storage rings from the driver concept does that, and much more.

Designing the driver without storage rings avoids the emittance increase that accompanies multi-turn injection into storage rings. This brings into play the much lower emittance of the beams at the output from the linac. The key means to replace the beam-compaction effect of storage rings is the use of multiple isotopes, which was first proposed in 1978 and validated by the HIDIF study in the mid 1990s. Like the 1978 proposal, the Single Pass RF Driver uses ten isotopes for the Compression pulse. A major benefit of the much lower emittance at the target is the 50µm spot for Fast Ignition, as used by Basko's pellet.

The 10-fold enlargement of the phase space, with ten different particle species, could be translated to reducing the number of each kind of ion. That would be the wrong translation. SPRFD applies the design opportunities to step up the driver parameters, by quantity (e.g., 20MJ for compression) but also through improvements of implosion efficiency. The sum of all SPRFD's advantages introduces a new paradigm for development of fusion power: Make the design as conservative as possible.

The SPRFD invests the phase-space wealth of multiple isotopes in beam restructuring—from long and spindly at the front end to compact and powerful at the target. Multiple isotopes also are used to provide components of the driver pulse that treat a number of details that are important for realistic implosions.
SPRFD's sequence of beam manipulations is straightforward and uses existing technology. For Fast Ignition, using a different set of isotopes, with ranges shorter by ≥7x than the Compression isotopes, reduces peak power requirement importantly. The shortened range of these ions is ~0.9-1g/cm2, i.e., the ρ•L of the fuel mass whose ρ•R=0.5g/cm2. SPRFD's flexibility includes, besides the time profile, using the shorter-range ions to implode the cylindrical end-caps while the longer-range ions implode the cylinder barrel.
The talk will summarize features that delineate and distinguish the SPRFD concept. The talk also will describe the unique, new driver benefits for implosion performance that arise from the SPRFD's features.

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Session Classification: Accelerator physics and technology I - Chairs: J. Kwan and A. Faltens - Featured Posters: R. Burke, K. Fukushima, T. Yoshimoto, R. Cassel