Google:[Leonid Zakharov] $\longrightarrow$ http://w3.pppl.gov/~zakharov

LiWall Fusion and its 3 step R&D program

Leonid E. Zakharov

Princeton Plasma Physics Laboratory, MS-27 P.O. Box 451, Princeton NJ 08543-0451

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LiWF science vs BBBL-70s (“The Bib$_{b}$le of the 70s”)

LiWF $\equiv$ NBI heating/fueling $+$ Lithium Pumping PFC. No cold particles except He. vskip1em

Issue	LiWF	Current BBBL-70s concept of “fusion”
The target	RDF (Reactor Dev.Facility, neutron source)	Political “Burning” plasma
Reactor Issues:	$P_{NBI} = E/\tau_E$	ignition criterion $f_{pk} p \tau_E = 1$?
Hot-α, 3.5 MeV	”let them go”	“confine them” ?
Cold-α, mixed with plasma	N/A	“let them go” ?
$P_\alpha = 1/5 P_{DT}$	goes to walls, Li jets	dumped to SOL ?
Power extraction from SOL	conventional technology	no idea except to “radiate 90 %” ?
Plasma heating	“hot-ion” mode: NBI $\longrightarrow i \longrightarrow e$	”hot-e mode”: $\alpha \longrightarrow e \longrightarrow i$?
Use of plasma volume	100 %	25-30 %
Tritium control	pumping by Li	tritium in all channels and in dust ?
Plasma contamination	no Z^2 thermo-force drive, core fueling	junk from walls to the plasma ?
He pumping	as ionized gas, $p_{in} < p_{out}$	gasdynamic, $p_{in} > p_{out}$?
Fusion producing β_{DT}	$\beta_{DT} > 0.5\beta$	diluted: $\beta_{DT} < 0.5\beta$?
Physics:		
Confinement	diffusive, RTM$\equiv \chi_{=}\chi_e = D = \chi_i^{neo}$	turbulent thermo-conduction ?
Anomalous electrons	play no role	YES for 40 years and ahead ? ? ?
Transport database	scalable by RTM (Reference Transp. Model)	not scalable to “hot e”-mode ?
Sawteeth, IREs	absent	unpredictable ?
ELMs, $n_{Greenwald}$-limit	absent	intrinsic for low T_{edge} ?
p'_{edge} control	by RMP through n_{edge}	through $T_{edge} \longrightarrow$ low performance ?
Fueling	existing NBI technology	unresolvable ?
Fusion power control	existing NBI technology	no idea ?
Tangible RDF time scale:	$\Delta t \simeq 15$ years	$\partial_t(progress) \simeq 0, \Delta t \simeq \infty$
Cost:	$2-2.5 B for RDF program	$\simeq$ $20 B with no RDF strategy
Scientific status:	Consistent with physics and technology	Everything is Upside-Down

LiWF R&D relies exclusively on existing technology. It does not need fusion power ("burning plasma") until step 3

Step toward RDF	Milestone	Priorities and Mission
NSTX with molten LLTP (Li Loaded Target Plate)	Reproduce T11-M, CDX-U, FTU plasma pumping experiments	Plasma pumping. Low energy NBI. Stability. Clarify the system compatibility with molten Li
ST0 (modified NSTX): B=0.3-0.5 T, I_{pl}=0.7-1 MA LTX (modified CDX-U): B=0.3 T, I_{pl}=0.3 MA	Achieve RTM-like confinement: $\tau_E \longrightarrow 2-3 \times \tau_{E,NSTX}$.	Plasma boundary. Stability. Start-up. Core fueling by low energy NBI. Collisionless SOL/PFC interaction. Role of C-walls. Creating a design concept of "Bleeding" LPD.
ST1: B=1.5 T, I_{pl}=2-4 MA, A $\simeq$ 5/3, $\beta = 0.2-0.3$	Achieve Super-critical regime: $Q_{DT}^{equiv} > 5, \quad f_{pk} p \tau_E > 1$	Plasma boundary. Stability. Physics and technology of "Bleeding" LPD. Secondary electron emission. Creating concept of a Startup and stationary LPD
ST2: DD-prototype of ST3, B=3 T, I_{pl}=4-8 MA, A $\simeq$ 5/3, $\beta = 0.3-0.4$	Achieve RDF stationary regime: $Q_{DT}^{equiv} = 30-50$	High $\beta \simeq 30-40$ %. Noninductive current drive. Integrate the stationary plasma regime for RDF. Assess the feasibility of DD fusion.
ST3: DT neutron source. B=3 T, I_{pl}=4-8 MA, A $\simeq$ 5/3, $\beta = 0.3-0.4$	Achieve DT-stationary regime: $Q_{DT} = 30-50, \; P_{DT} = 0.2-0.5$ GW	Power extraction from α-particles, He exhaust. Integrate the stationary neutron producing regime for RDF mission.

PPPL has everything for initiation of LiWF and for ST1,ST2

It needs FESAC assistance to make motivational steps