

DIII-D Wall Change Community Forum

Lithium in Tokamaks

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I will make several statements without supporting them by details

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Significant progress in getting $\simeq 59$ MJ DT energy and $Q=1/3$ for 5 s

Both JET campaigns relied wisely on hybrid regimes with $I_{pl}=2.5$ MA, $B_t=3.9$ T

In two decades after a “bad luck” in 1990s with the first attempts in getting $Q=1$ on TFTR and JET, the $Q=1/3$ is frustrating.

- 1. The minimal milestone $Q = 1$ was not even in the agenda for DTE2(3) on JET with ILW**
- 2. $Q < 1$ and no prototype regime for ITER is **a failure of the entire fusion community** in utilizing the best fusion facility, operated by the highly professional team and skillful management**
- 3. The entire high recycling approach (complicated, unpredictable and disruptive) failed (as it was expected by many of us in 1998 as well as by DoE)**

JET has discredited the present approach.

This is a fundamental contribution of this exceptional facility to fusion

***It is a huge mistake of fusion community and its agencies
(DoE, EuroFusion, UKAEA, China)
in considering lithium as incompatible with the burning plasma
(probably due to community failure to defend C in the ITER project)***

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In contrast, 24/7-LiLi is the only material

- ***working as a garbage collector maintaining an excellent vacuum in tokamaks***
- ***capable to pump out plasma with 1 g/s (my, LZ number) safe flow rate***
- ***capable (with fueling by NBI) of suppressing the plasma edge cooling by recycling***
- ***capable to prevent the tritium accumulation in machines with a burning plasma***
- ***consistent with the real time tritium recovery (RTTR) for the reuse by NBI***
- ***eliminating the PSI as it is known now, the major cause of plasma unpredictability***
- ***suggesting the simple plasma regimes, controllable and suitable for disruption avoidance***

***The present situation is perfect for the private business:
for generating all know-hows of fusion enabling technology with
no “tritium”, “neutrons”, “regulations”, and initially “tokamaks” involved***

With no Li, DIII-D was the major contributor to our understanding of tokamak physics and LiWall Fusion, just in the critical time of 1998: discrediting $T_e > T_i$, discovery of DBQH-mode regime, Keif Burrell talk to APS in Quebec city on EHO, RMP, tile diagnostics, SoL currents (Todd Evans, Hiro Takahashi and others)

- We will insist on LTX- β conversion to the first facility with the 24/7-LiLi environment. Nobody has such experiences with Li in tokamaks.
- DIII-D (which does not like Li) should start thinking about a new facility with 24/7-LiLi and $\tau_E \simeq 1 - 2s$ (?) with recycling suppressed to the residual 5-10 %.
- Then, it will be possible to think about an US facility with DT burning plasma and a nuclear blanket at a special site.
- JET is 95%-built bridge to the “tokamak-fusion-as-it-should-be”. With pure H, D (no T) plasma and 24/7-LiLi installed JET can get $\tau_E \simeq 4 - 5 s$ and generate the design data for He pumping. DIII-D (U?) can, and should, intercept this mission.

Figure. $\langle \sigma v \rangle$ calculations of Cx and Ion Impact ionization with NBI capture exceeding Cx losses for 30, 40, 60, 70 keV H-NBI ($\times 2$ for D-NBI)

with atomic 4 % of Li^{3+} doping (effect discovered on LTX- β)

Li is a real treasure for tokamaks in many aspects

