

NSTX-U Five Year Plan/Research Team Update

MFE Physics Meeting – Oct. 14, 2019

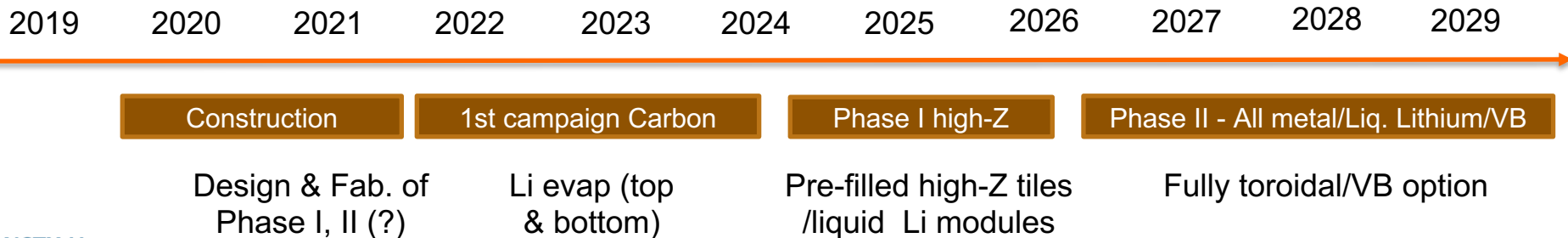
S.M. Kaye

NSTX-U Interim Director of Research

FES wants NSTX-U to develop Five Year Research Plan

- Refresh of 2014-2018 plan for 2020-2024 with focus on near-term goals
- No major upgrades during this period
 - 1 MW ECH
 - Cryopump*
 - Divertor TS*
 - NCC
- Liquid Metal program would be included in following (2025-2029) plan
 - Can include, however, technical development going on in 2020-2024 (in a limited sense) leading to Phase I of LM program

* Possibly a component of 2025-2029 plan



Focus is on 3 high-level research goals

1. Demonstrate **high-performance steady-state non-inductively sustained regimes** at large bootstrap fraction ($f_{BS} > 0.7$), large Greenwald density fraction ($f_{GW} > 0.7$) and β_N values surpassing typical conventional-A scenarios with sufficient stability margin for low disruptivity
2. Investigate if a **strong scaling of confinement and stability improvement with reduced collisionality** in regimes dominated by electron thermal transport at high- β and low-A persists at lower collisionality
3. Develop and utilize **power handling techniques**, e.g. impurity injection and possible low inventory liquid lithium components, **to mitigate very high projected heat fluxes**

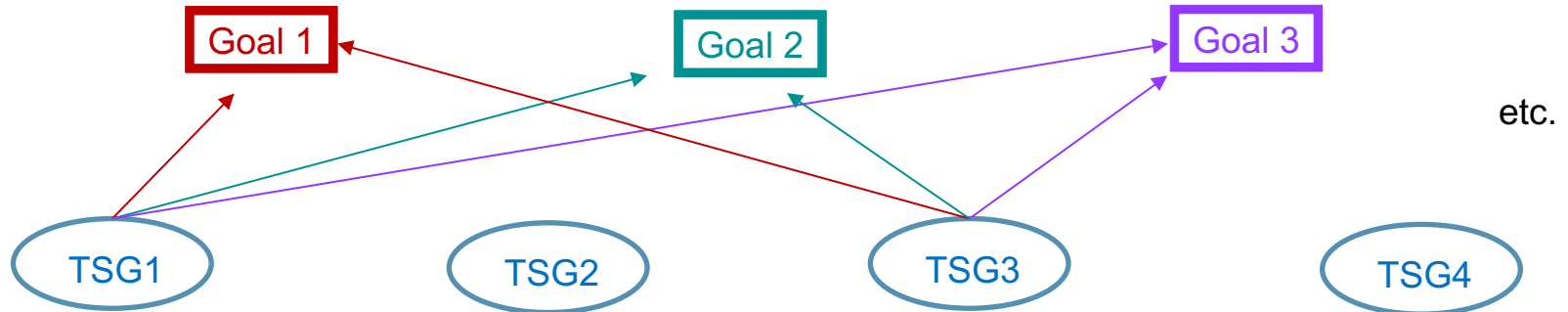
Added third goal as a foundation for moving towards Liquid Metal (Lithium) program

Plan guidelines

- Collaboration activities and how they will help us achieve our goals
- Theory: predictive model development
 - *Unify predictive modeling of transport, stability and fast ion physics at low- A , low- v_e^* and high- β_N with conventional- A tokamaks to improve confidence in projections to next-step fusion devices, including ITER and a CPP*
- How NSTX-U research can help optimize design of next-step devices
- Burning plasma (i.e., **ITER**)-related physics issues
- Diagnostics needed to achieve goals
 - B. Stratton gathering information needed to reconstitute diagnostics that we had in 2016, plus additional
 - Understand PPPL and collaborator resources needed to implement systems
 - Both will help in developing a list of diagnostics that we want to have

Five Year Plan writeup will be concise

- 2014-2018: >600 pages
- 2020-2024: ~100 pages
- Suggest write-up be in goal-oriented framework
 - 30 pages/goal
 - 10 pages Exec. Summary + other?
- Topical Science group thrusts (many relevant ones already in 2014-2018 plan) should feed into Goals



Research Team and Timeline

- Five Year Plan can be used as basis to reconstitute Research Team
 - Anticipate FOA to be connected to Five Year Plan review
 - Josh King to discuss FOA plans at Monday Physics meeting prior to Knoxville CPP
 - Develop justification for PPPL hires (4 – 5?) in FY20 to support prep for/initial ops
 - More in FY21
- Timeline (subject to change in either direction - later or earlier)
 - Onsite review by external panel: end-May/early-June 2020
 - Final version written: end-April (then dry runs)
 - PAC review of plan: end-March/early-April
 - Draft Plan written: mid/late-Feb (pre-“SNOMASS”) (then dry runs)
 - Team-wide meetings/discussions: start early-Nov
 - Include (potential) collaborators on- and off-site
 - Bi-weekly progress updates (informal)

Path forward

- Have asked the following to spearhead the individual Goals
 - Low v^* performance: Walter Guttenfelder
 - Non-inductive ops: Devon Battaglia
 - Divertor physics: Rajesh Maingi
- Everyone's input/participation needed!