



Neutral Beam Roadmap at Realta Fusion

September 24th, 2026

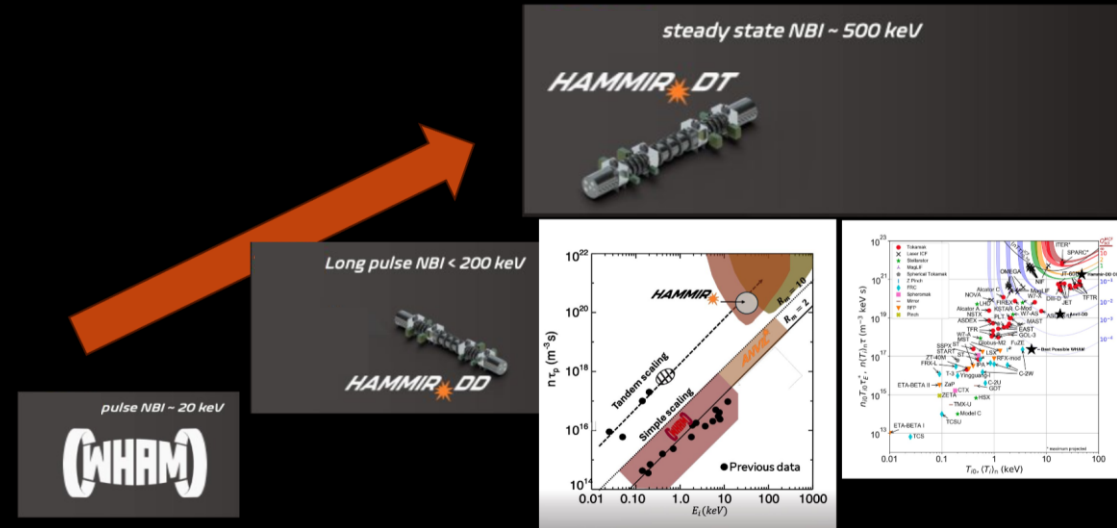
Anthony Cooper, Kai Shih, Joey Eickman, Miral Shah, Eleanor Powell, & Ikhlas Addow

Presentation Overview

1. Realta Fusion: Who We Are
2. NBI in Axisymmetric Tandem Mirrors

3. Realta's NBI Roadmap

1. Overview
2. WHAM: Current Experimental NBI
3. NARSIL: Single Module Derisking Device
4. Hammir-DD: First Reactor Like Device



Realta Fusion: Who We Are

Location:

Madison, Wisconsin

Current Status:

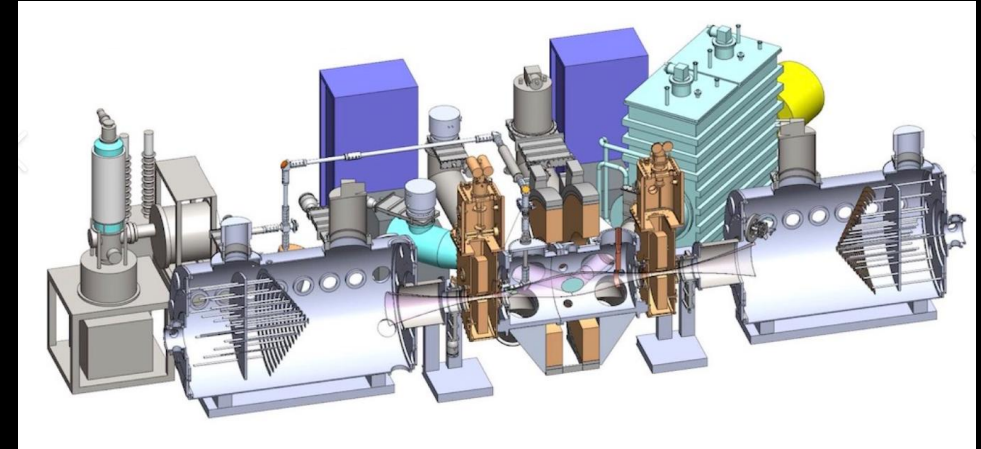
Our current experiment is WHAM

Fusion Power Plant Concept:

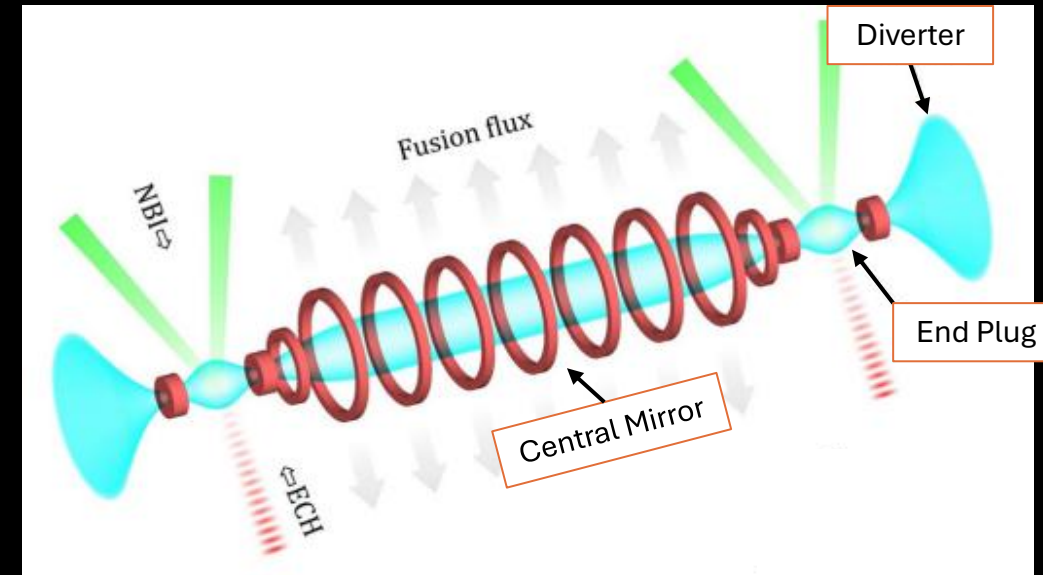
Axisymmetric Tandem Mirror



INDUSTRIAL HEAT & POWER FROM FUSION



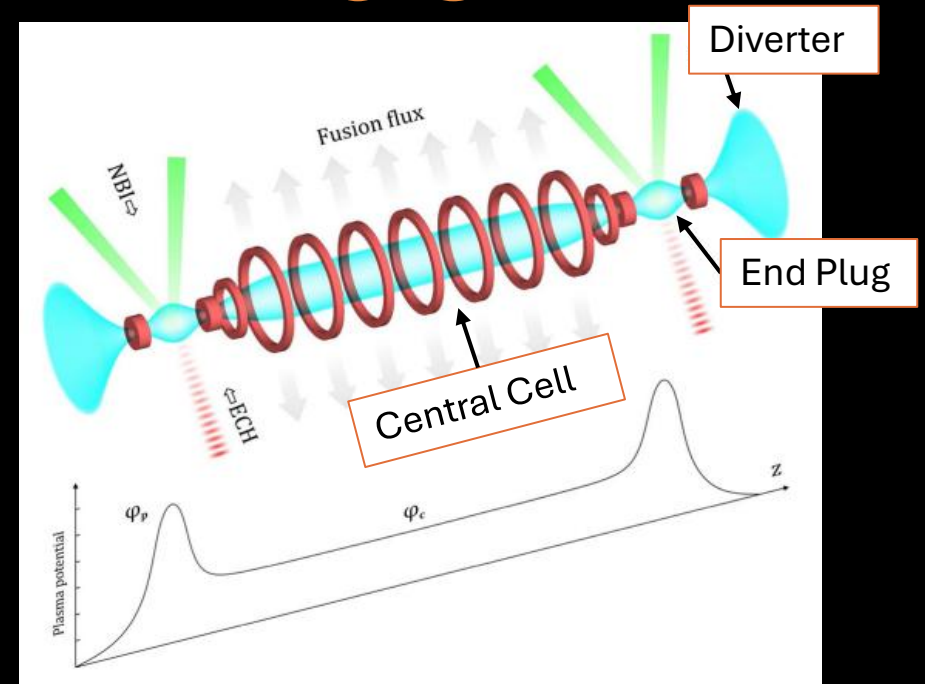
Wisconsin High temperature superconducting magnet, Axisymmetric simple Mirror device (WHAM)



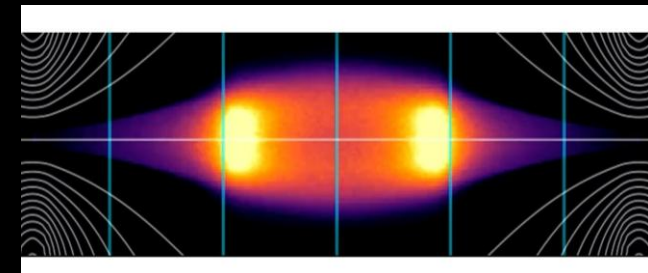
T.K. Fowler et. al, A new simpler way to obtain high fusion power gain in *tandem mirrors*. 2017, Nucl. Fusion 57, 056014

NBI in Axisymmetric Tandem Mirrors

- End plug plasmas must have a **high density, high temperature** plasma
- The “sloshing” ions effect produces a Central Cell confining ambipolar potential
- **NBI provides direct power injection deep within the plasma core**
- **NBI stabilizes plasma against Alven-ion cyclotron (AIC) instabilities**

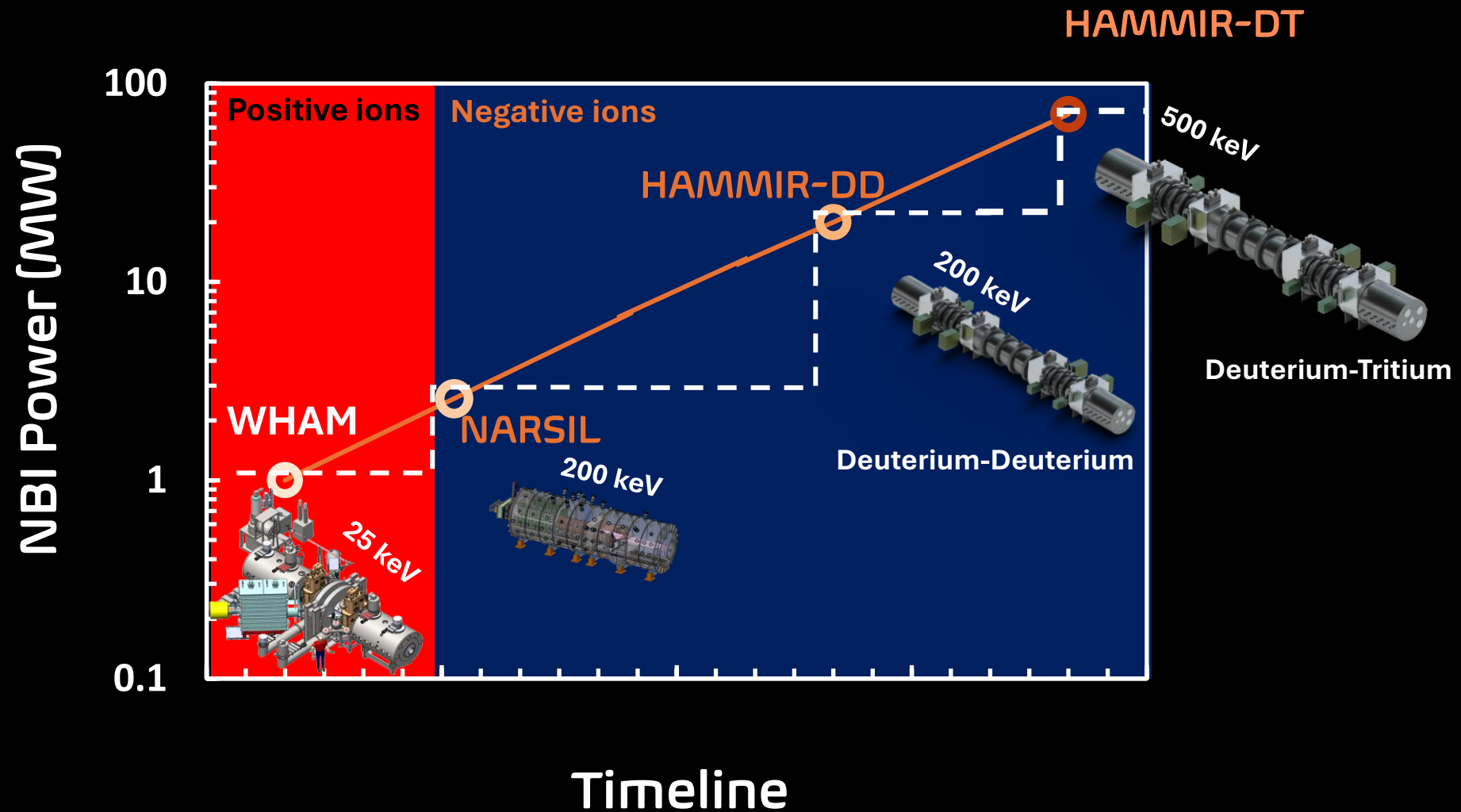


T.K. Fowler et. al, *A new simpler way to obtain high fusion power gain in tandem mirrors*. 2017, Nucl. Fusion 57, 056014

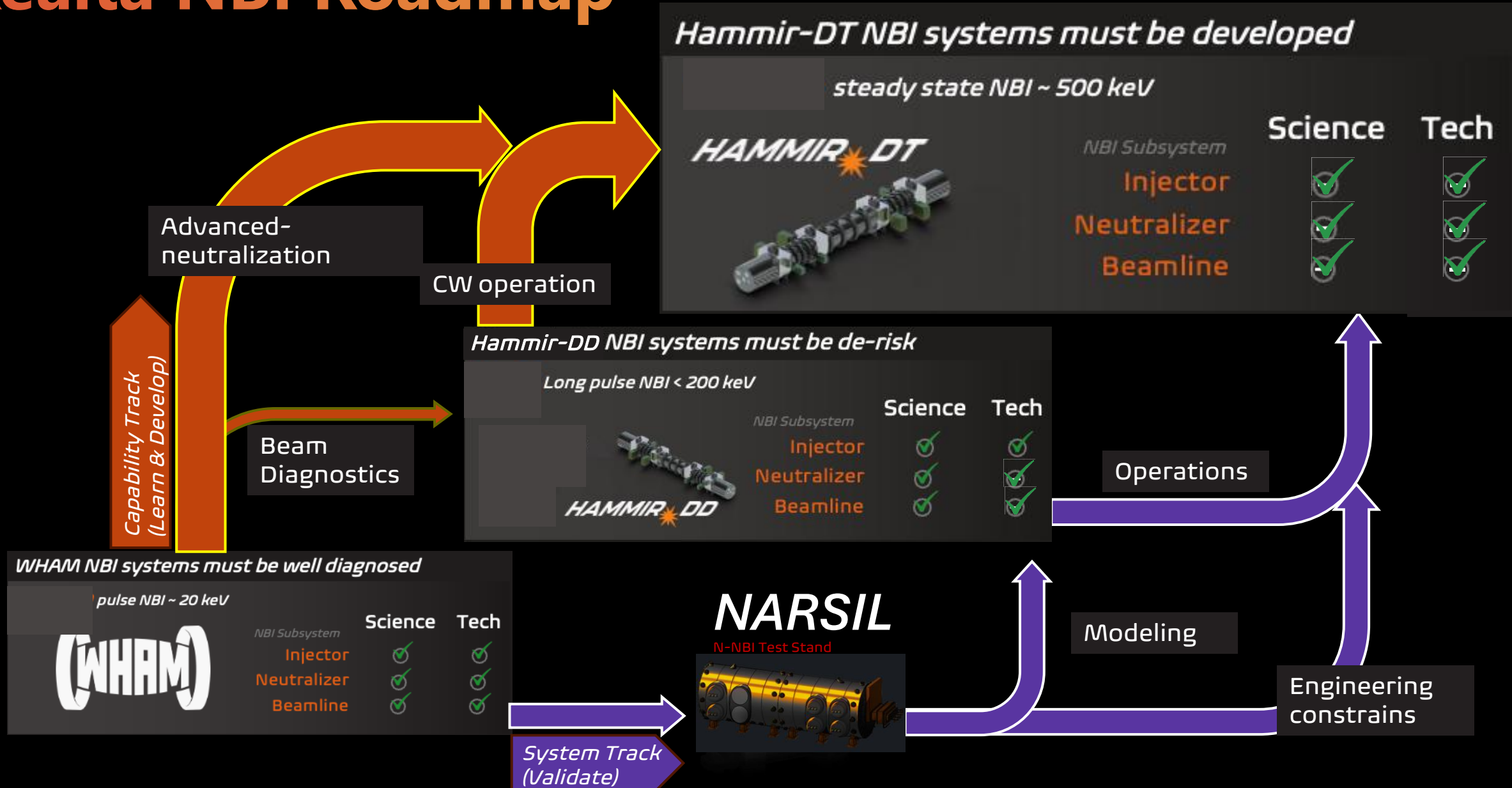


Representation of the “Sloshing” ion distribution within the end plugs

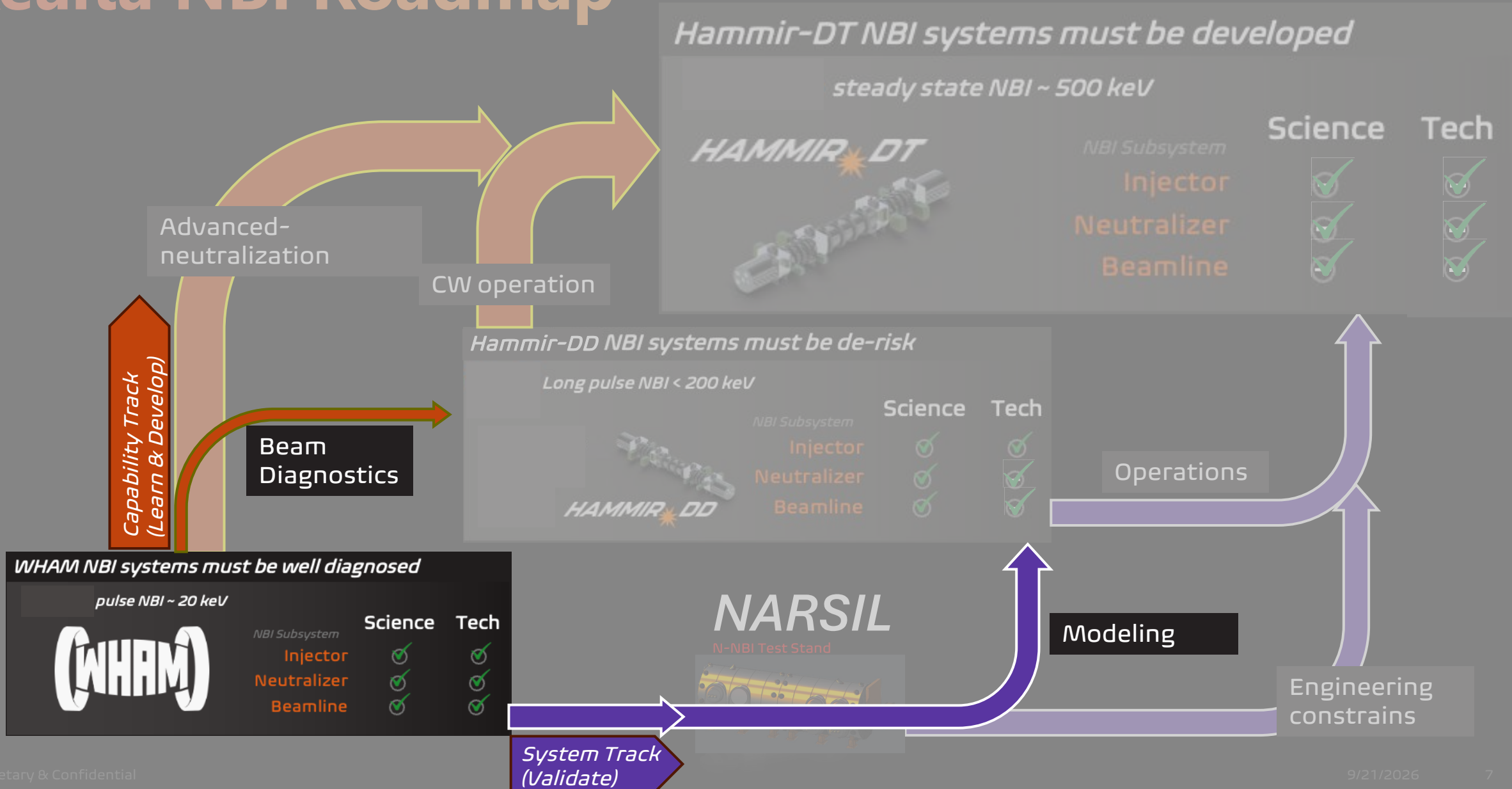
Realta NBI Roadmap



Realta NBI Roadmap



Realta NBI Roadmap

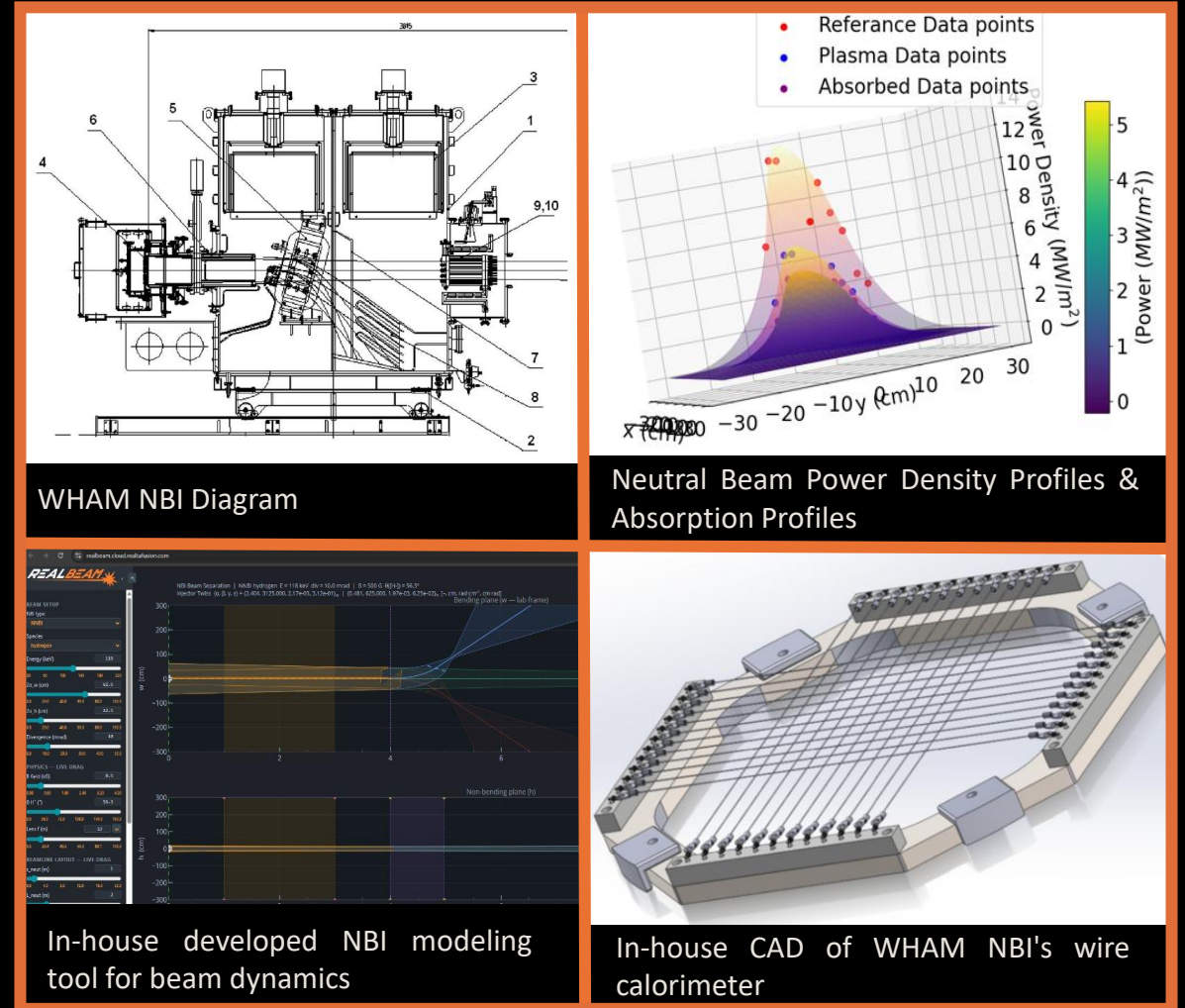


WHAM: NBI Validation Platform

This device allows us to gain experience with:

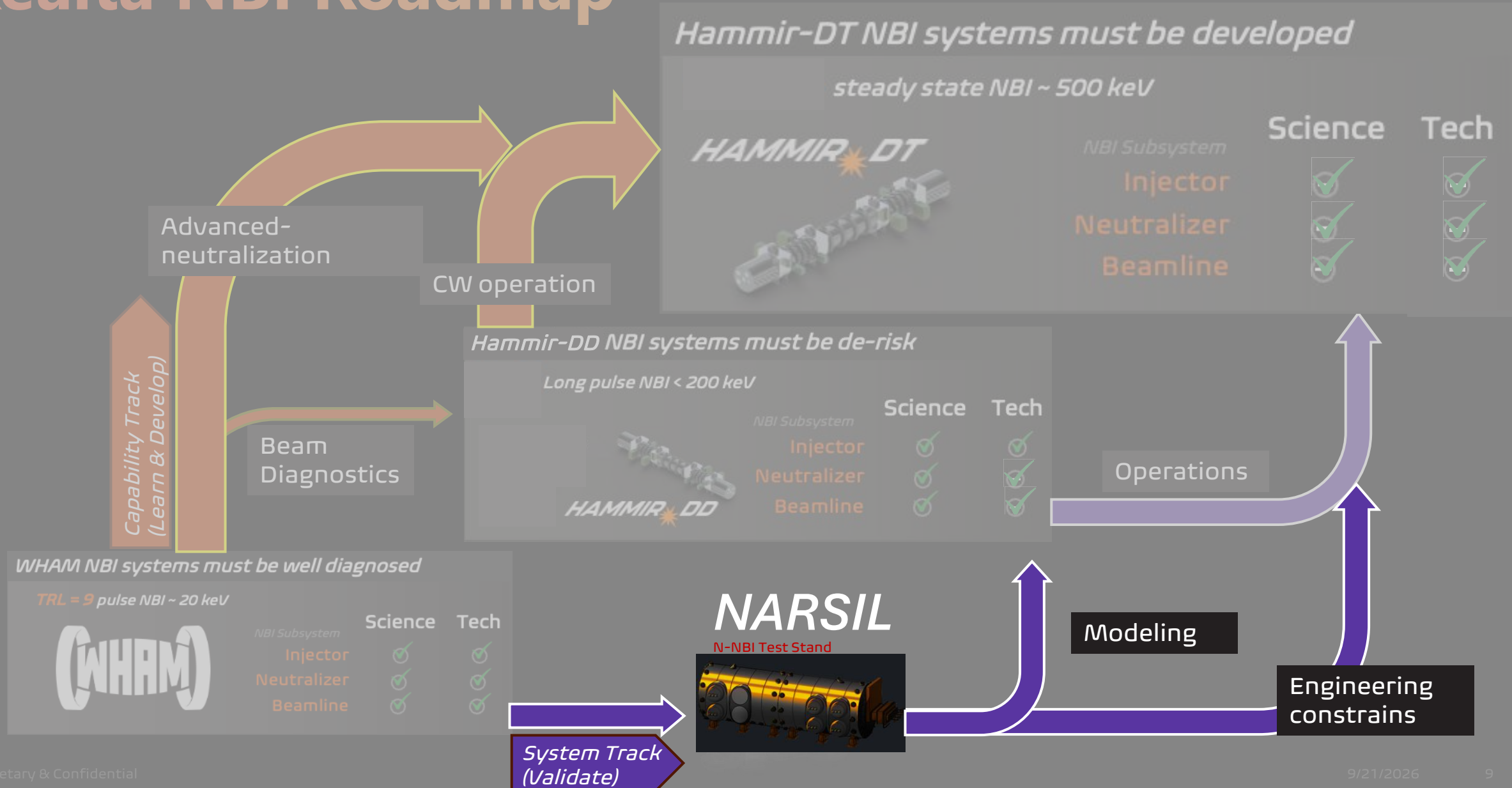
- Operating and maintaining an NBI system
- Handling of control parameters and DAQ
- Building and deploying NBI relevant diagnostics
- Verify a suite of modeling NBI relevant parameters

Beam Parameters	Value
Ion Type	H+ or D+
Beam Energy	25 keV
Extracted Current	50 A
Duration	15 ms
Composition Fraction	70:25:5
Divergence	<1deg



Characterization of 1 MW, 40 keV, 1 s neutral beam for plasma heating, by A.Sorokin et. al, 2010, Rev. Of Sci. Inst. 81, 02B108.

Realta NBI Roadmap

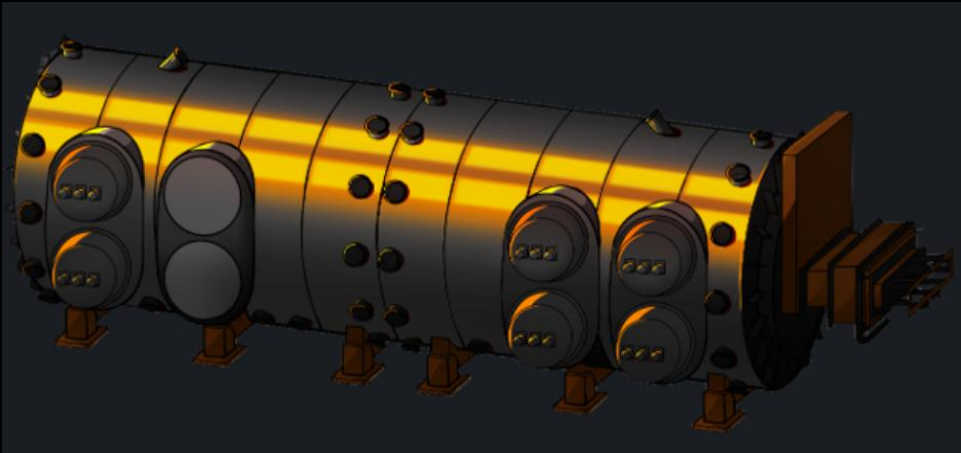
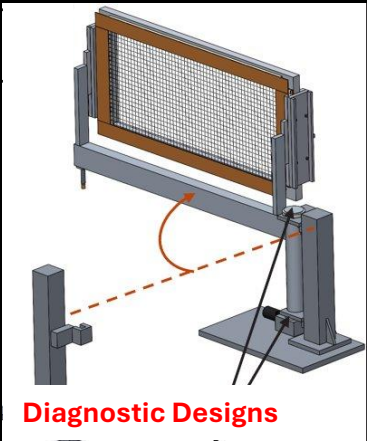
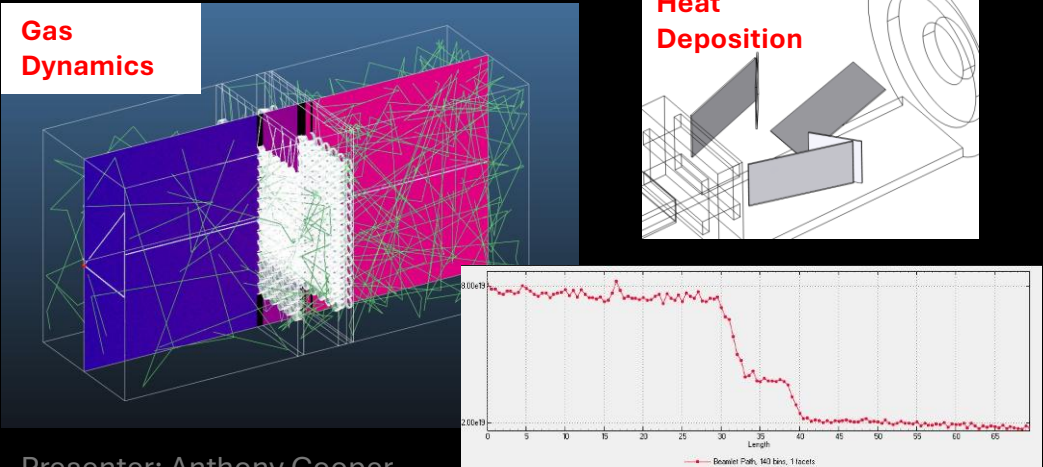


NARSIL: Single Module Derisking Device

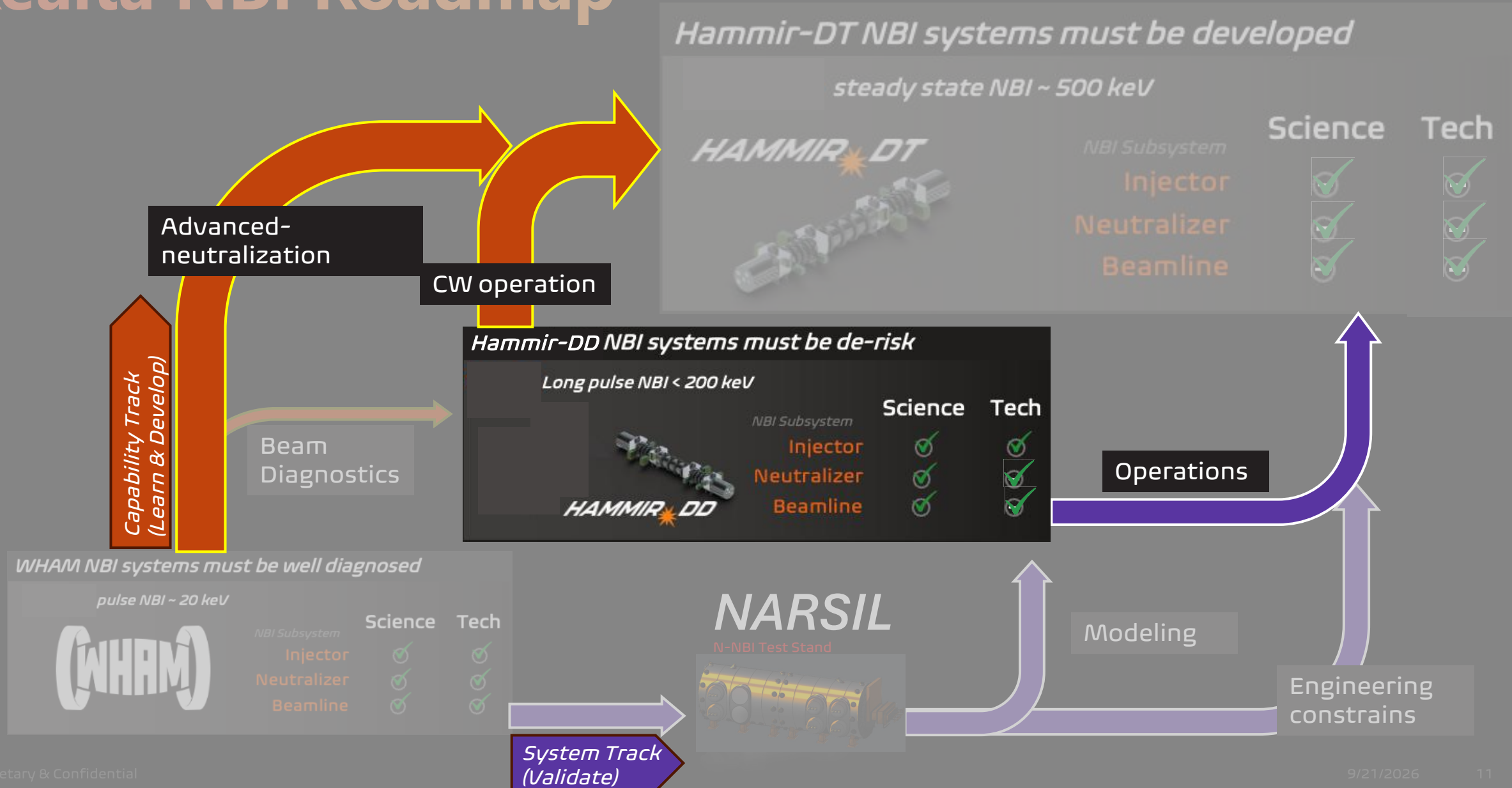
NARSIL is one **MODULE** of the Hammir-DD NBI design.

- Validate key physics and engineering models
- Provide operational experience with NNBI
- Allow for a complete diagnosis of a large negative ion source + high powered neutral beam
- Optimize source for high power deuterium operation

Parameter	NARSIL NBI	Hammir-DD Beamline
NBI Power (MW)	1.5	5
Beam Energy (keV)	200	200
Pulse Duration (s)	1.5	10



Realta NBI Roadmap



Hammir-DD: First Power-Plant Like Device

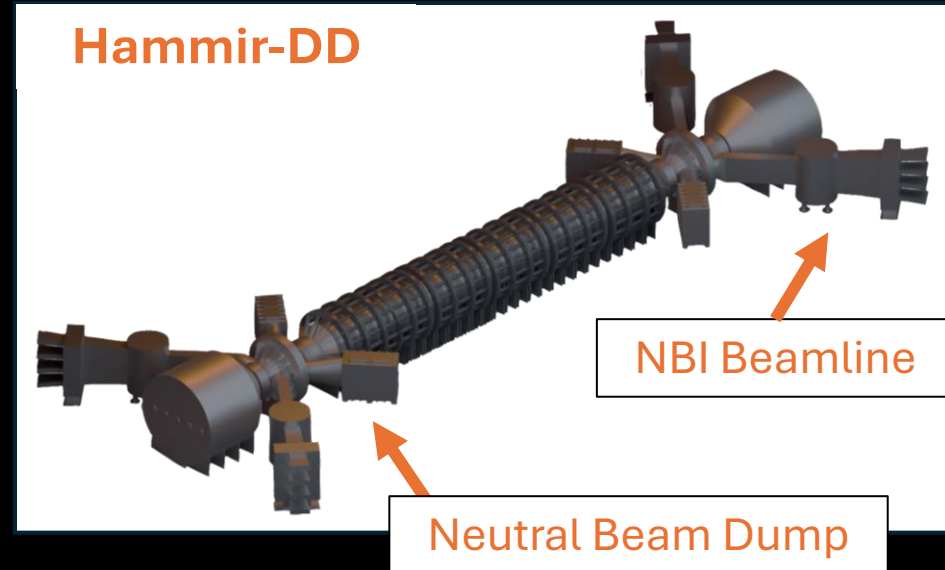
Hammir-DD is an axisymmetric tandem mirror

The end plugs are primarily heated and fueled by neutral beam injection

Hammir-DD requires 20 MW of injected neutral power in each end plug

- 5 sources per beamline
- 2 beamlines per end plug
- **20 total ion sources**

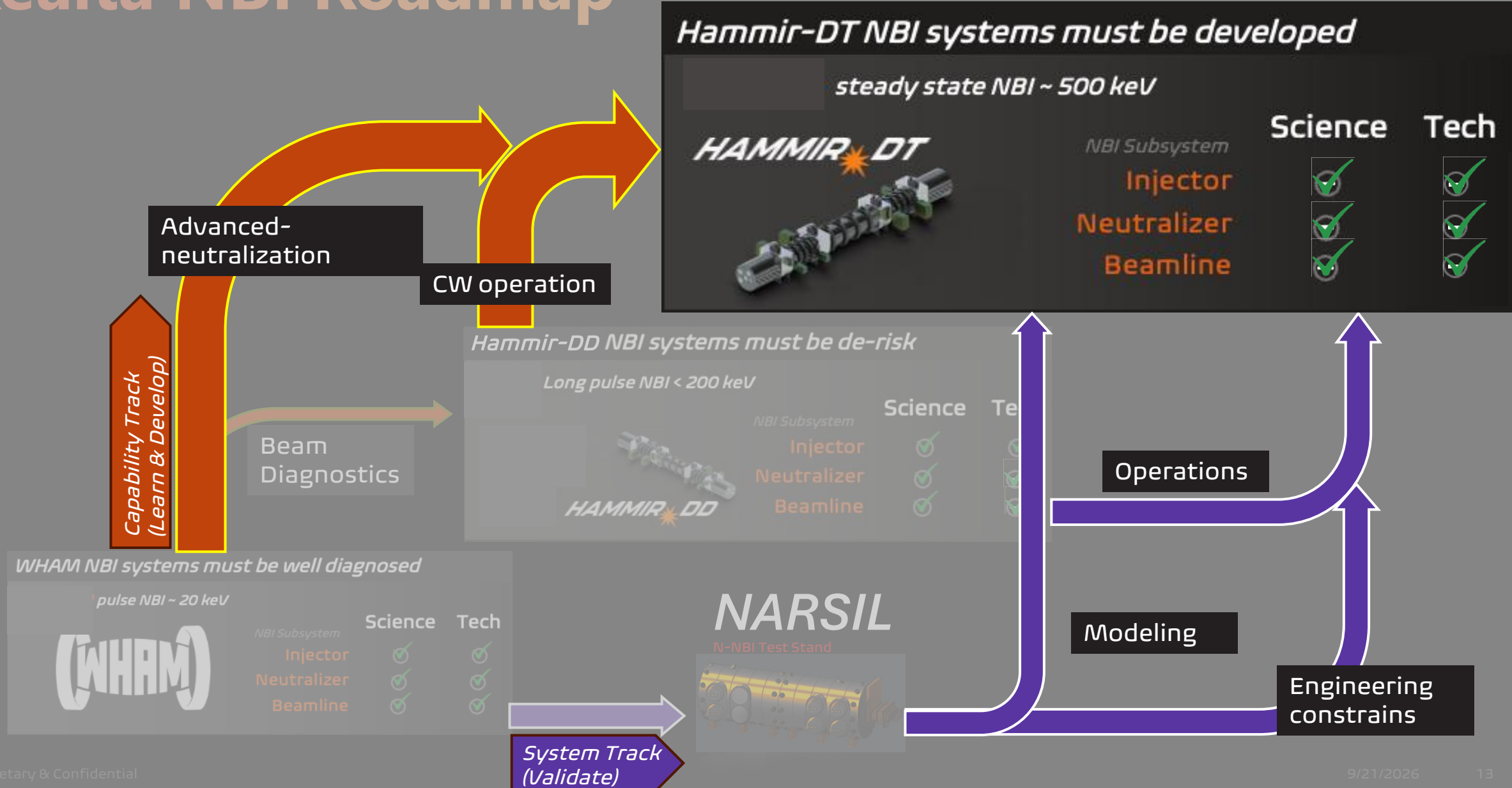
Opposite of each beam is a neutral beam dump to absorb the shine-through power



Collaboration subset:



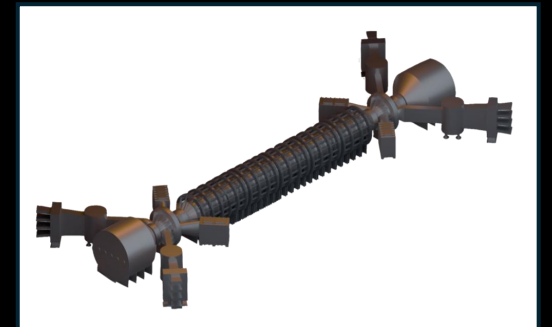
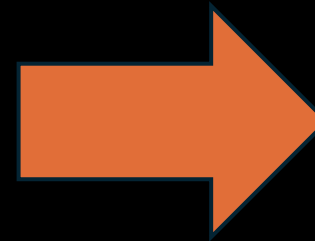
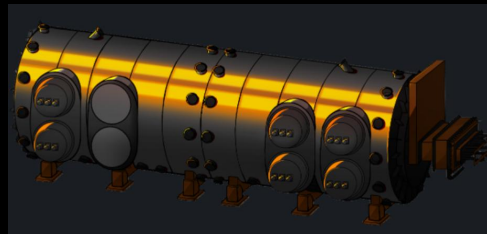
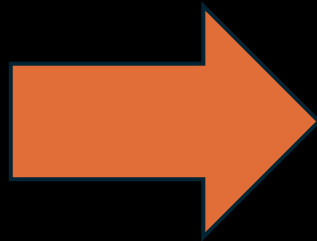
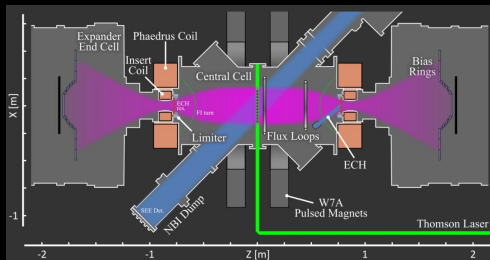
Realta NBI Roadmap



A Summary of Realta's Operational Concept

While leveraging all of our collaborations, and with the use of **multiple** devices, intelligent modelling, and an extensive diagnostic suite we unlock the ability to:

1. Derisk our designs
2. Optimize operational parameters
3. Create a digital twin of each newly developed NBI system
4. Pinpoint/predict system failures

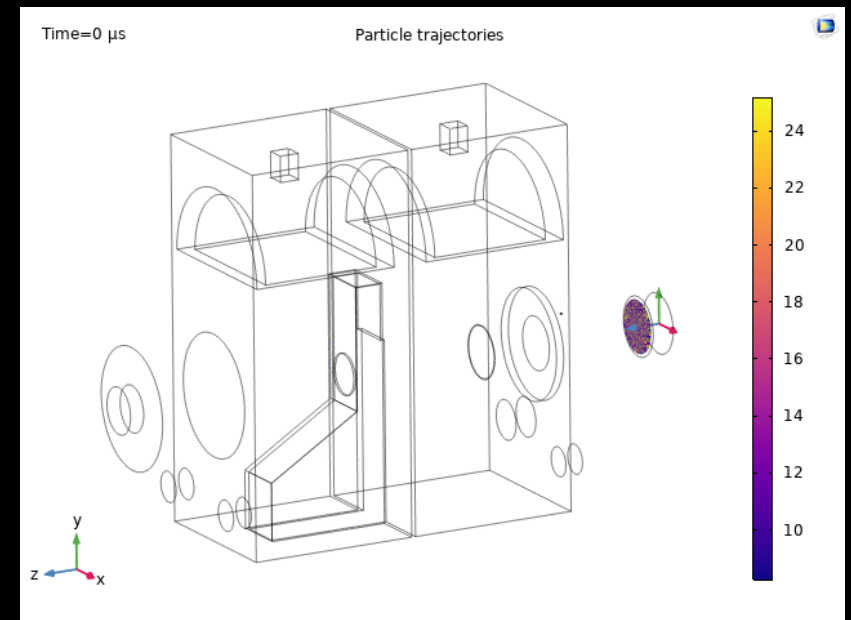


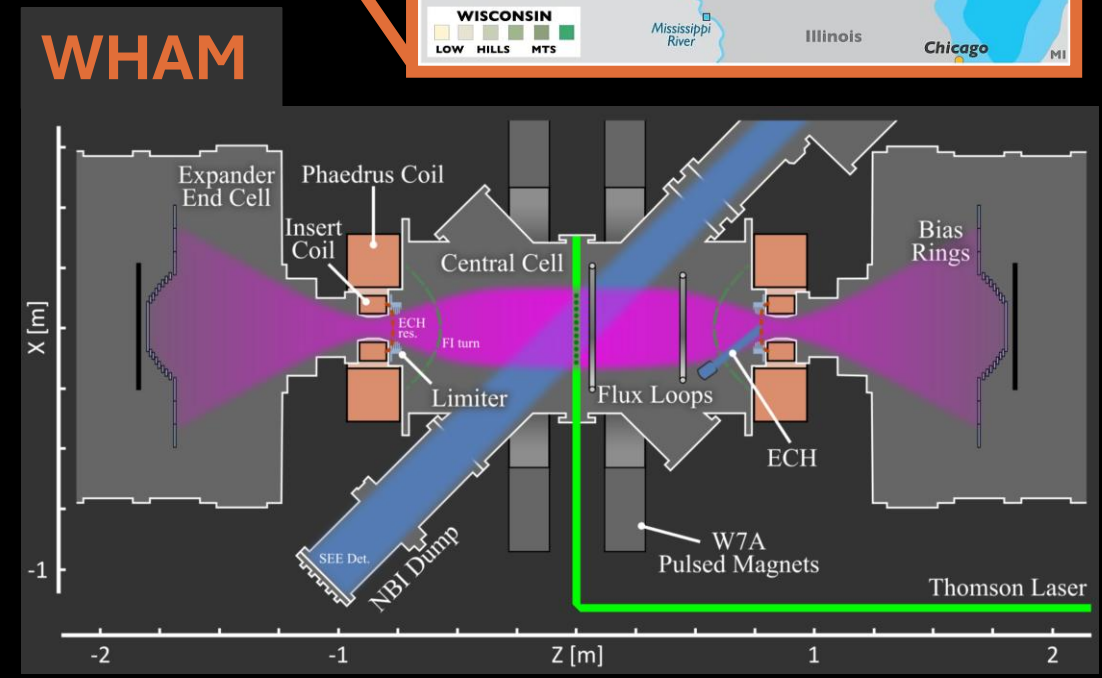
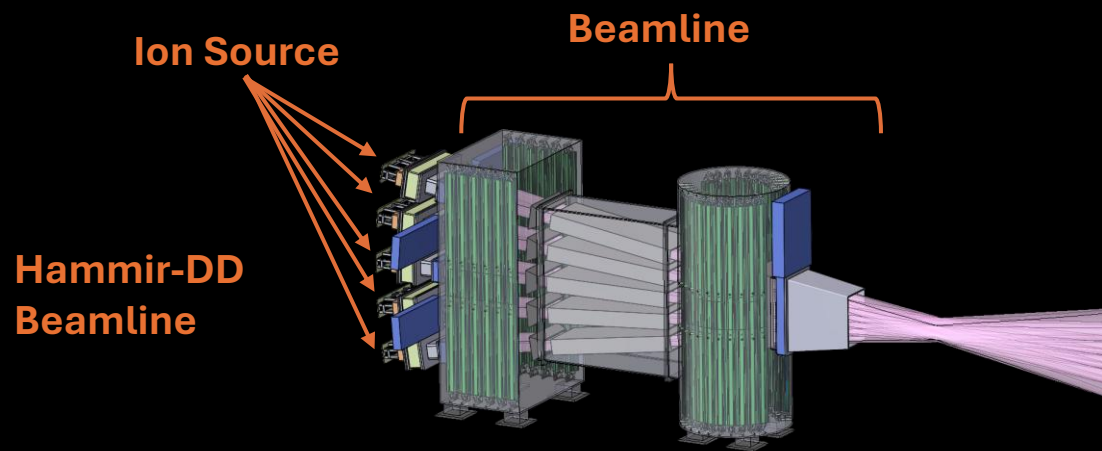
Thank you! Questions?

Please stay tuned for Joey Eickman's presentation on our modeling capabilities!
@ 3:35 PM

T+: +5.057 ms

File: 251209060.mp4 AcqRes: 480 x 120 Rate: 10000 Exp: 99 μ s





TRL = 9 pulse NBI ~ 20 keV

(WHAM)

TRL = 8 Long pulse NBI < 200 keV

HAMMIR DD

TRL 3 – 6 steady state NBI ~ 500 keV

HAMMIR DT

