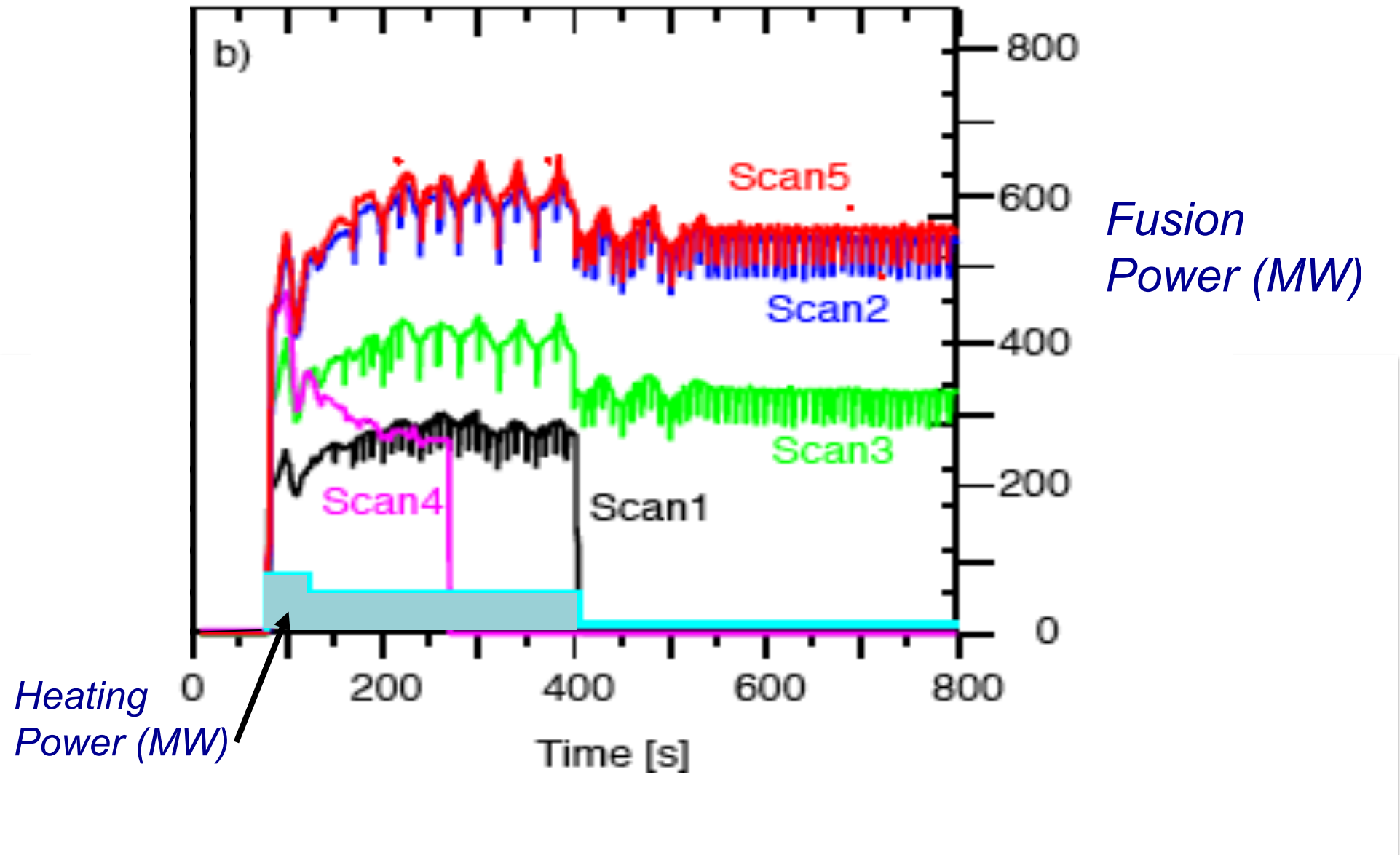


# Fusion Power Burn and .....

**Steve Cowley**

UK Atomic Energy Authority and Imperial College  
Contributions from Tim Hender, Ian Chapman and  
MAST team,

Simulation by Bob Budny: Based on JET, DIII-D results



Superconducting magnets

Blanket for tritium breeding and heat exchange.  $\sim 2\text{MWm}^{-2}$   
Neutron power crossing boundary

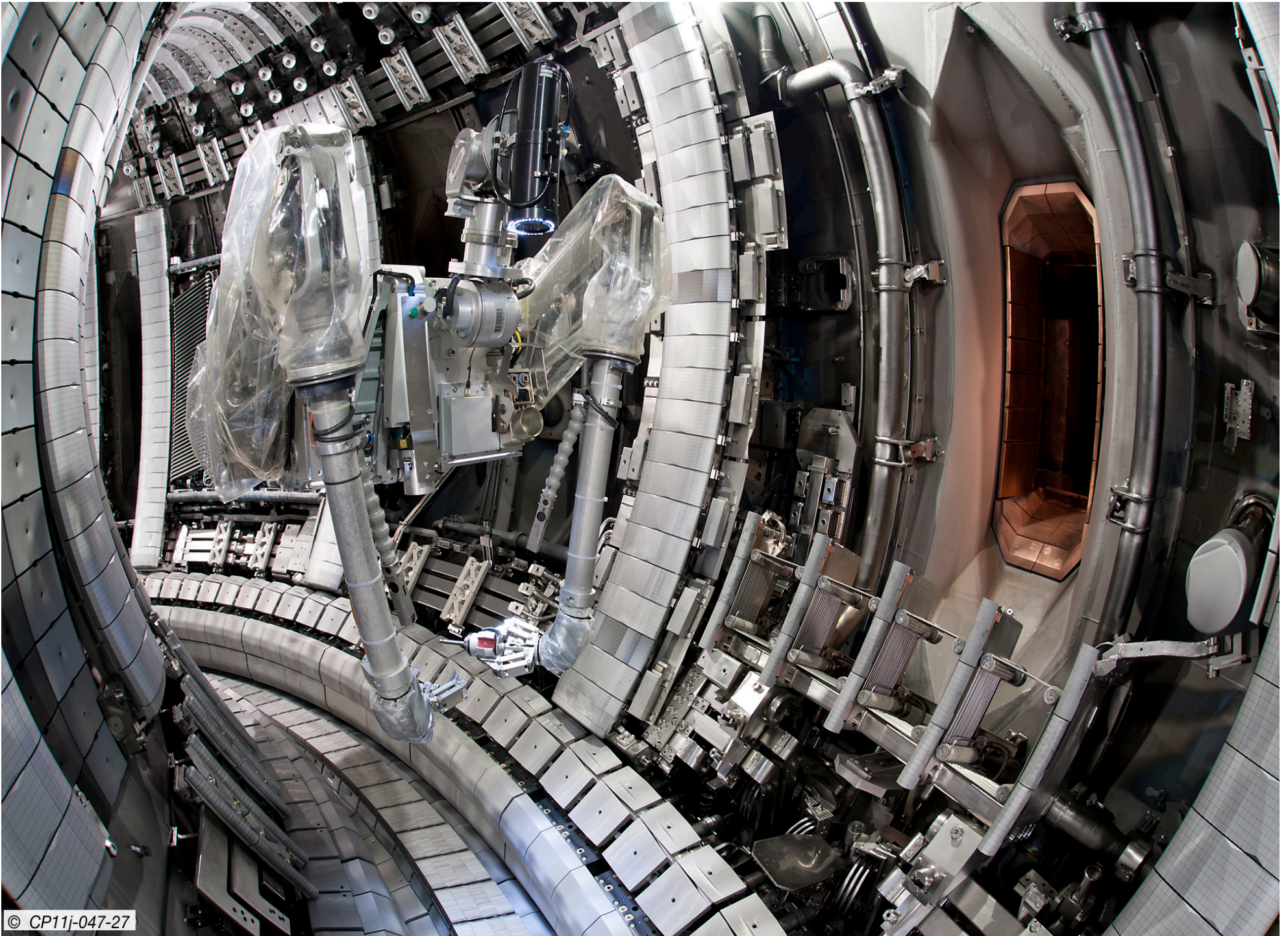
# 2040 ?

Shielding

Plasma exhaust, power loading  $>10\text{MWm}^{-2}$

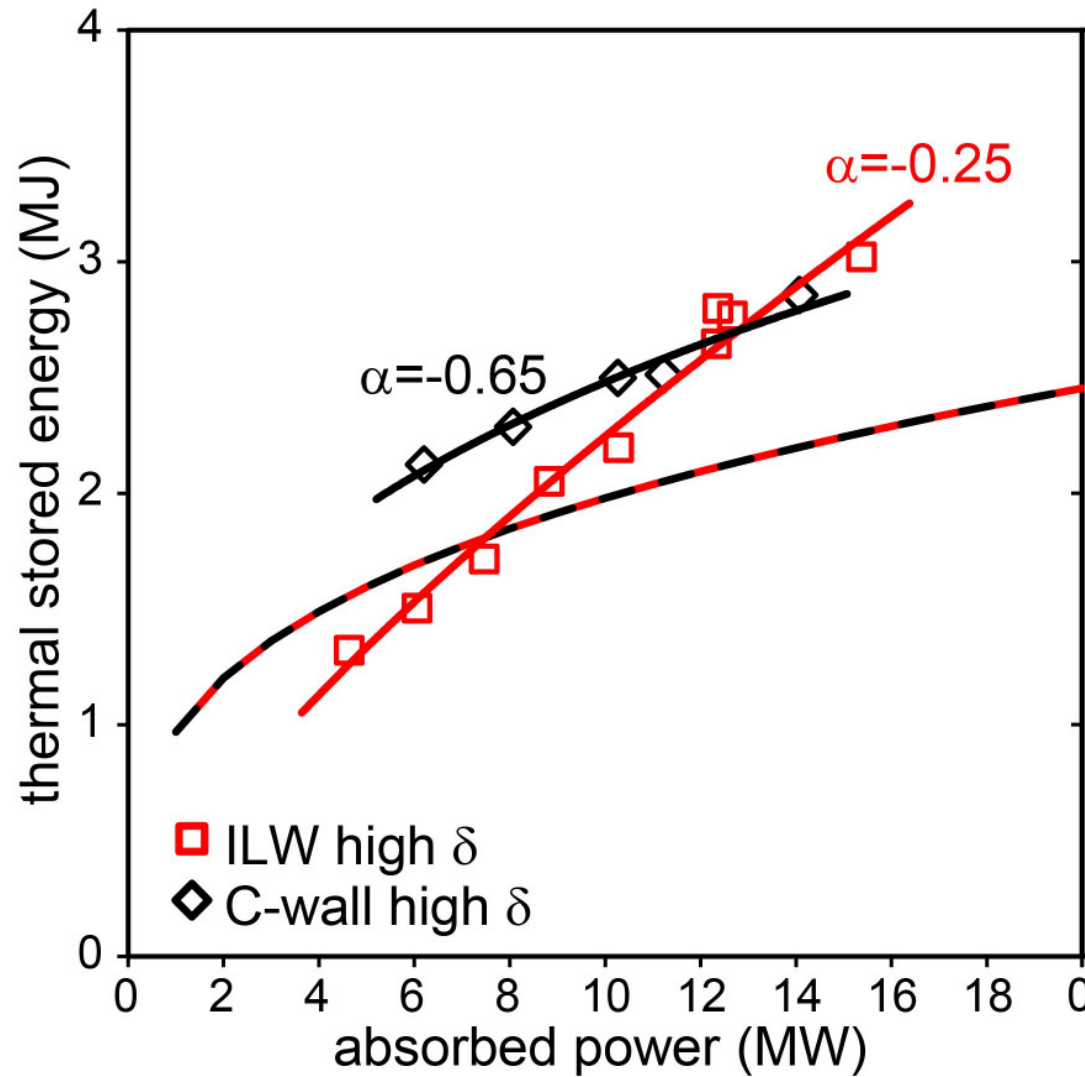
- “Fast Track to Fusion” – clear message.
  - EFDA roadmap – clear message
- US position – unclear, contradicts EU?
  - FESAC panels 10 year plan
- Is fusion necessary? By when?
  - could it all be done with solar (McKinsey 2014)?
- Does ITER cost reflect the intrinsic cost of fusion?
  - if not can we estimate cost?
- Is DEMO a scaled up ITER?
  - US view.
  - if not what is needed?

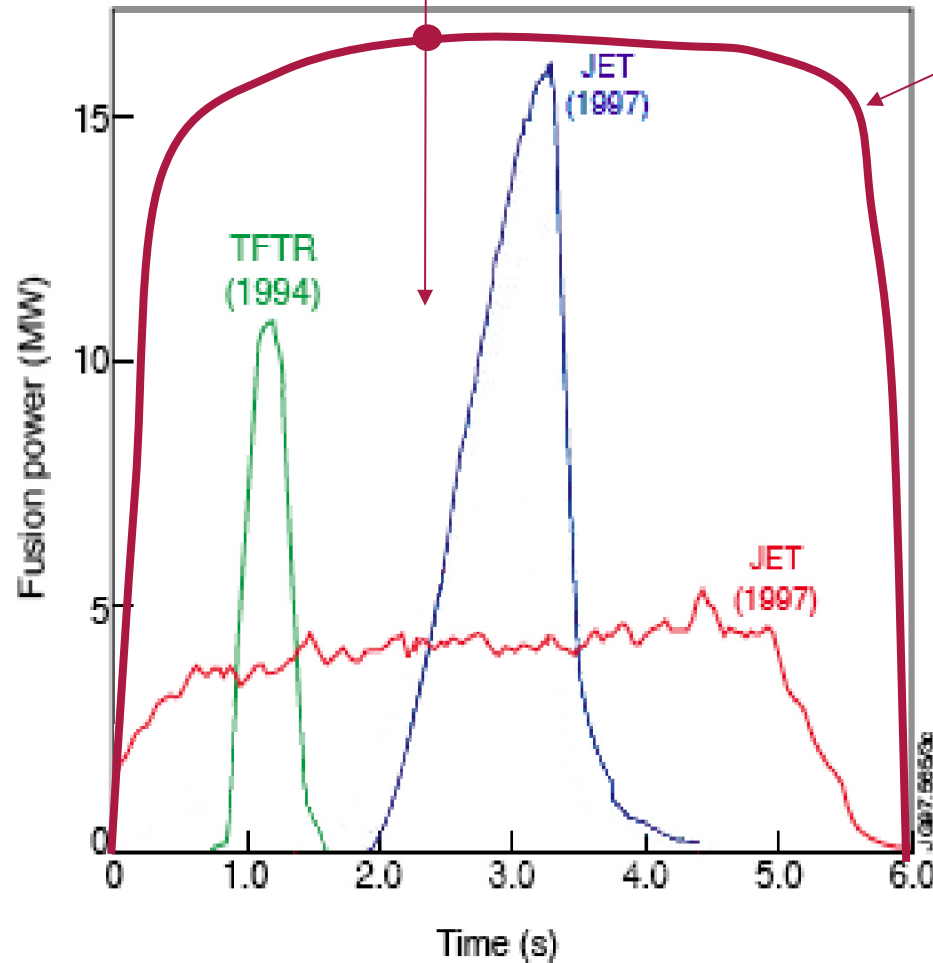
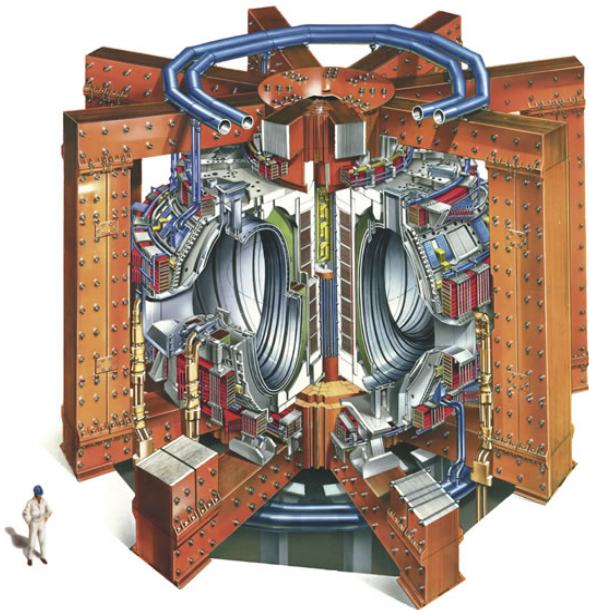






Challis 2014



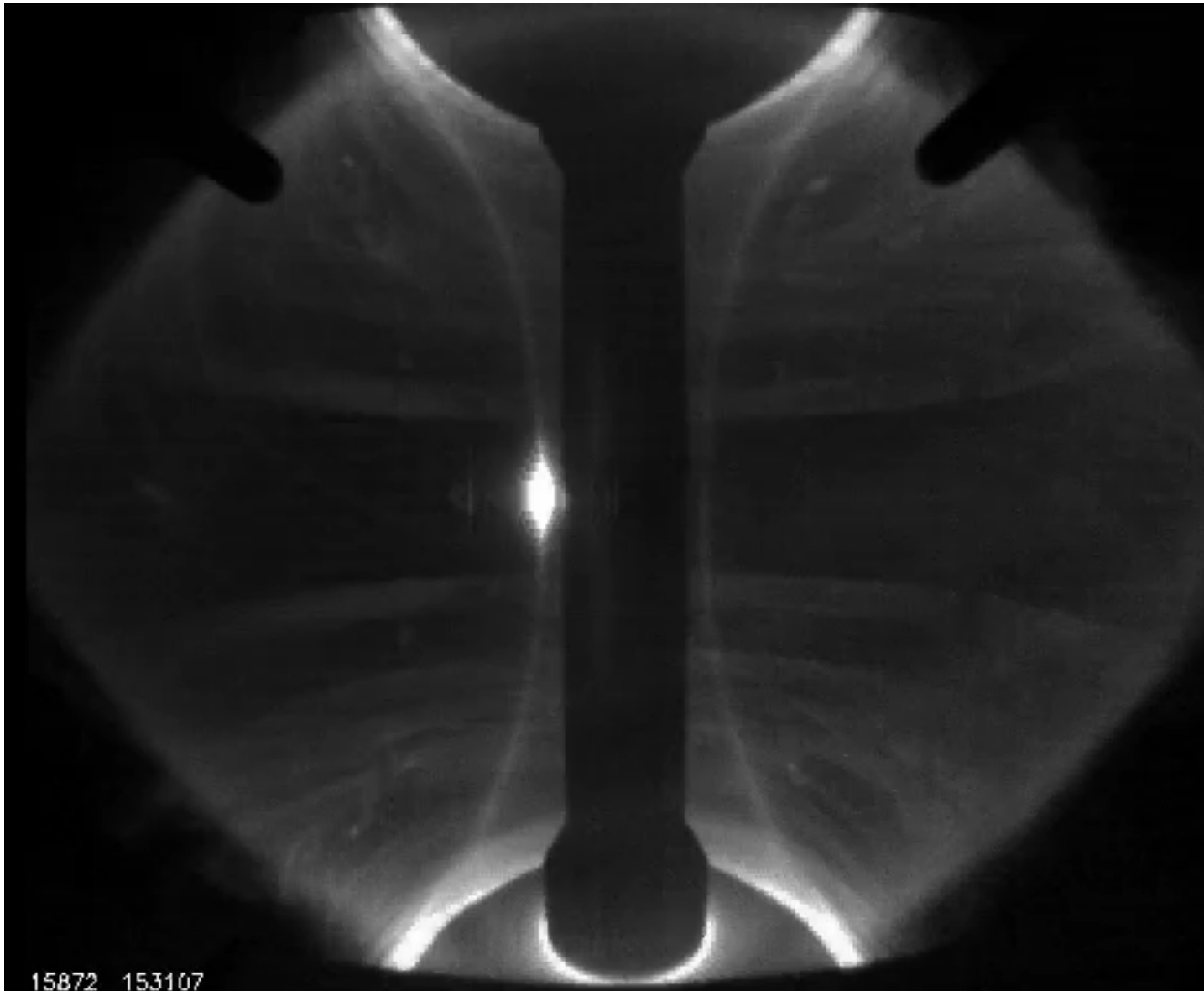


JET 2017  
Prediction  
Romanelli  
2014

We need a very good tritium run

Can we do fusion at a compact  
scale?

Faster, cheaper, smaller?



15872 153107

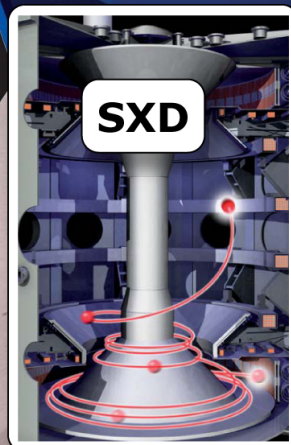


## MAST Upgrade Stage 1

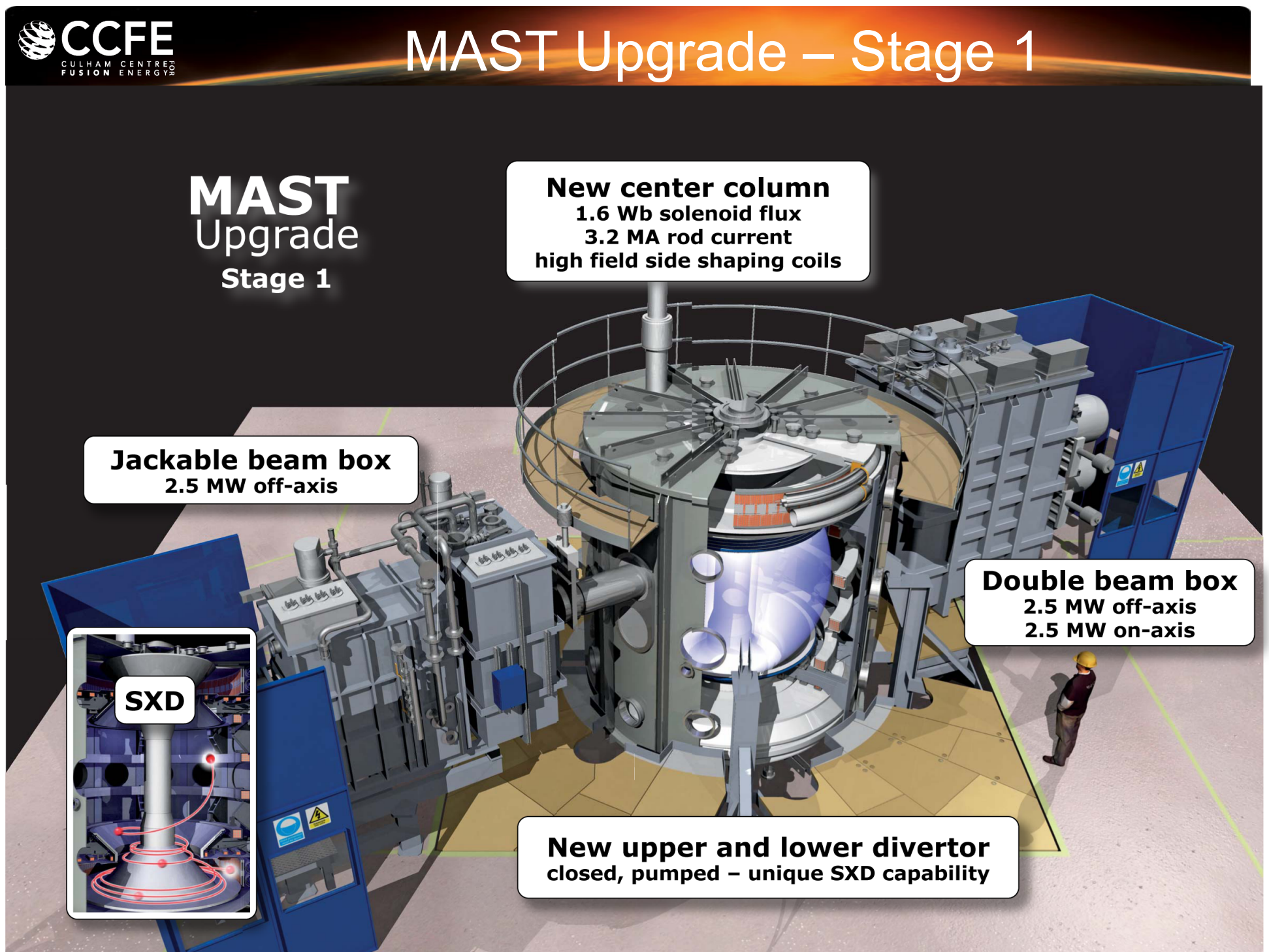
**New center column**  
1.6 Wb solenoid flux  
3.2 MA rod current  
high field side shaping coils

**Jackable beam box**  
2.5 MW off-axis

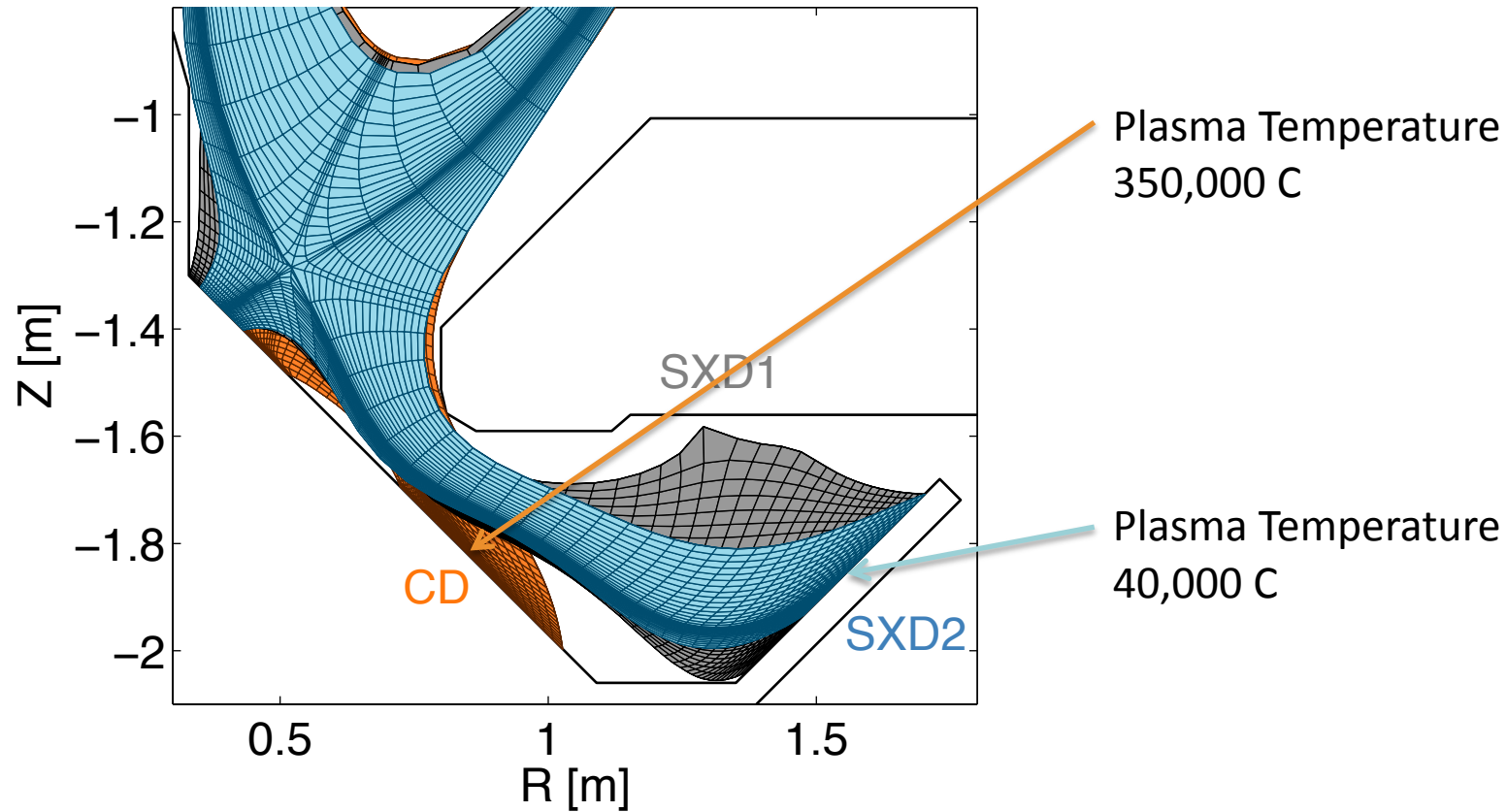
**Double beam box**  
2.5 MW off-axis  
2.5 MW on-axis



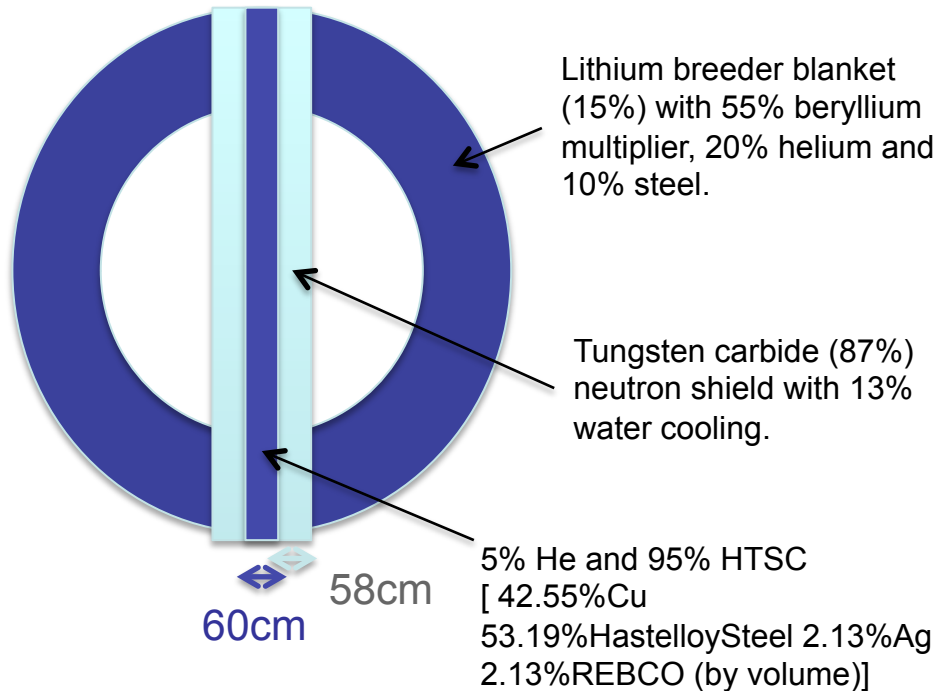
**New upper and lower divertor**  
closed, pumped – unique SXD capability



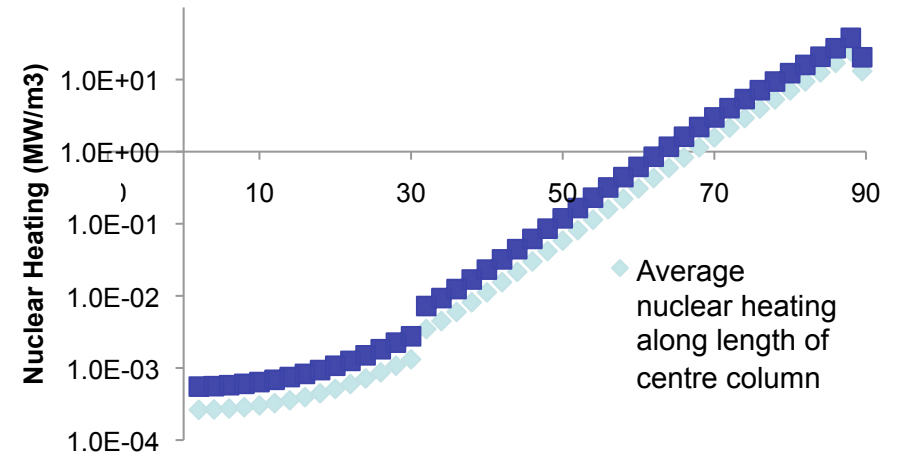
E Havlicková, J Harrison, B Lipschultz, G Fishpool, A Kirk, A Thornton, M Wischmeier, S Elmore, S Allan







**Nuclear heating through centre column (in cylindrical layers increasing in radial distance from the centre point )**



Nuclear Heating Centre Column	1.9kW	2.9MW cryo power at 10% of Carnot
Fast neutron flux at Centre Column	$8.1 \times 10^{14} \text{ n/m}^2/\text{s}$	1.8 year lifetime (at $5 \times 10^{22} \text{ n/m}^2$ limit)
Tritium Breeding Ratio	1.27	No holes!

Our message is confused and  
needs work.

Innovation before DEMO is  
possible.

Spherical Tokamaks will help  
innovation