

NSTX-U Active Cooling

- **Why consider?** Eventually active cooling is a part of every reactor concept (ReNeW thrust 11: Improve power handling through engineering innovation)
 - Nearer-term: an implicit part of the slow-flow liquid metal PFC concepts (soaker hose/Li CPS, FLiLi, LiMiT – even SnLi/Sn)
- **How urgent for NSTX-U?** First year of operation will determine new thermal response of PFC tiles to determine if NSTX-U CS cooling is adequate
- **What's available now?** Gas cooling schemes are under active development around the world improving He cooling efficacy (via T-tubes/thimbles and other clever arrangements)
- **NSTX-U divertor could provide demonstrator for these technologies or for something even more innovative...**

Concept of “Active PFC”

- NSTX-U will not be steady-state, nor is it short-pulse. 1/2” ATJ has thermal time constant of 1.7s, but inter-shot time will be >750s(12.5min) and NSTX-U PFCs still need to deal with multi-MW/m² heat fluxes *in some locations*
- Liquid metal heat-pipes/vapor-chambers can achieve relevant heat fluxes and **spread** incident power at modest temperatures (e.g. sonic limit of 500C sodium is 6MW/m²)
- Combine with thermal “accumulator” (e.g. copper block) for short-pulse storage (2cm Cu over 1m² can store 7MJ with 100C rise, i.e. LLD-scale)
- Can pull energy from accumulator over longer time period via simple cooling pipes – reduces flow rate requirements and complexity
- Can extrapolate to reactor by mitigating need for intense gas cooling via spreading of incident heat flux, internal working fluid determines operating temperature range

