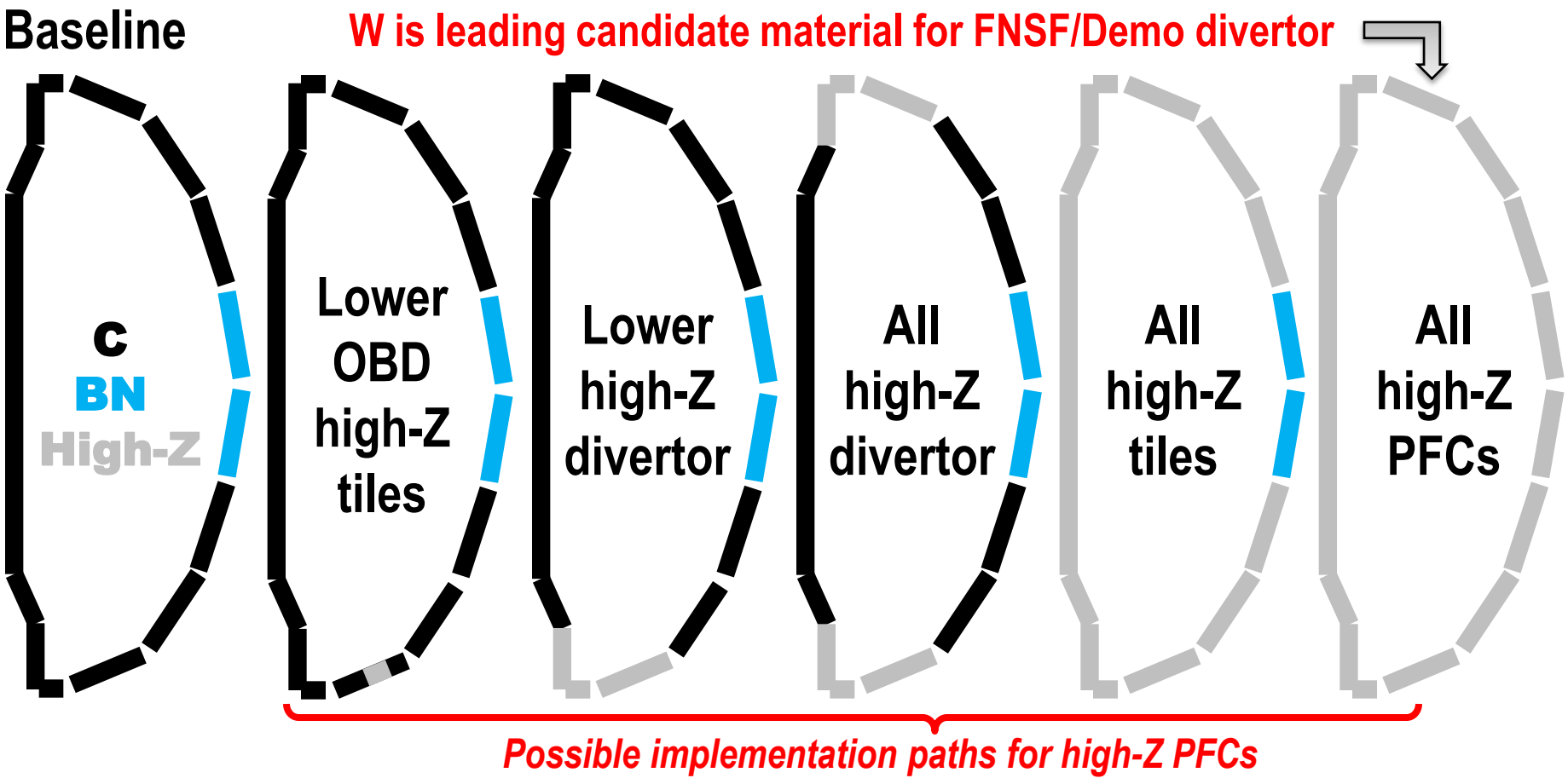
NSTX-U 5 year plan goal: implement cryo-pumping and *begin* transition to metallic PFCs to support PMI / FNSF next-steps

- Long-term goal: assess compatibility of high τ_E and β + 100% NICD with metallic PFCs



A possible approach

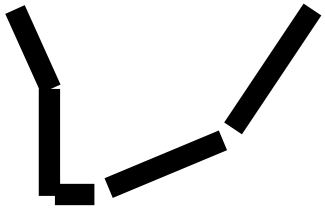
- Start with all graphite PFCs:
  - Most tolerant PFC to high heat flux, disruptions, impurity accumulation
  - Compare/contrast to previous full C PFC operation of NSTX
  - Included in NSTX Upgrade project – minimizes cost and time
- Implement cryo on bottom outer divertor (bakeable baffle)
  - Establish density control without lithium coatings
  - Develop cryo-only scenarios for next-steps, compare to Li coatings
  - Diagnose pumped plasmas (many divertor diagnostics view bottom)
  - Reversed-B_T field-line pitch not compatible with BES, GPI, tFIDA views
    - LSN ∇B-drift up is standard / best-diagnosed configuration from NSTX
- Put first high-Z PFC tiles at larger R on lower outboard divertor
  - Begin transition to high-Z PFCs to support PMI / FNSF next-steps
  - Minimize risk to standard higher-δ shapes and scenarios
  - Assess high-Z tile design(s) tolerance to thermal loads and disruptions
  - Assess erosion, migration of high-Z materials
  - Small high-Z area to compare Li on C vs. Mo/W, bakeable → mini-LLD
- Increase high-Z coverage as plasma/PFC performance permit

Some implementation decisions for cryo + high-Z PFCs
Baseline plan – 2015-2018

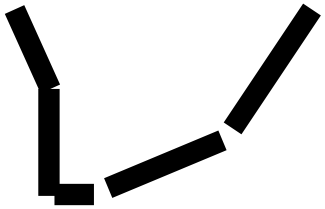
Lower risk/slower path

More aggressive path

2015

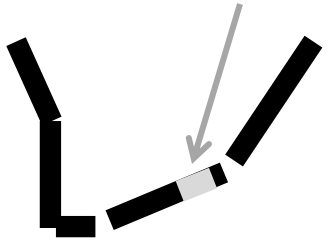


2016



- Minimize risk, cost, and time

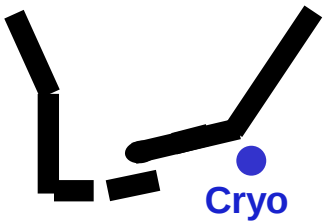
Or



- Earlier start on high-Z research
- Inform decision on high-Z tile row for cryo-shelf

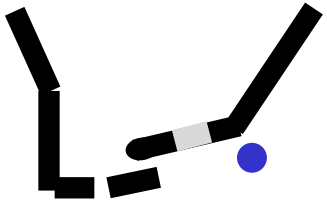
Extended outage

2017



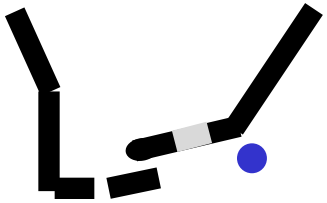
- Avoid mixed PFC materials

Or



- Earlier start on high-Z research
- Inform full high-Z divertor decision
- Bakeable baffle → tile-based LLD

2018



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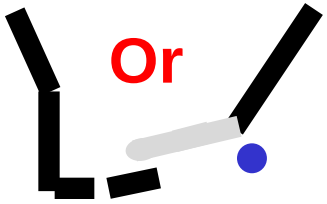

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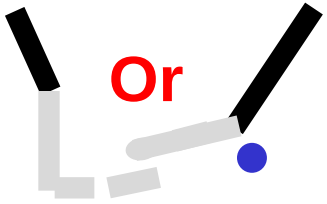
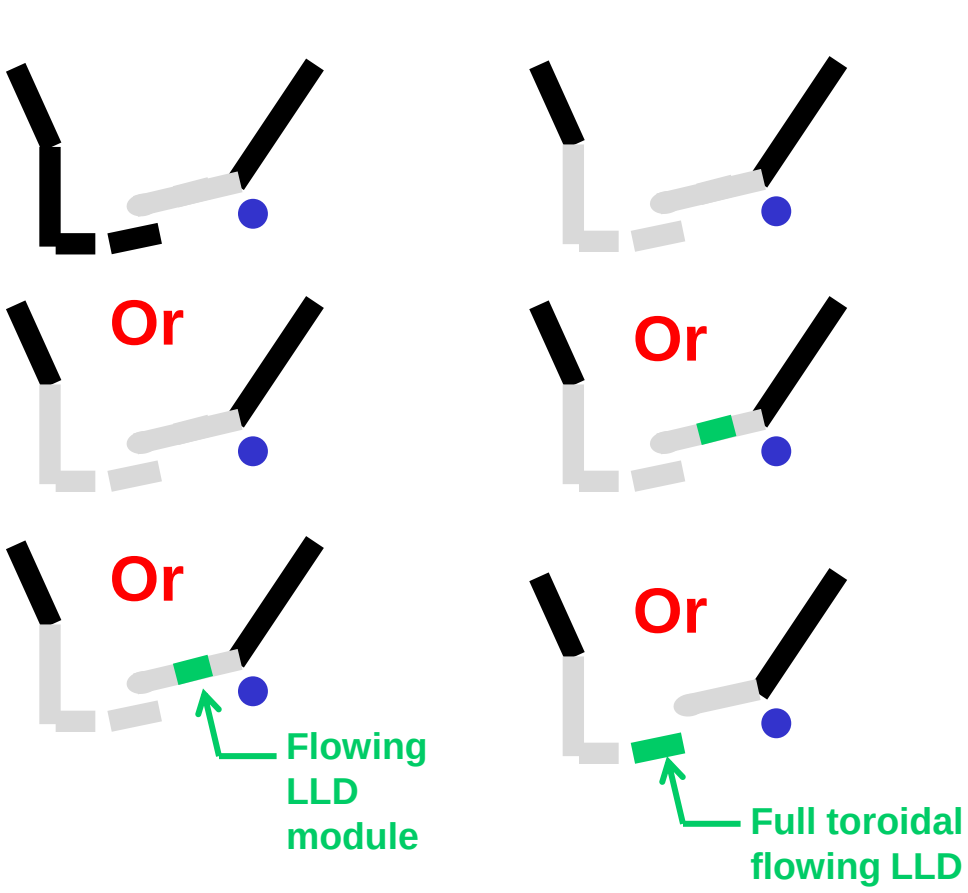
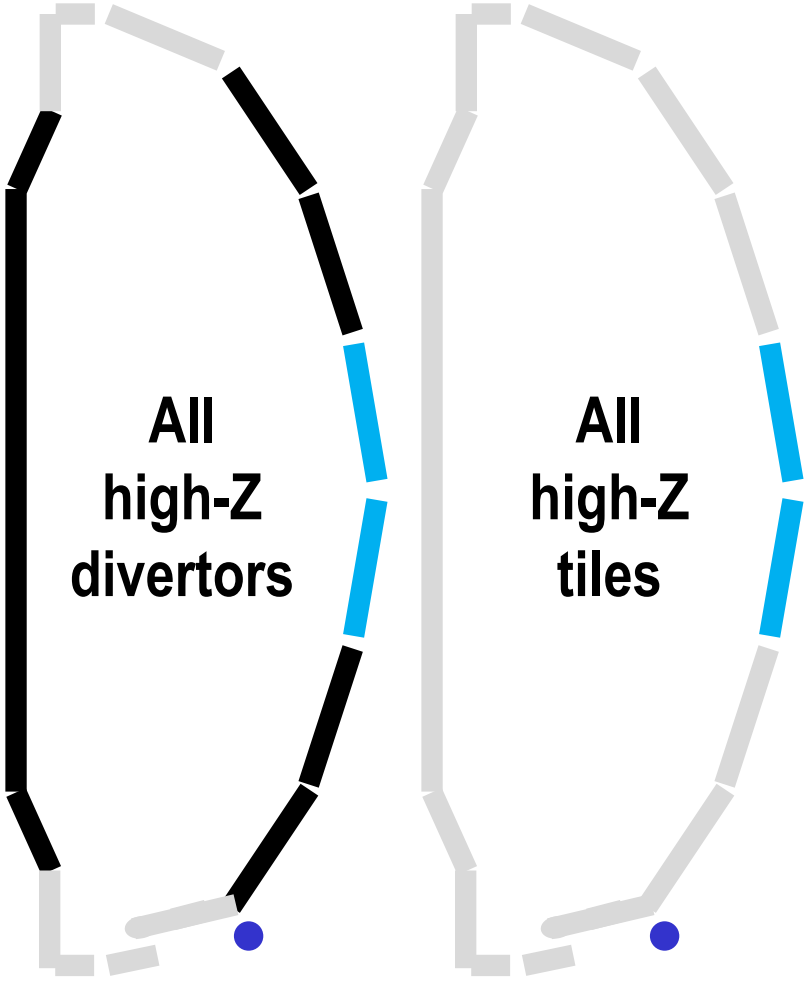


- Inform decision on full high-Z coverage of upper divertor and wall
- Full high-Z lower LLD

Long-term decisions for 2019-22





For 5YP, MP groups need to be specific about the ideas that will be considered for how PFCs would be implemented

- Example options to be considered and described are provided below. Can/should reference/quote results/plans from other facilities (JET, EAST, ASDEX)

- High heat flux regions (strike-point regions)
  - W Lamellae or TZM tiles
- Intermediate heat flux regions (cryo-baffles, CS midplane)
  - TZM tiles
- Low heat flux regions (passive plates, CS off-midplane)
  - W-coated graphite