LLD 2D Mirnov Rework.

Work Planning Number (LLD # 1382)

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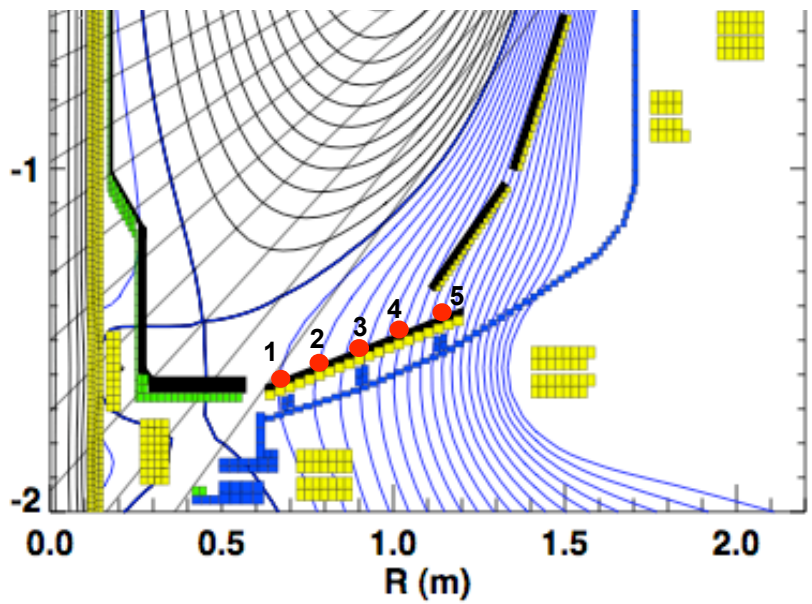
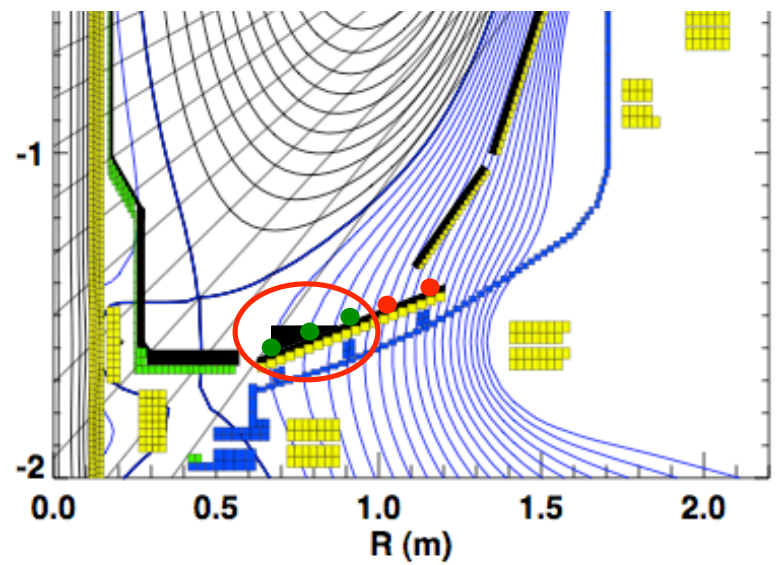
Goal: Maintain The Functionality of the Lower OBD Mirnov Array For Operations with LLD.

- 5 rows of tiles in the OBD
- At 217.5 toroidal angle, each tile has a 2D Mirnov Sensor (i.e. measuring field both normal and tangent to the tile surface).
- Critical for equilibrium reconstruction with EFIT, LRDFIT.
- Used as constraints in RT-EFIT.
- Three of those tiles, and the associated sensors, will be replaced for LLD.

Must devise a plan to replace these sensors, preserving the present functionality.





Which Sensors are Impacted?

2DM: Two-Dimensional Magnetic Sensor
OBD: Outboard Divertor
L: Lower
1,2,3,4,5: Which one of the 5
T,N: Normal or Tangent Field

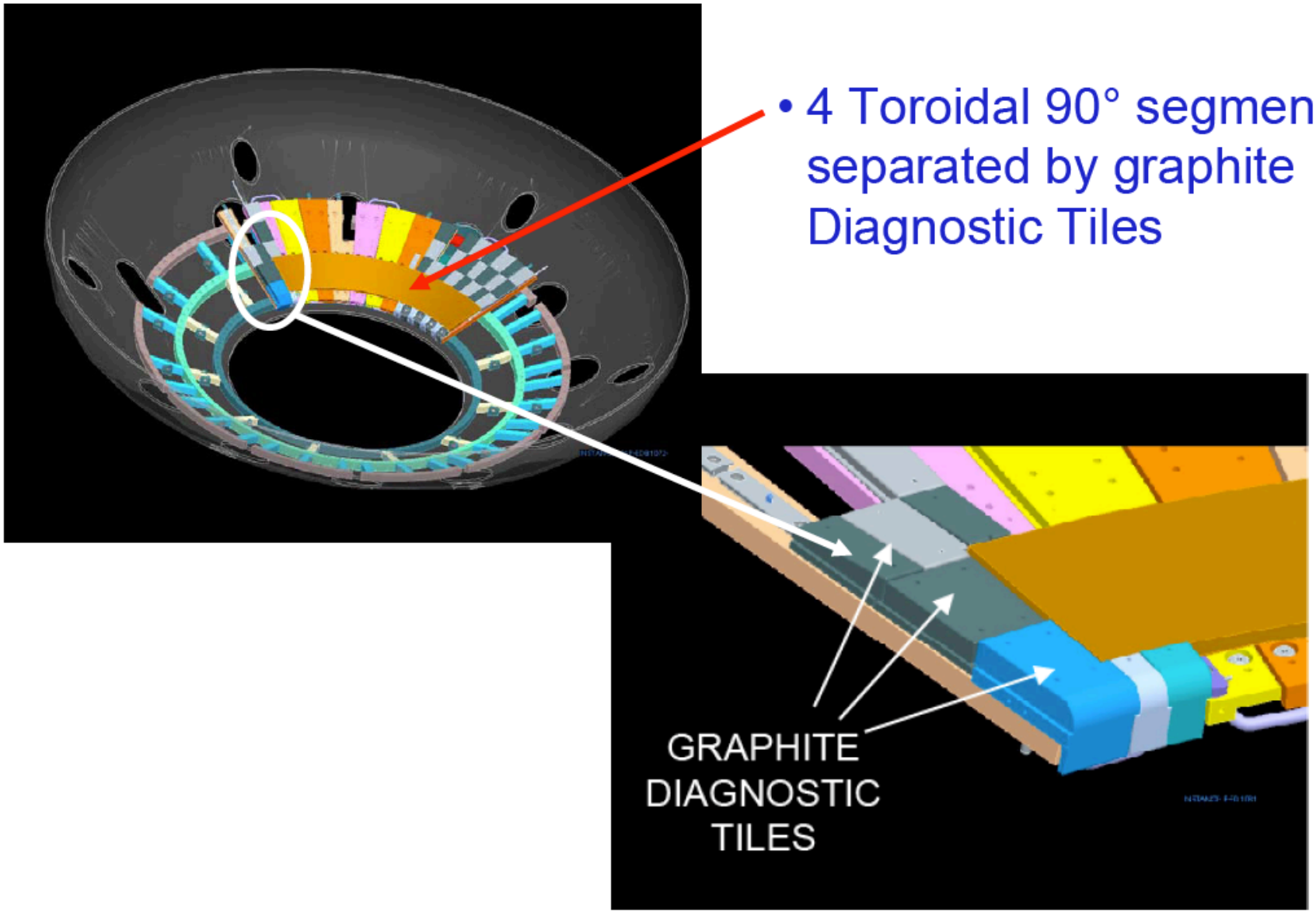
Used for Equilibrium Constraints

Used for "Wiggle Watching"

Sensor	R (m)	Z (m)	TANGLE1
B_2DMOBDL1T	0.6816	-1.6153	217.5
B_2DMOBDL1N	0.6816	-1.6153	217.5
B_2DMOBDL2T	0.7900	-1.5726	217.5
B_2DMOBDL2N	0.7900	-1.5726	217.5
B_2DMOBDL3T	0.9055	-1.5271	217.5
B_2DMOBDL3N	0.9055	-1.5271	217.5
B_2DMOBDL4T	1.0211	-1.4816	217.5
B_2DMOBDL4N	1.0211	-1.4816	217.5
B_2DMOBDL5T	1.1366	-1.4361	217.5
B_2DMOBDL5N	1.1366	-1.4361	217.5

Need to Be Replaced

LLD!

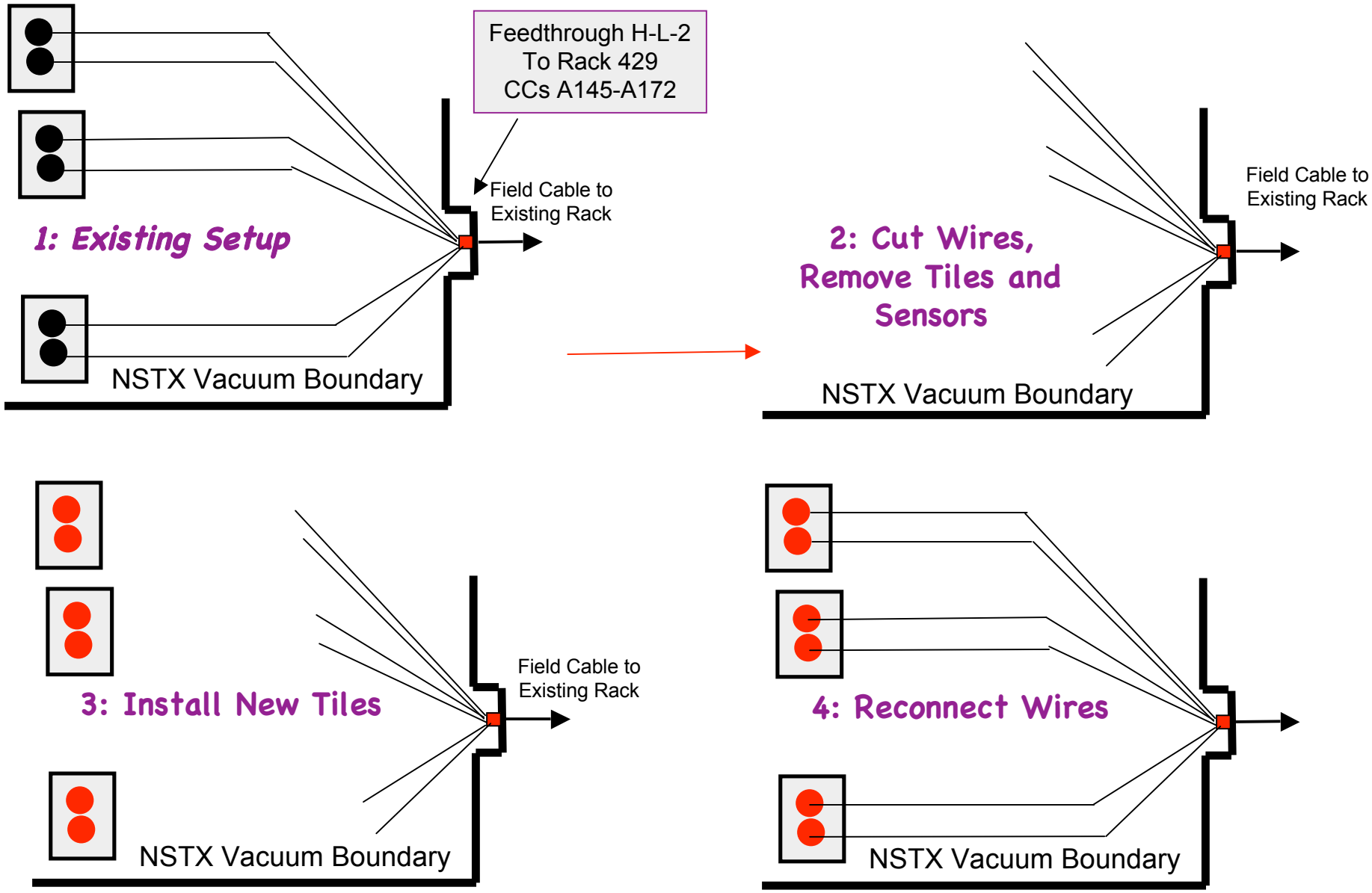


- 4 Toroidal 90° segments separated by graphite Diagnostic Tiles

Overall Scheme

- LLD is divided into 4 sectors, with “diagnostic” tiles located in the gaps.
- LLD is clocked so that a gap tile overlaps with the existing sensor array-> toroidal angles are unchanged
- The present sensors are imbedded in tiles, with i) a pocket to hold the sensor, and ii) a channel to carry out 4 wires.
- New tiles will be machined the same way, so that the poloidal location (R,Z) of the sensors is not significantly modified.
- The existing in-vessel cables will be utilized.
- No need for CWD modifications, no need to touch existing feedthroughs, no new electronics or field cables.

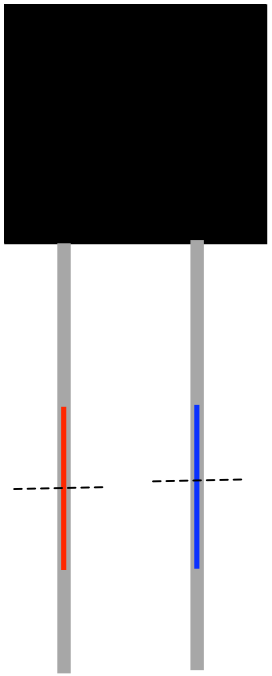
Elementary Schematic



How Do We Remove Existing Tiles?

How To Keep Track of Which Lead Goes to Tangent Sensor And Which Goes to Poloidal Sensor.

- Remove Surrounding Tiles Sufficiently Expose the Leads.
- Mark one pair of leads blue, the other red.
- Cut the leads across the colored mark, leaving some color on in-vessel leads and some on the sensor leads.
- Mark the in-vessel leads with the tile they originated from.
- Take the tile to the lab and determine which sensor (tangent or normal) goes with which lead.
  - ~~Destructively, by extracting the sensor.~~
  - Kindly, using a Helmholtz coil. Allows reinstallation if necessary.



Other methods of marking the leads would be acceptable…colors are SPG's suggestion.

How Do We Prepare New Tiles?

- Weld ~6' leads to new sensors (2 pairs per sensor, S. Jurczynski).
- Insulate the weld beads.
- Mark the ends of the twisted pairs for the normal & tangent sensors.
- Cut cavities in the tiles.
  - Most removal of graphite for cavity done in the RESA shot, as per drawings.
  - Larry Guttadora and R. Ellis to co-ordinate the physical size of the cavity. Cavity to accurately locate the sensor, with space for Forta-Fix.
  - Can be touched with a Dremmel.
  - Add channel for leads with a Dremmel.
- Install the sensors in the tiles.
  - Use Forta-Fix to adhere sensor to tile.
  - Nextel to insulate sensor from T-bar.
  - Routine method, utilized all over NSTX.

How Do We Install (Electrically) New Tiles.

- At installation, we have tiles with long leads, with normal & tangent marked on them.
- We have leads going to the feedthroughs, color coded so that the tangent and normal leads are identified.
- Mechanically install the tile & route wires to the void behind the SPP.
- Connect the leads using standard crimp-connections of a hypodermic needle.
- Add any necessary insulation to the crimp.

Strategy Presented Should Meet All Requirements

- New sensors are located at same positions as old ones.
- Old tiles should have their functionality preserved.
- Sensors exist, we have lots of experience putting them in tiles.
- Procedures are specified for lead identification.
- Crimping procedure for splicing is well established.
- Procedures need to be written to ensure success.