SMES Coil Status

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BROOKHAVEN NATIONAL LABORATORY
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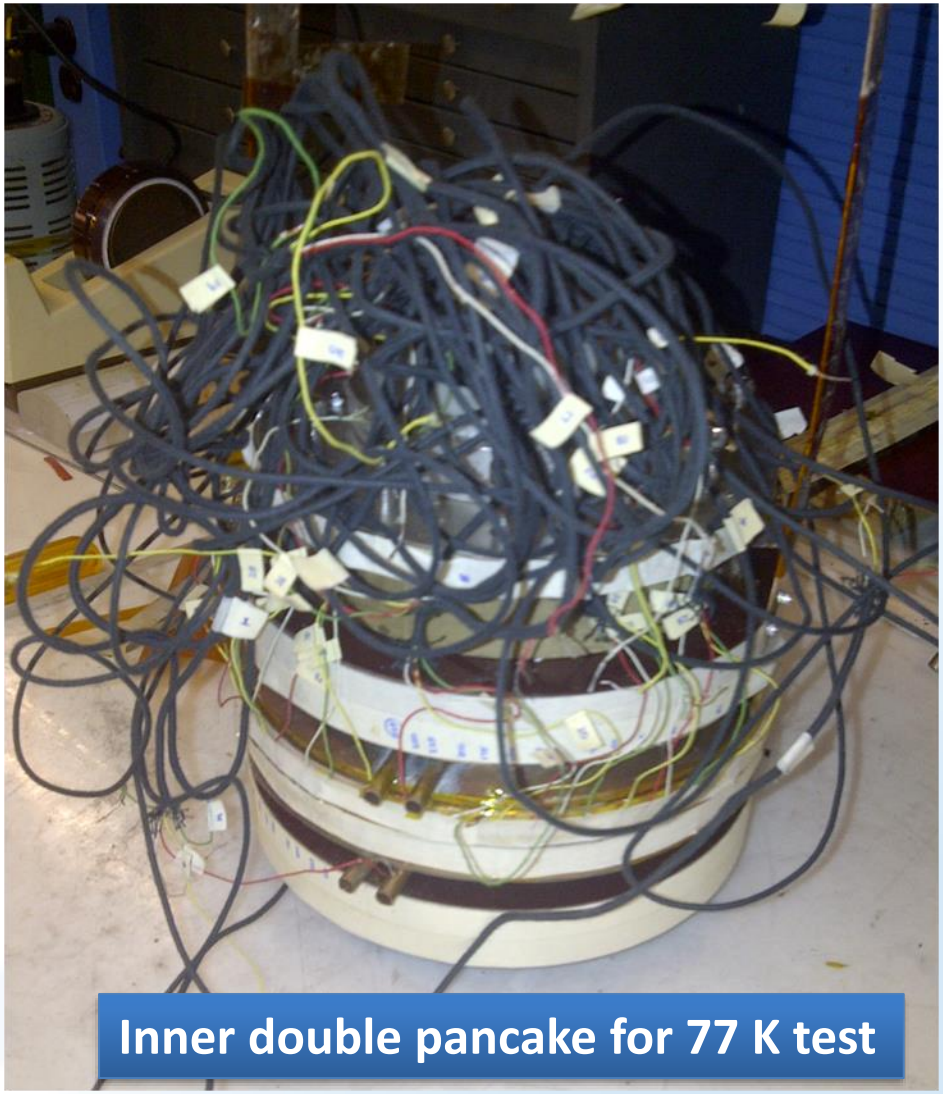
Overview of Activities

- Inner coil construction and 77 K QA test
  - All 28 inner coils wound; all 14 double pancake tested
  - A significant internal milestone met right on schedule
- Outer coil construction and 77 K QA test
  - 1 single pancake tested; 3 completed winding, 4th is being wound
- Construction of test fixture for outer double pancake tests at 77 K and 4 K
  - All parts received; final machining and assembly underway
- Progress in the developing electronics with coil subdivided for quench protection
  - Slides by Piyush Joshi
- Evaluation of alternate scenarios for integration if plus-up funding not received
  - Three options, one with 4 K testing (details in James Higgins presentation)
- Update on Milestones
- Summary

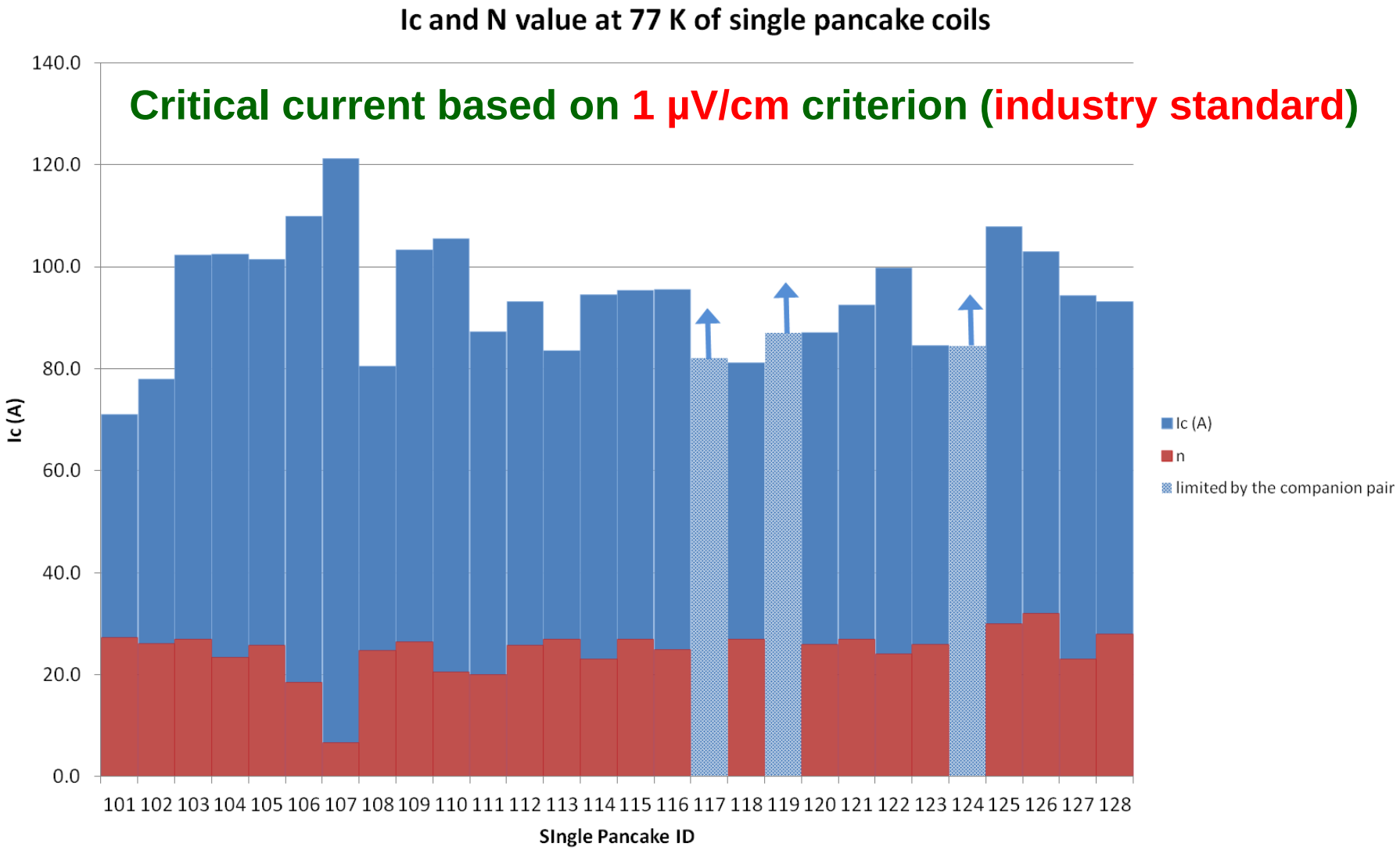
77K Test of Each Double Pancake

- Each double pancake is subjected to a detailed QA test at 77 K (see the amount of instrumentation on right).
- This assures that all joints are good and the conductor, as wound in coil, does not have an unacceptably large drop in performance along the length.
- A weak link at wrong place may limit the performance of the entire system as the conductor is subjected to unprecedented level of stresses.
- A significant variation in performance has been found from pancake to pancake (both in the overall critical current and in the distribution within).
- These measurements are allowing us to use 100% of pancakes by appropriately choosing their location.



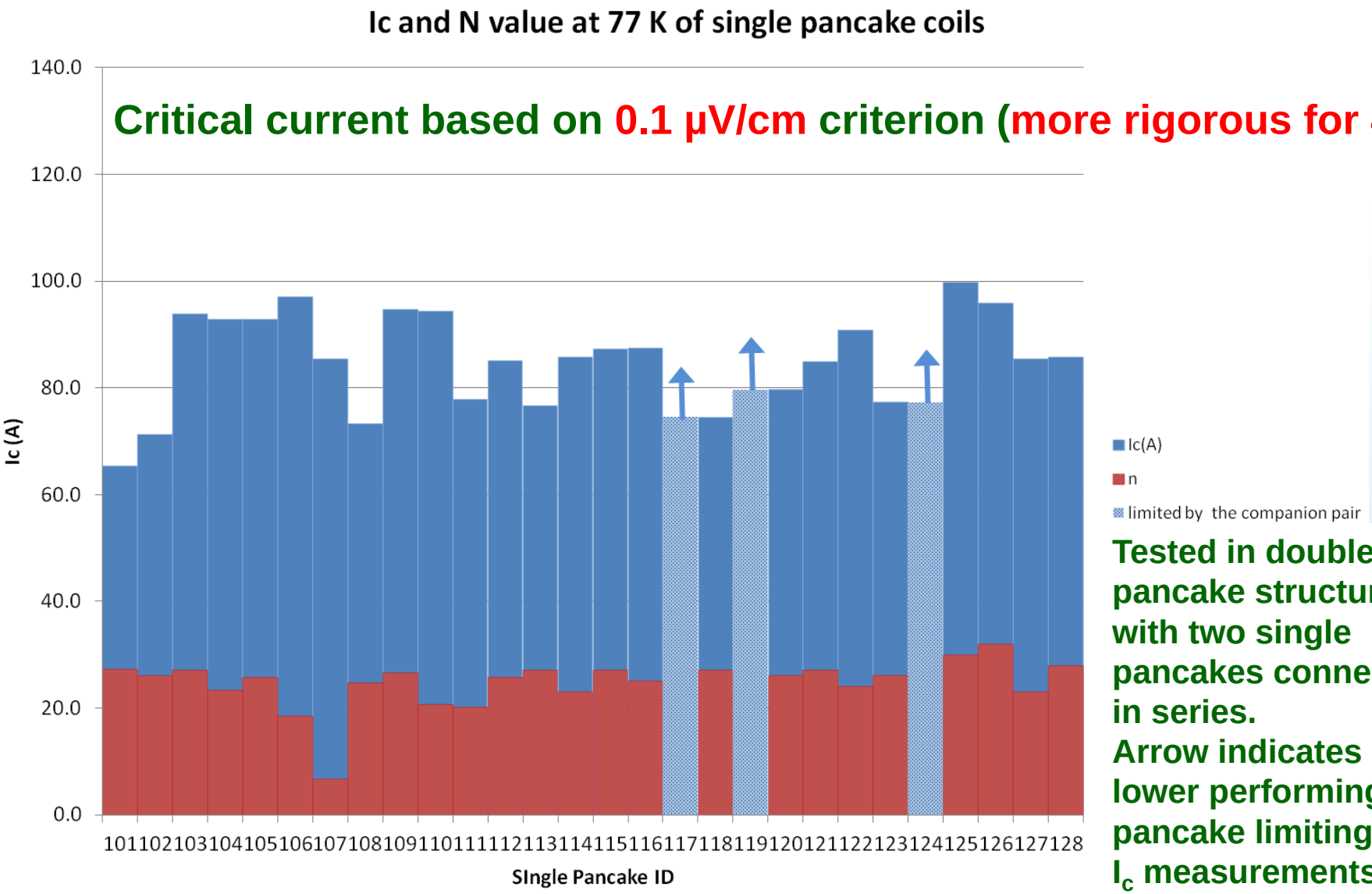
Inner double pancake for 77 K test

Summary of 77 K test of all inner pancakes



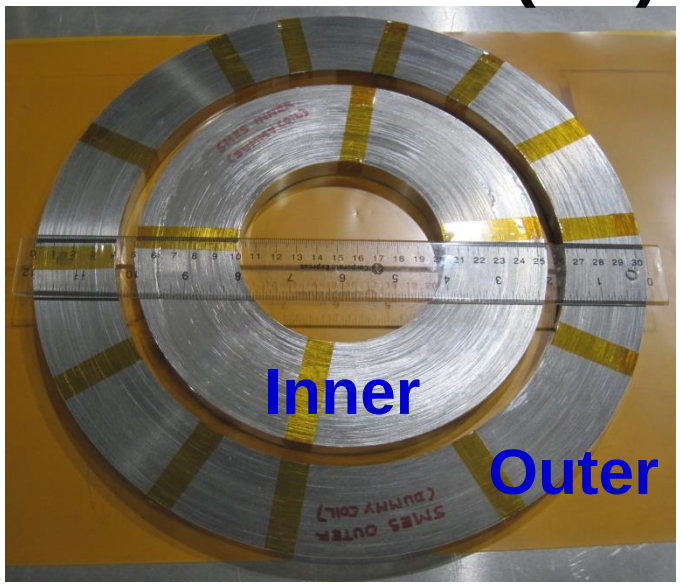
Tested in double pancake structure with two single pancakes powered in series.
Arrow indicates lower performing pancake limiting the I_c measurements.

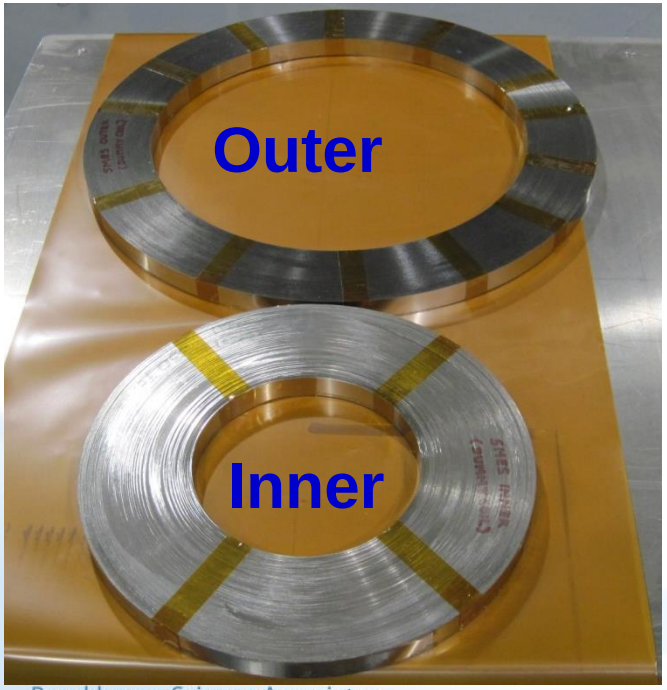
Summary of 77 K test of all inner pancakes



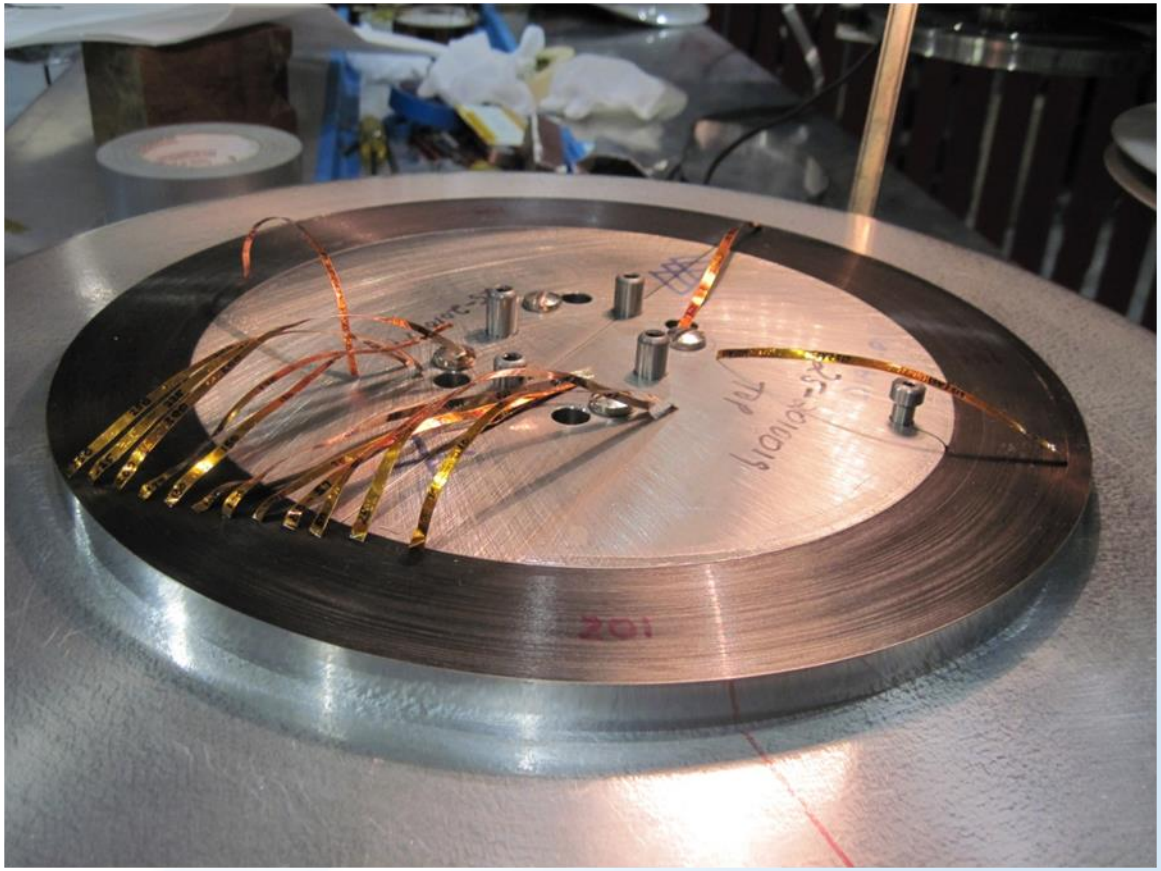
Tested in double pancake structure with two single pancakes connected in series.
Arrow indicates lower performing pancake limiting the I_c measurements.

Practice coils (SS)





Outer Pancake #1

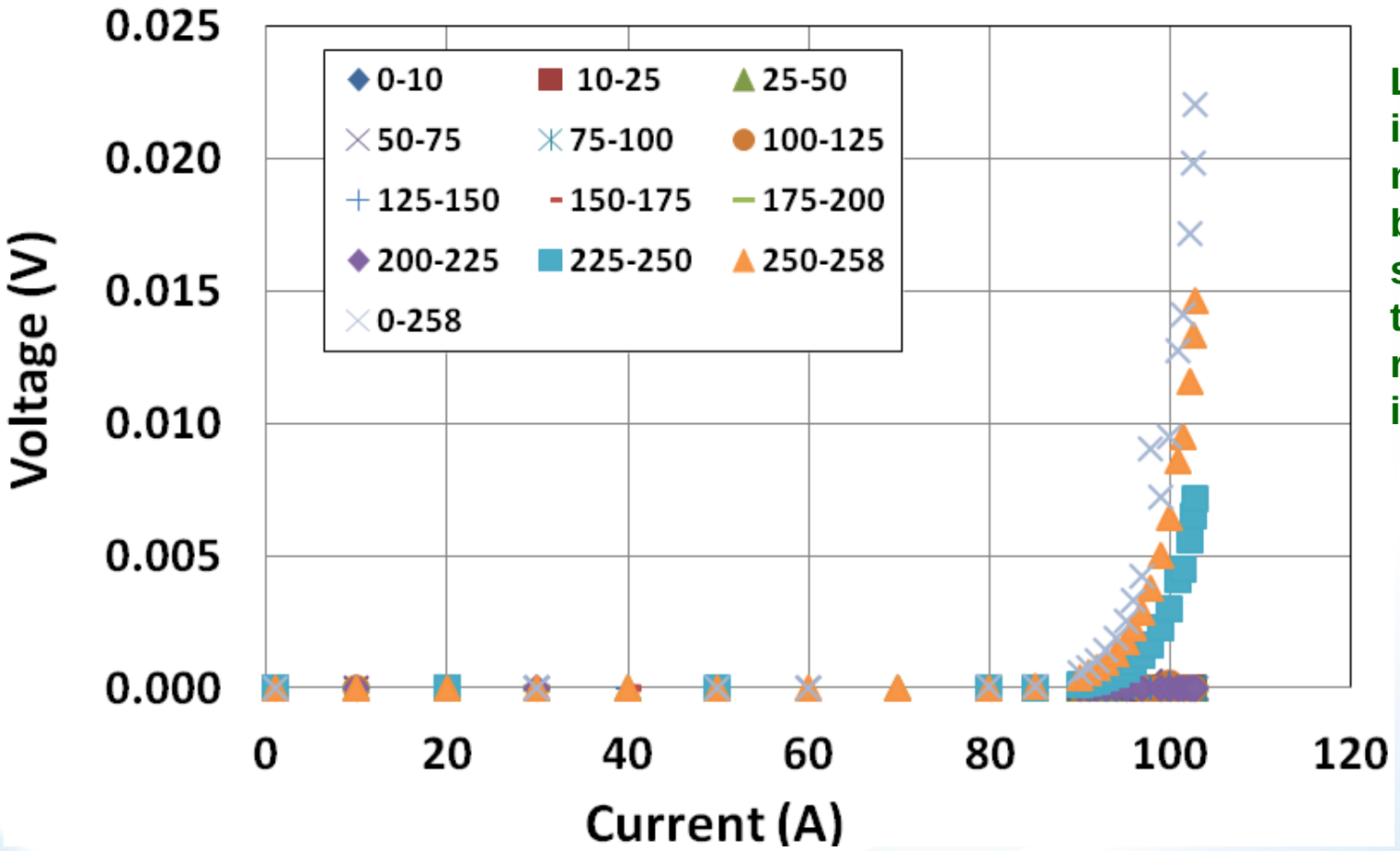


Made with ~210 meter of 12 mm tape with 65 micron copper.
25 micron of SS tape between turns (No. of turns = 258).

77 K test set-up for outer single pancake

- A simpler single pancake test fixture to qualify outer pancake so that we can proceed with winding.
- Double pancake coil fixture is under construction (nearing completion) which will allow testing of joints and double pancake assembly.

77 K Test Result of the First Outer Pancake



Legends indicate the turn numbers between the sections where the onset of resistive voltage is measured

Pancake reaches over 100 A (1 μV/cm criterion)

- **Coil and winding techniques are acceptable**
  - ✓ **OK to proceed**

Preparation of the Test Fixture for the Outer Double Pancake (for both 77 K and 4 K tests)

Inner SS tube being machined to size after putting fiberglass epoxy insulation

More Parts of the Test Fixture for the Outer Double Pancake (for both 77 K and 4 K tests)

Work in progress. Some more machining and assembly is still needed.

The fixture should be ready in December for 77 K double pancake test.

A simpler single pancake test fixture was used to qualify construction.

Status of Milestones

- **SMD does not have any official milestone till Q11.**
- **Internal milestone of (a) construction of all inner single pancake and (b) assembly and 77 K QA test of all inner double pancake has been met - right on time.**
- **Q11 milestone (4 K test of 1.7 MJ SMES coil) is on track.**
- **Integration test has to be planned carefully.**

2 Power Supplies and Energy Extraction systems

2 Control and Quench detection systems

NI FPGA based Quench Detector

NI PXIe based Data Logger

NI PXI based Data Logger

NI FPGA based Quench Detector

Summary

- Inner pancake construction and 77 K QA testing has been completed.
- With proper sorting (based on the location of coil), we should be able to use all 28 pancakes in the final SMES assembly.
- First outer pancake has been successfully built and tested. 4th coil (of total 16 pancakes) is being currently wound.
- Fixture for testing outer double pancake is getting ready.
- Construction of quench protection electronics is progressing well.
- Integration plans have to be carefully developed.

Backup Slides