Progress with the Field penetration experiment

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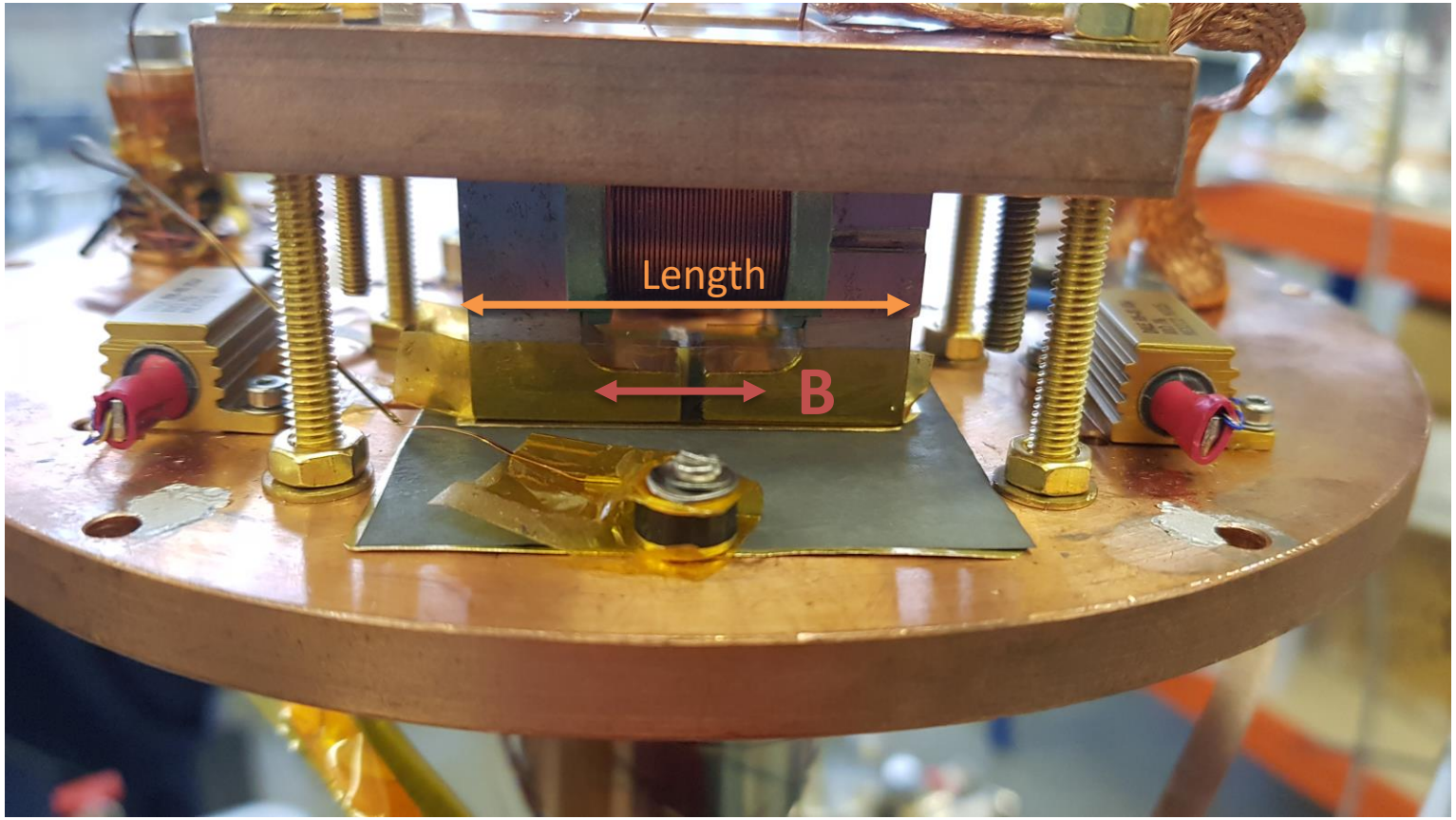
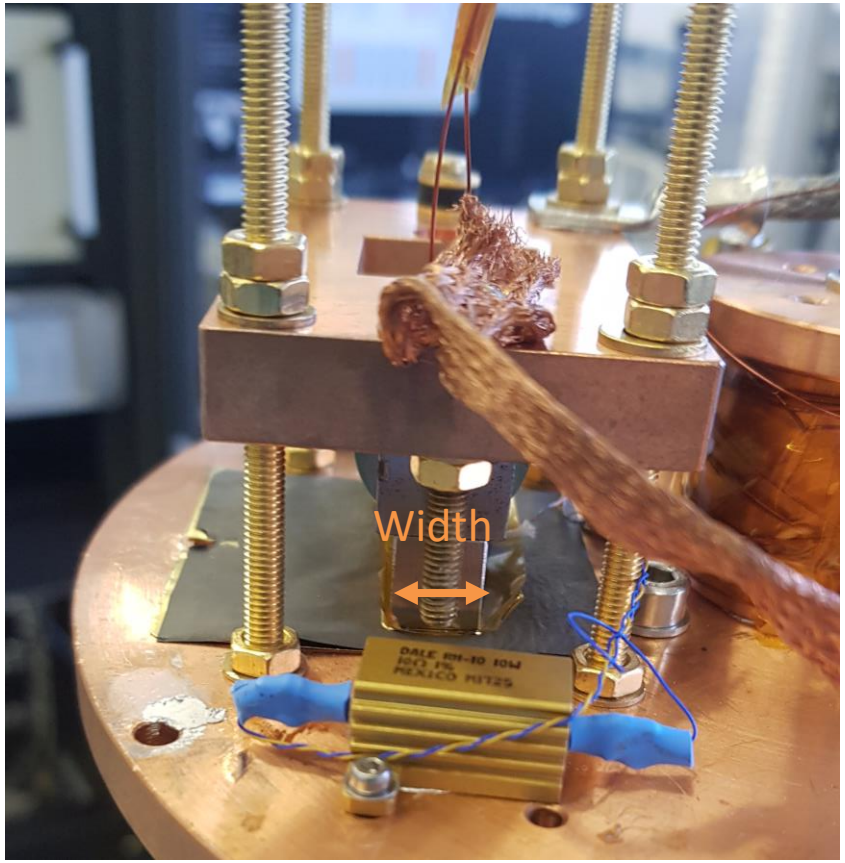
Testing a type I superconductor – Pb - Goodfellows

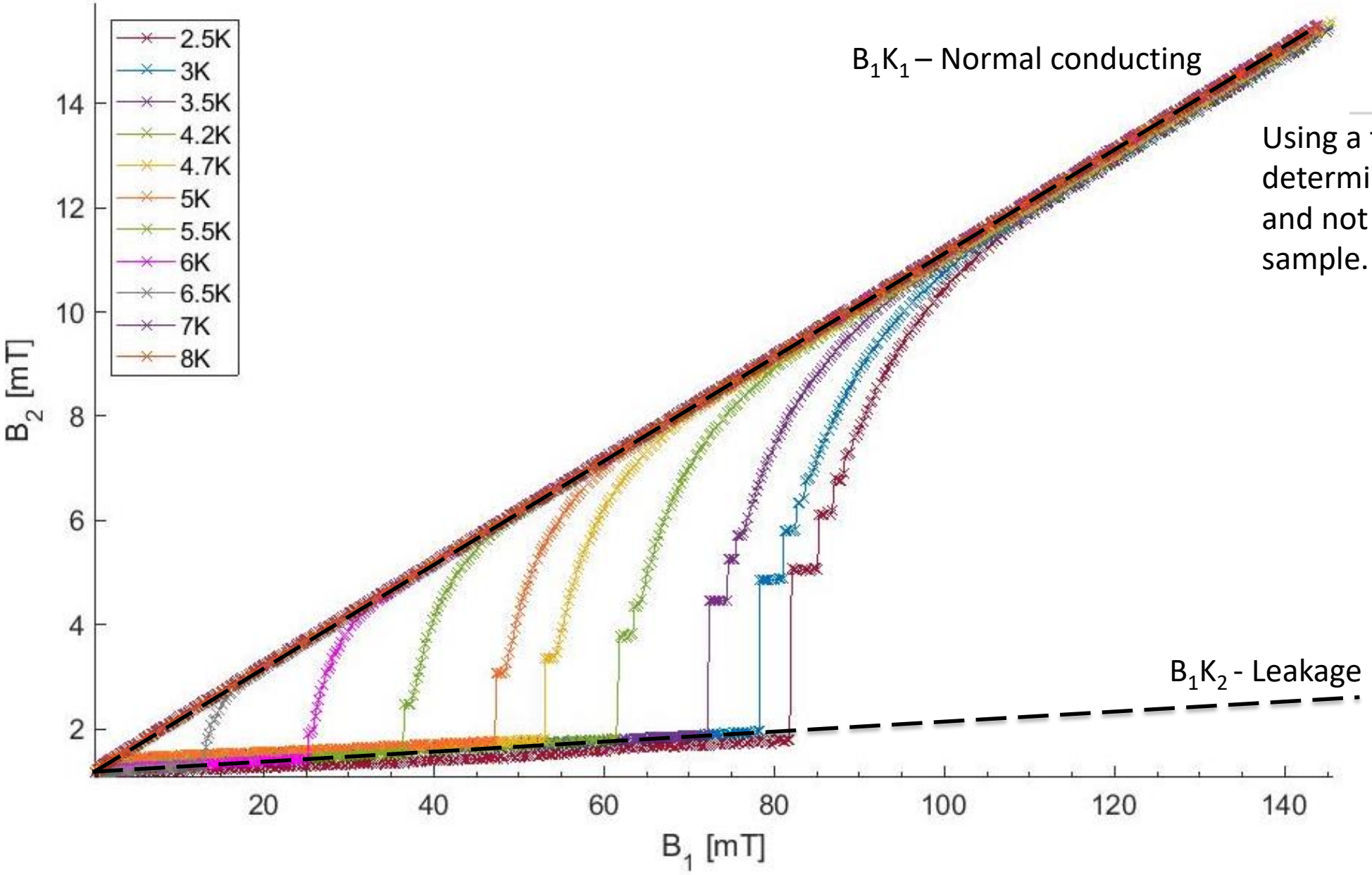




To investigate the effect of geometry a Pb sample (50 × 50 × 0.01 mm) was bought from Goodfellows to determine the effect of sample size.

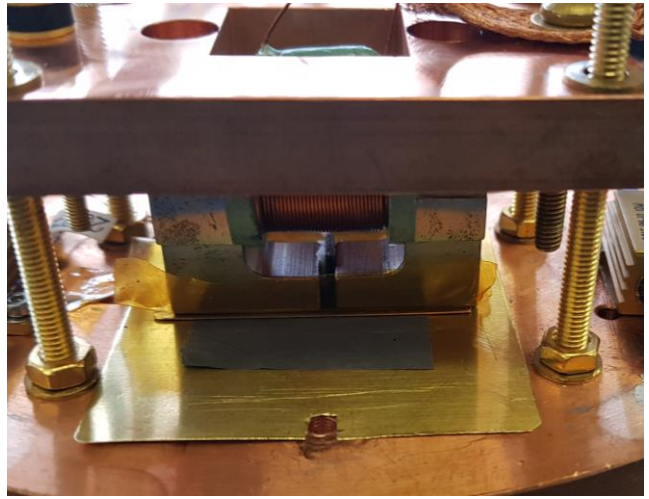
Magnet length = 40 mm Magnet width = 10 mm

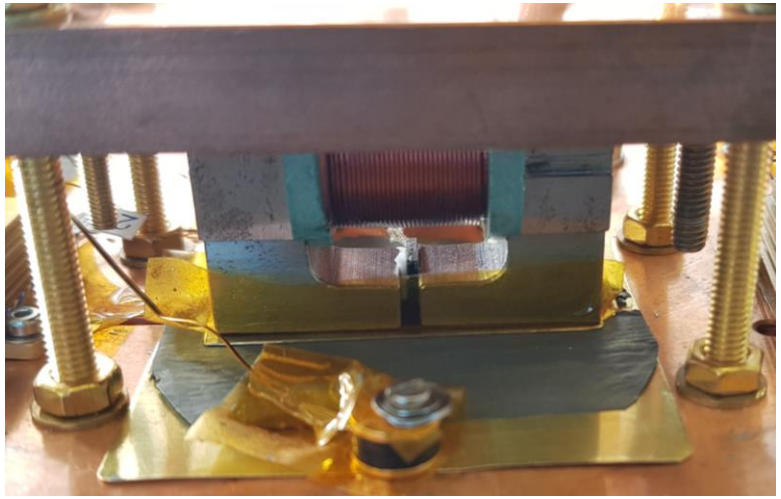
Pb 50 × 50 mm^2

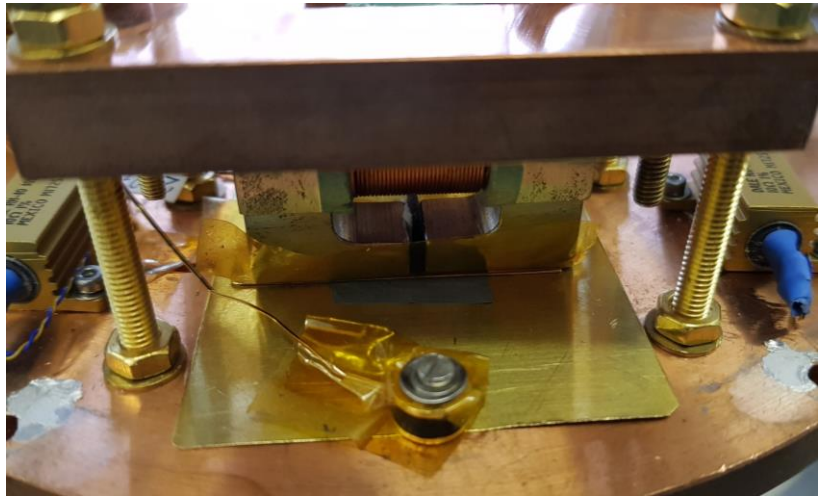


Using a type I superconductor to determine if there is a leakage field, and not early flux entering the sample.

Pb sample size was then slowly reduced

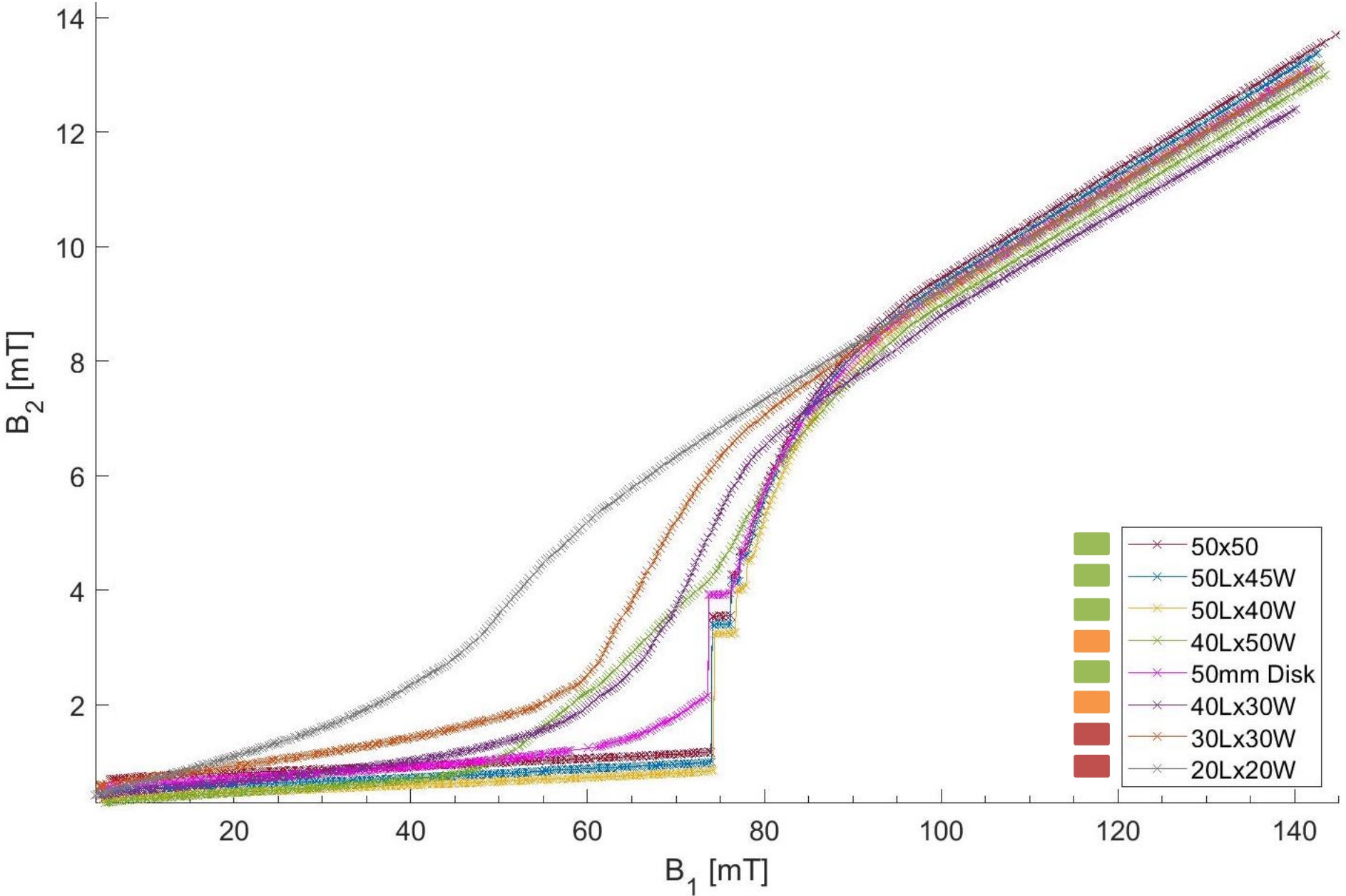






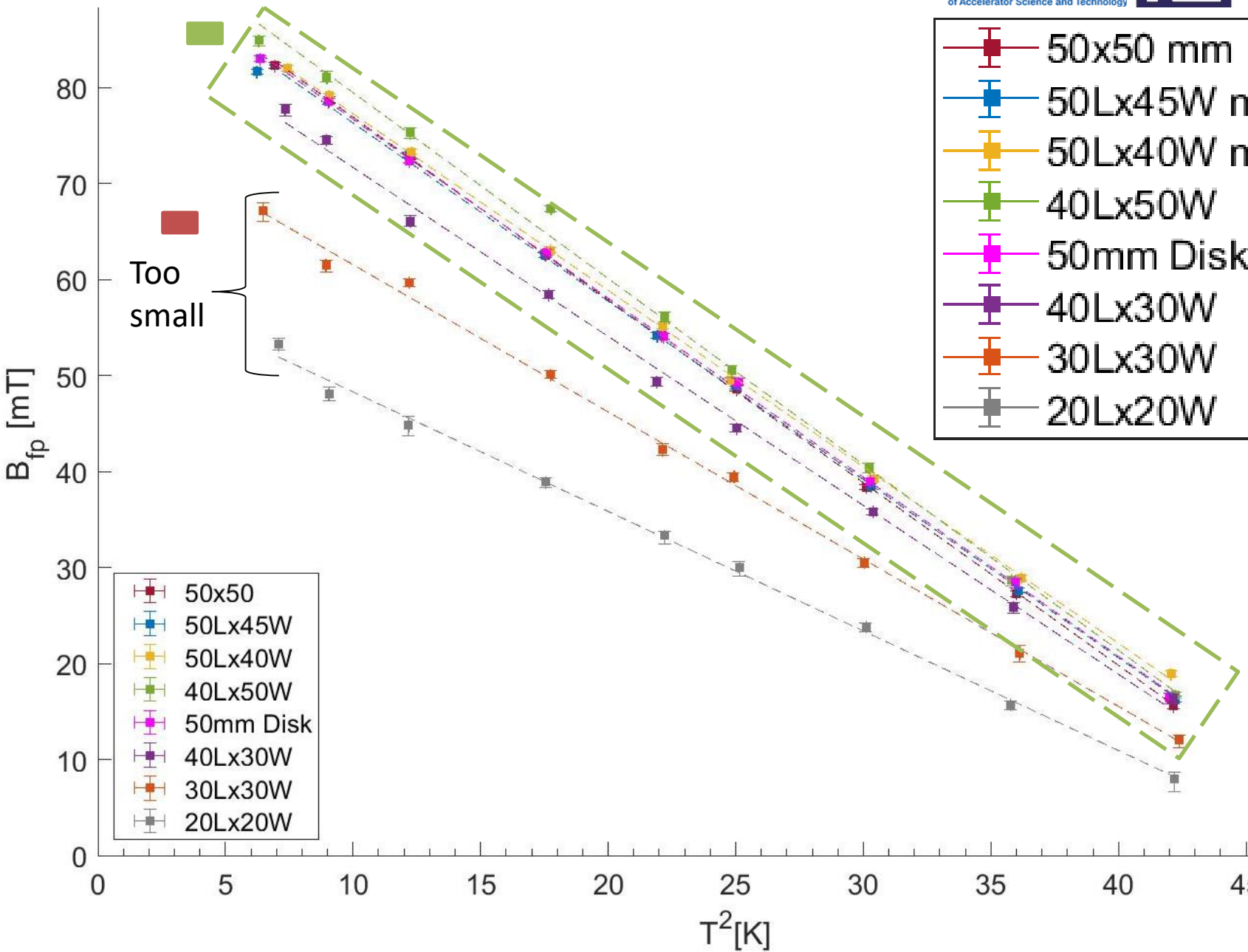
Pb is soft and was cut by a scalpel to determine how the effect of sample size affects the leakage produced. This also allows the field of full flux penetration (B_{fp}) to be compared for different sample sizes, and if sample size has any effect.

A brass spacer was placed either side of the Pb to make sure the sample did not get break or tear during testing.



Reducing the sample size creates an increase in the 'Leakage slope'

B_{fp} can be found easily for samples that are 50mm in length. Reducing the sample length creates more leakage, which masks $B_{fp,}$, which is therefore harder to find.



50x50 mm	Tc1
50Lx45W mm	Tc2
50Lx40W mm	Tc3
40Lx50W	Tc4
50mm Disk	Tc5
40Lx30W	Tc6
30Lx30W	Tc7
20Lx20W	Tc8

	7.0993
	7.1478
Max	7.2127
	7.1437
	7.1504
	7.1223
	7.0800
Min	6.9845

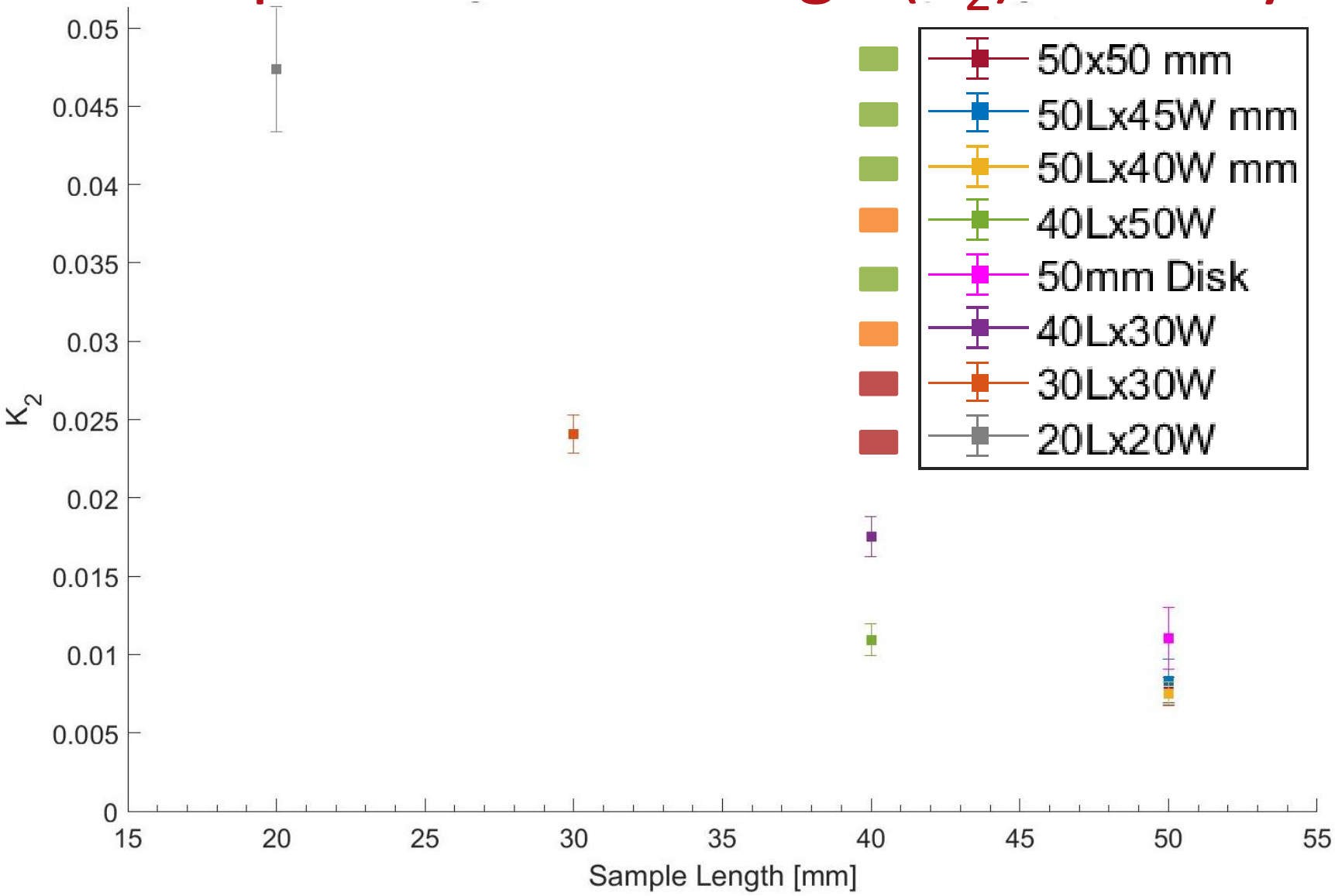
Theoretical T_c of Pb ~ 7.2 K

Field penetration facility T_c = 7.11 ± 0.06 K

Here it can be seen that the smaller samples produce a lower B_{fp} due to the difficulty in the extraction of B_{fp} from the raw data.

Samples which have a length >or equal 40 mm have a similar B_{fp}.

Comparison of Leakage (K_2) for varying sample size



Decreasing the sample size increases the leakage constant, K_2. Therefore is has been deduced that the length of the sample is important to reduce the leakage.

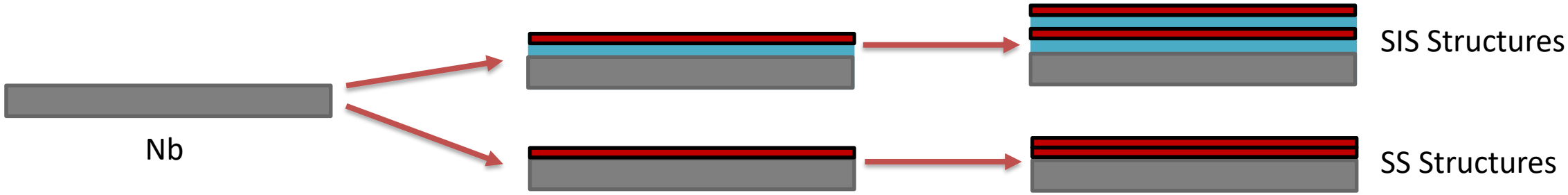
Minimum sample size we would like it 40mm in length, and 30 mm in width.

Ideal sample size is 50×45 mm **OR** 50 mm diameter disk.

Results for Nb are very similar

Conclusion

- How the behaviour of a type I superconductor (Pb) differs from Nb has been tested.
- The effect of sample size has been further investigated with a type I SC, and the affect on B_{fp} has been compared.
  - We are trying to find a new method to determine B_{fp} which reduces the effect of sample size.
- Effect of laser polishing will be tested – Samples are currently in shipping (I think)
- Looking for multilayer samples to test.
- The larger the sample the better as it reduces B leaking around the sample
  - 50×45 mm maximum, or a 50 mm diameter disk.
  - Minimum we have tested so far is 20×20 mm, however the B_{fp} reliability has been presented today. For accurate measurements, larger samples are preferred.
- We are looking for multilayers which we can have a full story, ie;
- And the thin films by themselves, not on a superconducting substrate.
- Nb substrate 1-10 µm, thin films < λ_L of **<u>any material</u>** (Nb_3Sn, MgB_2, NbTiN etc etc)



Penetration facility change over

- Facility is operational and ready to test samples from IFAST partners,

BUT

- I have 4 months left and I am transitioning away from sample testing and Liam is now taking over. Please send all enquires to Liam Smith (liam.smith@stfc.ac.uk) for future measurements and tests.

- Sample turn around is approximately 1 sample every 2/3 days depending on the temperature range used.

Thank you for your attention, I am happy to answer any questions.