Field penetration experiment

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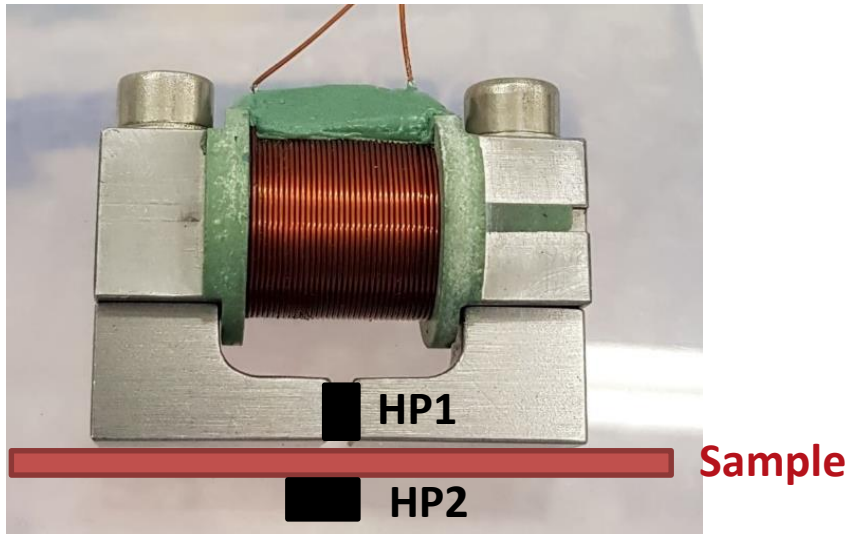
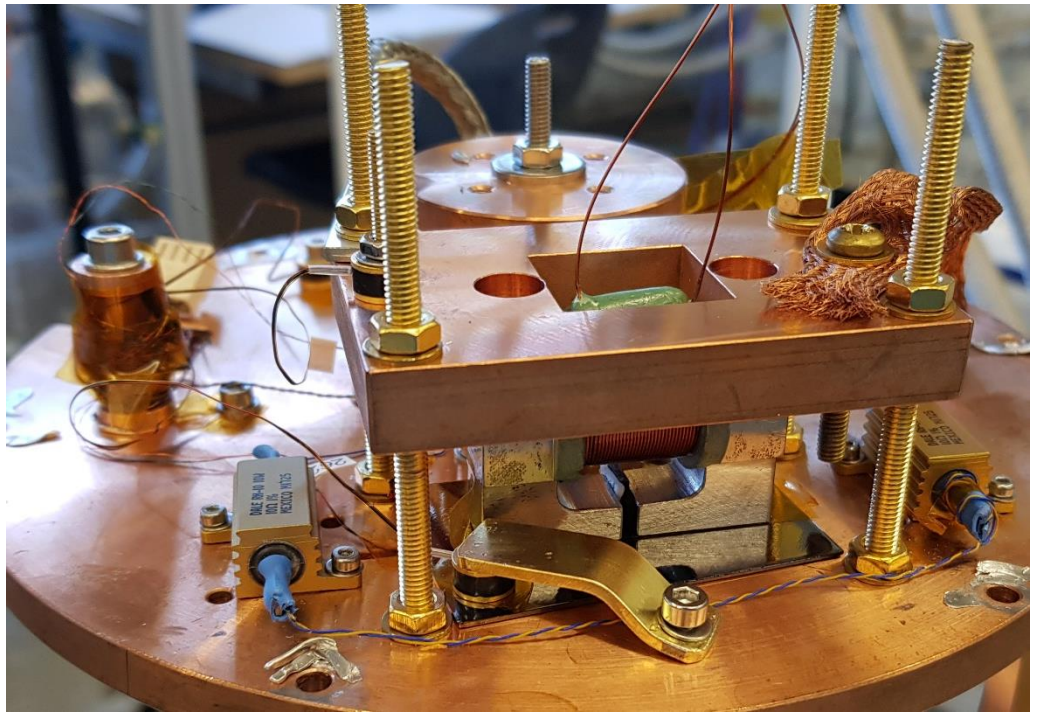
Field penetration concept

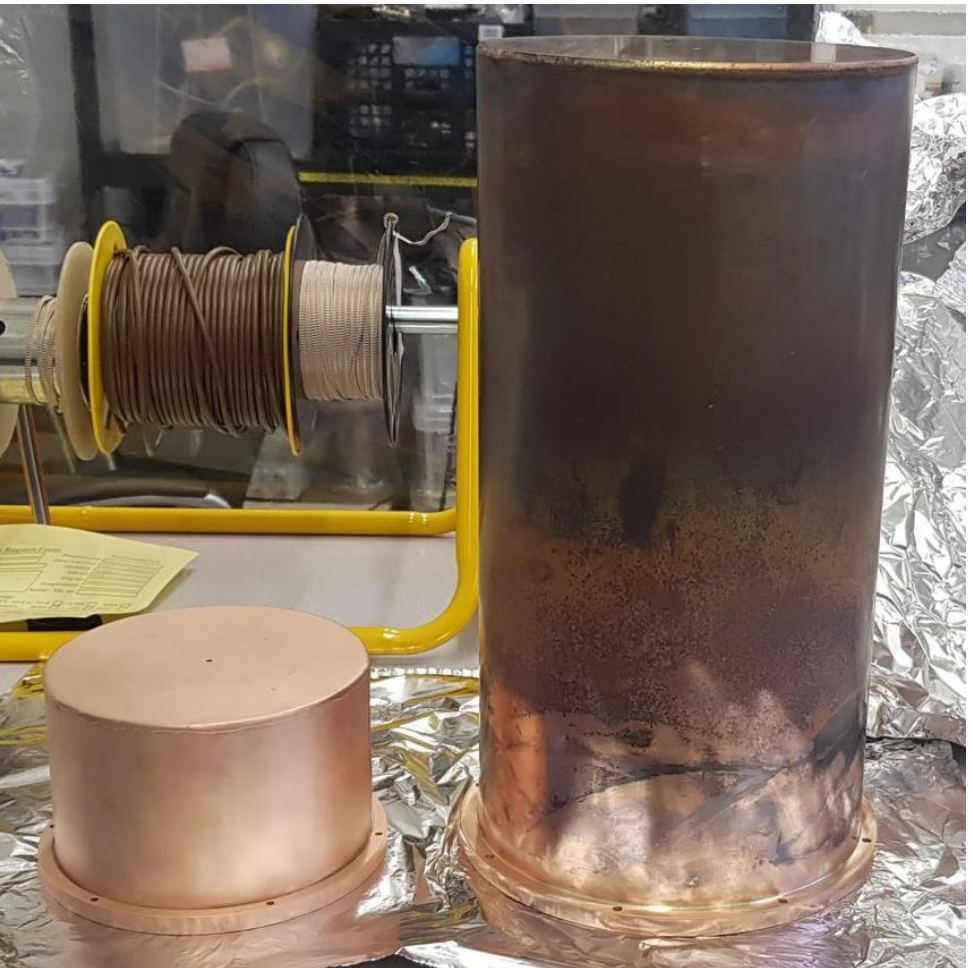


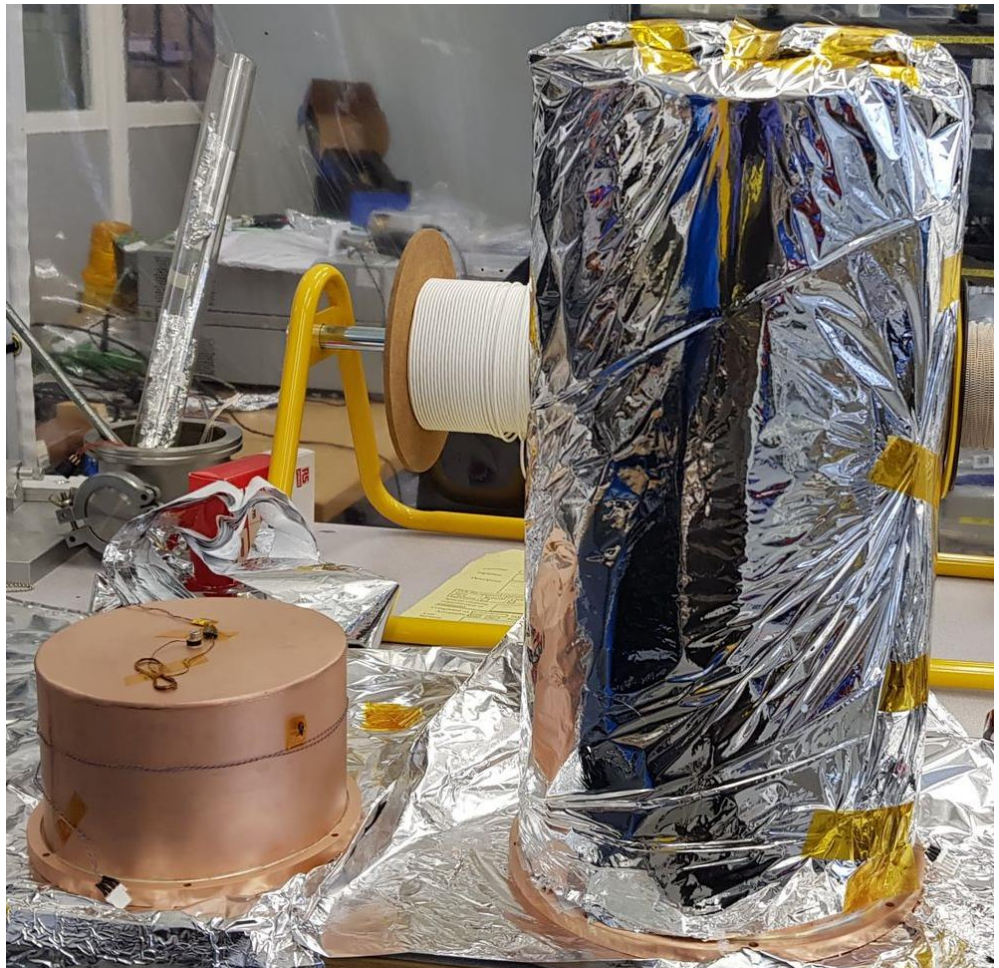


- DC magnetic field parallel to the surface
- Field local to the sample surface
  - Avoid edge effect.
  - Allow possibility if sample scanning.
- Magnetic field applied from one side of the sample to the opposing side, similar to an SRF cavity.
- Applied and penetrated field measured by Hall probe sensors

New Thermal radiation shields

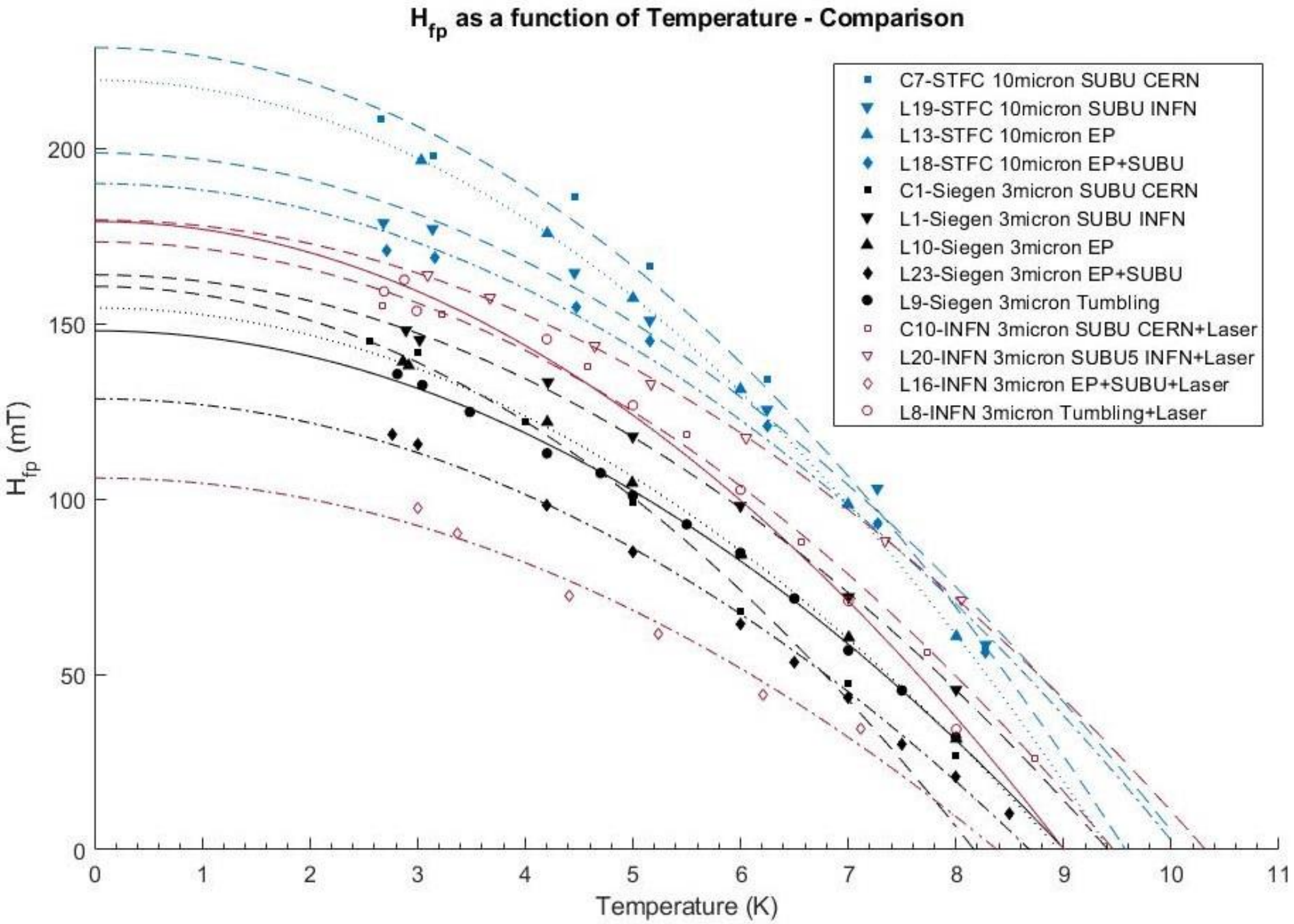
Larger mass compared to Al radiation shields gives a better thermal stability.

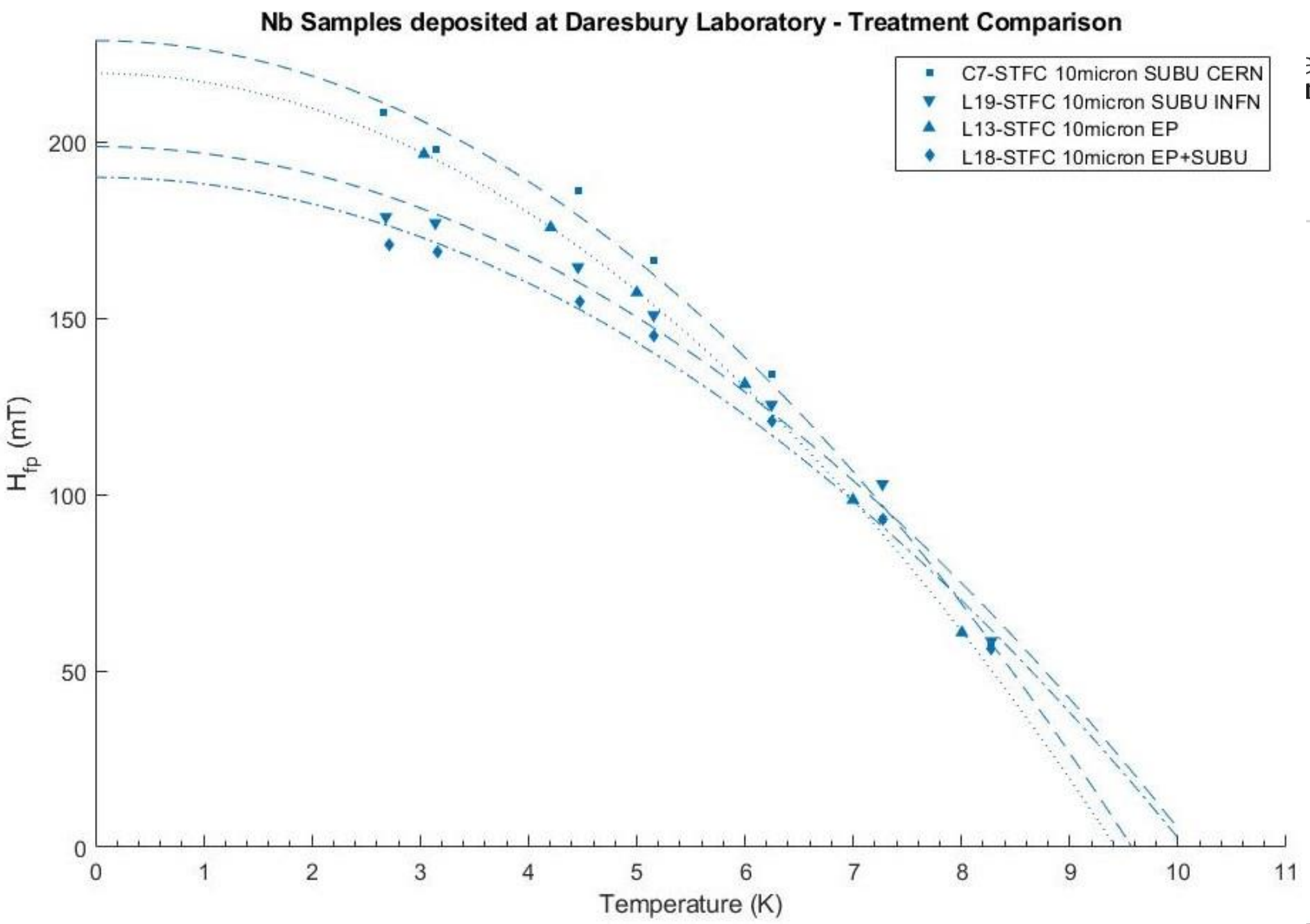


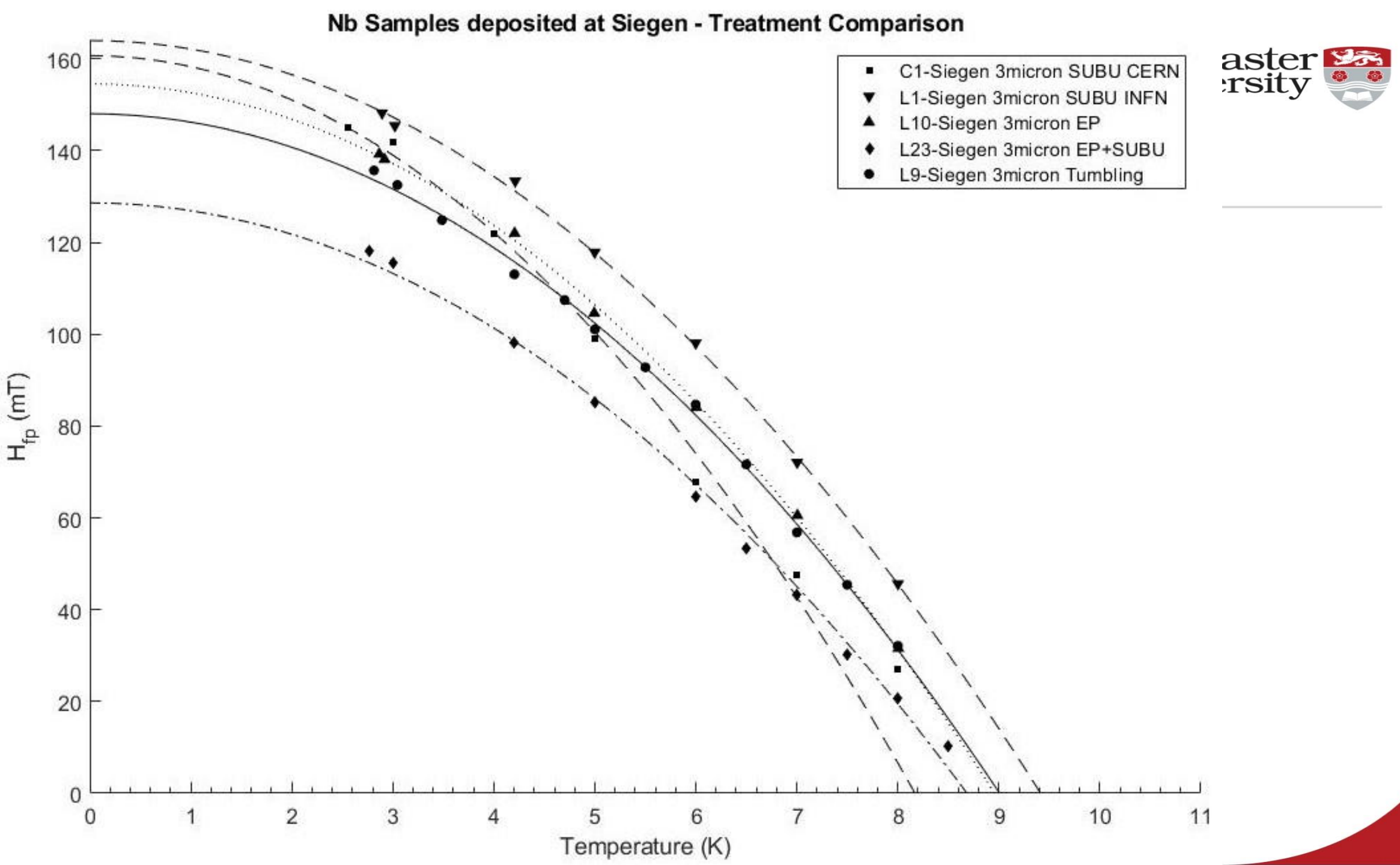


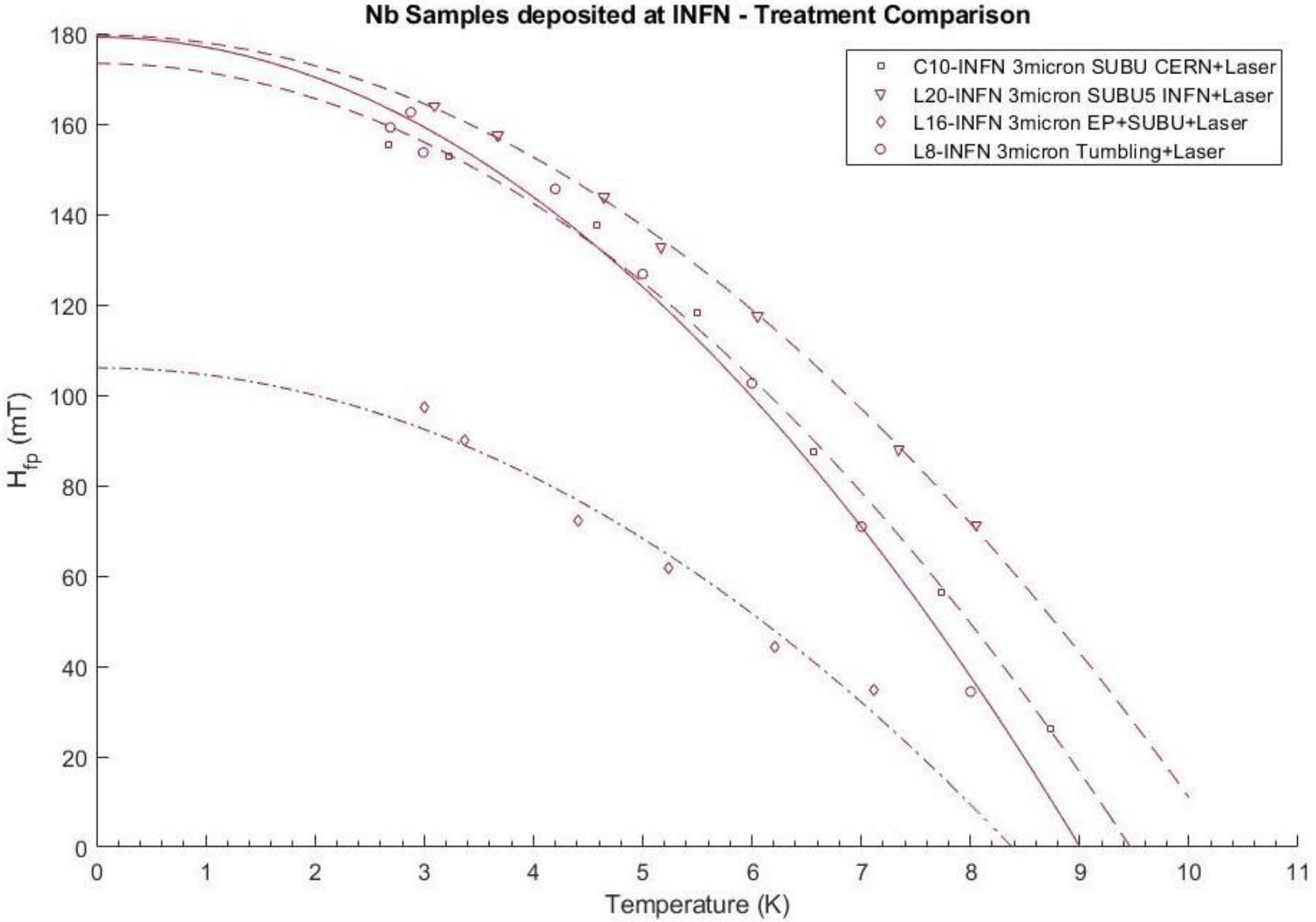
Table

					Bratislava VSM			Laser RTU		STFC Field penetration			
		Sample	Substrate Treatment		B Perp (mT)	B para (mT)	Tc (K)	B Perp (mT)	B para (mT)	Tc (K)	Hfp(0) (mT)	Hfp(4.2K)	Hfp(4.5K) (mT)
Code	Origin	Material											
C7	STFC	Nb	10µm	SUBU CERN	24.1	150.1	9.35	0	0	9.43	228.82	183.4291	186.405
L13	STFC	Nb	10µm	EP	22	100.3	9.35	0	0	9.42	219.53	175.816	0
L18	STFC	Nb	10µm	EP + SUBU	17.7	61	9.3	0	0	9.87	190.03	155.6199	154.606
L19	STFC	Nb	10µm	SUBU	17.3	73.2	9.2	0	0	9.91	208.15	170.7624	164.562
C1	Siegen	Nb	3µm	SUBU CERN	15.5	49.6	9.5	0	0	8.25	160.7	101.6734	
L1	Siegen	Nb	3µm	SUBU INFN	14.5	38	9.6	0	0	9.37	163.98	133.368	0
L9	Siegen	Nb	3µm	Tumbling	16	38.6	9.38	0	0	9.03	148.04	113.059	0
L10	Siegen	Nb	3µm	EP	15.5	32.7	9.38	0	0	8.97	154.55	122.007	0
L23	Siegen	Nb	3µm	EP + SUBU	15	24.5	9.38	0	0	8.74	128.62	98.244	0
C10	INFN	Nb	3µm	SUBU5 CERN	12	0	9.37	17	50.2	9.38	173.39	138.627	137.629
L8	INFN	Nb	3µm	Tumbling	18	0	9.48	19.1	42.5	9.01	187.46	113.059	0
L16	INFN	Nb	3µm	EP + SUBU5	14	0	9.37	15.5	47.2	8.77	106.03	81.71198	72.332
L20	INFN	Nb	3µm	SUBU5 INFN	20	0	9.58	23.7	45	10.36	179.65	150.1239	143.805
L21	INFN	Nb	3µm	EP	18	0	9.28	18.8	45.2	0	0	0	0


H_{fp} as a function of Temperature - Comparison
C7-STFC 10micron SUBU CERN
L19-STFC 10micron SUBU INFN
L13-STFC 10micron EP
L18-STFC 10micron EP+SUBU
C1-Siegen 3micron SUBU CERN
L1-Siegen 3micron SUBU INFN
L10-Siegen 3micron EP
L23-Siegen 3micron EP+SUBU
L9-Siegen 3micron Tumbling
C10-INFN 3micron SUBU CERN+Laser
L20-INFN 3micron SUBU5 INFN+Laser
L16-INFN 3micron EP+SUBU+Laser
L8-INFN 3micron Tumbling+Laser
H_{fp} (mT)
0
50
100
150
200
0
1
2
3
4
5
6
7
8
9
10
11
Temperature (K)

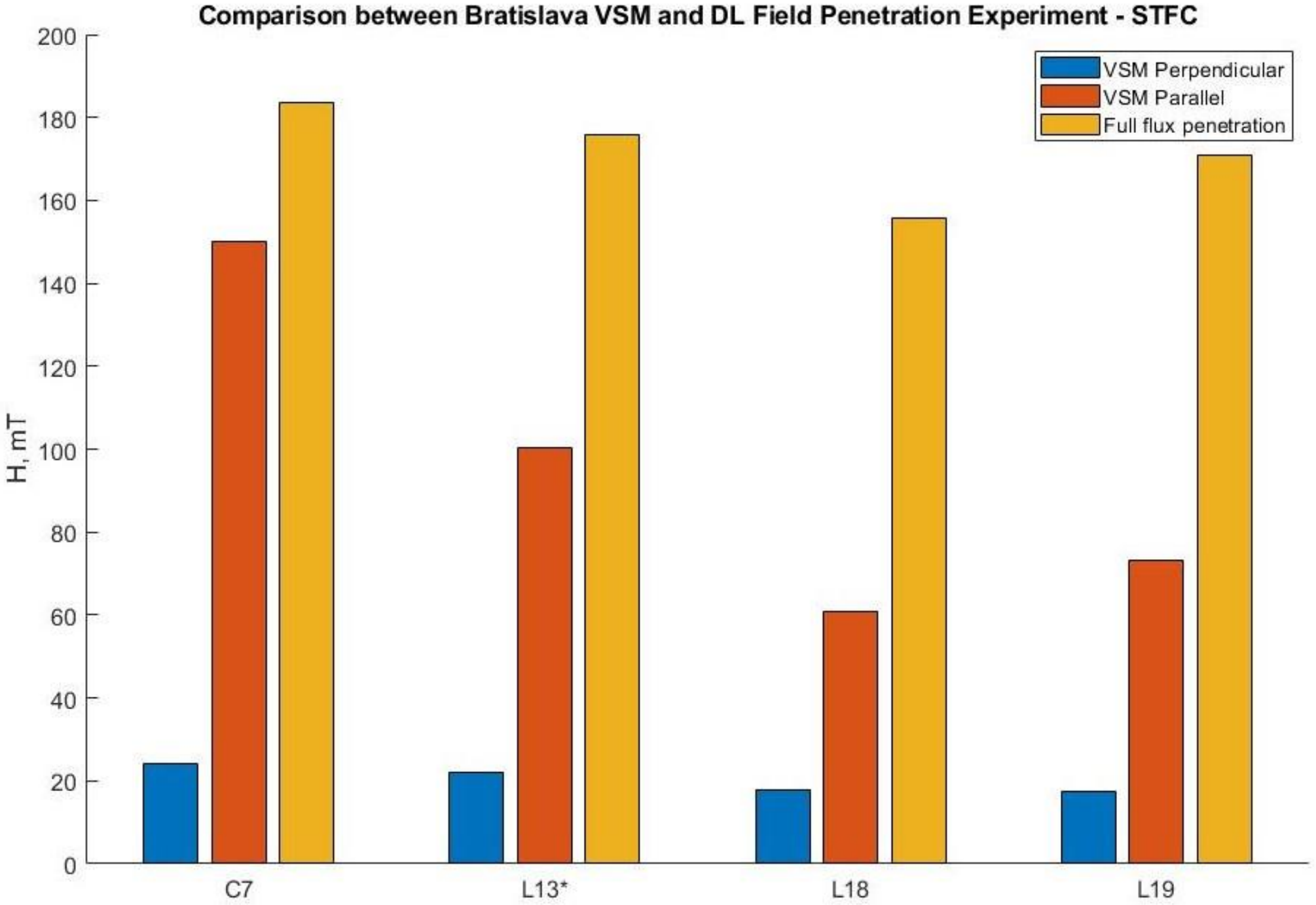

Nb Samples deposited at Daresbury Laboratory - Treatment Comparison
C7-STFC 10micron SUBU CERN
L19-STFC 10micron SUBU INFN
L13-STFC 10micron EP
L18-STFC 10micron EP+SUBU
H_{fp} (mT)
Temperature (K)
0
50
100
150
200
0
1
2
3
4
5
6
7
8
9
10
11

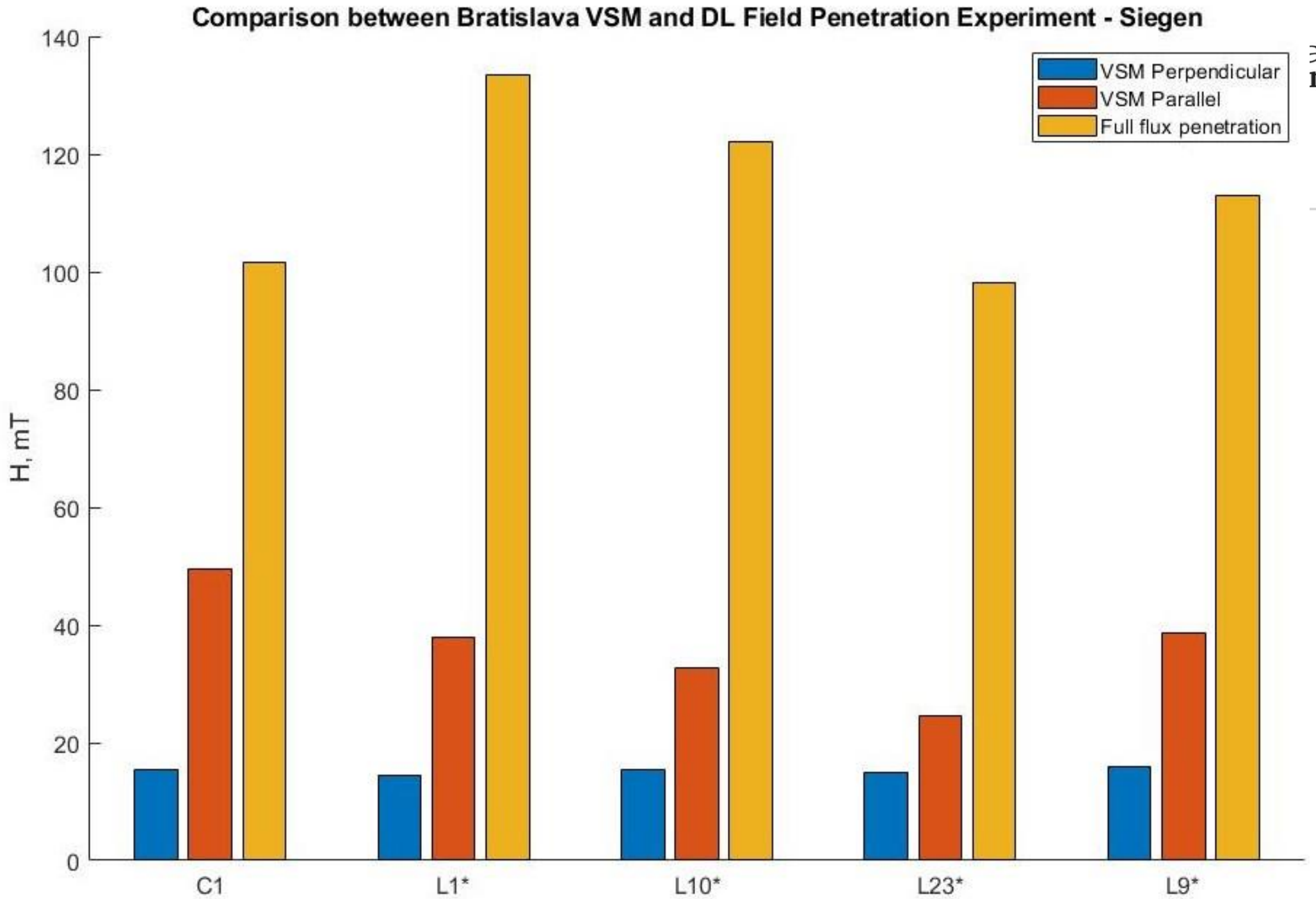

Nb Samples deposited at Siegen - Treatment Comparison
C1-Siegen 3micron SUBU CERN
L1-Siegen 3micron SUBU INFN
L10-Siegen 3micron EP
L23-Siegen 3micron EP+SUBU
L9-Siegen 3micron Tumbling
H_{fp} (mT)
Temperature (K)
0
20
40
60
80
100
120
140
160
0
1
2
3
4
5
6
7
8
9
10
11

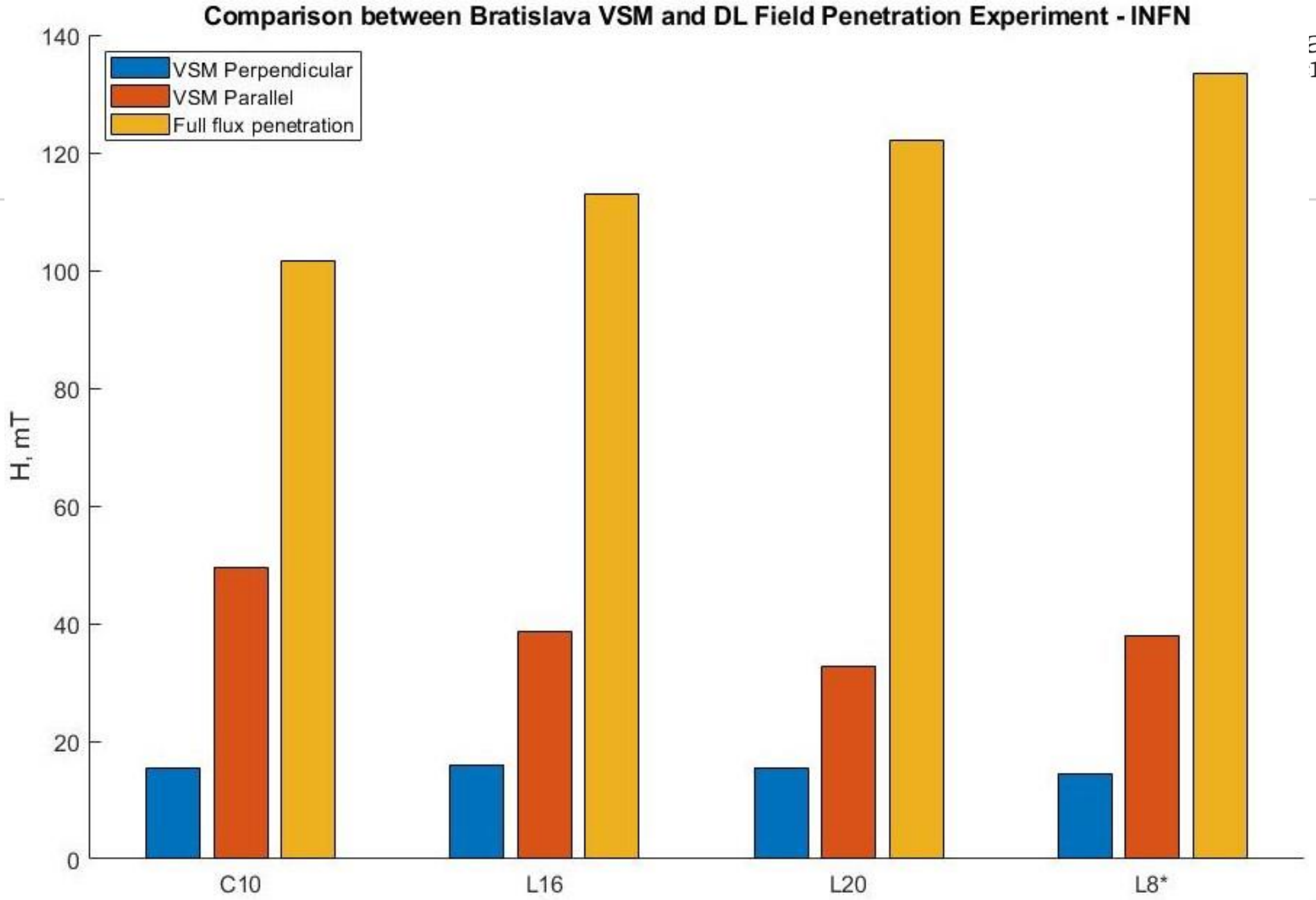

Nb Samples deposited at INFN - Treatment Comparison
C10-INFN 3micron SUBU CERN+Laser
L20-INFN 3micron SUBU5 INFN+Laser
L16-INFN 3micron EP+SUBU+Laser
L8-INFN 3micron Tumbling+Laser
H_{fp} (mT)
Temperature (K)
0
20
40
60
80
100
120
140
160
180
0
1
2
3
4
5
6
7
8
9
10
11

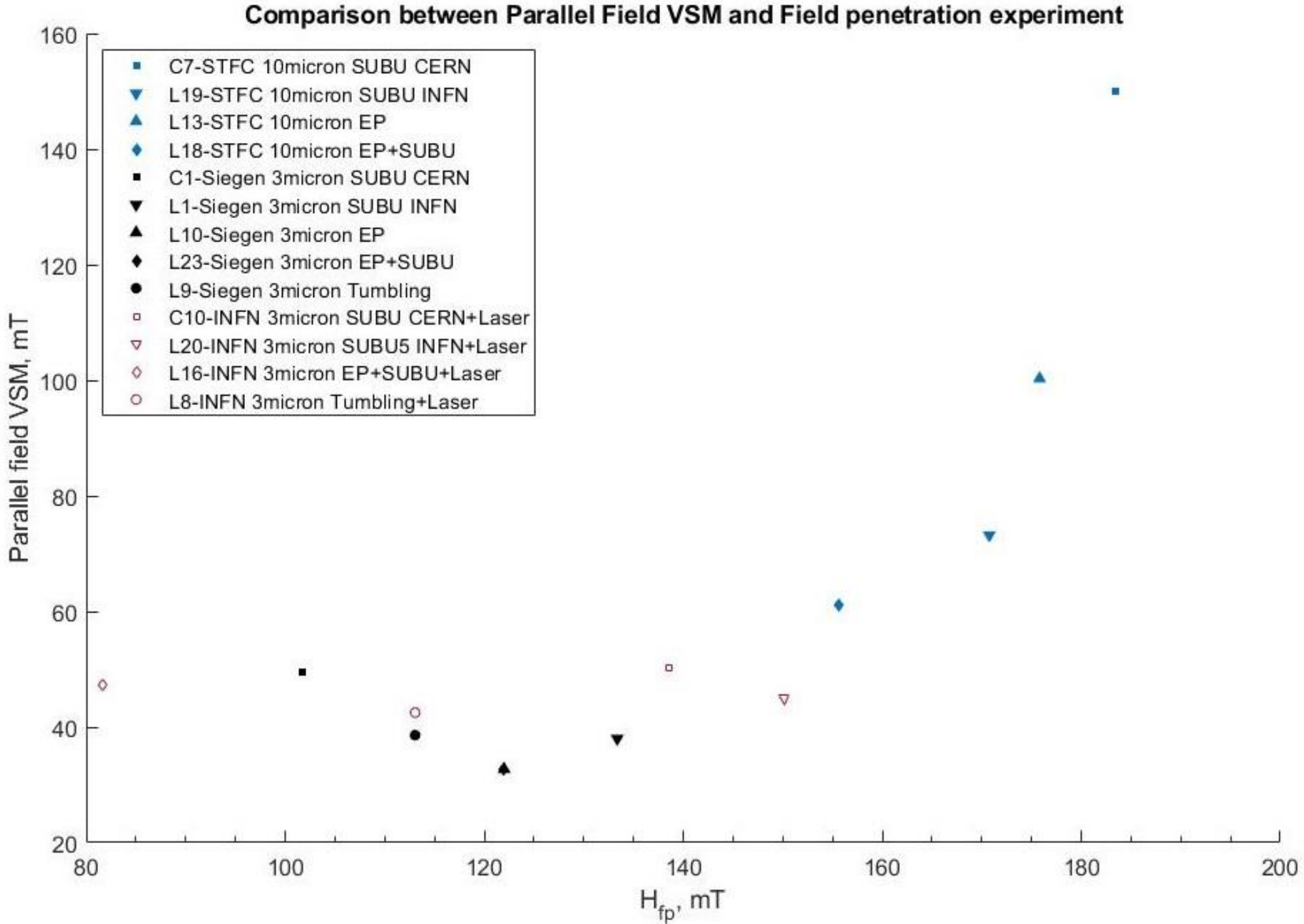
Best surface treatment determined by H_{vp}

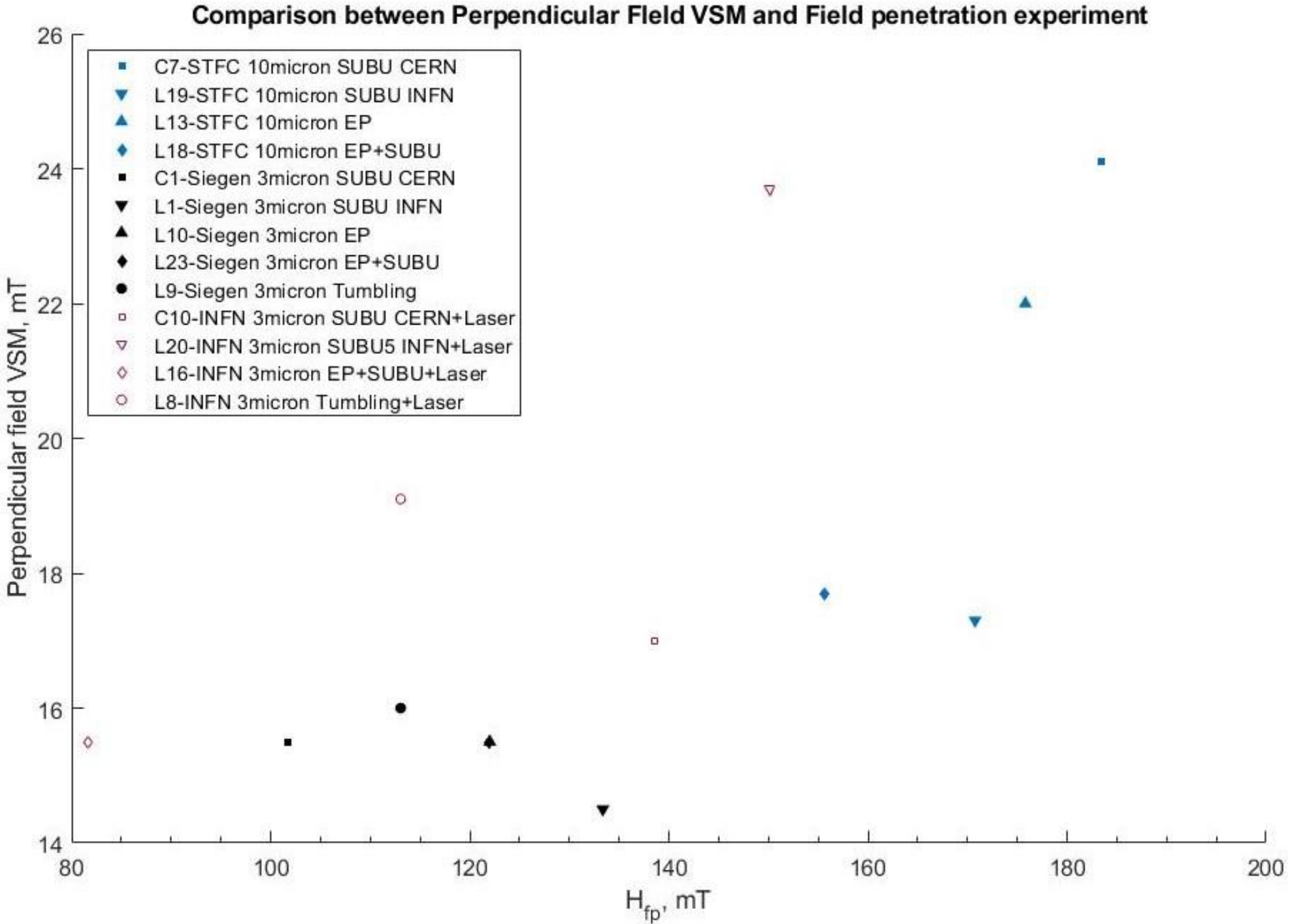
STFC	Siegen	INFN with laser treatment
SUBU CERN	**SUBU** INFN	**SUBU** INFN
EP	**SUBU** CERN	Tumbling
SUBU INFN	EP	SUBU CERN
EP + SUBU	Tumbling	EP + SUBU
	EP + SUBU	


Comparison between Bratislava VSM and DL Field Penetration Experiment - STFC
VSM Perpendicular
VSM Parallel
Full flux penetration
H, mT
0
20
40
60
80
100
120
140
160
180
200
C7
L13*
L18
L19


Comparison between Bratislava VSM and DL Field Penetration Experiment - Siegen
VSM Perpendicular
VSM Parallel
Full flux penetration
H, mT
0
20
40
60
80
100
120
140
C1
L1*
L10*
L23*
L9*

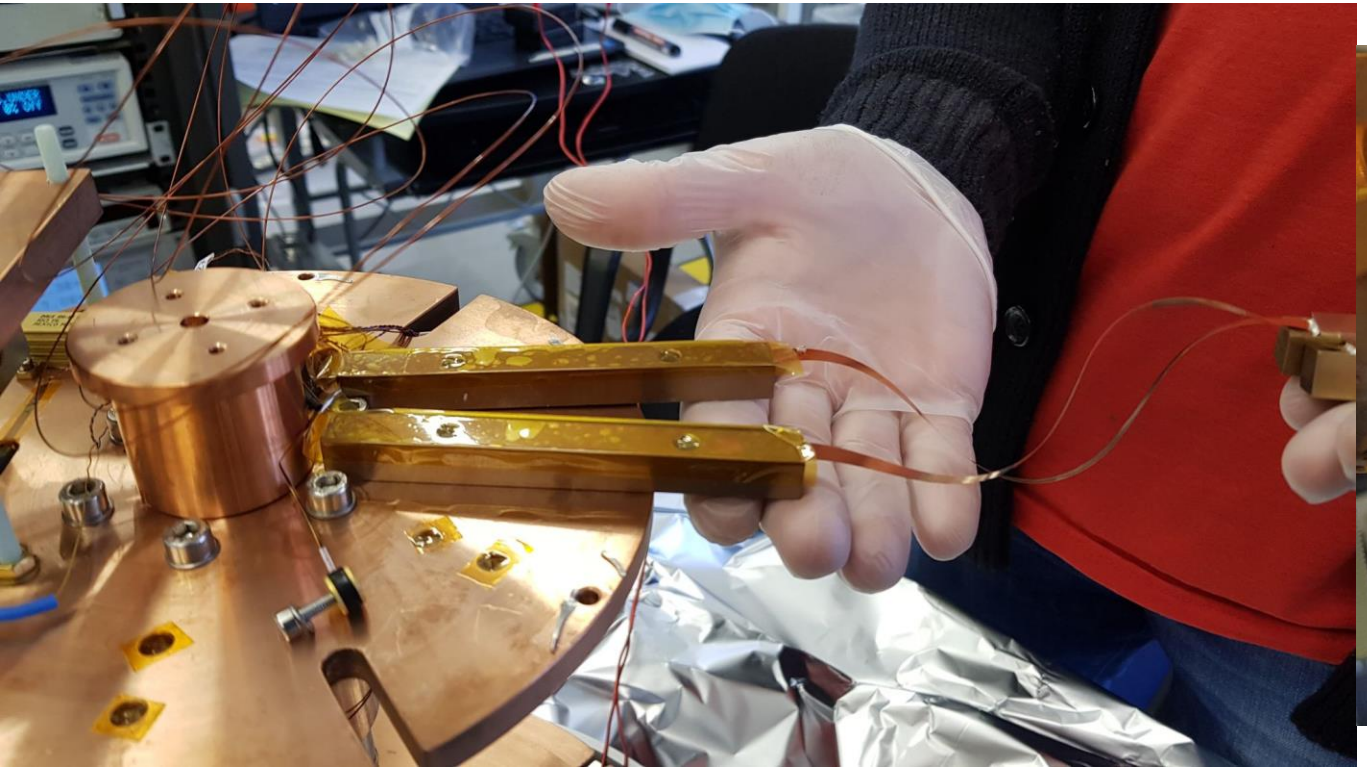

Comparison between Bratislava VSM and DL Field Penetration Experiment - INFN
VSM Perpendicular
VSM Parallel
Full flux penetration
H, mT
0
20
40
60
80
100
120
140
C10
L16
L20
L8*

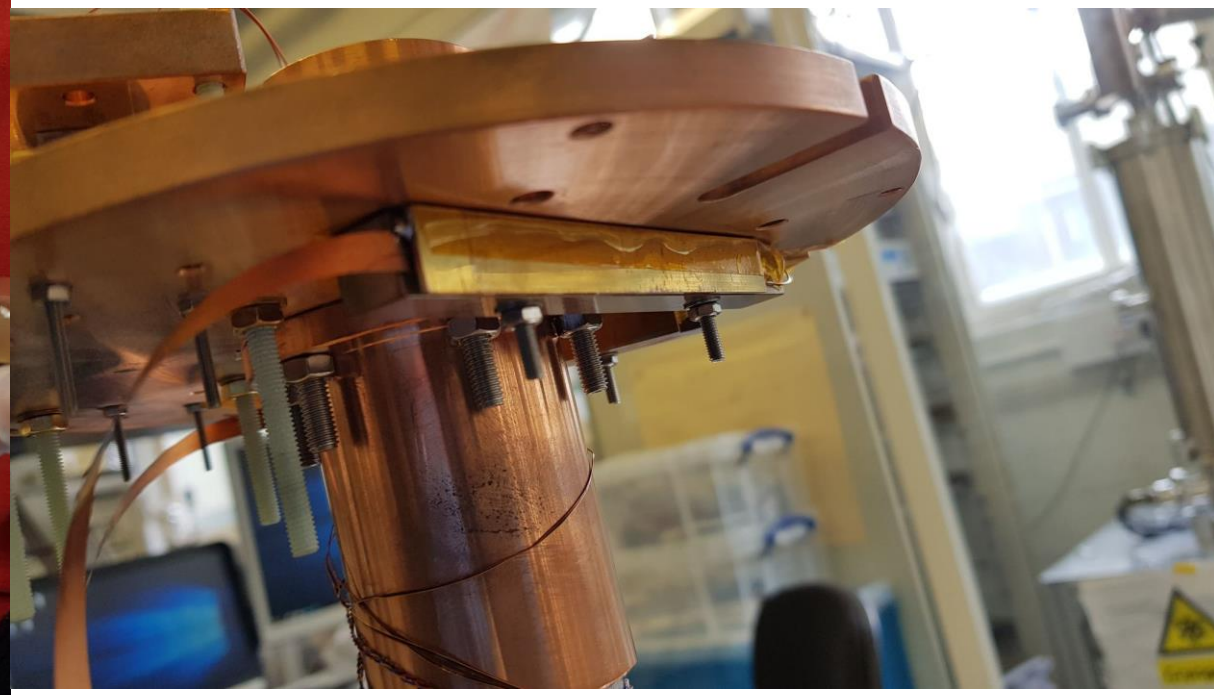

Comparison between Parallel Field VSM and Field penetration experiment
C7-STFC 10micron SUBU CERN
L19-STFC 10micron SUBU INFN
L13-STFC 10micron EP
L18-STFC 10micron EP+SUBU
C1-Siegen 3micron SUBU CERN
L1-Siegen 3micron SUBU INFN
L10-Siegen 3micron EP
L23-Siegen 3micron EP+SUBU
L9-Siegen 3micron Tumbling
C10-INFN 3micron SUBU CERN+Laser
L20-INFN 3micron SUBU5 INFN+Laser
L16-INFN 3micron EP+SUBU+Laser
L8-INFN 3micron Tumbling+Laser
Parallel field VSM, mT
160
140
120
100
80
60
40
20
80
100
120
140
160
180
200
H_{fp}, mT

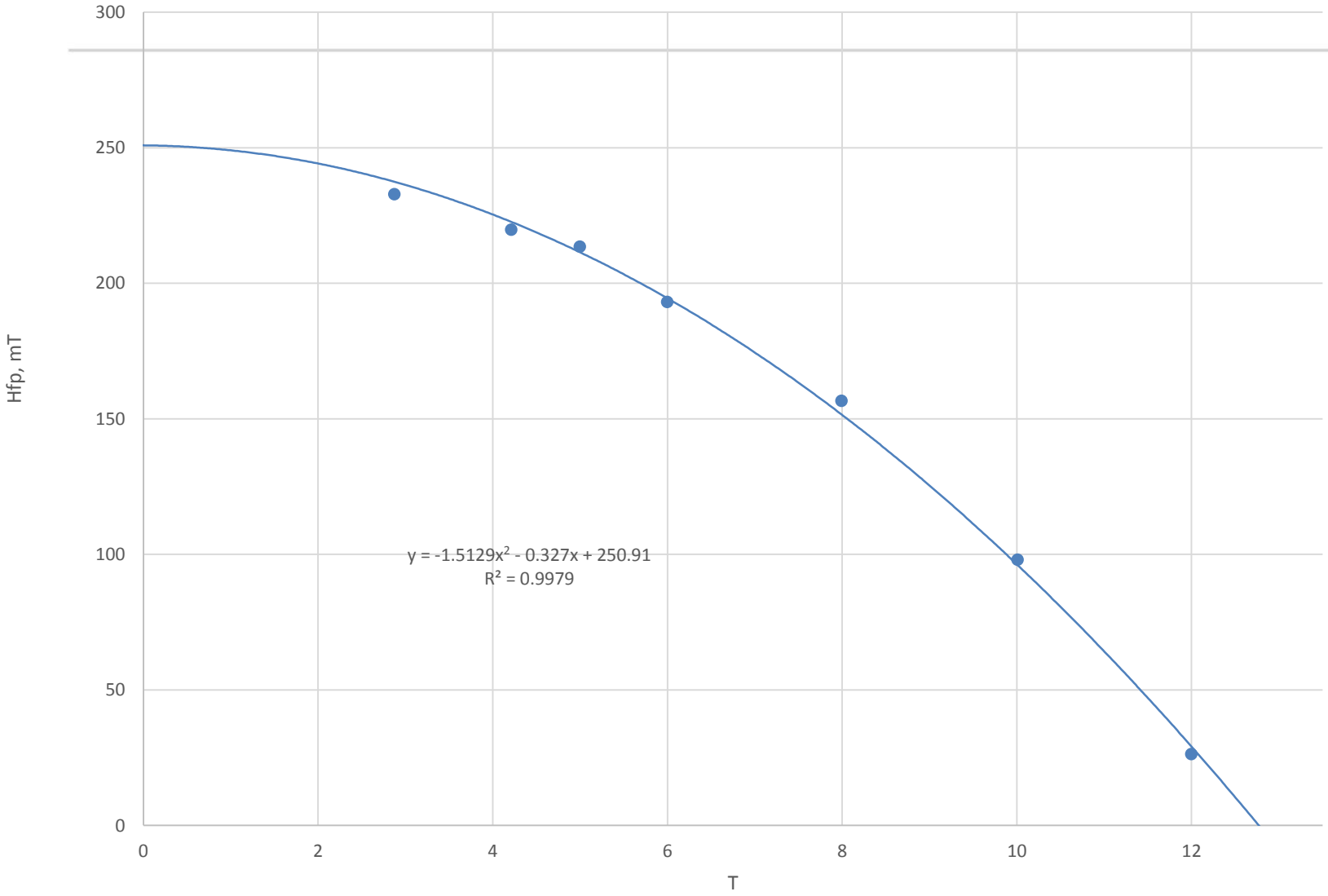

Comparison between Perpendicular Field VSM and Field penetration experiment
C7-STFC 10micron SUBU CERN
L19-STFC 10micron SUBU INFN
L13-STFC 10micron EP
L18-STFC 10micron EP+SUBU
C1-Siegen 3micron SUBU CERN
L1-Siegen 3micron SUBU INFN
L10-Siegen 3micron EP
L23-Siegen 3micron EP+SUBU
L9-Siegen 3micron Tumbling
C10-INFN 3micron SUBU CERN+Laser
L20-INFN 3micron SUBU5 INFN+Laser
L16-INFN 3micron EP+SUBU+Laser
L8-INFN 3micron Tumbling+Laser
Perpendicular field VSM, mT
26
24
22
20
18
16
14
80
100
120
140
160
180
200
H_{fp}, mT

Next steps

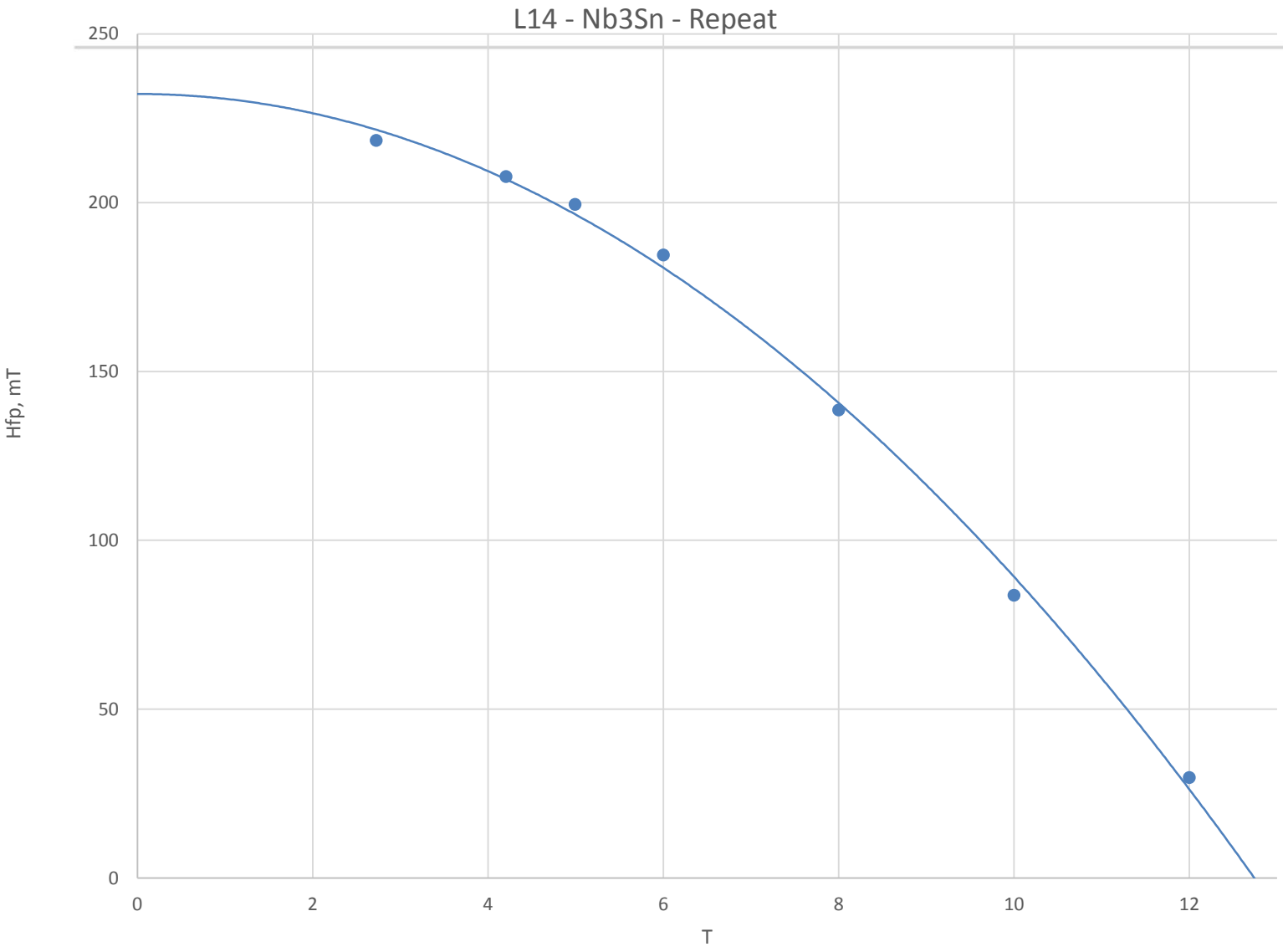
- Test how the field of full flux penetration varies with varying thickness’
- Laser treated QPR disk
- Move onto multilayer samples



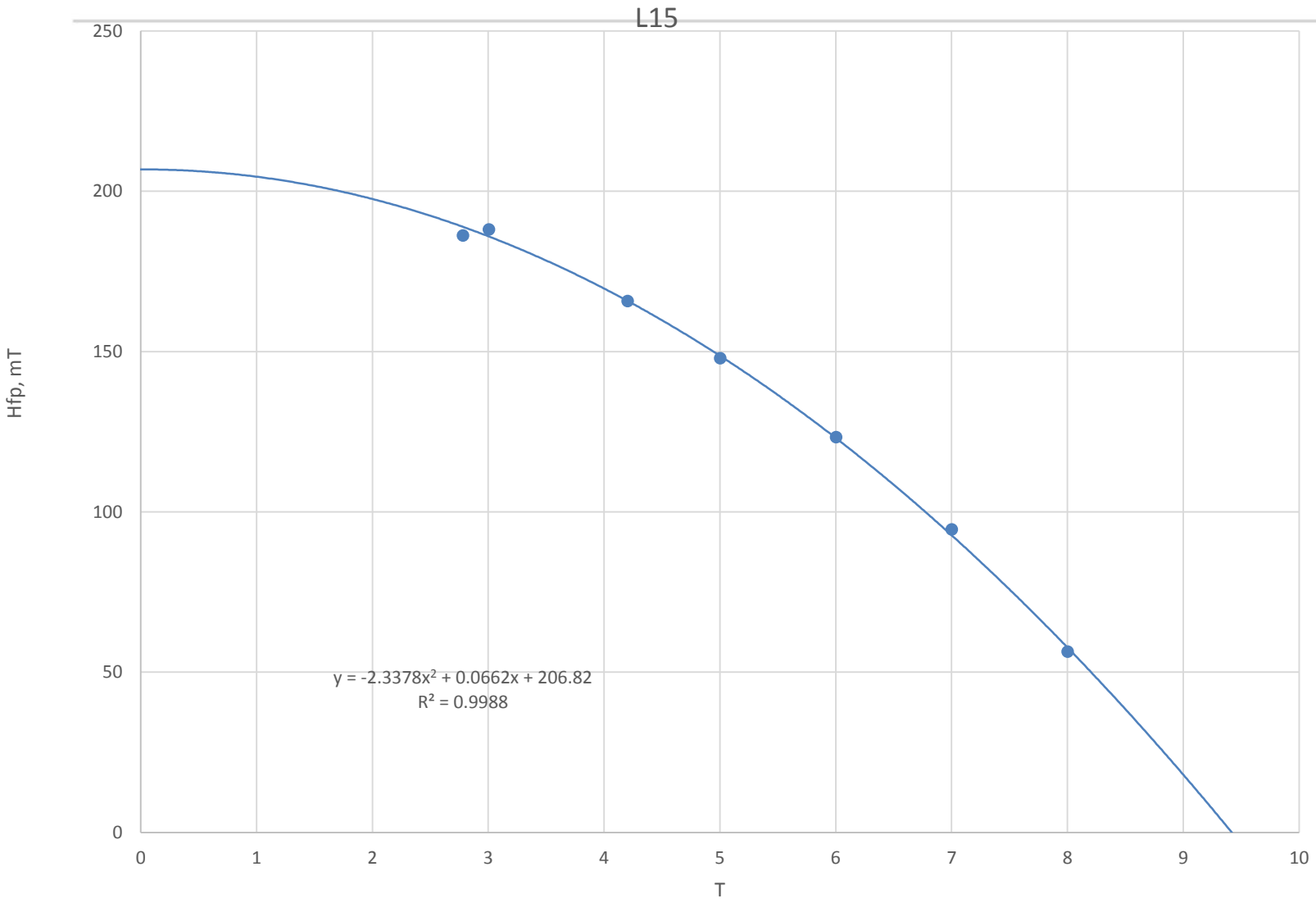




L14 – Nb_3Sn initial - 2µm
Hvp(0) = 250.37 mT
Tc = 12.76 K



Nb_3Sn – Repeat - 2µm
Hvp(0) = 232.2 mT
Tc = 12.72 K



L 15 Nb_3Sn - 2µm
Hvp(0) = 206.82 mT
Tc = 9.42 K