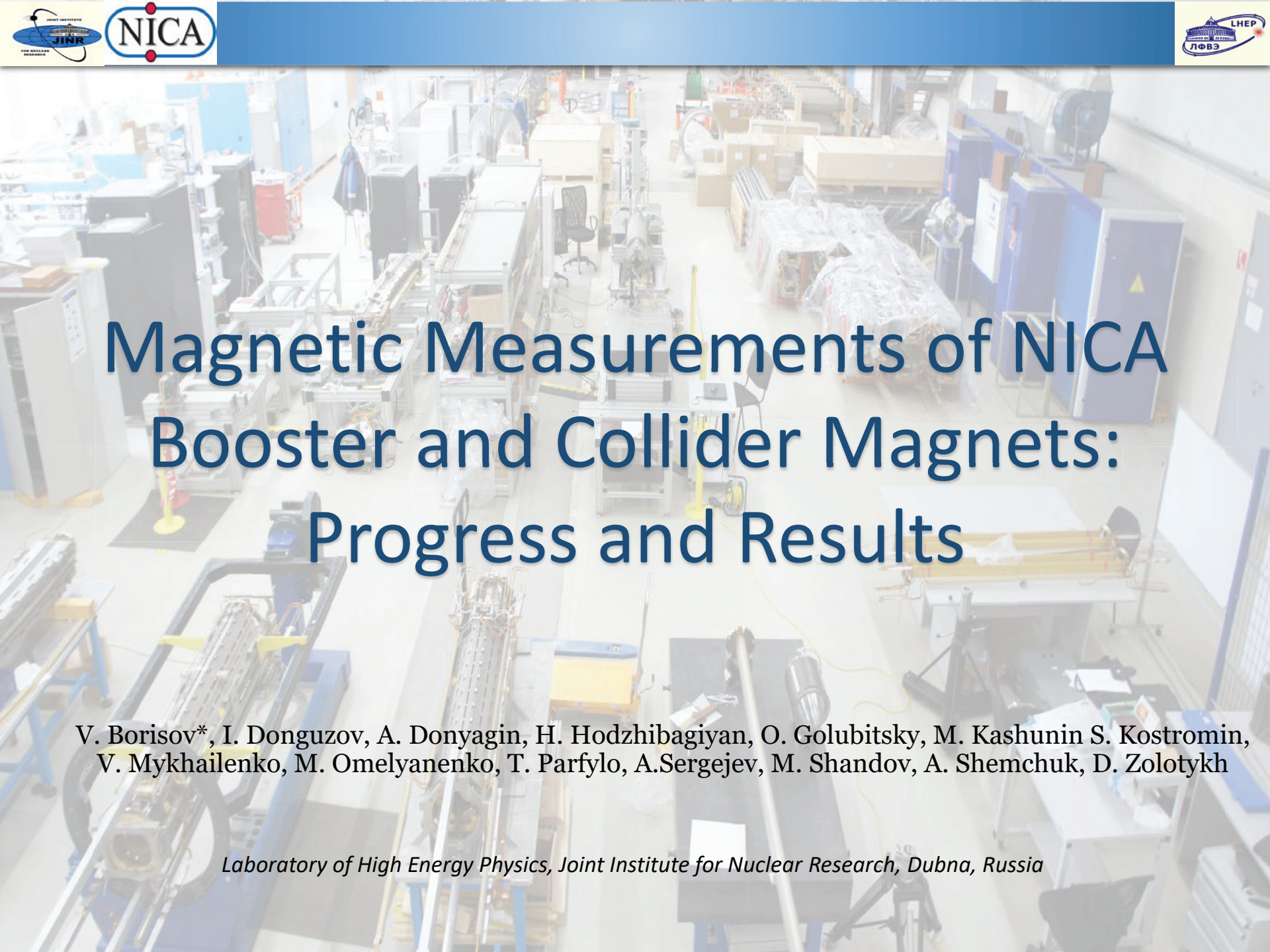

Magnetic Measurements of NICA Booster and Collider Magnets: Progress and Results

V. Borisov*, I. Donguzov, A. Donyagin, H. Hodzhibagiyan, O. Golubitsky, M. Kashunin S. Kostromin, V. Mykhailenko, M. Omelyanenko, T. Parfylo, A.Sergejev, M. Shandov, A. Shemchuk, D. Zolotykh

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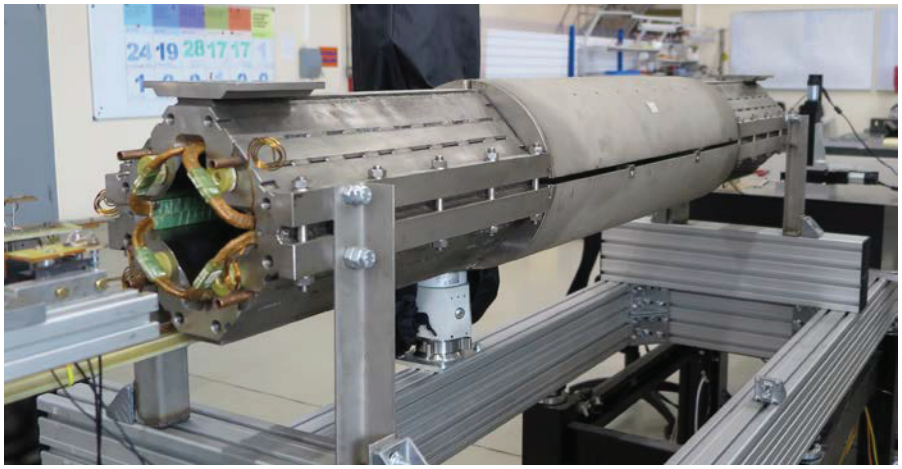
Outline

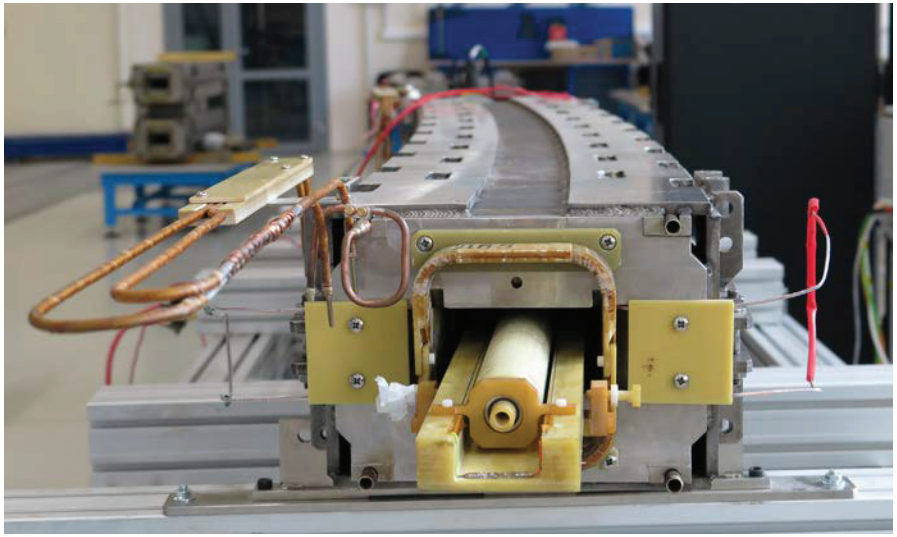
Introduction

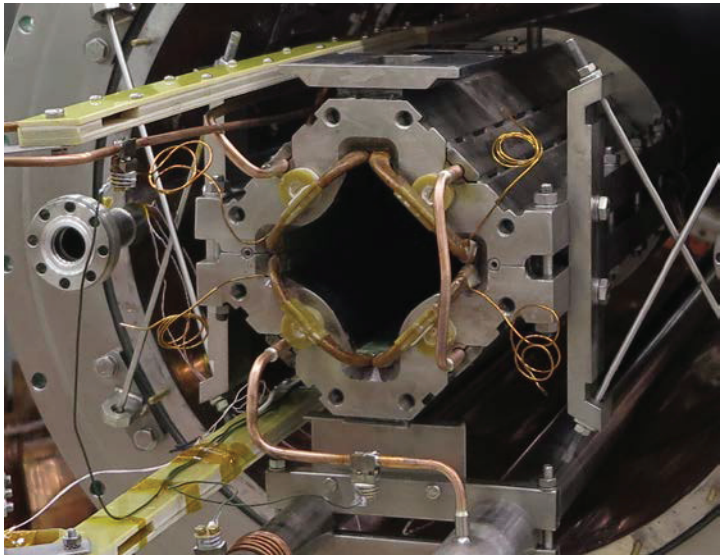
1. Progress of magnetic measurements
2. Results of magnetic measurements
    a) Booster dipoles
    b) Booster quadrupoles doublets
    c) Collider dipoles
3. Plans

Introduction: Design of the NICA booster magnets

The Nuclotron-type design based on a cold, window-frame iron yoke and a winding of the hollow superconductor was chosen for the NICA Booster.

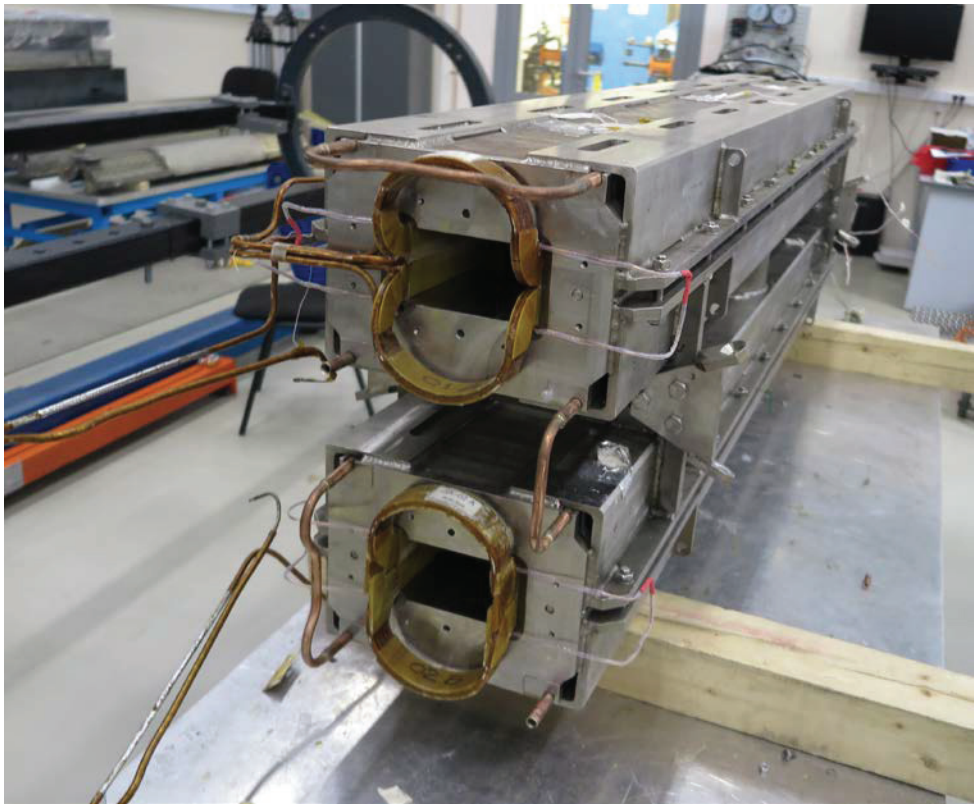


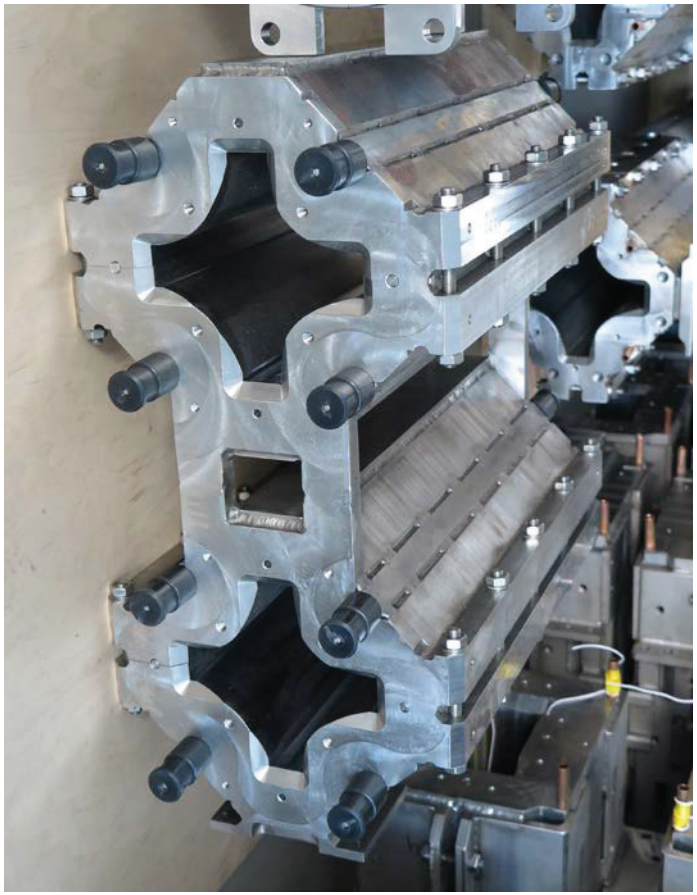




Introduction: Design of the NICA Collider magnets

The Nuclotron-type design based on a cold, window-frame iron yoke and a winding of the hollow superconductor was chosen for the NICA Collider.





Main Parameters of the NICA Magnets				
Parameter	Booster		Collider	
	Dipoles	Quadrupoles	Dipoles	Quadrupoles
Number of magnets	40	48 (24 doublets)	80+8*	86+12**
Maximum magnetic field	1.8 T	21.5 T/m	1.8 T	23.1 T/m
Minimum Magnetic field	0.11 T	1.3 T/m	0.57 T	7.3 T/m
Effective magnetic length	2.2 m	0.47 m	1.94 m	0.47 m
Beam pipe aperture (h/v)	128 /65 mm	128 /65 mm	120 /70 mm	120 /70 mm
Radius of curvature	14.01 m			
Operating current	9.68 kA	9.68 kA	10.4 kA	10.4 kA

Facility for SC Magnets Assembling and Cryogenic Tests

Test facility in full configuration was commissioned in November 2016. JINR and FAIR/GSI participate together in funding of this test facility

Parameters of the magnetic field of the booster magnets have to be measured:

- Relative deviation of effective lengths

$$\delta L_{eff} = \Delta L_{eff} / < L_{eff} >$$

- Main field direction

$$\alpha_N = -\frac{1}{N} arctg(A_N^* / B_N^*)$$

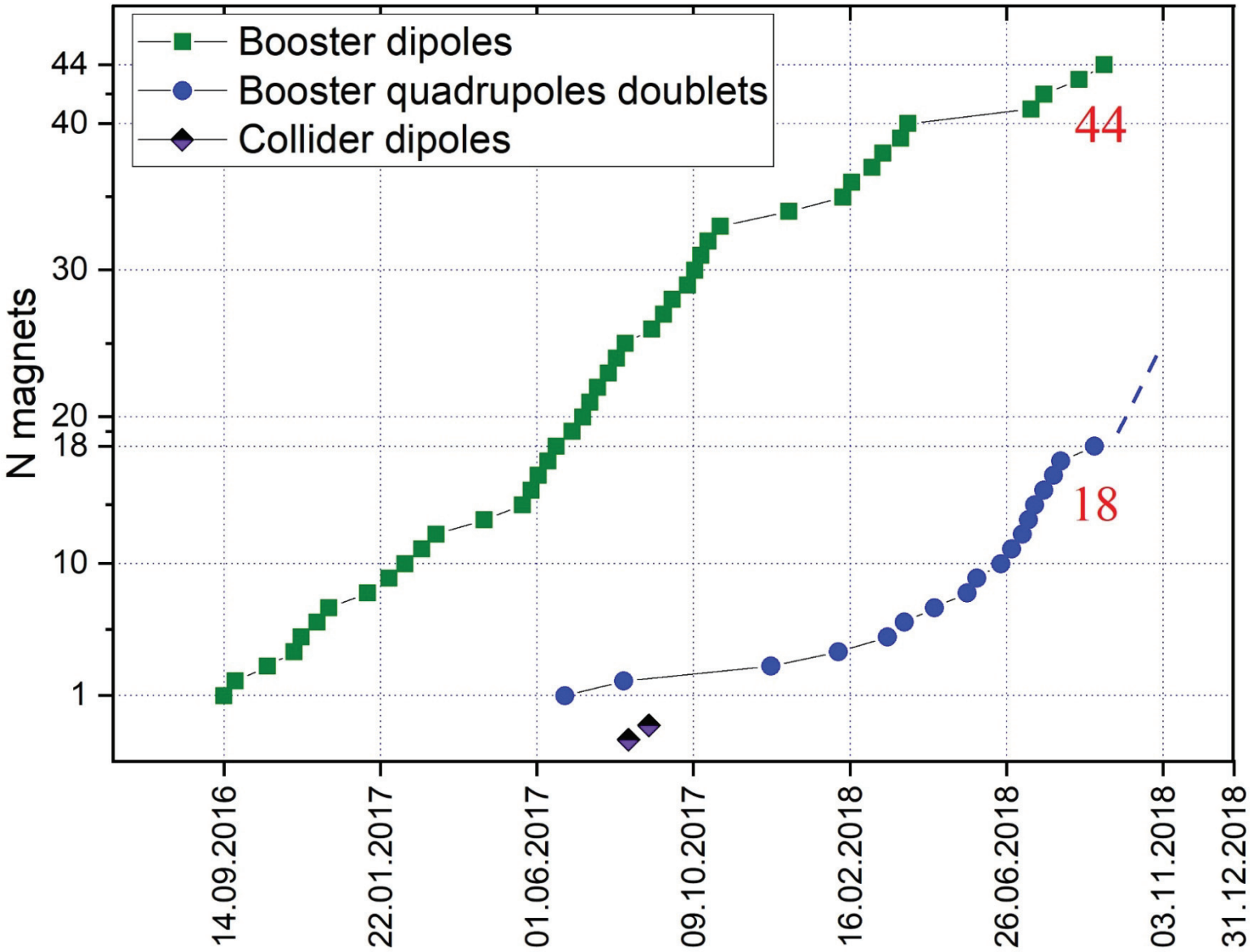
- Axis center (for quadrupoles)

- Relative integrated harmonics up to the 6th

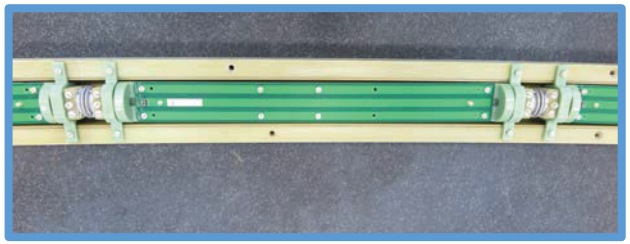
Tolerances For Magnetic Field Parameters

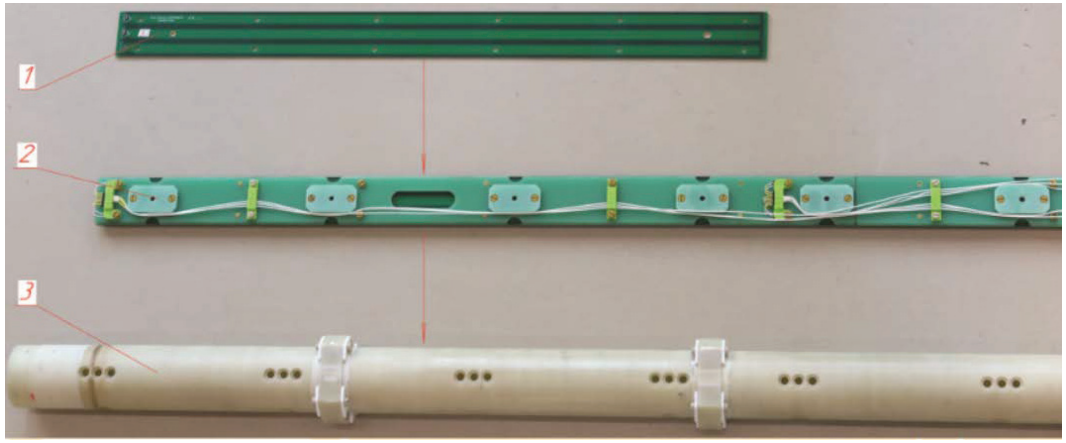
Parameter	Dipole		Quadrupole	
	Tolerance	Accuracy	Tolerance	Accuracy
Relative deviation of effective length	$5 \cdot 10^{-4}$	10^{-4}	$5 \cdot 10^{-4}$	10^{-4}
Main field direction	-	0.1 mrad	-	1 mrad
Axis center	-	-	0.1 mm	0.02 mm
b_2 , a_2	5	0.2	-	-
b_3	10	0.2	10	0.2
b_3 at injection	1	0.2		0.2
a_3	5	0.2	10	0.2
b_4 , a_4, b_6 , a_6	1	0.2	5	0.2
b_n , a_n , ≥ 5	1	0.2	1	0.2

Progress of magnetic measurements

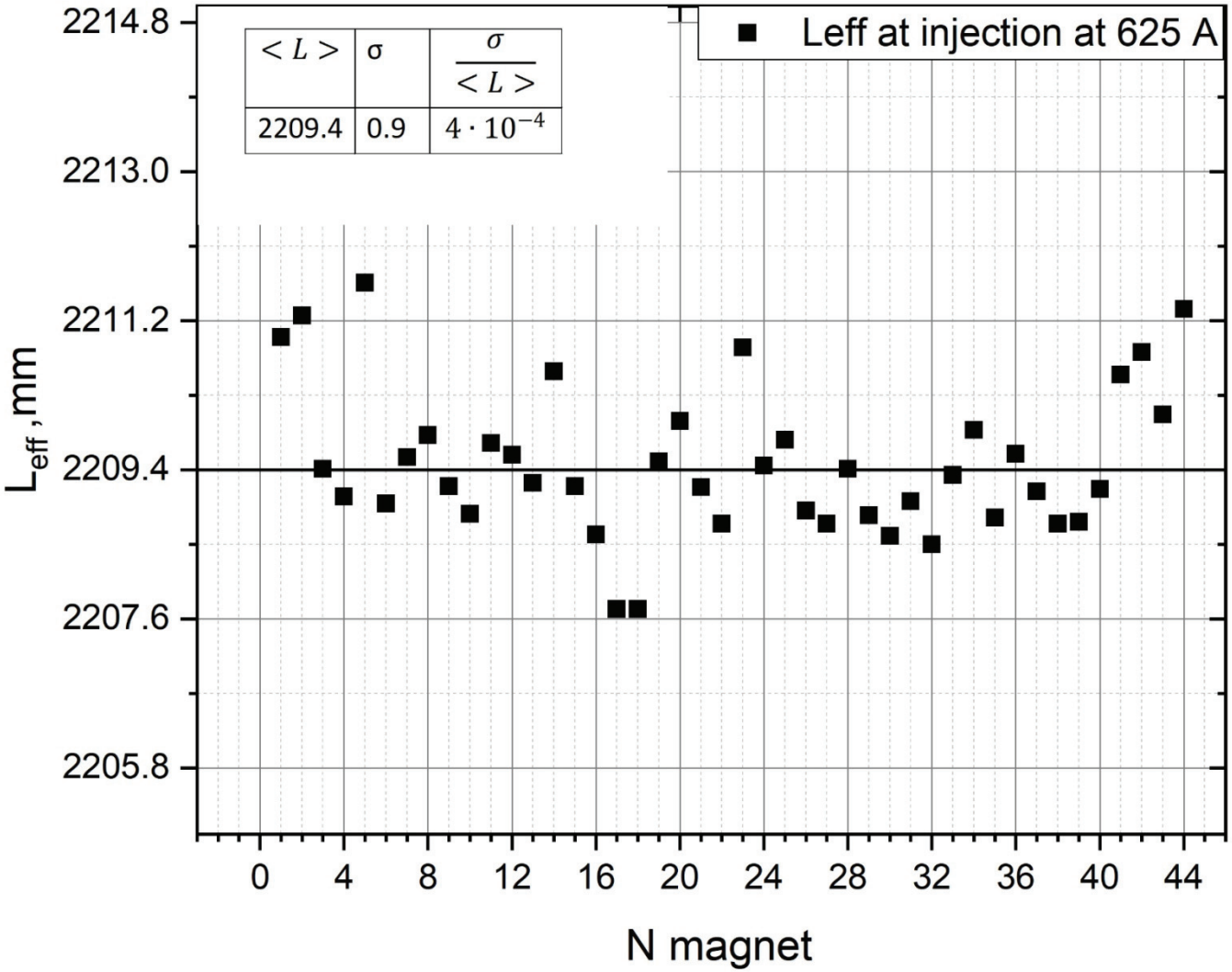


Harmonic Coils Method

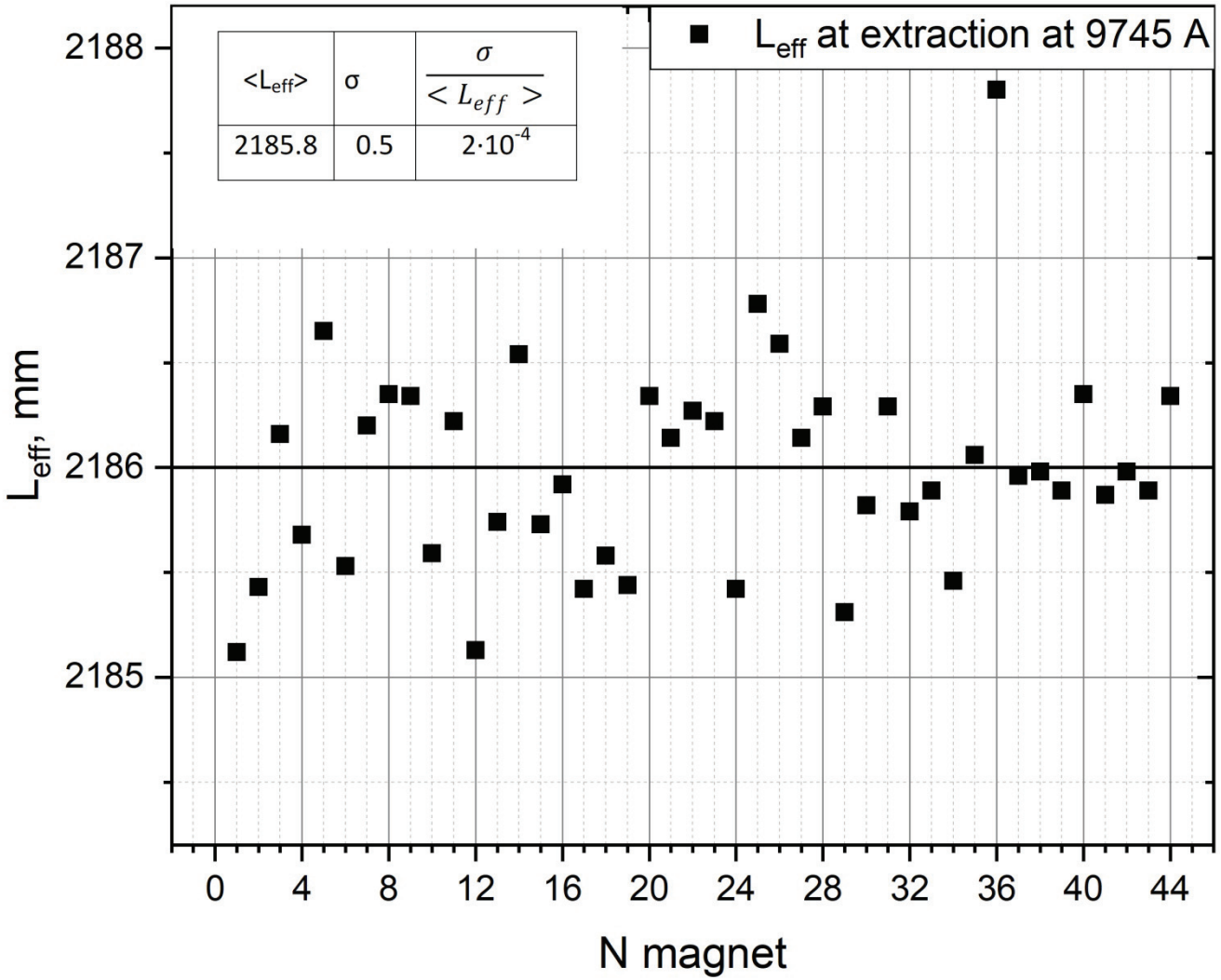




Booster dipoles



Booster dipoles

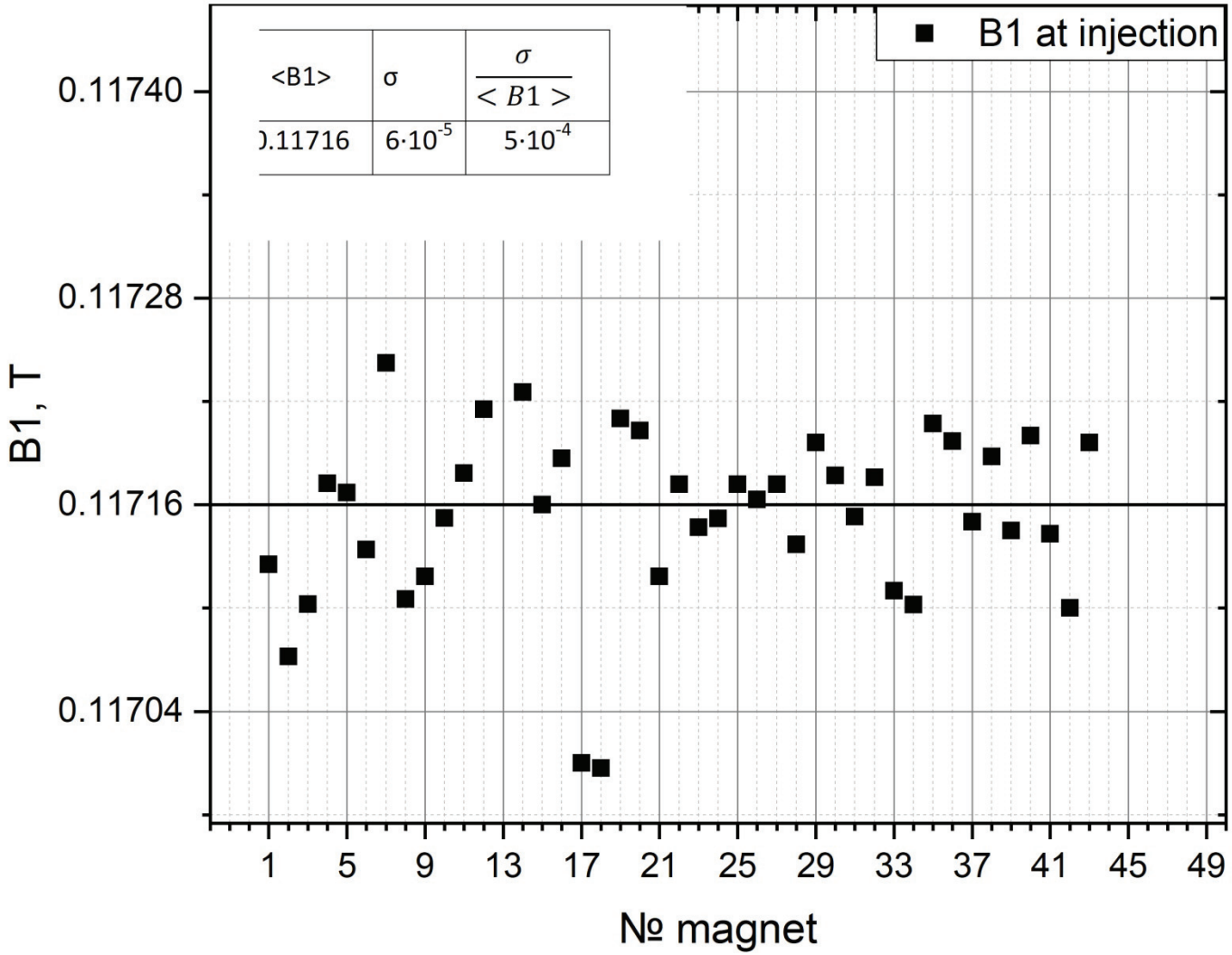


Booster dipoles

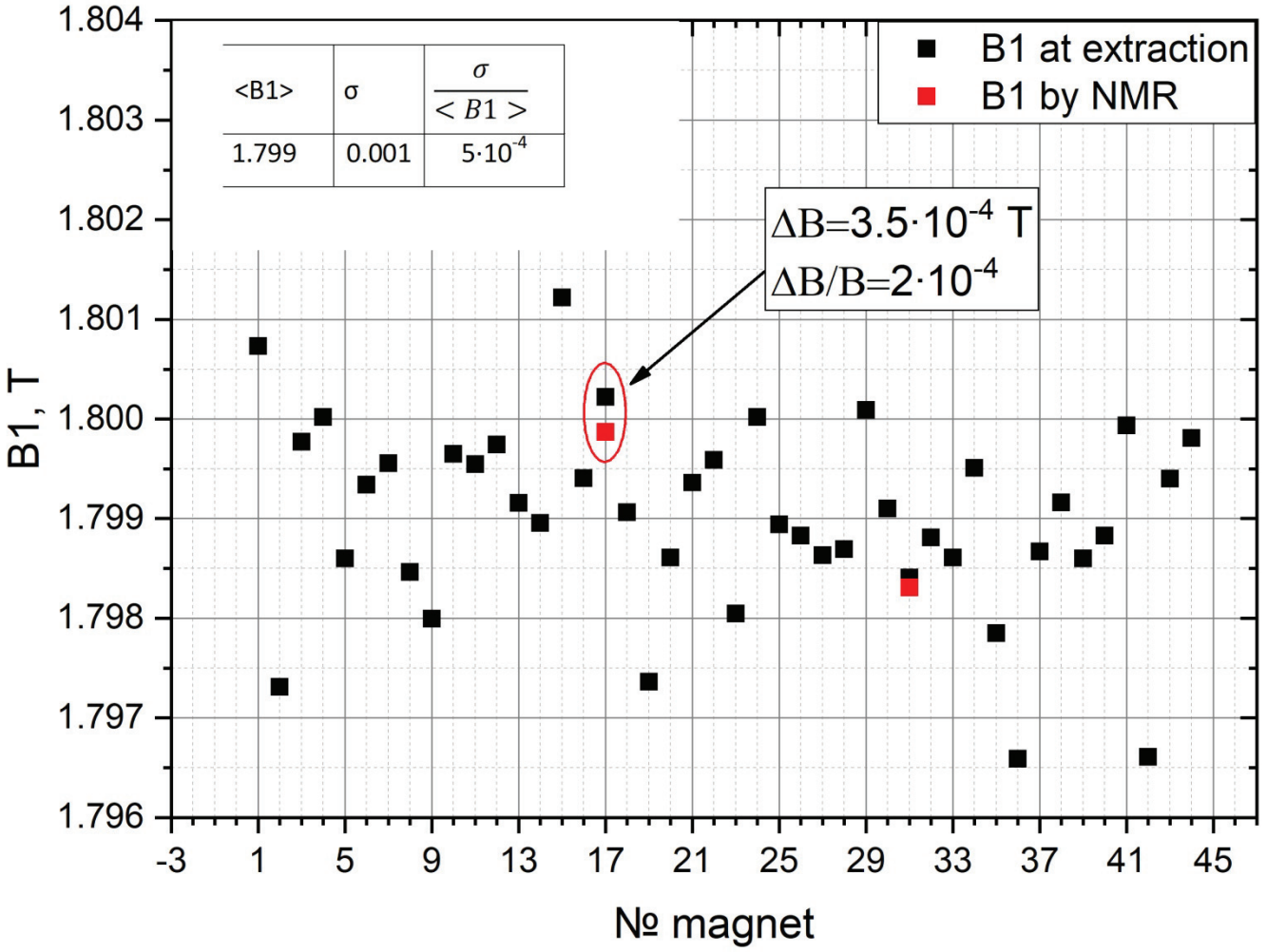
An arrangement of magnets based on the measured effective lengths was made (by A. Philippov). Deviations of a given orbit from the reference are not more than

0.28 mm

Booster dipoles

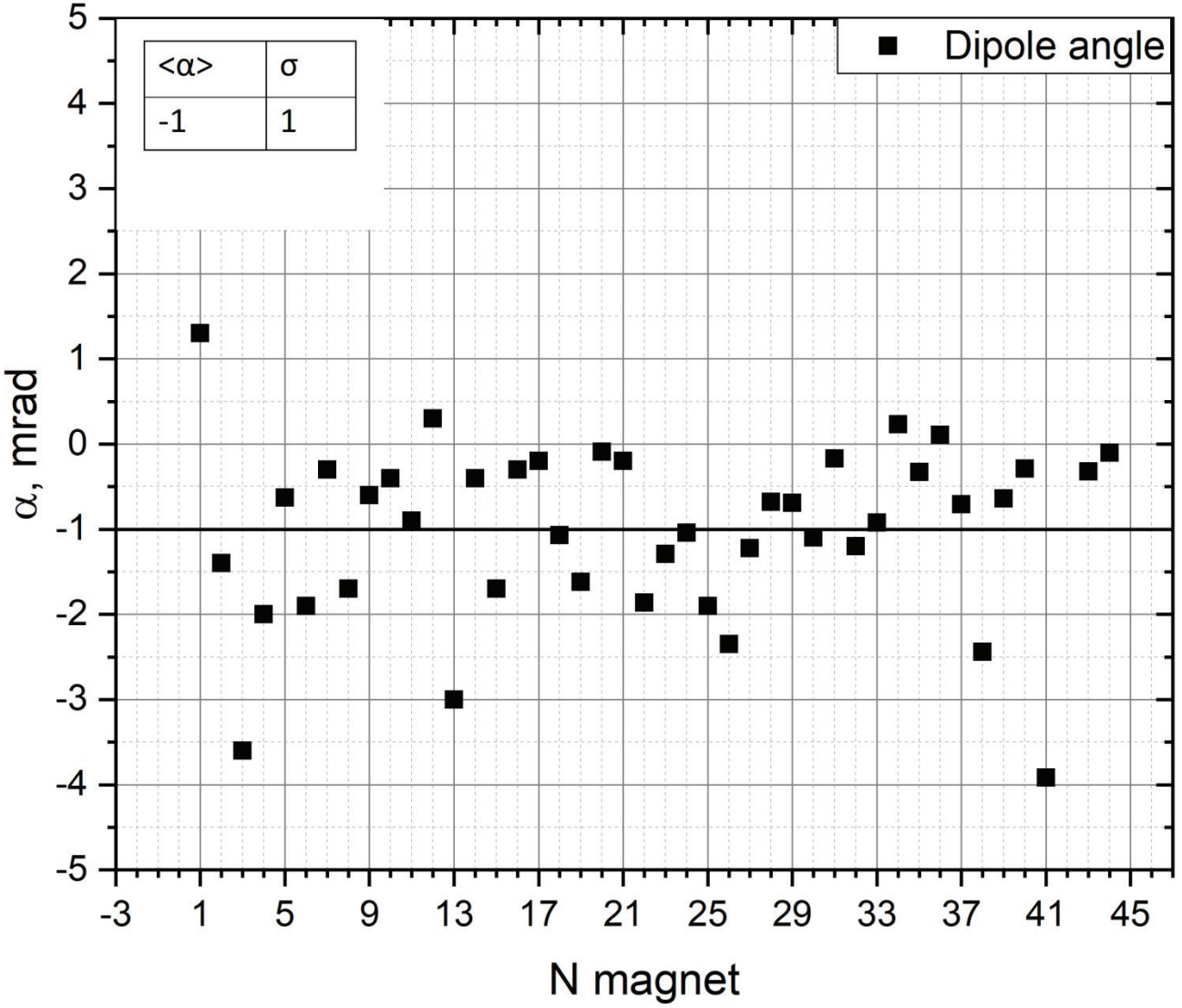


Booster dipoles

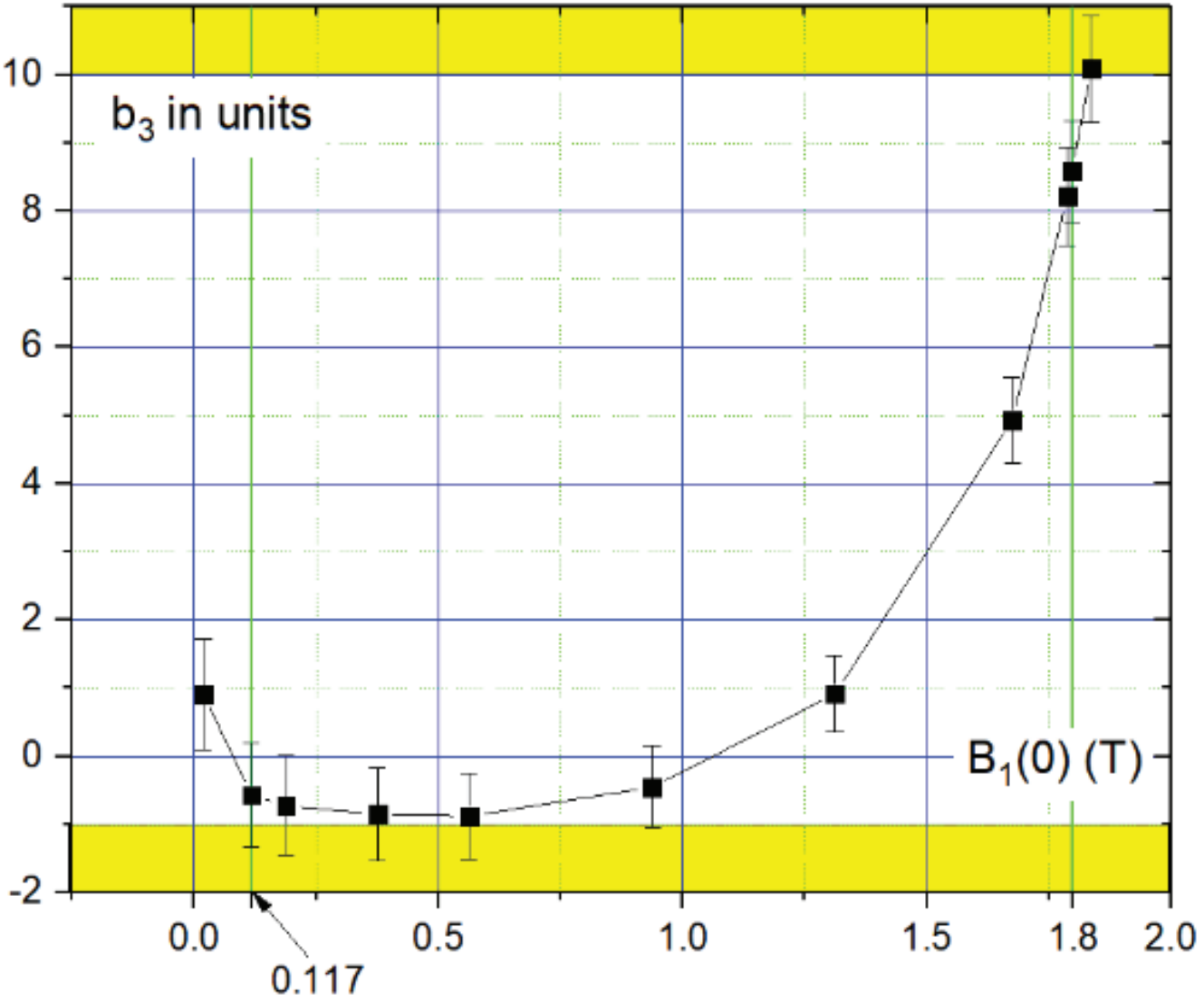


*NMR measurements were performed by the team of A. Batrakov (BINP)

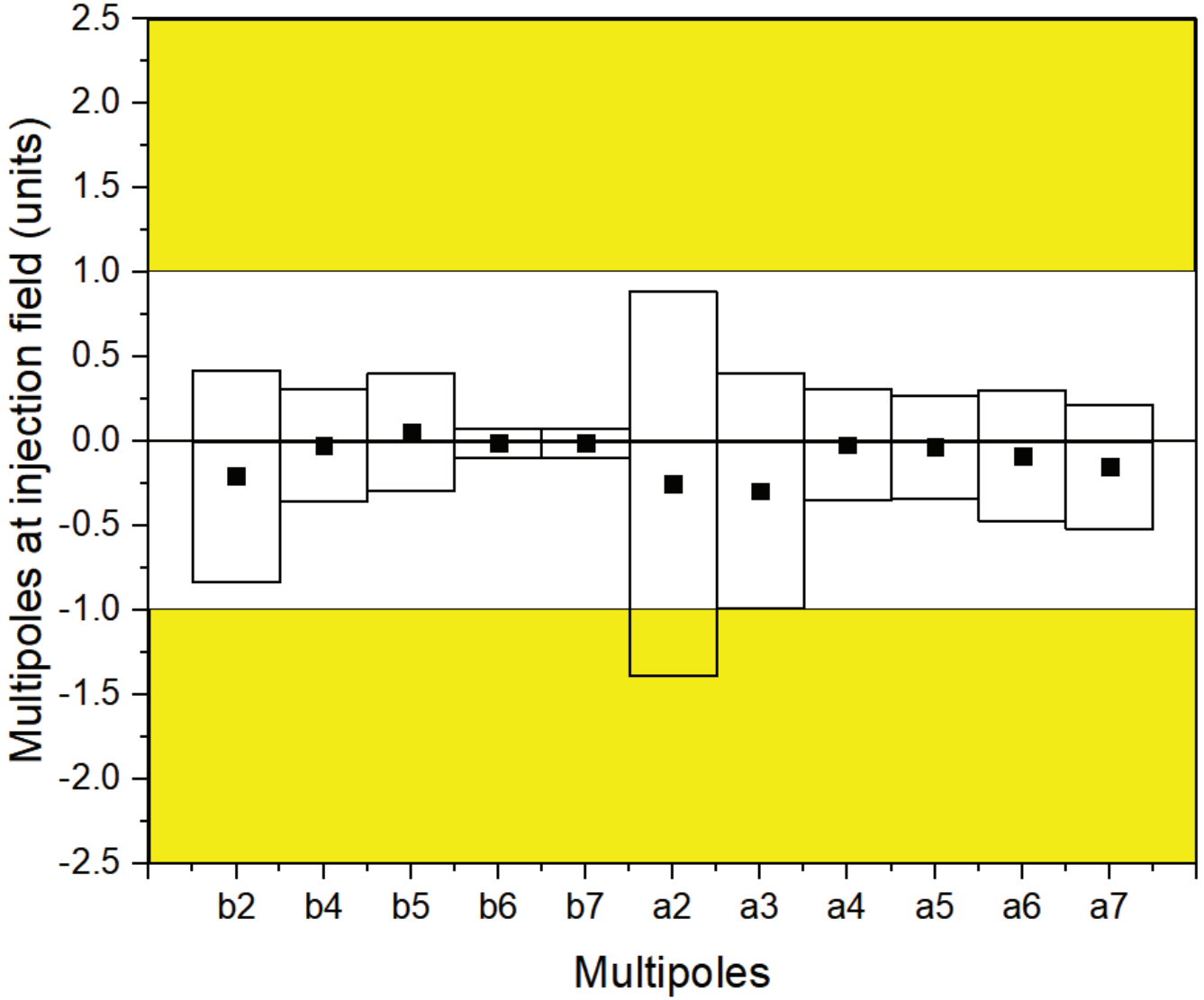
Results of magnetic measurements



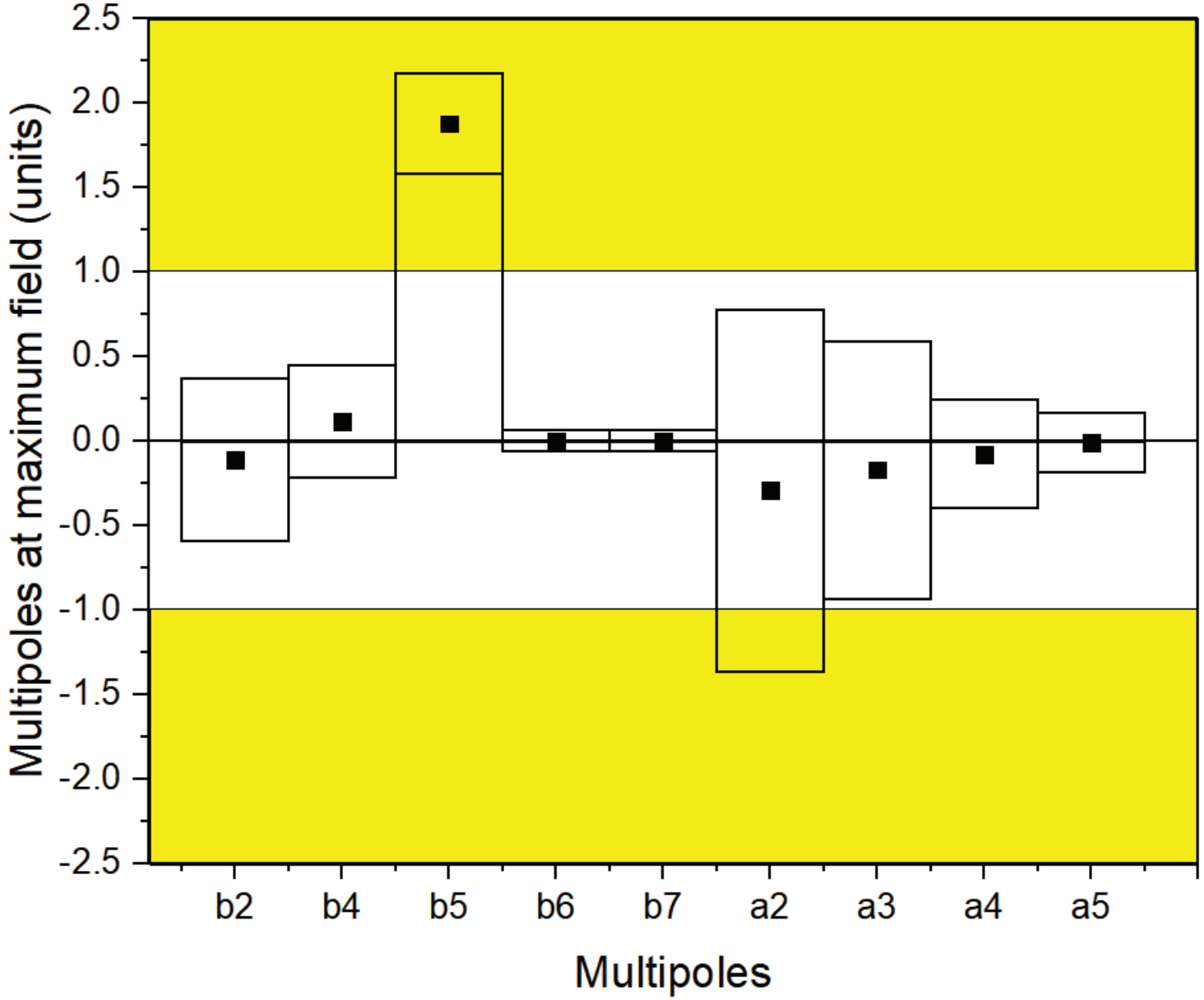
Booster dipoles



Booster dipoles

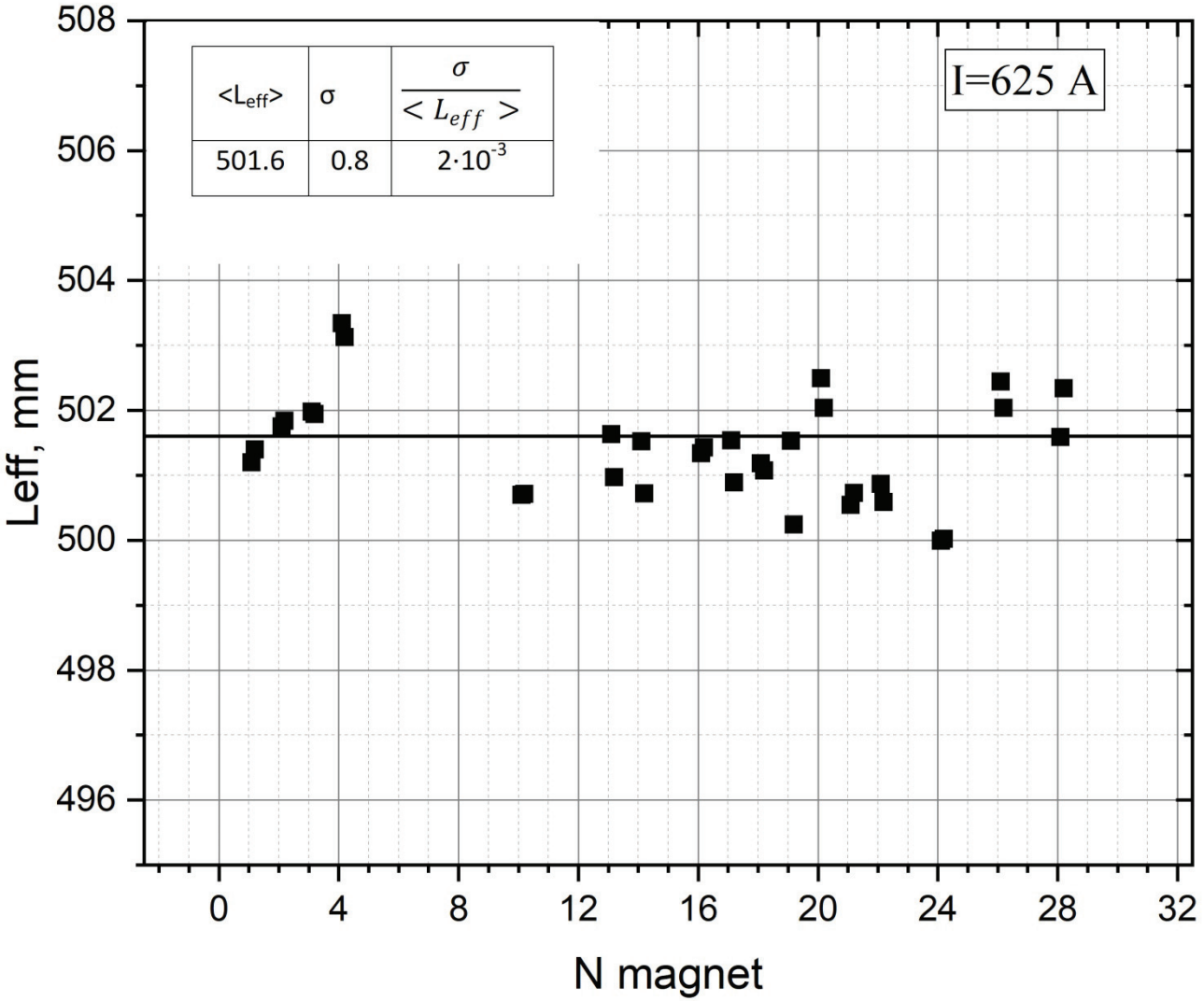


Booster dipoles

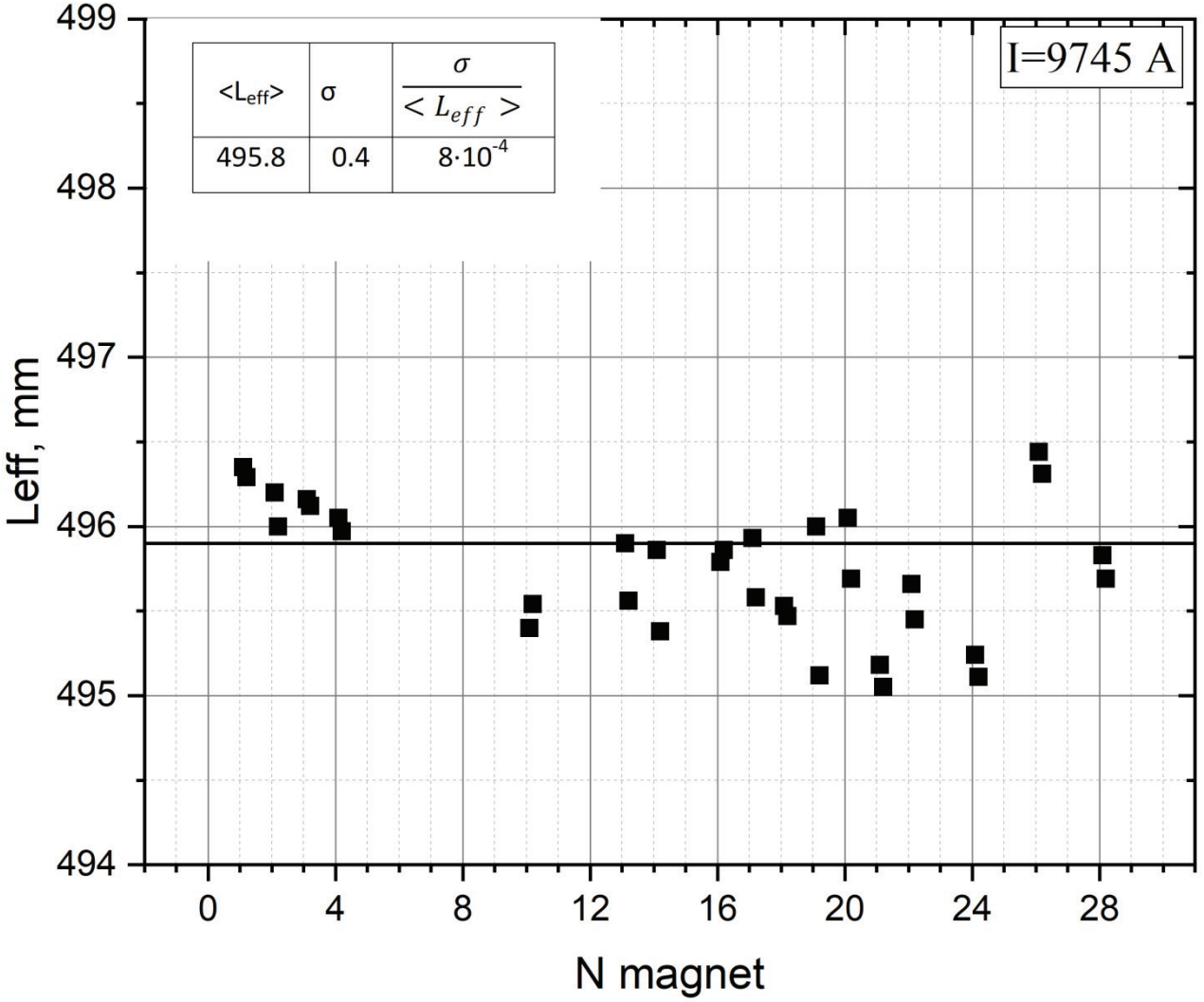


Booster doublets

Andrey Shemchuk WEPSB33



Booster doublets



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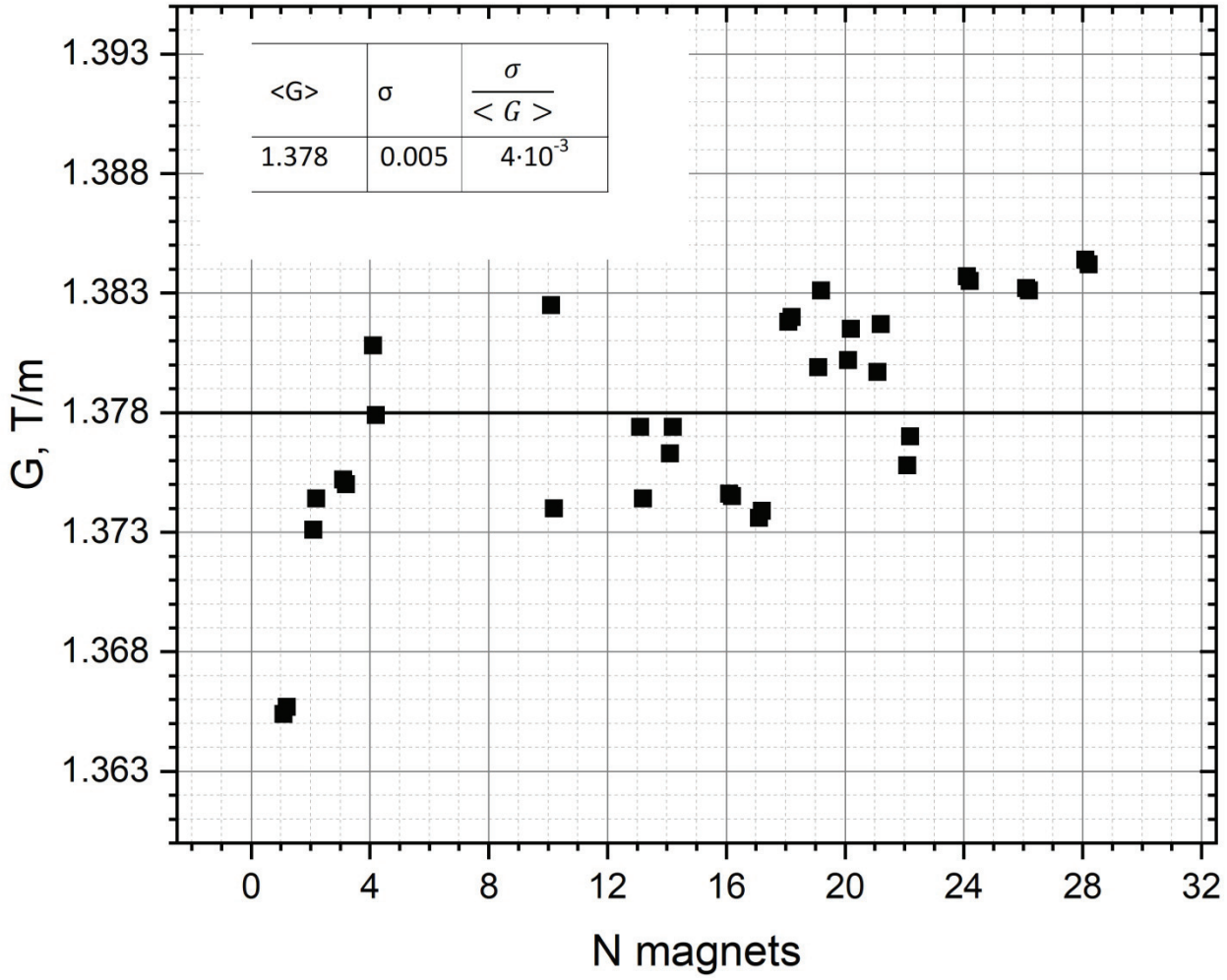
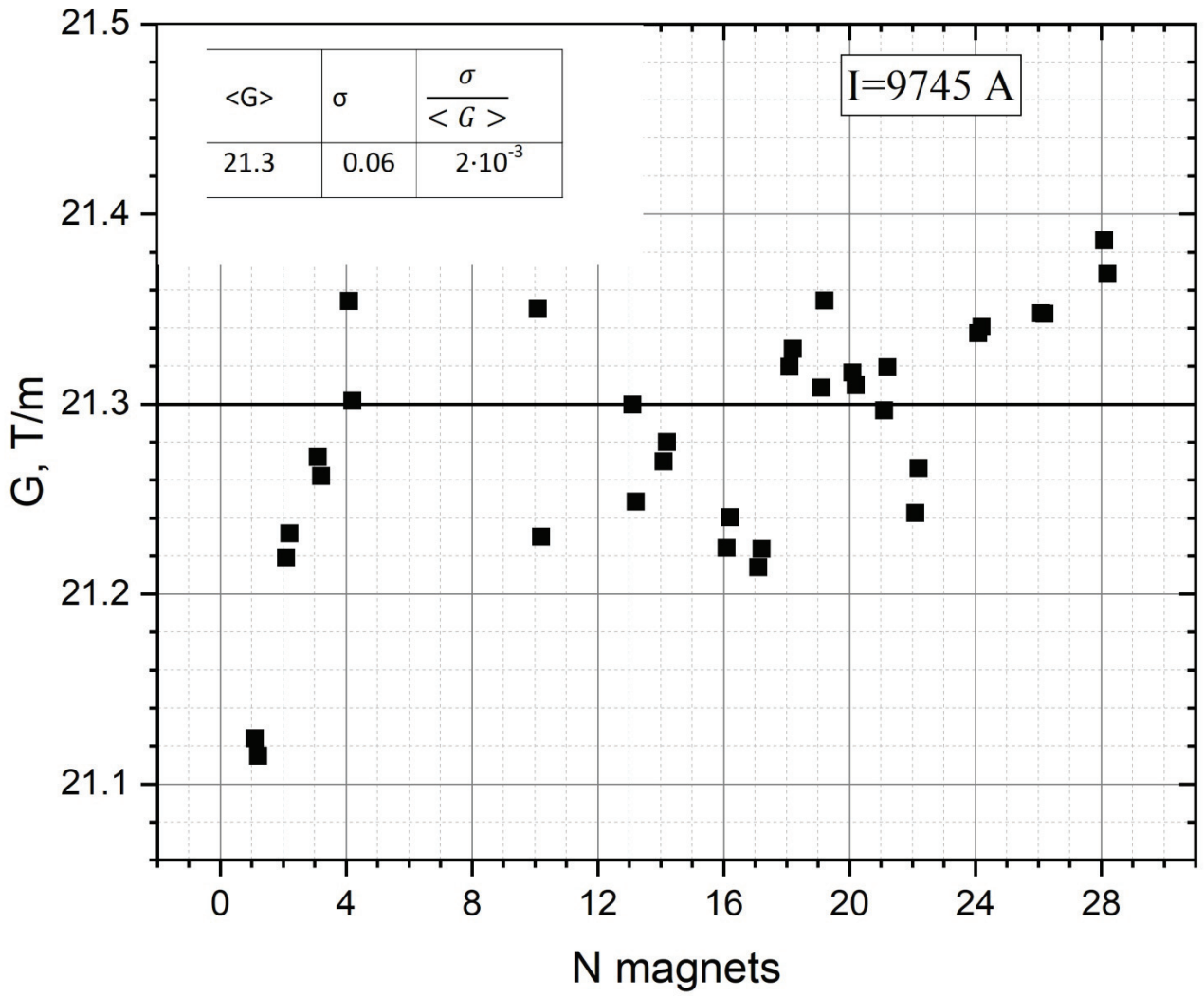
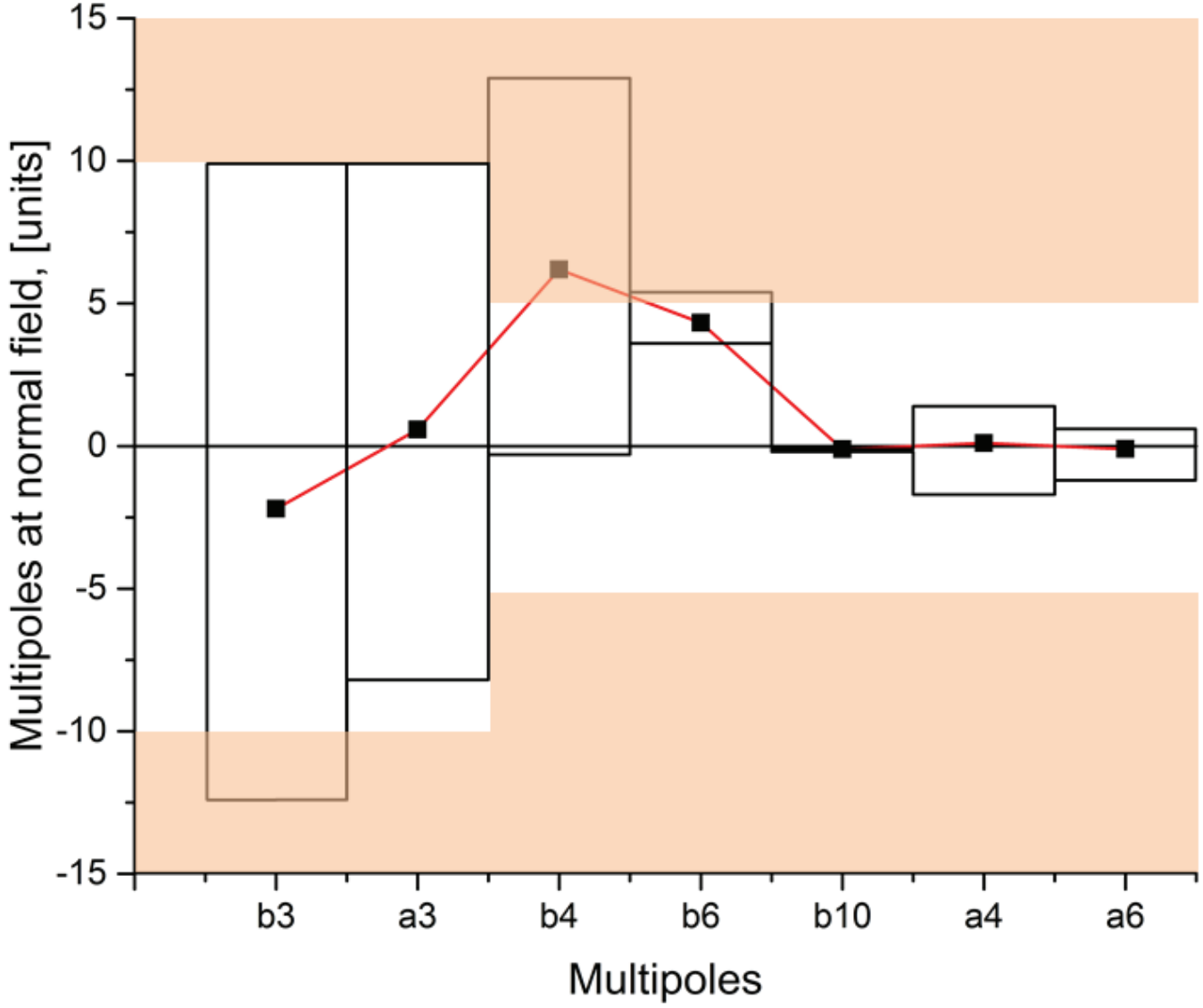


Booster doublets



Booster doublets



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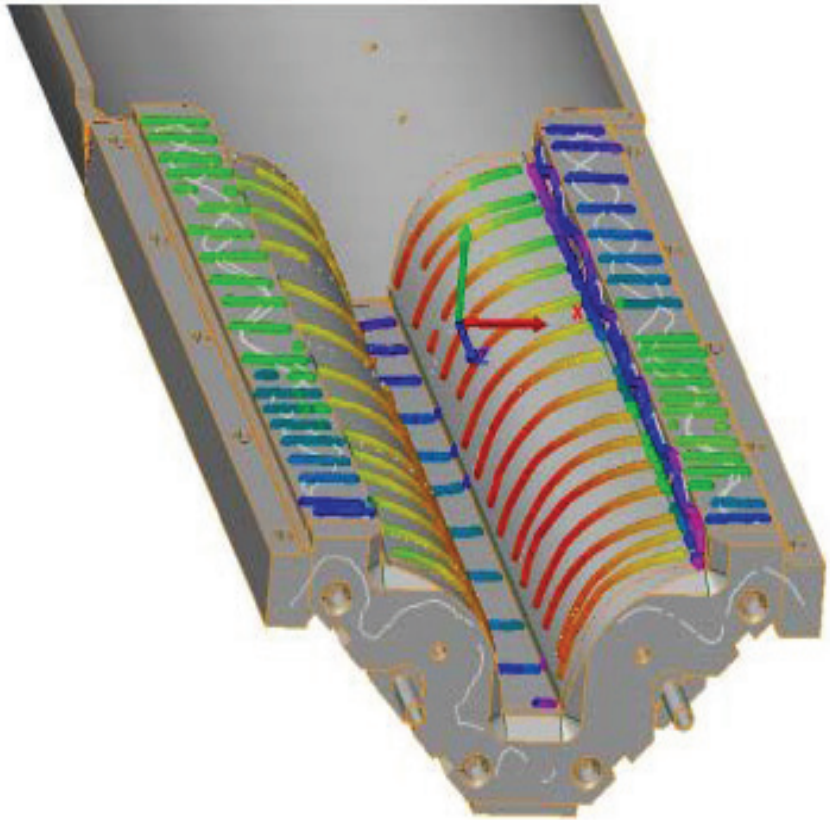
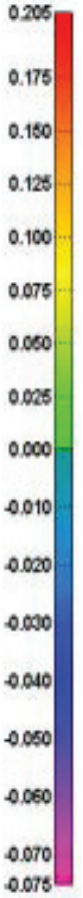
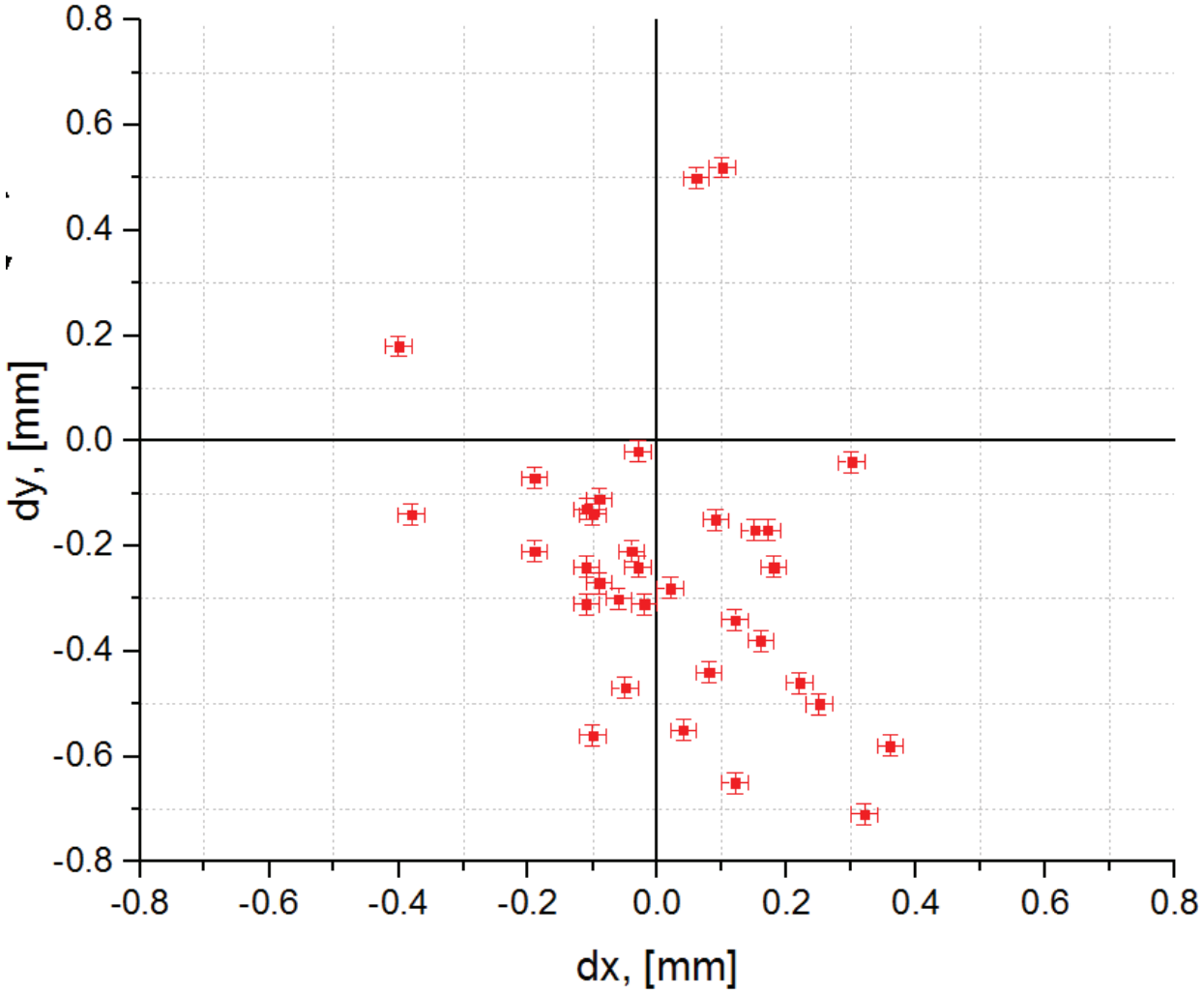


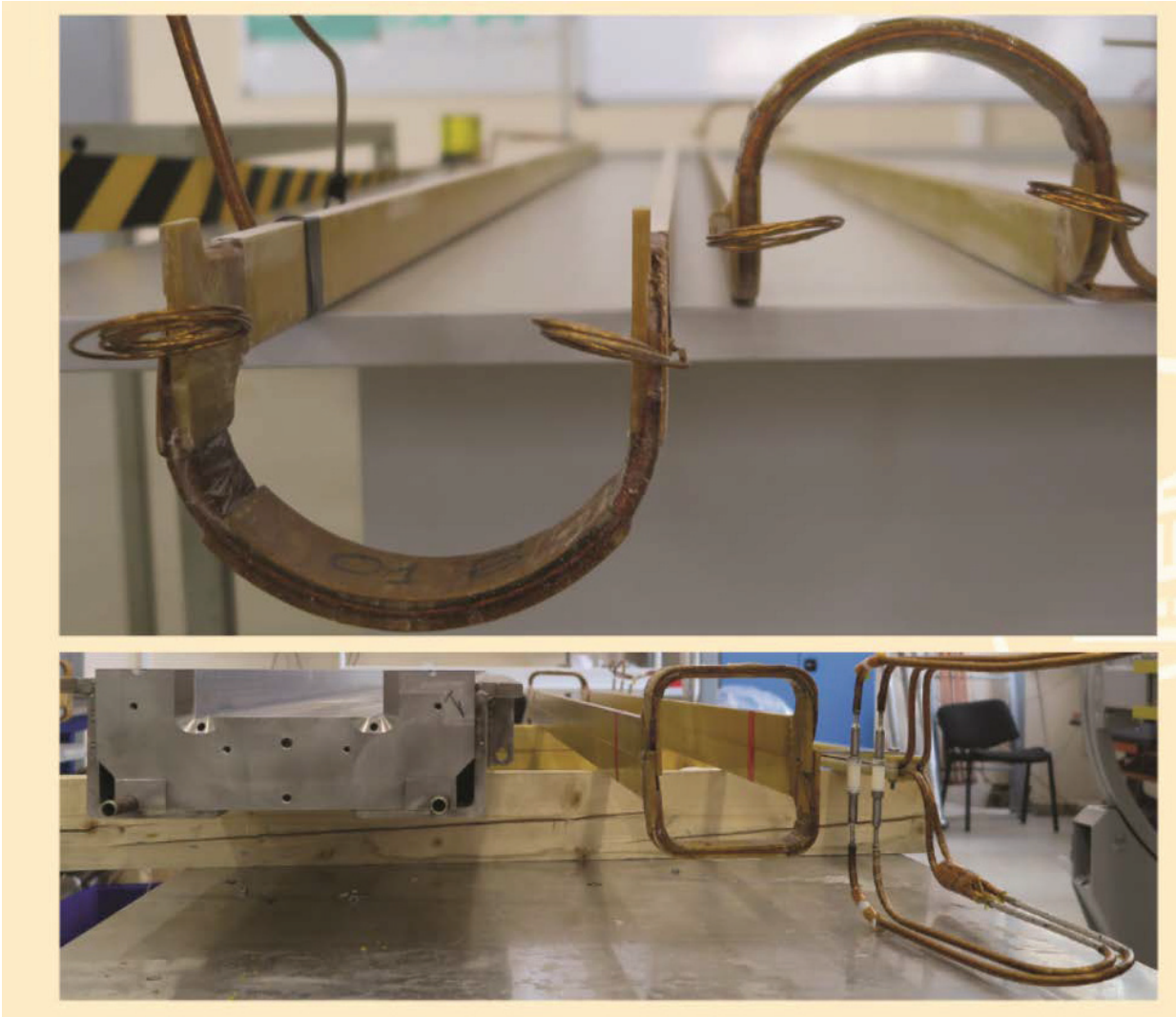


Booster doublets

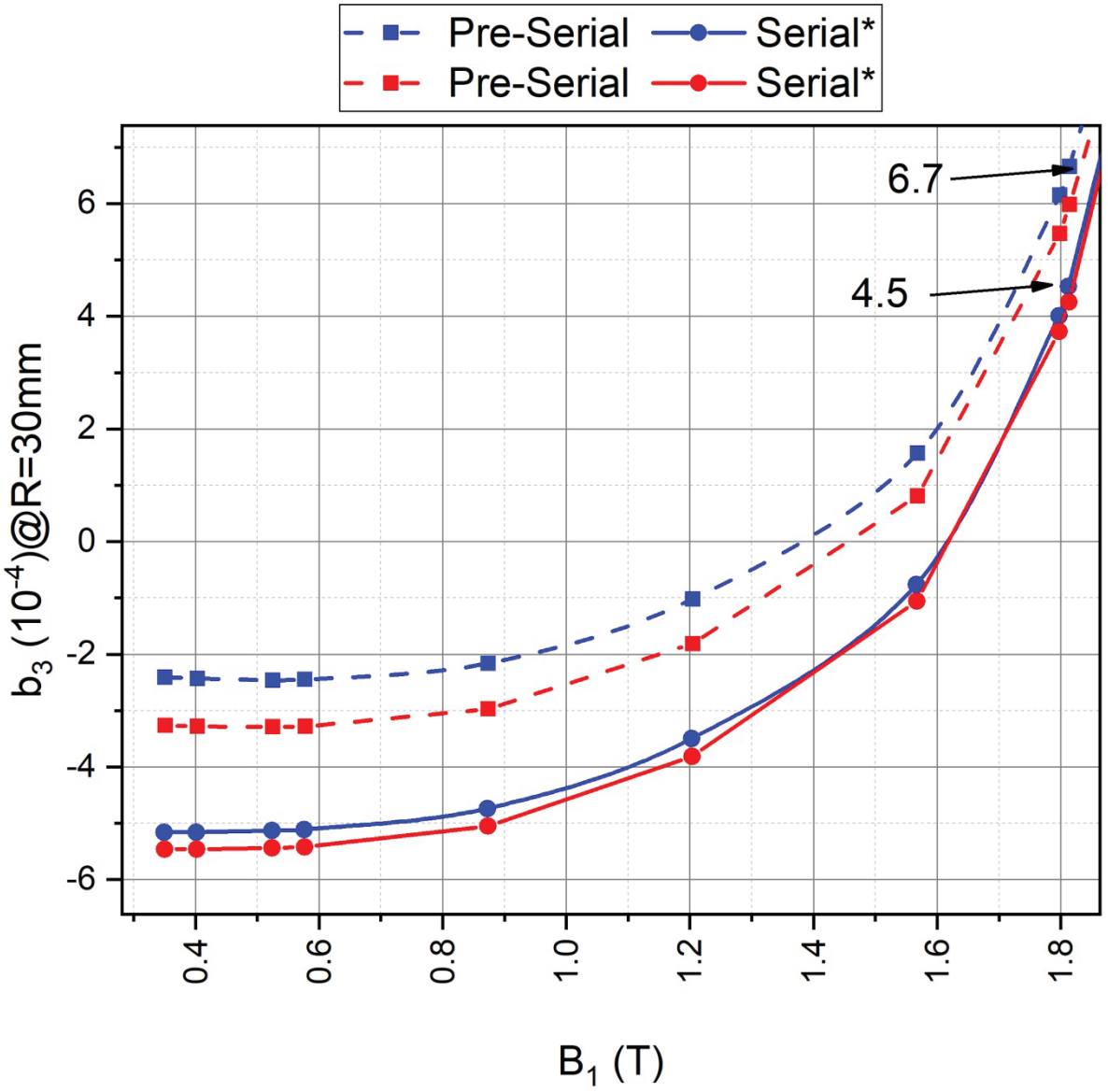


Pre series collider dipoles

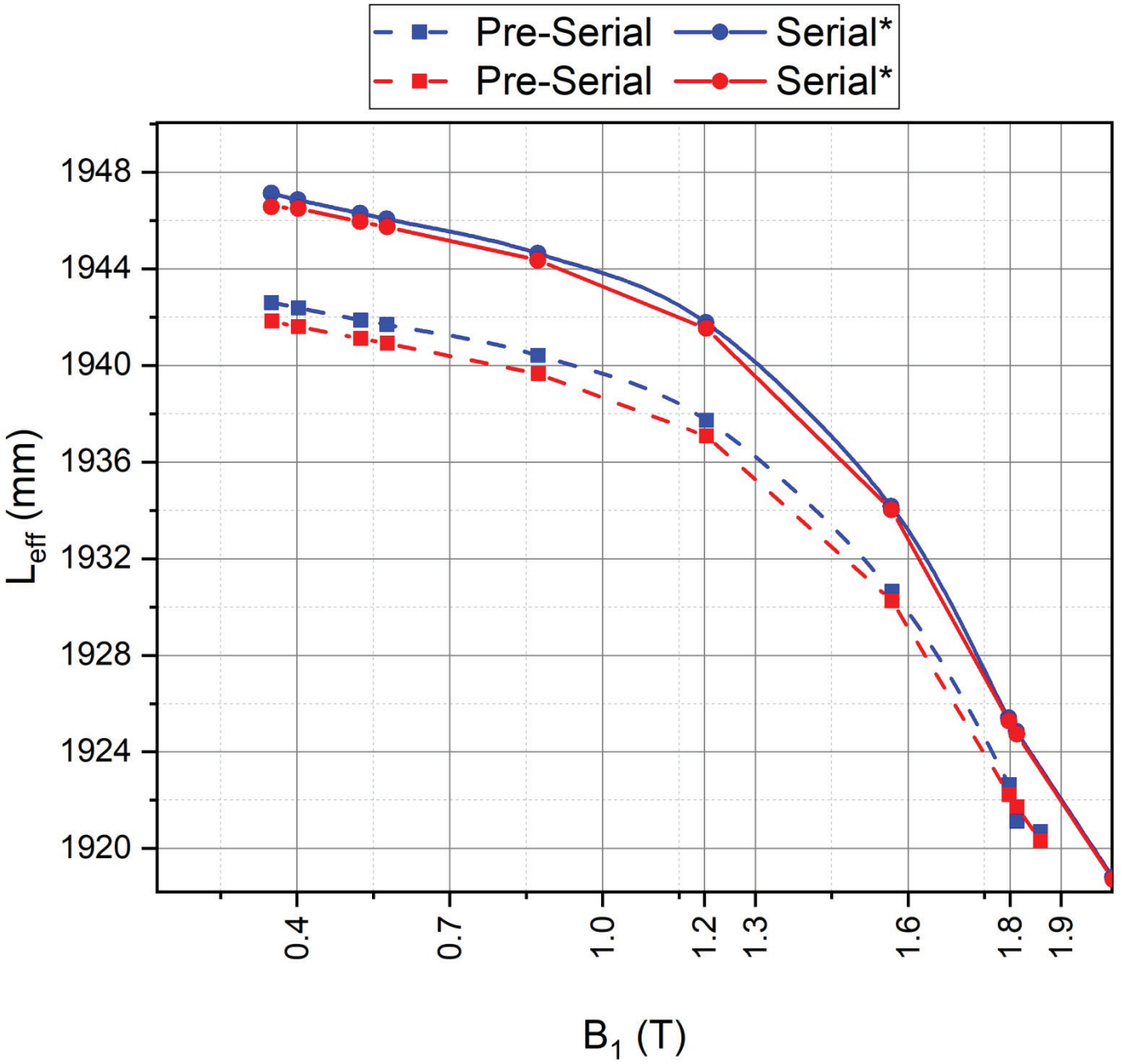
Mikhail Shandov
WEPSB32



Results of magnetic measurements



Results of magnetic measurements



- Finishing of doublets series magnetic measurements up to the end of the 2018 year
- Starting production and testing of series collider dipoles
- Production of the probe for series MM of collider quadrupoles
- Alignment of the booster pick-ups at the magnetic arises of doublets

THANK YOU VERY MUCH FOR YOUR ATTENTION!!