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PRODUCTION of SUPERCONDUCTING EQUIPMENT at IHEP

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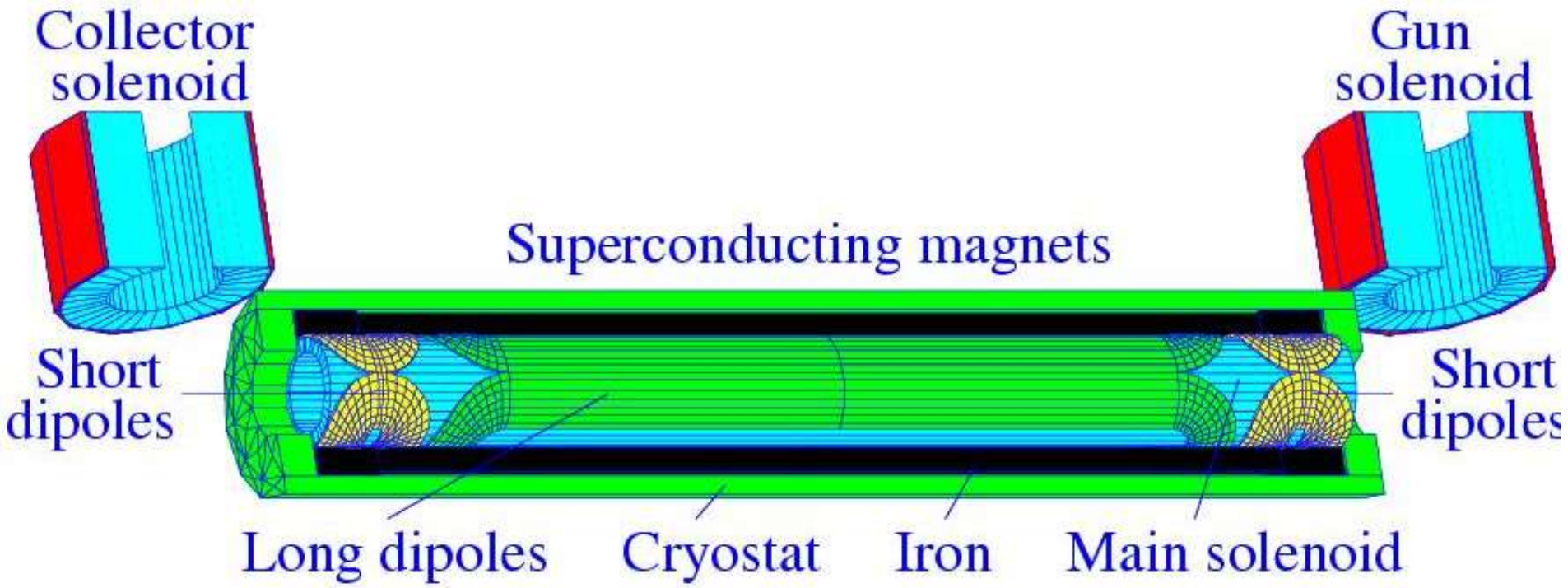
Superconducting magnets on basis of composite niobium - titanium wire

Tevatron Electron Lens (TEL)



Tevatron Electron Lens (TEL)

TEL magnetic system in tunnel of Tevatron

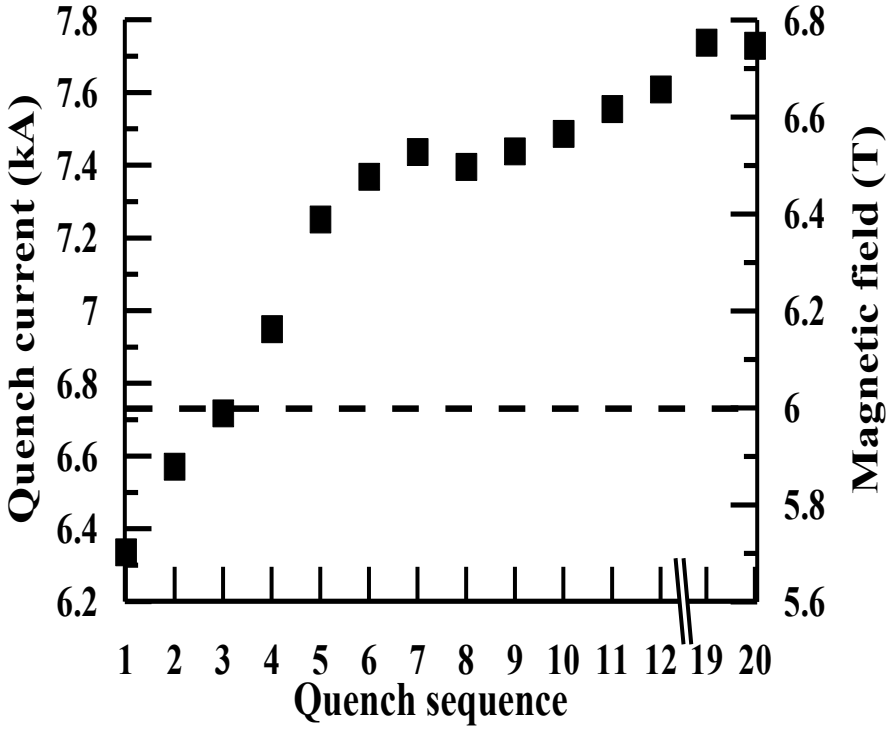
Parameters of TEL magnetic system

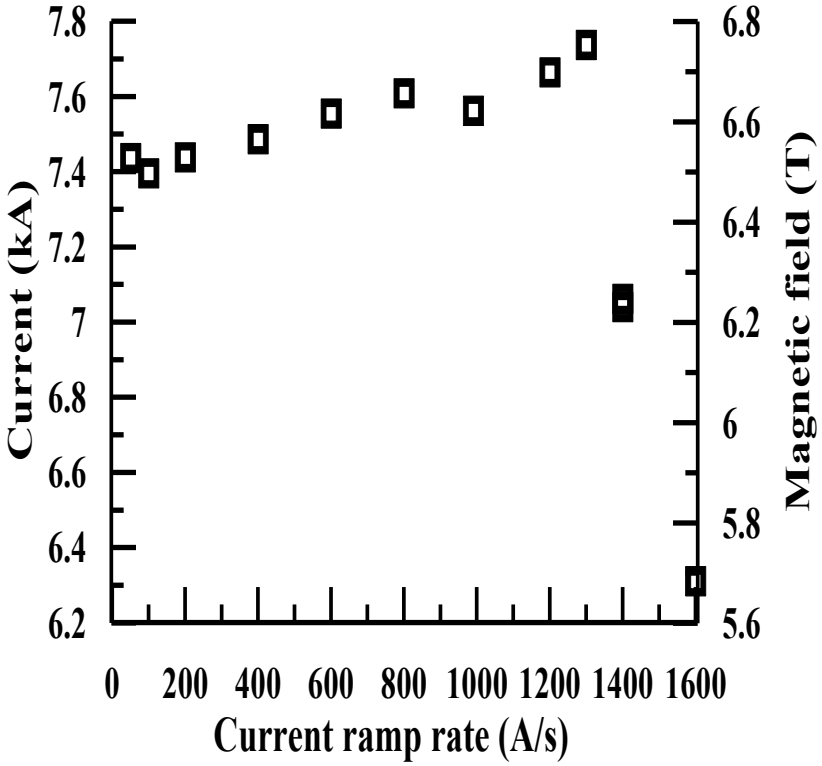
Magnet	B, T	I, A	D, m	L, m
SC solenoid	6.5	1800	0.152	2.5
SC central dipole	0.2	50	0.2	1.94
SC end dipole	0.8	200	0.2	0.25
Gun, collector solenoid	0.4	357	0.250	0.3
Bending solenoid	0.19	357	0.390	0.072

SIS300 superconducting high field fast cycling dipole model

Dipole magnet	SIS300	UNK
Magnetic field, T	6	5.1
Operating current, kA	6.72	5.22
Field ramp rate, T/s	1	0.11
Number of layers	2	2
Cable strand number	36	19
AC losses, W/m	4.7	0.95
In coil, W/m	3.4	0.6
In iron yoke, W/m	1.3	0.35
Stored energy, kJ	260	570
Inductance, mH	11.7	45
Coil inner diameter, mm	100	80
Length of SC coil, m	1	5.8
Mass of magnet, ton	1.8	6

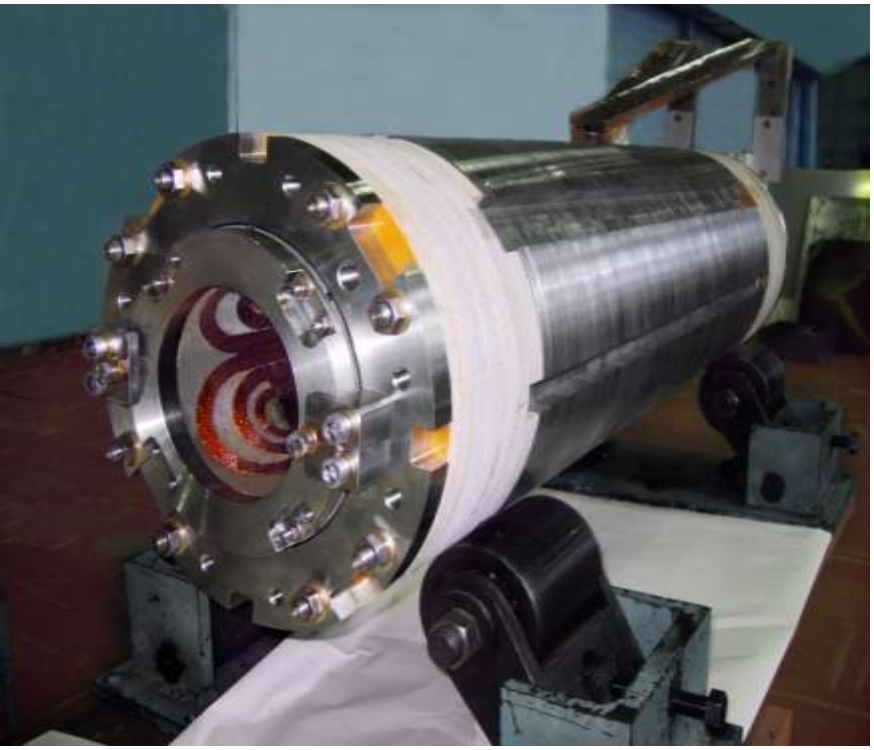
Test results of SIS300 dipole model





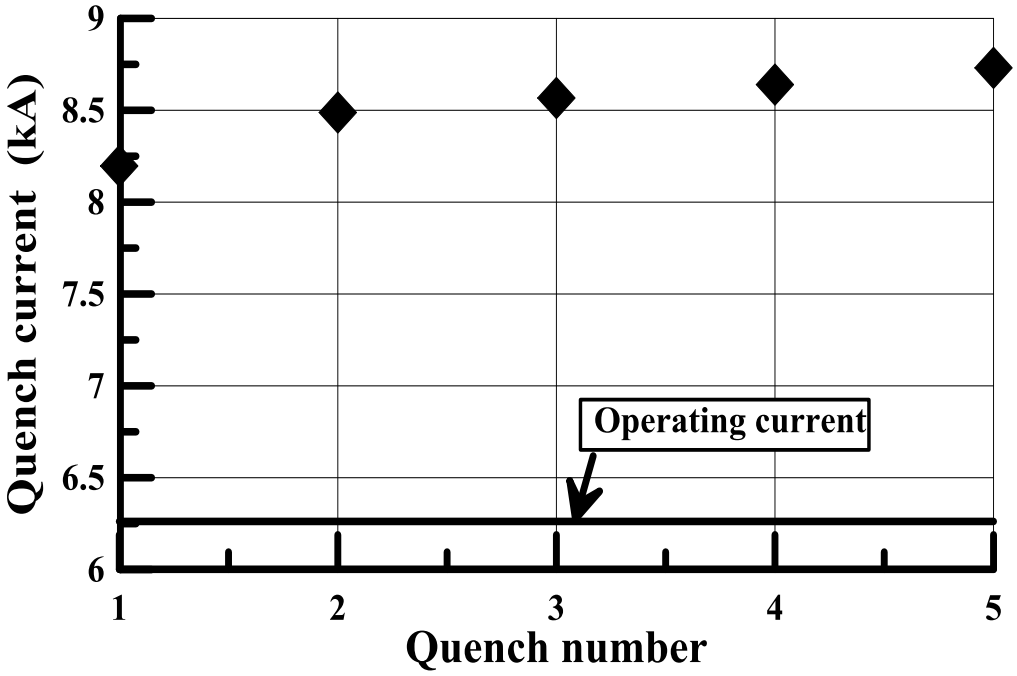
Dipole has unique parameters in world practice: 6.8 T magnetic field, up to 1.2 T/s ramp rate, 100 mm aperture

SIS300 fast cycling quadrupole prototype



Quadrupole magnet	SIS300	UNK
Field gradient, T/m	45	97
Operating current, kA	6.26	5.22
Ramp rate, T/m/s	10	2
AC losses, W/m	1	0.67
Coil inner diameter, mm	125	80
Length of SC coil, m	1	3.1
Number of layers	1	2
Cable strand number	19	19
Strand diameter, mm	0.825	0.85
NbTi filament diameter, μm	3	6
Step pitch, mm	8	12
J_C (5 T, 4.2 K), A/mm^2	≥2700	≥2300

Test results of SIS300 quad prototype



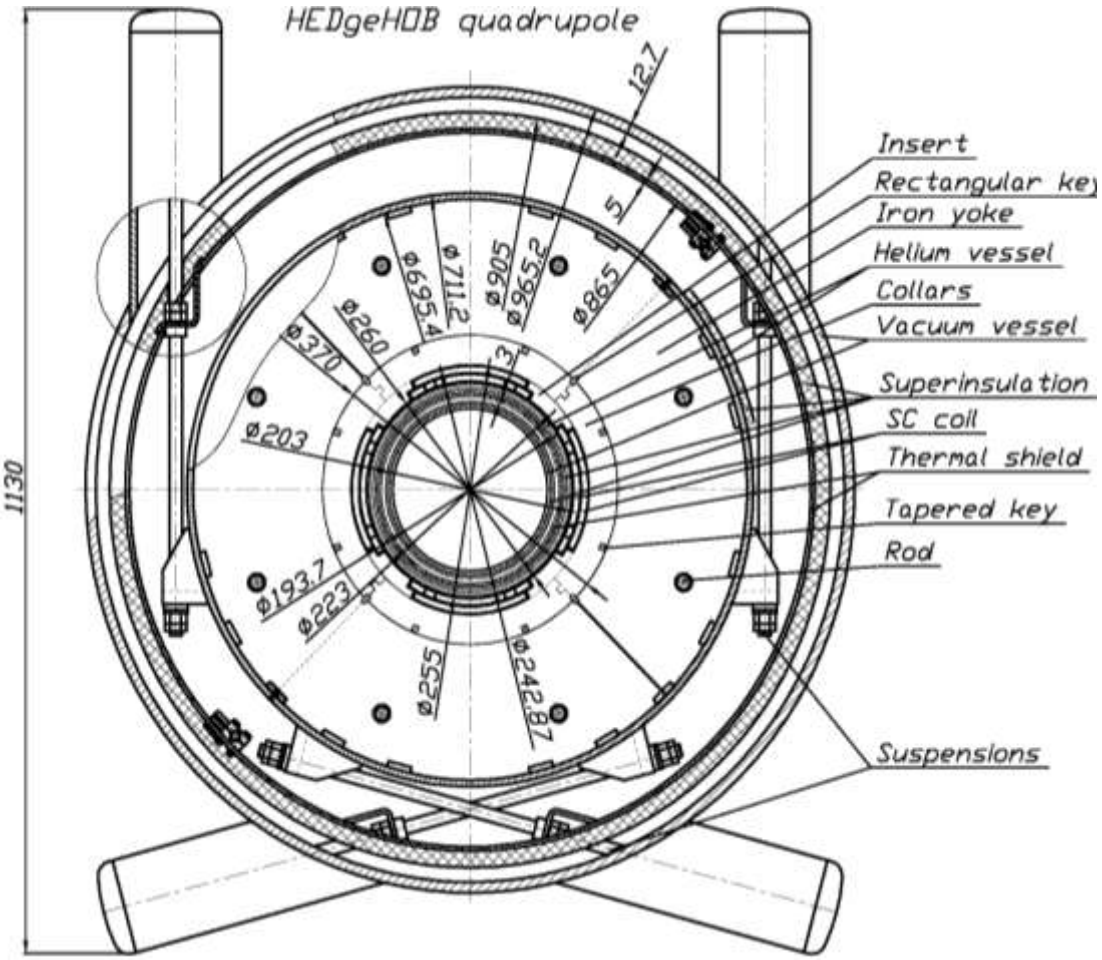
The quench current of the magnet reached 8200 A in the first quench and 8734 A in fifth quench that corresponds to 40% current margin.

Quench current was higher than 8.5 kA up to 5 kA/s (2.8 T/s) ramp rate.

Requirements to SIS300 fast cycling corrector magnets

Type of corrector	Strength	Coil length, m	Powering time, s
Chromaticity sextupole	130 T/m^2	0.78	0.21
Resonance sextupole	325 T/m^2	1	0.5
Steering magnet:			
Vertical dipole	0.5 T	0.65	2.27
Horizontal dipole	0.5 T	0.65	2.27
Multipole:			
Quadrupole	1.8 T/m	0.65	2.25
Sextupole	60 T/m^2	0.65	2.18
Octupole	767 T/m^3	0.65	2.24

FFS large-aperture high-gradient quadrupole



Central gradient, T/m	37.6
Inner diameter, mm	260
Maximal field, T	5.9
Operating current, kA	5.73
Total magnetic force/octant, kN/m	1454
Total energy in the magnet, kJ/m	613.5
Inductance, mH/m	36.5
Length of magnet, m	1.89

Cryogenic equipment and systems for cooling superconducting devices

Cryogenic helium vacuum heat exchanger

(10 g/s helium flow, 300-2 K temperature range)

LHC Electrical Feed Boxes

(2600 HTS current leads from 25 to 12500A)

Superfluid cryogenic system of 21 channel U-70 (280 W at 1.8 K)

Devices on basis high temperature superconductor

600 A HTS current leads

Nominal current	600 A
Heat load to liquid helium at 600 A	0.08 W
HTS	Bi-2223
Material of matrix	Ag+1at.%Au
HTS tape dimension	4.6*0.25 mm^2
Number of HTS tapes	14
Length of HTS tapes	400 mm
Resistive part length	500 mm
Diameter of copper wires	0.13 mm
Tube inner diameter	11 mm
Packaging density	35 %

HTS dipole magnet

Magnetic field	1 T
Nominal current	25 A
Operating temperature	65 K
Aperture	21*70 mm^2
Magnet dimension	280*345*590 mm^2
Inductance	0.85 H
Turn number	712
HTS	Bi2223
HTS tape dimension	3.8*0.25 mm^2

HTS four-layer racetrack coils

HTS tape: 3.8 mm*0.25 mm, SUPERPOWER

Coil #	Solder joint number	Critical current (1 μV/cm, 77 K), A
1	one	38.1
2	one	31.4
3	one	34.2
4	one	36.3
5	one	31.5
6	one	32.8
7	no	34.1
8	two	35.9

Conclusion

- **IHEP has meaningful experience and equipment for development and production of accelerator magnets on basis of Low Temperature Superconductors and High Temperature Superconductors as well as cryogenic system for cooling superconducting devices and systems.**

- **At present IHEP develops SC large-aperture high-gradient quadrupole for FFS FAIR and racetrack coils from HTS-2G tape.**

Thank you for attention!