STATUS OF THE HIGH VOLTAGE ELECTRON COOLER PROJECT FOR NICA COLLIDER

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Abstract

The 2.5 MeV electron cooler for the NICA collider is being designed at JINR [1]. The conceptual design of the electron cooling system has been developed and working design has been started. The 250 kV prototypes of the high voltage (HV) generator of the cooler has assembled and being tested.

DESIGN OF THE COOLER

The electron cooler (Fig. 1) consists of three tanks filled with SF6 gas under pressure of 8 at. The tanks 1 and 3 contain acceleration tube and electron gun for one of the electron beam and deceleration tube and electron collector for opposite direction electron beam. HV generator is placed in the tank 2.

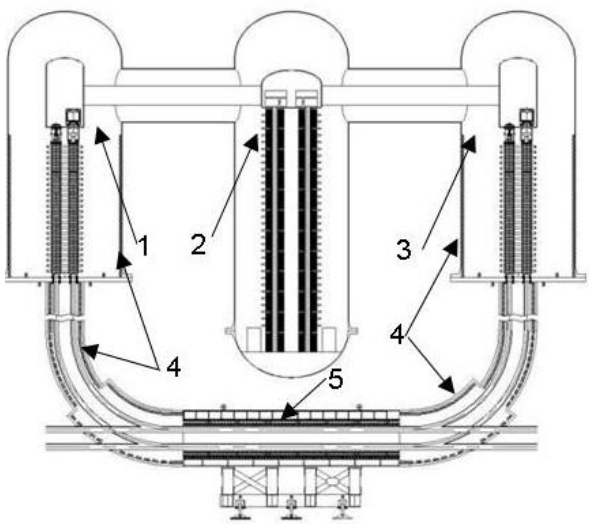

Fig.1. General view of the electron cooler (working design). 1, 3 – tanks with electron gun and acceleration tube and deceleration tube + collector for electron beam of opposite direction, 2 – tank with HV generator, 4 – beam transportation solenoids, 5 - electron cooling section.

MAGNETIC SYSTEM

The magnetic field is formed by a set of straight and toroidal solenoids (Fig.1). The solenoids forming the magnetic field in the region of acceleration/deceleration tubes are placed outside the tanks that resolve the problem of the high voltage insulation (Fig.2).

Table 1. Cooler parameters

Electron energy, MeV	0.5 ÷ 2.5
Electron beam current , A	0.1 ÷ 1,0
Beam diameter, cm	1,0
solenoid magnetic field, T	0.1 ÷ 0.2
HV PS current, mA	1
Collector PS, kW	2×2
HV PS stability, ΔU/U	1×10^{-4}
SF_6 gas pressure, at	5 ÷ 8

To form 2 kG magnetic field the solenoids have to have the next parameters: linear current density of 1.6 kA/cm; height of 2500 mm; diameter of 2100 mm. Comparing warm and superconducting solenoid parameters (cost, weight, power consumption, a.e.t), we have chosen the last one for tanks region (Table 2).

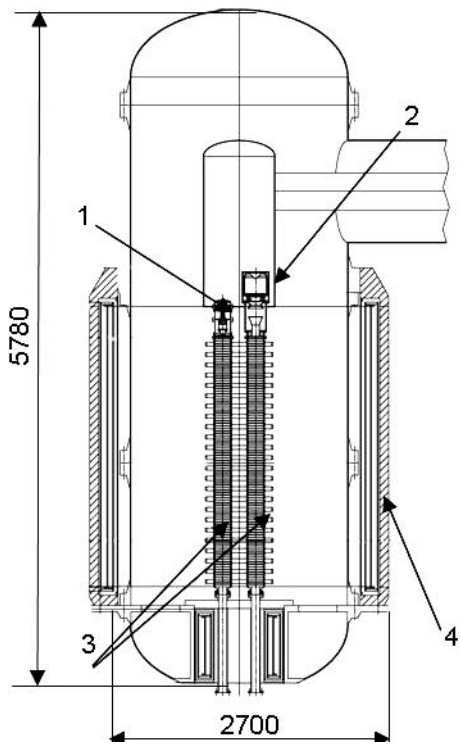

Fig.2. 1 - electron gun, 2 - electron collector, 3- acceleration/deceleration tubes, 4 - the SC solenoid in cryostats with iron shields.

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HIGH VOLTAGE GENERATOR

High voltage (HV) generator placed in one of the tank of the cooler (Fig.3) is based on the principle of the cascade scheme [1]. The power transmition to the high potential will be done with rotating rods (shafts).

The 250 kv prototypes of the high voltage generator of the cooler (fig.4) has assembled and being tested.

Table 2. Superconducting solenoids parameters

Magnetic field, T	0.2
Operating current, A	200
Solenoid height, mm	2500
Solenoid inner diameter, mm	2300
Number of winding layers	2
Number of turns	2000
Inductance, H	8.35
Mass of superconductor, kg	50
Superconductor cost, M$	0.07
Cryostat, mandrel, current leads etc, M$	0.47
Power consumption, MW	0.03
Electricity cost per 5000 hours, $M	0.017

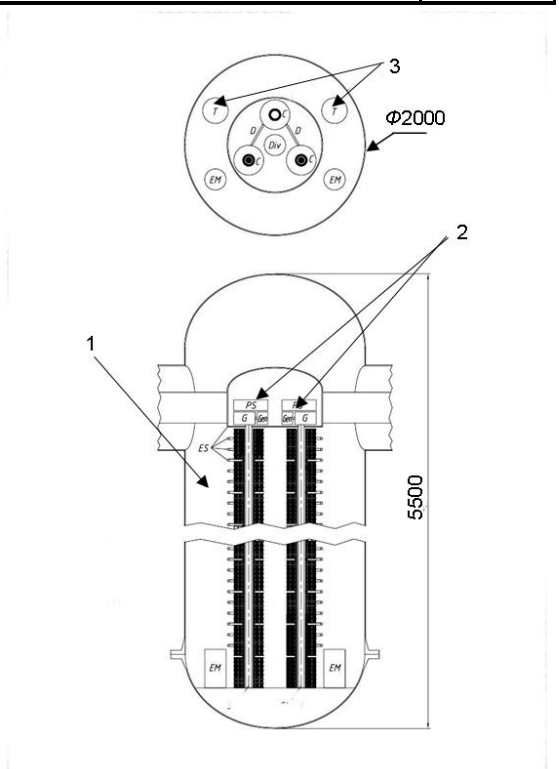

Fig. 3. Design of power supply of 2.5 MV.
1- cascade generator, 2 - gun and collector power supply,
3 - power transmitters to high potential (“shafts”)

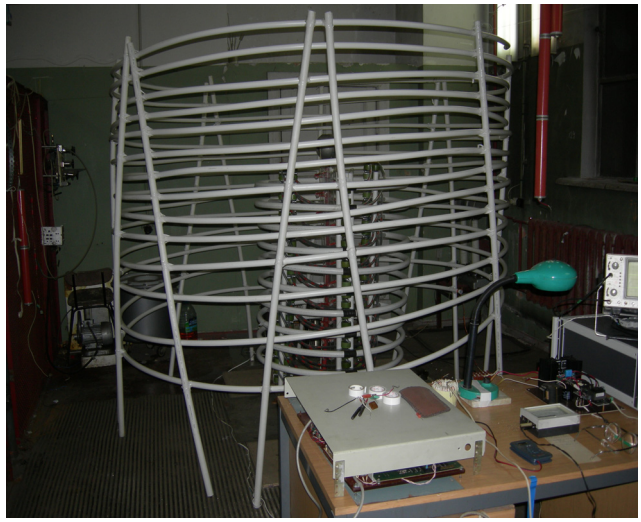

Fig.4. HV generator prototype U = 250 kV, Ii = 1 mA.

CONCLUDING REMARKS

The testing of the 250 kV prototype of HV cooler is in progress. The design and fabrication of HV generator and the design of the superconducting solenoids have been started.

REFERENCES

[1] E.V. Ahmanova, et. al./ “Electron cooler for NICA collider”, http://accelconf.web.cern.ch/accelconf/ COOL”11 , TUPS13, p.125-128.

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