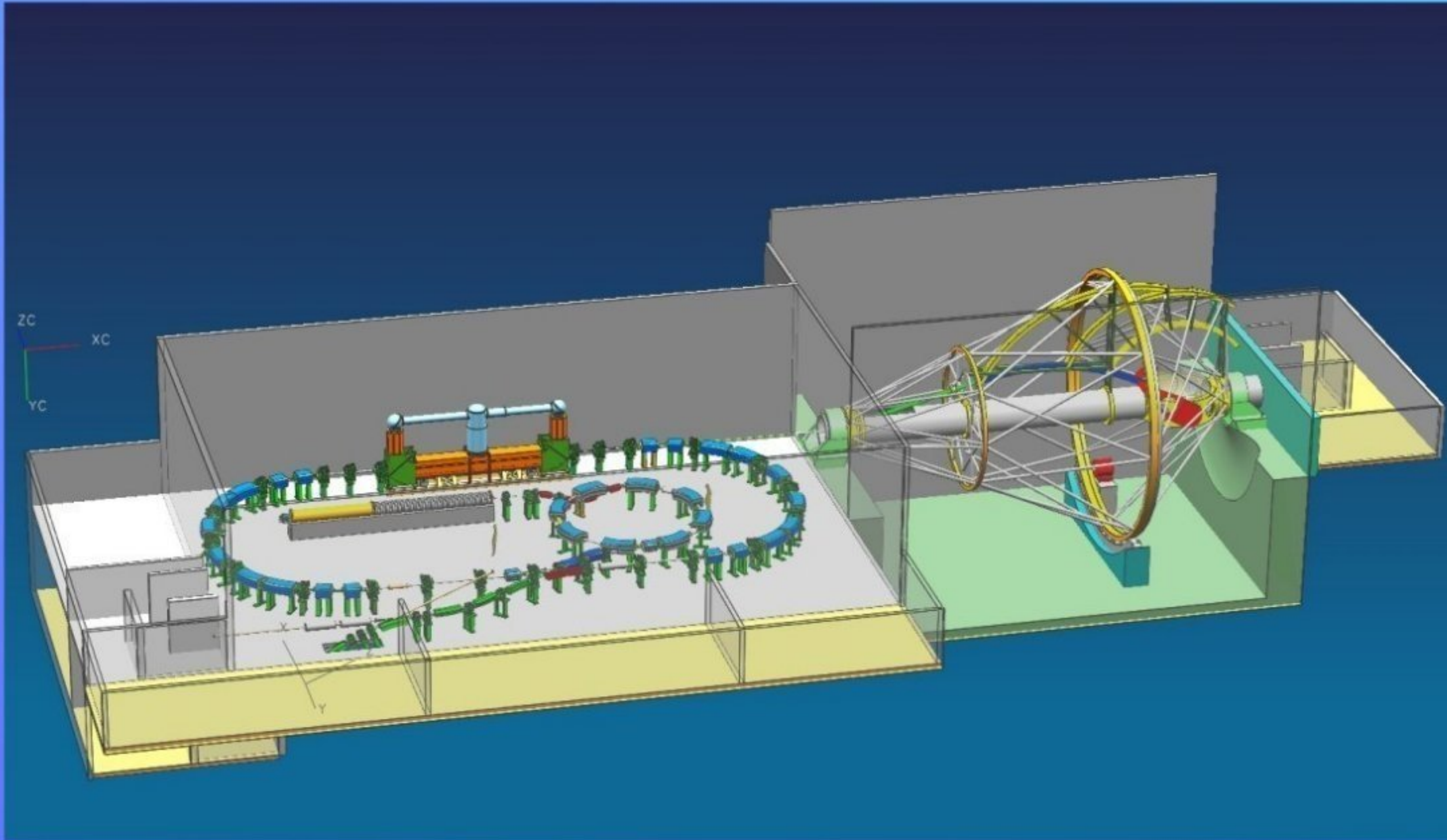


Electron Cooling for Cold Beam Synchrotron for Cancer Therapy

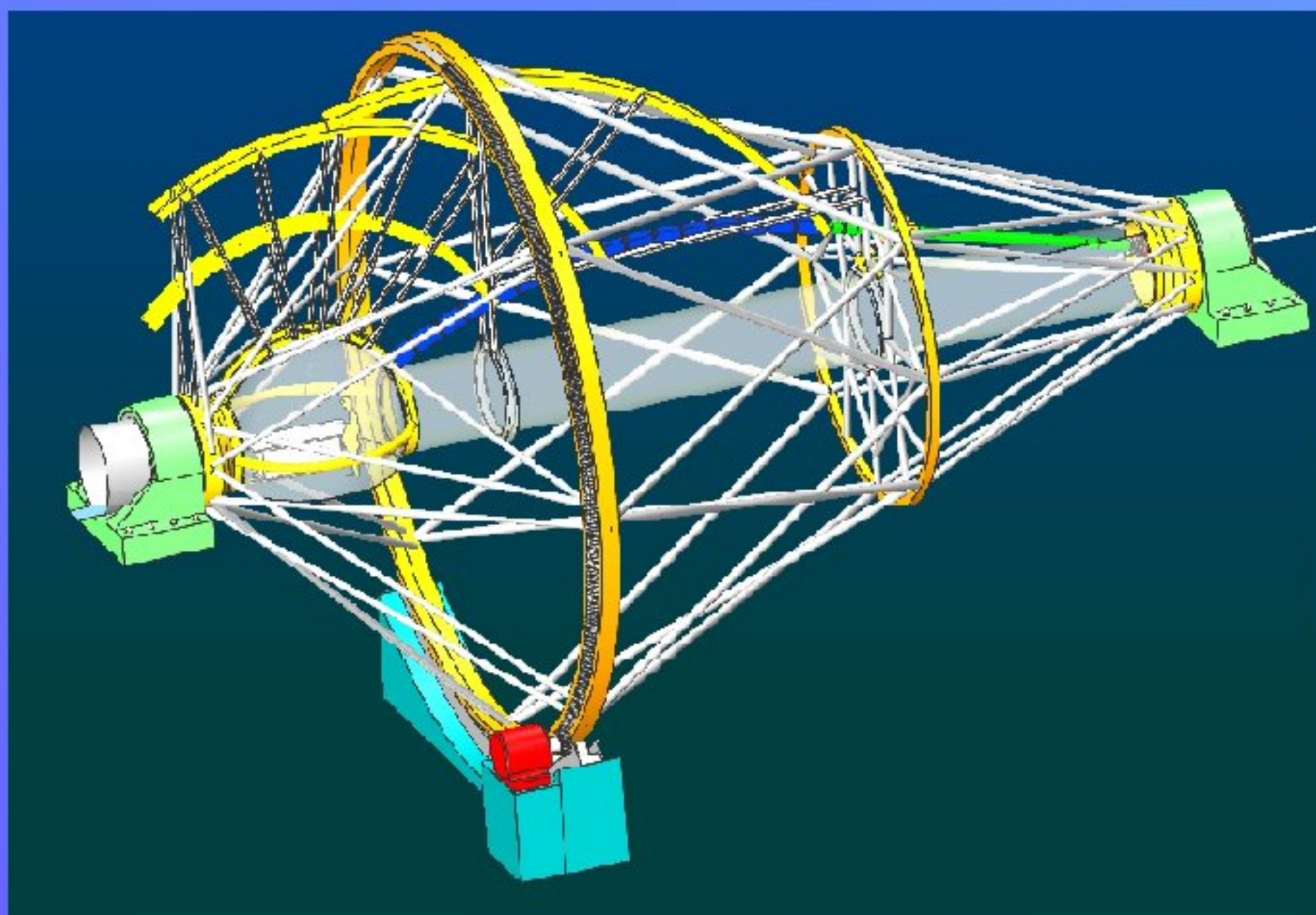
*B.I. Grishanov, V.V. Parkhomchuk, S.A. Rastigeev, V.B. Reva, V.A. Vostrikov, BINP, Novosibirsk
Masayuki Kumada, NIRS, Chiba*



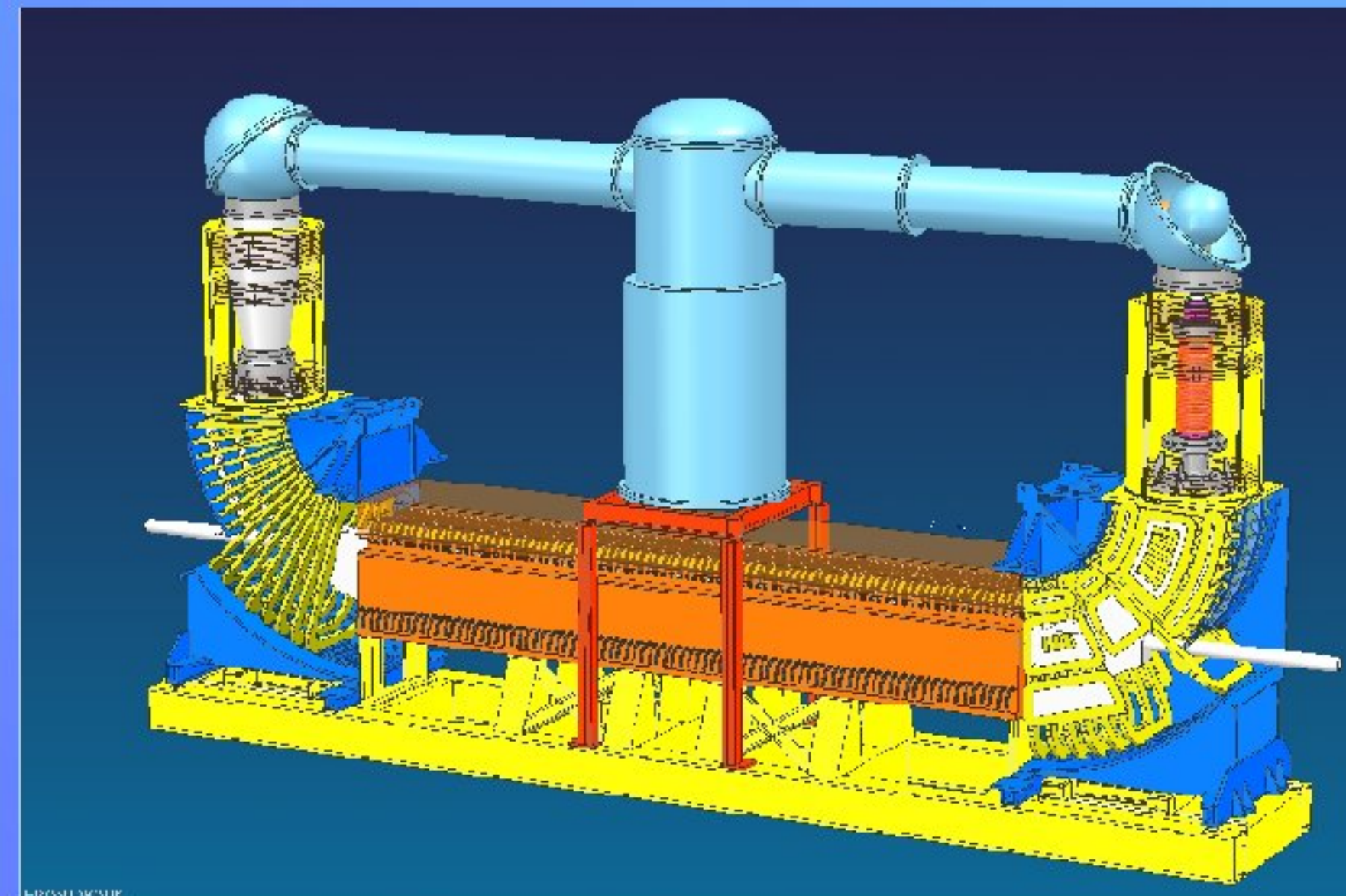
Clinical spec; 2 fixed port (horizontal & 45 degree), 1 gantry
Type of particles; C energy 140-400 MeV/unit.
Average dose rate; 5 Gy/min
Field size; 15 cm x 15 cm
Dose uniformity; 4% of the prescribed dose over treatment field
Delivered dose accuracy; 2%
Irradiation method; Revised spot scanning system with
synchronization of respiration

Electron Cooling is a key CBS Feature

Storage of intense ion beam, 10^{10} per cycle
Decreasing of Aperture; MR and HEBT, Gantry
Slow extraction on recombination
Slow “pellet” extraction (up to 10^4 pellets)
Small aperture fast scanner
Precision scanning of beam energy



Low aperture gantry



**CBS electron cooler design
based on EC-300 manufactured
by BINP for IMEP, China**

Electron Cooler Parameters

Length: 10.2 m

Cooling length: 7 m

Quality of the magnetic field: 10^{-4} or better

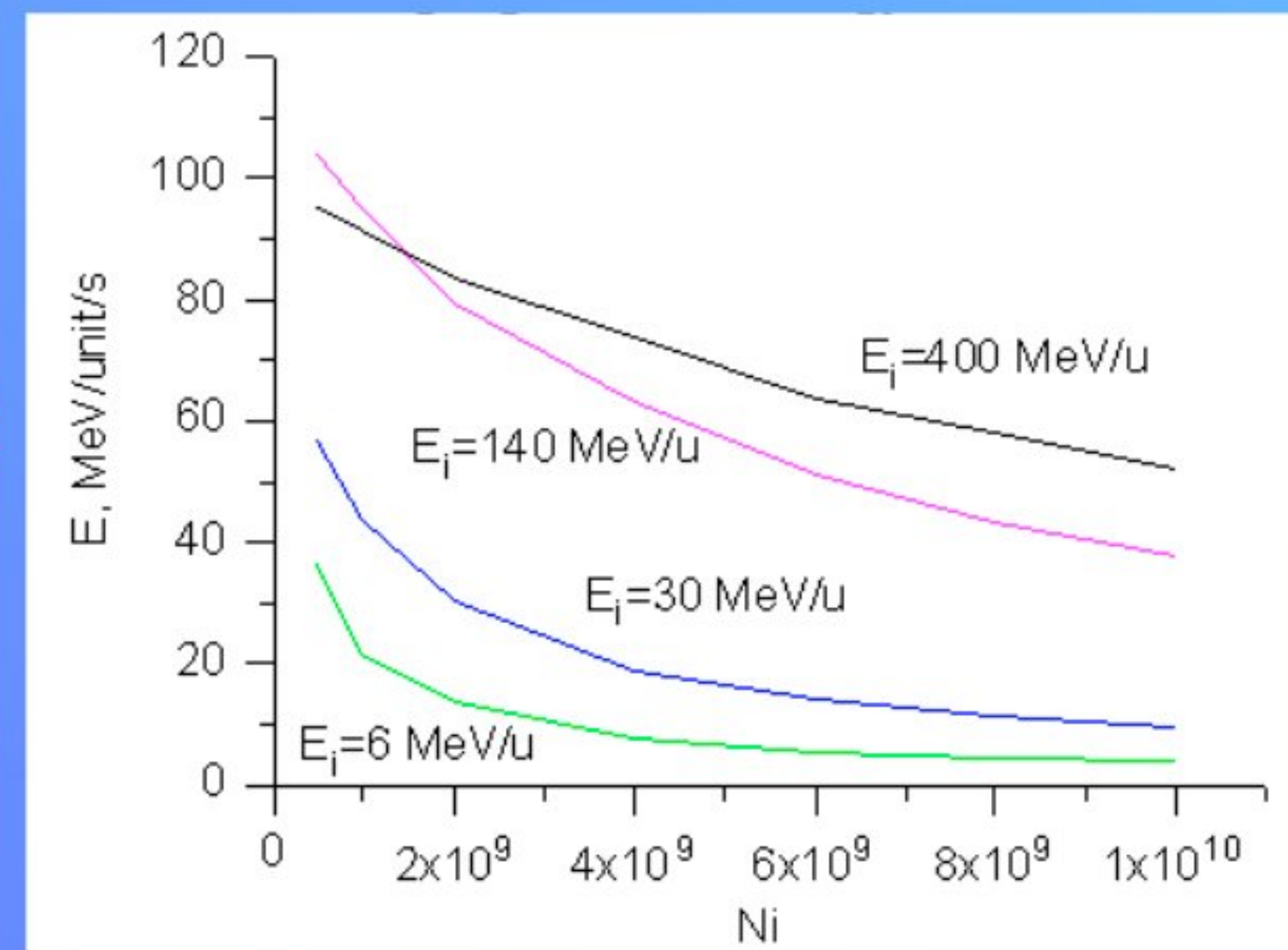
Power of magnetic system: 250 kW

SF6: 1.2 m³ at standard pressure

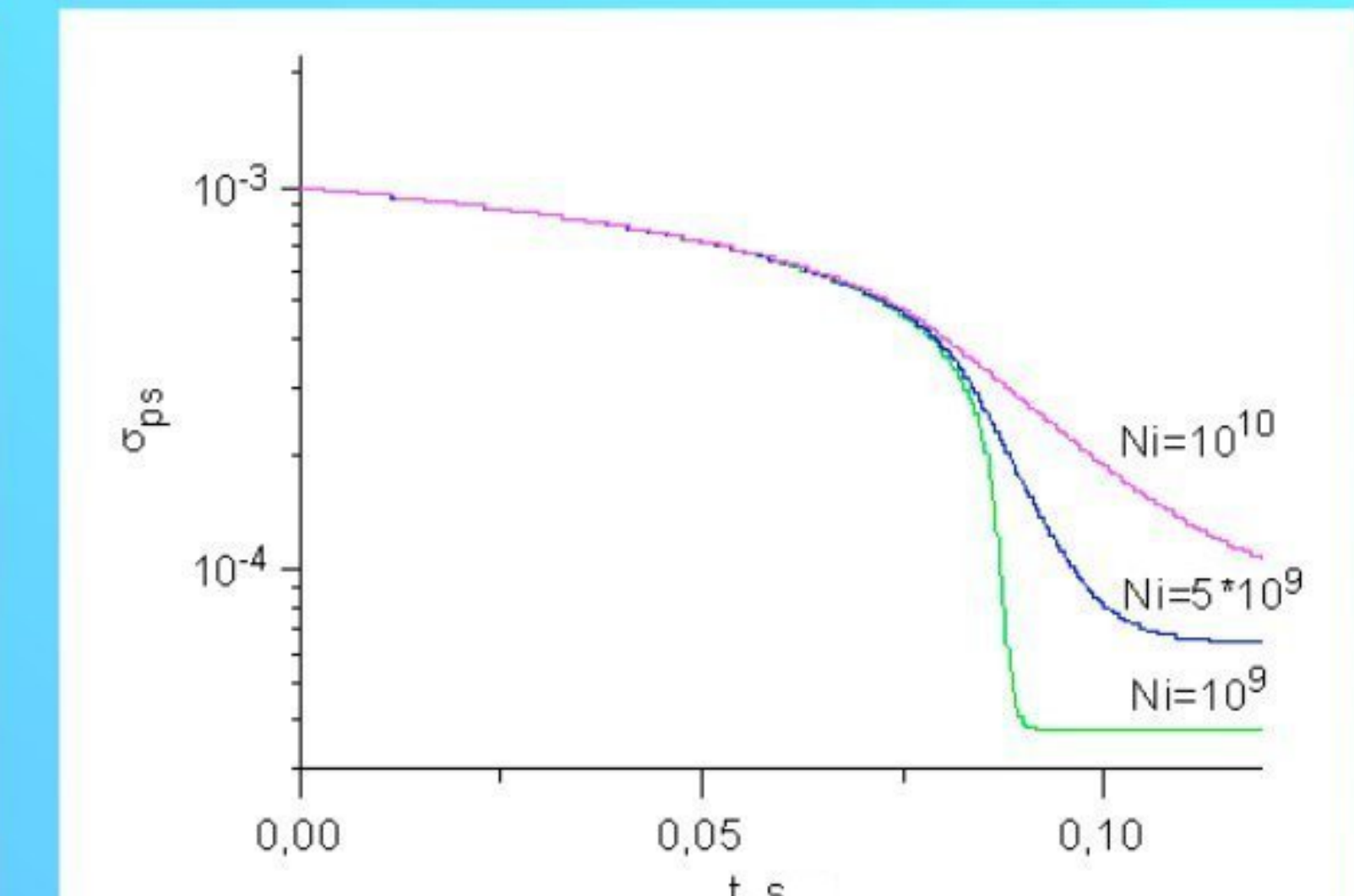
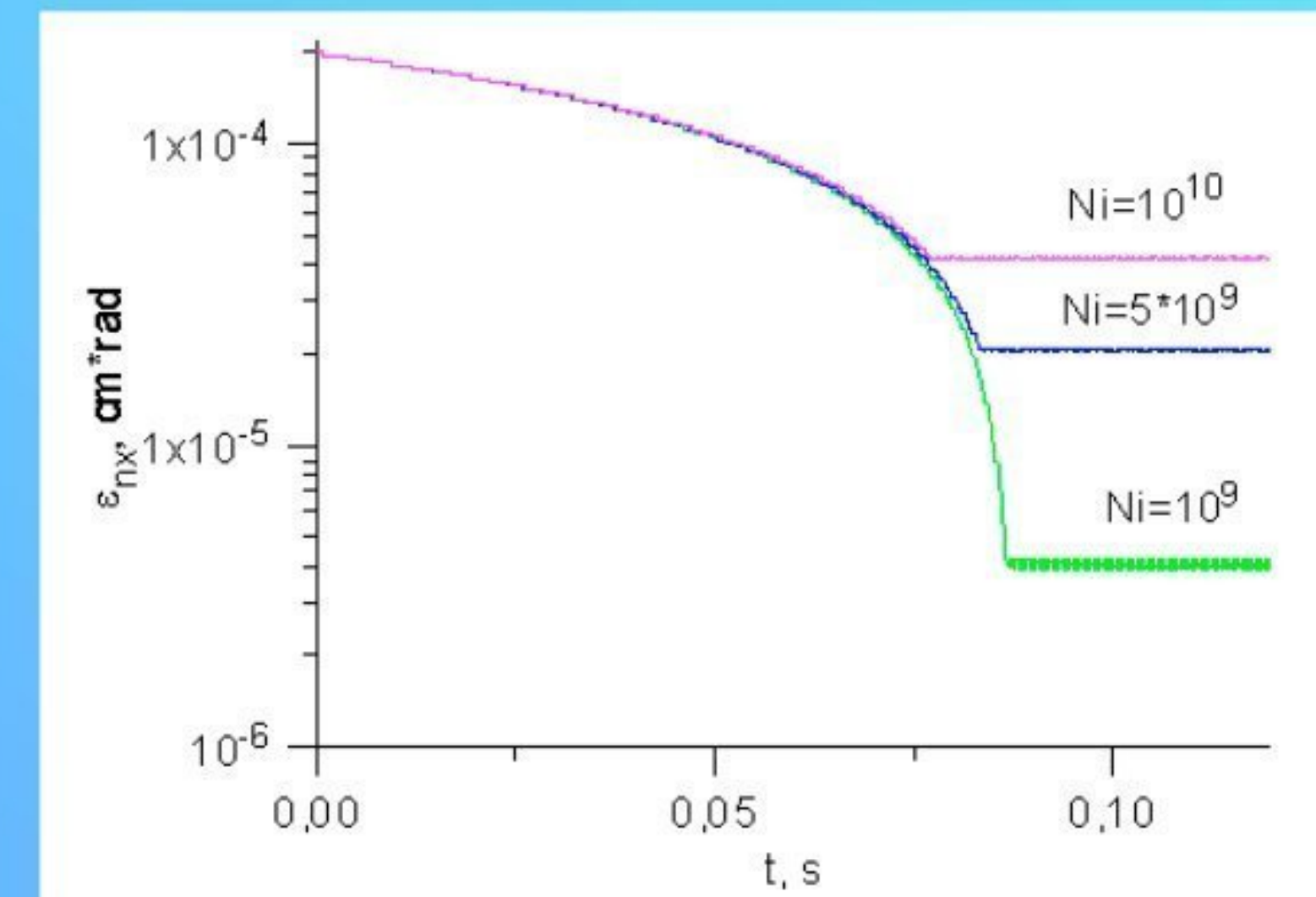
Water: 530 l/min

Oil cooling system:

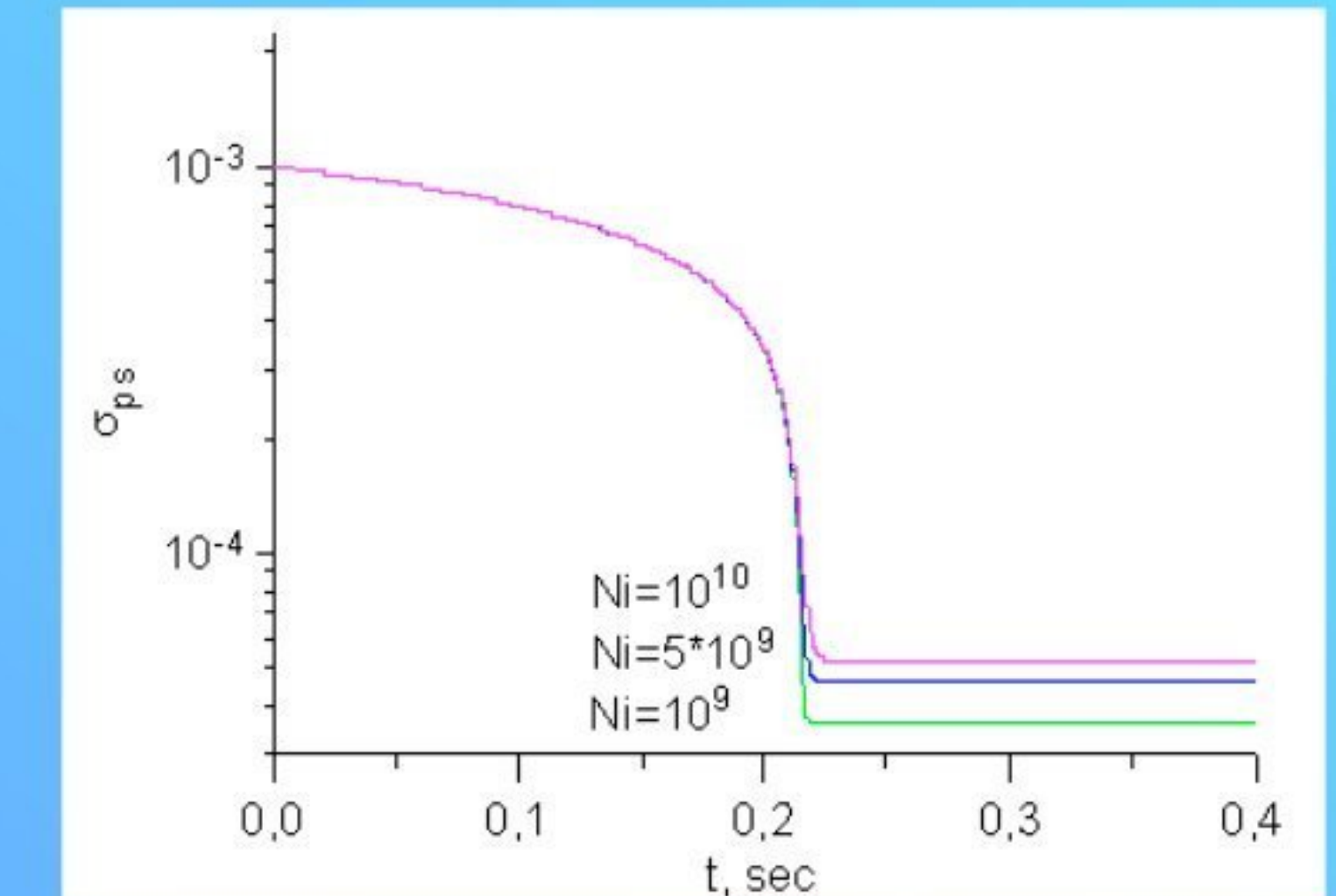
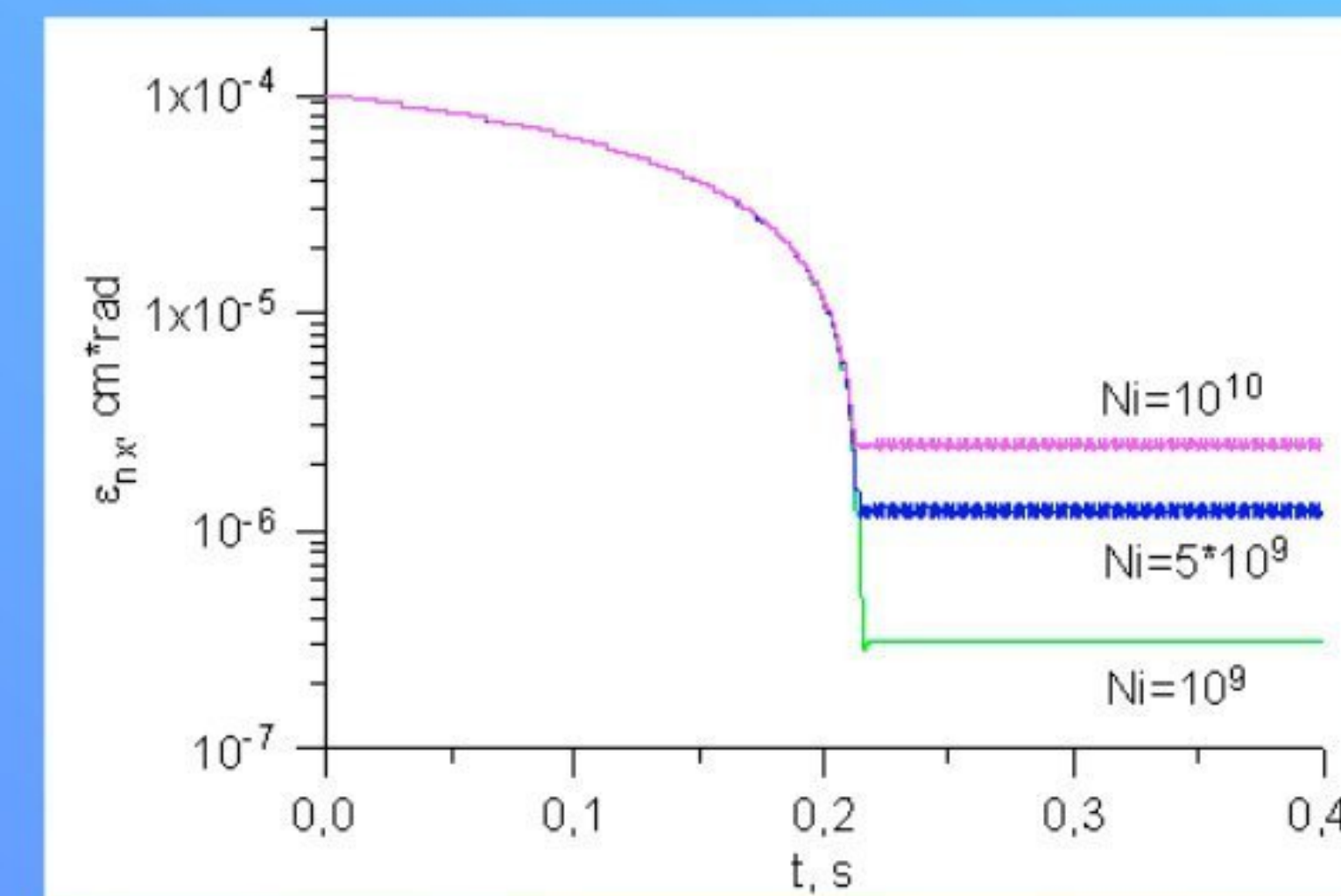
Vacuum: 10^{-10} torr



Storage & Cooling at Injection Energy 30 MeV/u



Cooling at Maximum Energy 400 MeV/u



Slow Extraction by Recombination

