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Cryogen Recondensed Cooling System for Electron Beam Ion Source Employing 7 T Superconducting Solenoid Magnet

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An electron beam ion source (EBIS) is required to fulfill the diverse requirements of proton-beam users facilitating enhanced application. Superconducting magnet is a critical part of EBIS, and cryogenic systems are essential for the design and the operation of the superconducting magnets. Thus, this study demonstrates the development of cryostat of 7 T superconducting solenoid for electron beam focusing in the EBIS system. The proposed cryostat will be used to cool the NbTi coil by using liquid helium. During the full operation of EBIS system, the strong emission of x-ray prevents the easy access to the apparatus. Therefore, through our study, we have realized the development of liquid helium recondensed system. Once the cryostat is filled with coolant, evaporated helium gas will be liquefied again at the recondensing device, which is directly connected to the cryocooler. The design of 7 T superconducting magnet comprises inner and outer diameters of 280 mm and 324 mm, respectively and the height is assigned as 2000 mm. Based on the unique shape of the superconducting magnet, the cryostat also has horizontally long configuration. Cooling margin of cryocooler is precisely calculated to obtain efficient performance of helium recondensation, including heat invasion from conductive and radiative components. Detailed specifications and design considerations of proposed cryostat will be explained through the extended paper.

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