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A new 2 K superconducting half-wave cavity cryomodule for PIP-II

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Argonne National Laboratory has developed and is implementing a novel 2 K superconducting cavity cryomodule operating at 162.5 MHz and designed for the acceleration of H-/proton beams from 2.1 to 10 MeV as part of the Fermilab Proton Improvement Project-II (PIP-II). The cryomodule supports operation of up to 2 mA average beam current and bunch population of up to 3.8x108 ppb. This work is an evolution of techniques recently implemented in two previous heavy-ion accelerator cryomodules now operating at Argonne National Laboratory [1, 2]. The 2 K cryomodule is based upon low-velocity superconducting half-wave cavity technology comprised of 8 half-wave cavities operated in the continuous wave mode with 8 superconducting magnets located in front of each cavity. All of the solenoids and cavities operate off of a single gravity fed 2 K helium cryogenic system expected to provide up to 50 W of 2 K cooling. Here we review the mechanical design of the cavities and cryomodule which were developed using methods similar to those required in the ASME Boiler and Pressure Vessel Code, overview the cryomodule layout and select subsystem design, and provide a status report on the cryomodule fabrication. Some of the subsystems to be discussed include the support and precision alignment of the cavity-solenoid assembly to within +/-0.5 mm at 2 K, the 5 and 70 K cooling of thermal intercepts and heat exchangers, and the 5 to 2 K cryogenic liquefaction system.

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