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## Thermal-structural analyses on magnetic structure of the CPMU prototype in SSRF

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Thermal effect on the magnet materials and magnetic structure plays an important role in the performance of the insertion devices such as the in-vacuum undulator. By cooling the magnetic structure to low temperature to achieve higher peak magnetic field and higher resistance to demagnetization, cryogenic permanent magnet undulator (CPMU) developed from the conventional in-vacuum undulator has complicated thermal effect on the magnetic performance including the RMS phase error. Temperature difference along the magnets array and the thermal deformation of the magnetic structure can cause a deterioration of the RMS phase error during cool down process. Shanghai Synchrotron Radiation Facility (SSRF) developed a NdFeB based CPMU prototype in 2016. This paper presents the analyses of the relation between the temperature distribution and thermal deformation of the magnets array and girders. Furthermore, the analyses of the thermal effect on the magnetic performance can provide guidance for optimizing the mechanical design and cryogenic cooling strategy to reduce the deterioration of the performance caused by sophisticated dynamic heat load.

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