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Development of prototype high gradient small aperture quadrupole magnets for HEPS-TF

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A test facility for storage ring based high energy photon source with a beam energy of 6 GeV, a circumference about 1300m, and an emittance about 59 pm•rad (HEPF-TF) is now under construction in china. Small aperture high gradient quadrupole magnets are important magnets in HEPS-TF. The design and manufacture of two prototype high gradient small aperture quadrupole magnets are finished. The bore diameters of the prototypes are both 25mm, and the field gradient is 80T/m and 90T/m, respectively. The field quality requirement of the prototypes is stringent, but the pole width is constrained by the requirement of the minimum gap between adjacent poles of 11mm. A lot of effect was spent to obtain an optimized pole shape which is convenient to be machined, and to avoid serious magnetic saturation in the iron. The detailed 2D and 3D magnetic design, field simulation and field error analysis of the two prototypes are presented, and preliminary field measurement results are also described and compared with the field simulations.

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