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Self-compensated Neutron Super Mirror Magnetic Yoke to Reduce Stray Fields

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supper mirror(SM) arrays to greatly reduce stray magnetic fields by using self compensation. This yoke is a minor modification to the typical existing magnetic yokes used for polarized SM arrays, often consisting of rows of very strong permanent magnets, such as NbFeB, arranged on either side between a cavity made of a pair of thick (> 1 cm) soft iron plates. Such configurations can produce high fields (on the order of 500 G) over the large volume of the SM array, however they also create an external dipole field. One can passively shield such devices with additional magnetic layers or shells of μ-metal, soft iron, or even steel, but this adds extra weight, complexity and size while not completely trapping the stray magnetic flux. Therefore we developed and produced a modification to the existing magnetic yoke to compensate the stray fields at long range. This is done by adding a balanced amount of magnets with opposite magnetization to the original yoke, thus effectively canceling the stray field at distances of relevance to neutron instrumentation. The final device is similar to a simplified cladded magnet structure, and can be produced essentially as a bolt-on addition to existing polarized SM array magnetic yokes. This modification, in addition to eliminating the stray dipole fields at long range, actually increases the magnetic field inside the active area of the yoke.

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