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## Development of Radial Magic Finger Design for Permanent Magnet Quadrupole

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Permanent Magnets (PM) have been used in Synchrotron Light Sources for years, but PM's do not have natural tuning capabilities. So, the use of Magic Fingers (MF) has been implemented to improve field quality in Insertion Devices and other PM designs. NSLS-II has been developing a new lattice design called "Complex Bend" \* using Permanent Magnet Quadrupole (PMQ) to replace the long dipole electro-magnets in the current ring. These PMQ's need to be characterized and tuned to make sure the required harmonics can be reached. Although the radial design of the PMQs makes improving field quality challenging, the need for a creative way to hold the magnets was sought out. This paper will describe the design, prototyping, testing and future design of the PMQ MF's. The prototype design consists of a circular array of square magnets that can be placed radially around the bore of the PMQ. The field quality of the PMQ was improved from 130 units down to 10 units using NSLS-II new Rotating-Coil measurement bench \*\*. Although the results were acceptable, designing the radial MF's to produce these results caused many mechanical challenges that will be explained in this paper.

### Footnotes

\* Shaftan, Timur, et al. "Concept of the Complex Bend." , Jan. 2018. <https://doi.org/10.2172/1504393>

\*\* M. Musardo et. al., "A New PCB Rotating Coil at NSLS-II", 5th North American Particle Accel. Conf, 2022, Albuquerque, NM, USA

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