Compact device for applying magnetic field designed for NV based magnetic field microscopy

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Nitrogen-Vacancy center based magnetic field microscopy is a powerful tool for describing the magnetic properties of magnetic samples with sub-micrometer spatial resolution while maintaining relatively high throughput. However, practically all applications of NV centers suffer from angular deviations of the magnetic field from the NV principal axis. Such a misalignment reduces signal contrast and has other deteriorating effects for example on dynamic nuclear polarization. Besides, the misalignment could change bias magnetic field homogeneity in the sensing area leading to signal broadening. We present an innovative design of magnetic field delivery to microscope systems that considerably reduces the magnetic field source size, increases the magnetic field homogeneity and amplitude, while potentially reducing production costs. The main idea is to use a set of specific permanent magnets to acquire a system that can change magnetic field properties in the measurement area of the magnetic field microscope. Our design is backed up by 2D and 3D simulations that show favorable properties in the magnetic field amplitude, orientation, and homogeneity, as well as physical dimensions of the device. This design could be used for any microscopy-related application that requires an external magnetic field.

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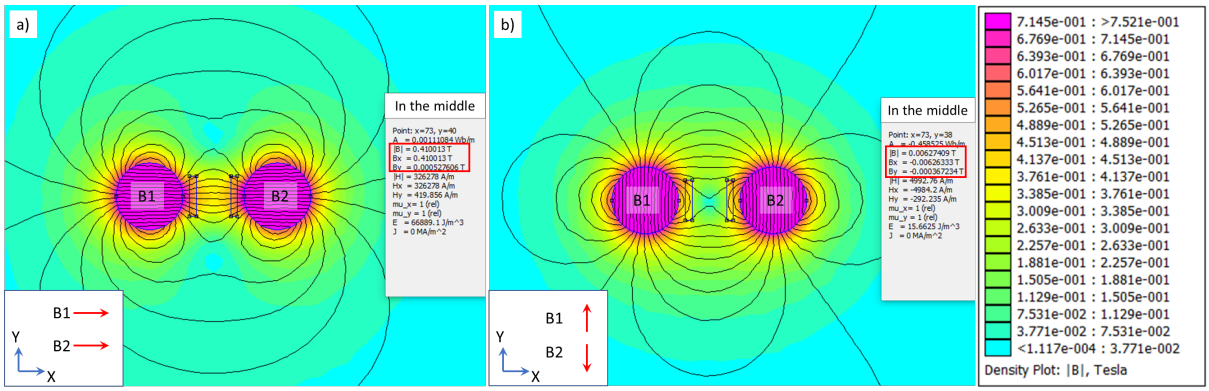

Figure 1: 2D simulations of magnetic field created by the combination of two permanent magnets 5 cm in diameter in combination with ferrite concentrators: a) poles of the magnets aligned parallel, b) poles of the magnets aligned perpendicularly. Right panel represents the color-coded magnetic field density plot values in Tesla.