1 Performances

The residual amplitude and frequency anisotropies of the magnetometer have been characterized thanks to a differential measurement between the isotropic helium sensor and a reference NMR magnetometer in order to get rid of the magnetic field temporal fluctuations. The resulting orientation effects were below 100 pT in the worst case (rotation in a plane containing the magnetic field, in which case induced effects occur), and amount to only # 40 pT in the Swarm selected configuration.

The magnetometer resolution has been estimated thanks to that direct measurement at 1 pT / √Hz (this resolution does not depend on the magnetic field magnitude, contrary to the case of NMR sensors, so that the low field capability is no more a challenge), with a bandwidth close to 300 Hz (-3dB cut off frequency).

Moreover differential measurements using either a Champ-type NMR magnetometer or a second helium sensor as a reference to get rid of the low frequency field variations, have confirmed that the helium magnetometer has no low frequency excess noise (white noise in the [DC-300 Hz] frequency band).

Given the linewidth of the resonance on which the magnetometer frequency is locked (around 70 nT under usual conditions) and the small physical dimensions of the cell (currently typically L = 45 mm, Ø = 30 mm) the helium magnetometer is relatively insensitive to magnetic field gradients: its resolution is degraded by a factor of two only for gradients above 1 µT/m, to be compared to the 100 - 200 nT/m that an Overhauser NMR magnetometer can withstand. Combined to its excellent EMC behaviour this contributes to allow correct operations in most environments for the optically pumped helium magnetometer.

See also: "SWARM Absolute Scalar Magnetometer accuracy: analyses and measurement results"