HIC $VNT LEONE$ - The case for high-sensitivity sub-mm atomic vapor magnetometry

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There is currently no non-cryogenic technology to measure "dc" magnetic fields with pT sensitivity and sub-mm spatial resolution (see Fig. 1). I will discuss what it would take for atomic vapors to provide such sensitivity & spatial resolution, how the physics of such sensors might differ from larger sensors, and what signals one might be able to find with such a system.

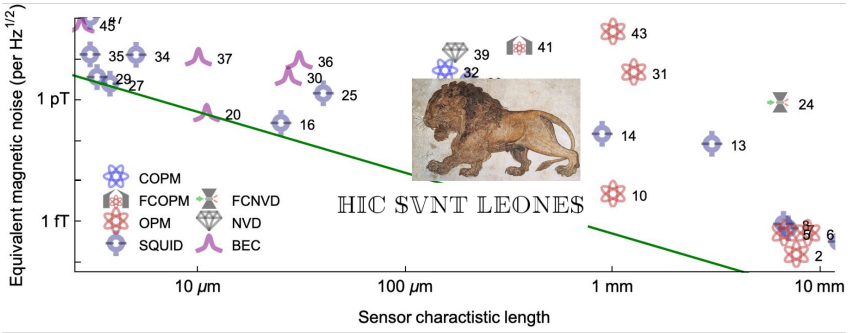

Figure 1: Sensitivity and size for various dc magnetometer technologies, including hot vapor optically-pumped magnetometers (OPM), field-concentrator hot-vapor OPMs (FCOPM), cold-atom OPMs (COPM), superconducting quantum interference devices (SQUID) and nitrogen-vacancy centres in diamond (NVD). Figure adapted from [1], numbers refer to references there. There is a notable lack of room-temperature sensors in the region with upper border $10\,\mathrm{pT}/\sqrt{\mathrm{Hz}}$, right border 1 mm and lower left border $E_R = \hbar$ (green line).

References

[1] Morgan W. Mitchell and Silvana Palacios Alvarez. Colloquium: Quantum limits to the energy resolution of magnetic field sensors. *Rev. Mod. Phys.*, 92:021001, Apr 2020.