Production and detection of atomic hexadecapole at Earth's magnetic field

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Abstract: Optical magnetometers measure magnetic fields with extremely high precision and without cryogenics. However, at geomagnetic fields, important for applications from landmine removal to archaeology, they suffer from nonlinear Zeeman splitting, leading to systematic dependence on sensor orientation. We present experimental results on a method of eliminating this systematic error, using the hexadecapole atomic polarization moment. In particular, we demonstrate selective production of the atomic hexadecapole moment at Earth's magnetic field and verify its immunity to nonlinear Zeeman splitting. This technique promises to eliminate directional errors in all-optical atomic magnetometers, potentially improving their measurement accuracy by several orders of magnitude. © 2008 Optical Society of America.

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