Fields, Moments, Units

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While expanding knowledge in a field, we tend to consider situations and concepts that are ever more complex. By doing so, our understanding of basic concepts may soften as we do not use them as such, and we consider them as firmly established so that we do not anymore question their significance. Who has never felt unsure when facing induction **B** versus field **H**, the discrete versus continuous description of magnetized matter, or conversion from cgs-Gauss to SI units and formulas? In this lecture, I will do my best to shed light on these, turning back to very basic concepts.

Lecture topics:

1. Fields and moments in vacuum
    a. The concepts of electric charge, electric field **E**, induction field **B**, the magnetic dipole.
    b. The meaning of Maxwell equations to describe our observations.
    c. Torque and energy of a point dipole
2. Fields and moments in magnetized matter
    a. The description of magnetized matter, and the definition of the magnetic field **H**.
    b. Amperian and pseudo-charge descriptions of matter
    c. Demagnetizing fields and energies
3. Units and dimensions
    a. What is a physical quantity? What is a unit?
    b. How do S.I. and cgs-Gauss systems differ? How to convert from one system to the other?
    c. Why is the definition of the kilogram intimately linked with magnetism since earlier this year 2019?

Recommended reading:

[1] W. F. Brown, Micromagnetics, Wiley (1963)
[2] J. M. D. Coey, Magnetism and Magnetic Materials, Cambridge University Press 2010, Chapter 2 and Appendix B.
[3] Bureau International des Poids et Mesures, http://www.bipm.org/