Atomic Units and their cgs/gaussian equivalents

We will for the most part use SI units in this course. However, many texts and most graduate E&M courses are still taught using gaussian electromagnetic units, in which the electromagnetic field equations are somewhat more symmetric. This page illustrates the correspondence of basic physical quantitites between the gaussian unit system and atomic units (a.u.), the "theorist's units" appropriate to atomic physics, in which many uninteresting constants are made to disappear by setting them equal to unity.

The system of atomic units is defined by the following (dimensions given in square brackets):

$\hbar = 1$ [E ·t or m ℓ^2 t^{-1}]

$m_e = 1$ [m]

$e = 1$ [$m^{1/2}$ $\ell^{3/2}$ t^{-1}]

The atomic units for other common physical quantities are given below:

Quantity	Unit	cgs equivalent	Name
Charge	$e = 1$	4.803×10^{-10} esu	electron charge
Angular Momentum	$\hbar = 1$	1.05×10^{-27} erg·sec	"h-bar"
Mass	$m_e = 1$	9.11×10^{-28} g	electron mass
Length	$a_0 = \dfrac{\hbar^2}{m_e e^2} = 1$	5.29×10^{-9} cm	Bohr or "atomic unit"
Velocity	$e^2/\hbar = 1$	2.188×10^{8} cm/sec	velocity in first Bohr orbit
Energy	$m_e e^4/\hbar^2 = 1$	4.36×10^{-11} ergs, or 219474 cm^{-1}	Hartree (= 2 Rydbergs)
Magnetic moment	$\mu_0 = \dfrac{e\hbar}{2m_e c} = 1$	1.400 MHz/gauss	Bohr magneton
Electric field	$e/a_0^2 = 1$	5.142×10^{9} V/cm	Internal field of H atom

Also very useful: The wavenumber or "inverse centimeter" is very often used as an energy unit in spectroscopy; what one means by this is:

$$1\ \text{cm}^{-1} = hc/\lambda \text{ with } \lambda = 1\ \text{cm}$$
$$= 1.98658 \times 10^{-23}\ \text{J}$$
$$= 2.99792458 \times 10^{10}\ \text{Hz (exactly)}$$
$$= 1/8065.02\ \text{eV}$$