Mathematical Physics

MP467: Astrophysics and Cosmology

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Textbooks:

1. B. Carroll and D. Ostlie: An Introduction to Modern Astrophysics, Addison-Wesley (1996) 523.01 CAR
2. A.C. Phillips: The Physics of Stars, 2nd edition, Wiley (1994) 523.8 PHI
3. A. Liddle: An Introduction to Modern Cosmology, Wiley (1998) 523.1 LID
4. S. Weinberg: The First Three Minutes, Basic Books (1994) 523.12 WEI
5. R. Bowers and and T. Deeming: Astrophysics I+II, Jones and Bartlett (1984) 523.01 BOW
6. S.L. Shapiro and S.A. Teukolsky: Black Holes, White Dwarfs and Neutron Stars: the physics of compact objects, Wiley (1983) 523.01 SHA

Topics:

1. Moons and Planets
2. Stellar formation and stellar structure
3. Degenerate Stars: white dwarves, neutron stars and black-holes
4. Cosmology and the early Universe
5. Astro-particle physics

Quantity	Symbol	Value
Speed of light (in vacuum)	c	299 792 458 $m\ s^{-1}$ (exact)
Newton's constant	G	$6.673 \times 10^{-11}\ kg^{-1}\ m^3\ s^{-2}$
Planck's constant	h	$6.626 \times 10^{-34}\ J\ s$
Electron charge (magnitude)	e	$1.602 \times 10^{-19}\ C$
Electric permittivity (vacuum)	$\epsilon_0 = \frac{1}{\mu_0 c^2}$	$8.854 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$
Magnetic permeability (vacuum)	μ_0	$4\pi \times 10^{-7}\ N\ s^2\ C^{-2}$
Fine structure constant	$\alpha = \frac{e^2}{2\epsilon_0 hc}$	7.297×10^{-3}
Thompson cross-section	σ_T	$6.652 \times 10^{-29}\ m^2$
Electron mass	m_e	$9.109 \times 10^{-31}\ kg$
Proton mass	m_p	$1.673 \times 10^{-27}\ kg$
Atomic mass unit (mass of ^{12}C atom)/12	$a.m.u.$	$1.661 \times 10^{-27}\ kg$
Boltzmann's constant	k_B	$1.381 \times 10^{-23}\ J\ K^{-1}$
Stefan-Boltzmann constant	σ_{SB}	$5.670 \times 10^{-8}\ J\ s^{-1}\ m^{-2}\ K^{-4}$
Avagardo's number	N_A	$6.022 \times 10^{23}\ mol^{-1}$
Earth mass	$M_\oplus$	$5.97 \times 10^{24}\ kg$
Earth radius (equatorial)	$R_\oplus$	$6.38 \times 10^{3}\ km$
Lunar mass	$M_{\leftmoon}$	$7.35 \times 10^{22}\ kg$
Lunar radius	$R_{\leftmoon}$	$1.74 \times 10^{3}\ km$
Earth-Moon distance (mean)	$d_{\oplus-\leftmoon}$	$3.84 \times 10^{5}\ km$
Earth-Sun distance (mean)	$d_{\oplus-\odot}$	$1.50 \times 10^{8}\ km$
Solar mass	$M_\odot$	$1.99 \times 10^{30}\ kg$
Solar radius (equatorial)	$R_\odot$	$6.961 \times 10^{5}\ km$
Solar luminosity	$L_\odot$	$3.85 \times 10^{26}\ J\ s^{-1}$
Temperature of microwave background	T_0	$2.725 \pm 0.002^\circ K$
Hubble constant	H_0	$72 \pm 4\ km\ s^{-1}\ Mpc^{-1}$
($H_0 = 100h\ km\ s^{-1}\ Mpc^{-1}$	h	0.72 ± 0.04)
Critical density	$\rho_c = \frac{3H_0^2}{8\pi G}$	$1.88 \times 10^{-26} h^2\ kg\ m^{-3}$
Dark energy density (Cosmological constant)	Ω_Λ	0.73 ± 0.04
Baryon density	$\Omega_B = \rho_B/\rho_{crit}$	0.044 ± 0.004
Dark matter density	$\Omega_M = \rho_M/\rho_{crit}$	0.27 ± 0.04
Total density	Ω_{tot}	1.02 ± 0.02
Age of the Universe	t_0	$13.7 \pm 0.2 \times 10^9\ yr$
Electron Volt	eV	$1.602 \times 10^{-19}\ J$
year	yr	$3.156 \times 10^{7}\ s$
light year	lyr	$9.461 \times 10^{15}\ m$
parsec ($1pc$=3.26 lyr)	pc	$3.086 \times 10^{16}\ m$