

Index for Chapter 14

boldface indicates a definition
italic indicates a figure

- Accretion disks, **678**
Active galaxies, **687**
Age
 of stars, 676
 of the universe, 689
Andromeda galaxy, 685
Anthropic principle, **698**
Antiparticles, primordial, 697
Apparent brightness (f), **660**, 674
Astronomical units (AU), 660
Astrophysics, **659**–684
Auroras, 667
- Barred spiral galaxies, **685**–686
Bethe, Hans A., 665, 700
Big Bang, 693–696
Binary pairs, **678**
BL Lac objects, **687**
Black dwarfs, **681**
Black holes, **682**–**684**
 at the center of the Milky Way, 672, 684
 at the center of the sun, 666
 and missing mass problem, 673
 and quasi-stellar objects, 688
Blackbody radiation
 from the Big Bang, 694–695
 from the sun, 660
Brightness, apparent (f), **660**, 674
- Carbon, stellar fusion of, 677
Cepheid variables, 685, 689, **701**
Chandrasekhar, Subrahmanyan, 681, 700
Chandrasekhar limit, **681**–682
Chromosphere, solar, **662**
Classical novae, **678**
Clusters, **670**
Compton wavelength (λ_c), 698
Constellations, **668**–669
 Southern Cross, 669
Copernicus, Nicolaus, 671
Core, solar, **664**
- Corona, solar, **663**
Cosmic microwave background radiation, 694–695, 697
Cosmogensis, 693–698
Cosmological constant, **693**–694
 and missing mass problem, 694
Cosmological principle, **691**
 perfect, **693**
Cosmology, **659**, 684–698
Crab nebula, 680, 682–683
Critical mass density of the universe (ρ_c), 691–693
 and missing mass problem, 693
- Dark matter, 673
Declination, 690
Degenerate dwarfs, **680**–681
Deuterium, primordial synthesis of, 697
Dirac, Paul A. M., 700
Disk galaxies, **685**–686
Distance measurements, galactic
 by Doppler broadening of spectral lines, 687
 by parallax, **674**–675
Doppler redshifts, 688–689, 697
Dwarf novae, **678**
- Effective temperature (T_e)
 of the solar surface, 660, 663
 and stellar evolution, 674–675
Einstein, Albert, 693–694
Electromagnetic interactions
 in the early universe, 695
Electron degeneracy pressure, **681**
Electron-positron pairs, primordial, 697
Electroweak interactions
 in the early universe, **697**
Elements, fusion and synthesis of. *See* Nucleosynthesis
Elliptical galaxies, **685**–686
Escape velocity
 and black holes, 682–683
- Event horizons (L), **698**
Exclusion principle
 and degenerate dwarfs, 680–681
 and neutron stars, 682
- Filaments, solar, **668**
Flares, solar, **667**–668
Forces. *See* Electromagnetic interactions;
 Electroweak interactions; Grand unification theories; Gravitational interactions; Strong interactions; Weak interactions
Fusion
 solar, 664–668
 stellar, 674, 676–677, 679, 694
- Galactic clusters, **670**
Galaxies, 684–691, **700**. *See also* Milky Way
 Andromeda, 685
 classification of, 685–688
 distribution of, 690, 692
 radio, **687**, 694
Galileo Galilei
 and sunspots, 666
 and supernovae, 680
Gamow, George, 701
Gaseous nebulae, 685
Geller, Margaret, 690–691
Globular clusters, **670**
Grand unification theories (GUTs), 696–697
Gravitational interactions. *See also* Quantum gravity; Supergravity
 and cosmology, 691–693
 in the early universe, 695
Gravitational lenses, 689, 692
Gravitational redshifts, **683**
Great Wall, 690–691
GUTs. *See* Grand unification theories
- Hartmann, J. F., 685
Hawking, Stephen, 666

- Helium
 primordial synthesis of, 694, 697
 stellar fusion of, 676–677
- Hertzsprung-Russell diagrams, **675**, 677, 679–680
- Horizontal branches, **677**
- H-R diagrams. *See* Hertzsprung-Russell diagrams
- Hubble, Edwin, 700–701
 and classification of galaxies, 685–686
 and expansion of the universe, 688, 693–694
- Hubble constant (H), **688**–689, 691
- Hubble time ($1/H$), **689**, 691
- Hubble's law, **688**–691
- Huchra, John, 690–691
- Hydrogen
 primordial synthesis of, 697
 stellar fusion of, 664–666, 674, 676
- Interactions. *See* Electromagnetic interactions; Electroweak interactions; Grand unification theories; Gravitational interactions; Strong interactions; Weak interactions
- Interstellar dust and gas, **684**–685, 694
- Iron, stellar synthesis of, 679–680
- Irregular galaxies, **685**–686
- Kant, Immanuel, 685
- Kepler, Johannes, 680
- Lagrangian points, **678**
- Lepton era, **697**
- Lifetime of stars, 676
- Limb, solar, **662**
- Lindblad, B., 672
- Lithium, primordial synthesis of, 697
- Luminosity (L), **660**
 and stellar evolution, 674–676
- Magnetic fields
 solar, 666–668
 terrestrial, 667
- Main sequence, **675**
- Main sequence dwarfs, **675**
- Maxwell-Boltzmann distribution and solar fusion, 665
- Milky Way, 668–673, 686, 700
 black holes in, 672, 684
 mass of, 672–673
 and missing mass problem, 673, 684
 rotation of, 672
 structure of, 670–672
- Millikan, Robert A., 701
- Missing mass problem, **673**, 684, 698
 and black holes, 684
 and cosmological constant, 694
 and critical mass density of the universe, 693
 and interstellar gas and dust, 684
- Michell, John, 700
- N galaxies, **687**
- Nebulae
 Crab, 680, 682
 gaseous, 685
 Tarantula, 677
- Neon, stellar fusion of, 679
- Neutrino oscillations, **666**
- Neutrinos
 and missing mass problem, 673
 primordial, 697
 solar, 665, 665–666
- Neutron stars, 681–683, **682**
- Novae, **678**
- Nucleosynthesis
 primordial, 694, 697
 stellar, 664–668, 674, 676–677, 679, 694
- Nucleosynthesis era, **697**
- Olbers, Heinrich, 694
- Olbers' paradox, **694**
- Oort, Jan H., 672
- Open clusters. *See* Galactic clusters
- Parallax angle (θ), **674**–675
- Parsecs, 674–675
- Particle annihilation, primordial, 697
- Penzias, Arno A., 695, 701
- Perfect cosmological principle, **693**
- Photons, primordial, 697
- Photosphere, solar, **660**–661, 663
- Plages, solar, **668**
- Planck length (L or λ), **698**
- Planck mass (m), **698**
- Planck time (t), **698**
- Planck's law
 and the solar spectrum, 661
- Planetary nebulae, 677, 680
- Plasma, solar, 664–665
- Polaris, 701
- Pole stars, 669, 701
- Population I and II stars, **670**, 680
- Prominences, solar, **668**
- Proton-proton cycle, **665**–666
- Proxima Centauri, 675
- Pulsars, **682**–683
- QSOs. *See* Quasi-stellar objects
- Quantum gravity, 695, 698
- Quarks, primordial, 697
- Quasars, **687**–688
- Quasi-stellar objects (QSOs), **687**–688
- Quiet galaxies, **687**
- Radiation era, **697**
- Radio galaxies, **687**, 694
- Recurrent novae, **678**
- Red giants, **677**
- Red subgiants, **677**
- Red supergiants, **677**
- Redshifts
 Doppler, 688–689, 697
 gravitational, **683**
- Right ascension, 690
- Roche, Edouard A., 700
- Roche lobes, **678**
- Ryle, Martin, 694, 701
- Sagittarius A, 672
- Schwarzschild radius (R_s), **683**–684
- Seyfert, Carl, 687
- Seyfert galaxies, **687**
- Shapley, Harlow, 670–671, 700
- Silicon, stellar fusion of, 679
- Sirius, 669, 700
- Solar constant (f), **660**, 674
- Solar flares, **667**–668
- Solar neutrinos, 663, 665–666
 problem of, **666**
- Solar wind, **663**
- Southern Cross, 669
- Spiral galaxies, **685**–686
- Standard model of the early universe, **695**–696
- Star clusters, **670**
- Stars, 668–673
 age or lifetime of, 676
 Cepheid variables, 685, 689, **701**
 degenerate dwarfs, **680**–681
 evolution of, 674–680
 fate of, 680–684
 mass of, 676
 neutron, 681–683, **682**
 Polaris, 701
 Pole stars, 669, 701
 population I and II, **670**, 680
 Proxima Centauri, 675
 Sirius, 669, 700
- Stefan-Boltzmann law
 and solar temperature, 660
- Stellar populations, 670
- Strong interactions
 in the early universe, 695
 and neutron stars, 682
- Sun, 659–668
 as blackbody radiator, 660
 core of, **664**
 hydrogen fusion in, 664–668
 interior of, 663–664
 magnetic field of, 666–668
 mass of, 664
 plasma in, 664–665
 pressure in, 664
 source of energy for, 665–668
 spectrum of, 661
 and sunspots, **666**–667
 surface and atmosphere of, 660–663
 temperature of, 660–661, 663–664
- Sunspots, **666**–667
- Supergravity, 698

Supernova 1987A, 679–680
Supernovae, 679–680

Tarantula nebula, 677

Temperature. *See also* Effective
temperature

of the sun, 660–661, 663–664
of the universe, 694–695, 697

Type I and II supernovae, 680

Uncertainty principle, 698

Universe, 688–698

age of, 689

and the Big Bang, 693–696

critical mass density of, 691–693

evolution of, 695–697

expansion of, 688–691

steady-state model of, 693–694

temperature of, 694–695, 697

Weak interactions

in the early universe, 695

Weakly interacting massive particles
(WIMPs)

and missing mass problem, 673

White dwarfs, 677, 680–681

Wilson, Robert W., 695, 701

WIMPs. *See* Weakly interacting massive
particles

Zeeman effect

and solar magnetic field, 666