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Science Fiction Stories with Good Astronomy and Physics: A Topical Index

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Abstract. This is a selective list of some short stories and novels that use more or less accurate science and can be used for teaching or reinforcing astronomy or physics concepts. I include both traditional *science-fiction* and (occasionally) more serious fiction that derives meaning or plot from astronomy or physics ideas. The titles of short stories are given in quotation marks; only short stories that have been published in book form or are available free on the Web are included. While one book source is given for each short story, note that some of the stories can be found in other collections as well. (See the Internet Speculative Fiction Database, cited at the end, for an easy way to find all the places a particular story has been published.) The author[1] welcomes suggestions for additions to this list, especially if your favorite story with good science is left out.

Anti-matter

Davies, Paul *Fireball.* 1987, Heinemann. Antimatter micrometeorites threaten Earth.

Niven, Larry "Flatlander" in *Neutron Star.* 1968, Ballantine. Two explorers find a high-speed protostar and a planet made of antimatter, passing through the Galaxy.

Archaeoastronomy

Harrison, Harry & Stover, Leon *Stonehenge.* 1972, Scribners. A novel by a science fiction writer and an anthropologist.

Asteroids

Baxter, Stephen "Pilot" in *Vacuum Diagrams.* 1997, Harper Prism. Future space travelers hollow out Chiron and use it as a spaceship to escape invading aliens.

Clarke, Arthur "Summertime on Icarus" in *The Nine Billion Names of God.* 1967, Signet. An astronaut is stranded on Icarus, the asteroid with the smallest perihelion distance, just as it is approaching the Sun.

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Hoyle, Fred "Element 79" in *Element 79.* 1967, New American Library. An asteroid with significant amount of gold wreaks havoc with the Earth's economy.

Preuss, Paul "Small Bodies" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. A fundamentalist preacher and a scientist find fossils on an asteroid.

See also under "Impacts."

Astronomers

Banville, John *Doctor Copernicus.* 1976, Godine. A fictionalized biography of the astronomer.

Banville, John *Kepler: A Novel.* 1981, Godine. Fictionalization of Kepler's life.

Benford, Gregory *Timescape.* 1981, Bantam Spectra. *Eater.* 2000, Eos/HarperCollins. Many of the novels of physicist Benford portray what it is like to be a scientist. In these two books, some of the astronomer characters are based on real astronomers.

Bezzi, Tom *Hubble Time.* 1987, Mercury House. A fictional memoir of Hubble's life; gets some of the facts wrong, but an intriguing effort.

Brecht, Bertold *Galileo.* A 1938 stage play available alone (Grove Press) or in many collections; not historically accurate, but with strong political points to make.

McDevitt, Jack & Shara, Michael "Lighthouse" in *Cryptic: The Best Short Fiction of Jack McDevitt.* (2009, Subterranean Press) Also on the web.[2] A story about astronomical discovery told within the frame of a thesis defense colloquium; what it would be like if an astronomer discovered the existence of intelligent life out there by means of modifications they made to astronomical objects.

Sagan, Carl *Contact.* 1985, Simon & Schuster. Main character is loosely based on astronomer Jill Tarter.

Stover, Barrie *Lamp at Midnight.* 1966, Bantam Books. Revised edition of a 1942 play about Galileo and his conflict with the Church.

Willis, Connie "Schwarzschild Radius" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Haunting story combines episodes from the life of Karl Schwarzschild and black hole images.

Black Holes

Anderson, Poul "Kyrie" in Jerry Pournelle, ed. *Black Holes.* 1978, Fawcett. Explores the distortion of time near a black hole.

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[2] `http://www.webscription.net/chapters/1596061958/1596061958___8.htm`

Asimov, Isaac "The Billiard Ball" in *Asimov's Mysteries.* 1968, Dell. Committing murder using general relativity.

Baxter, Stephen "Pilot" in *Vacuum Diagrams.* 1997, Harper Prism. An asteroid space ship being chased by an enemy missile goes through the ergosphere of a rotating black hole, taking energy out and making the chasing missile fall in the event horizon.

Benford, Gregory *Eater.* 2000, Eos/HarperCollins. An ancient intelligent black hole comes to our solar system.

Brin, David "The Crystal Spheres" in *The River of Time.* 1987, Bantam. Advanced races use black holes to bear with the loneliness of a universe in which life is still rare.

Brin, David *Earth.* 1990, Bantam. A mini black hole falls into the Earth's core.

Haldeman, Joe *The Forever War.* 1974, Ballantine. An interstellar war is fought using black holes for travel between battles.

Landis, Geoffrey "Impact Parameter" in *Impact Parameter.* 2001, Golden Gryphon. A newly discovered gravitational lens turns out to be a wormhole being used by an alien civilization to visit us.

Landis, Geoffrey "Approaching Perimelasma" in *Impact Parameter.* 2001, Golden Gryphon. In the far future, a virtual human is dropped into a black hole and makes an interesting discovery about space and time.

McAuley, Paul "How We Lost the Moon" in Crowther, Peter, ed. *Moon Shots.* 1999, Daw. A glitch in a fusion experiment on the Moon creates a mini black hole that eats our satellite.

McDevitt, Jack & Shara, Michael "Lighthouse" in *Cryptic: The Best Short Fiction of Jack McDevitt.* (2009, Subterranean Press) Also on the web.[1] An alien race decides, as a public service, to mark the location of unaccompanied black holes in the Galaxy by putting very strange brown dwarfs around them that could not exist in nature. Shara is an astronomer.

Niven, Larry *World Out of Time.* 1976, Ballantine. Protagonist uses a supermassive black hole to travel into distant future.

Niven, Larry "The Hole Man" in *A Hole in Space.* 1974, Ballantine. How to commit murder using a mini-black hole.

Niven, Larry "The Borderland of Sol" in *Tales of Known Space.* 1975, Ballantine. Space pirates use a mini-black hole.

Pohl, Fred *Gateway.* 1977, Ballantine. Enjoyable novel with rotating black holes, event horizons, and "black hole guilt." (Has a series of sequels where the science gets too "far out" for inclusion on this list.)

Sagan, Carl *Contact.* 1985, Simon & Schuster. The protagonists use a kind of black hole-wormhole "subway" system for interstellar travel. The system was designed by astrophysicist Kip Thorne and his students and later shown to be scientifically plausible.

Sheffield, Charles "Killing Vector" in *Vectors.* 1979, Ace. Mini-black holes are used for space propulsion. Sheffield has a PhD in physics.

Varley, John *The Ophiuchi Hotline.* 1977, Dell. Complex novel, in which mini black holes are hunted as energy sources.

Varley, John "The Black Hole Passes" in *The Persistence of Vision.* 1978, Dell. A mini-black hole threatens two deep space outposts.

Wheeler, J. Craig *The Krone Experiment.* 1986, Pressworks. Mini black holes pose a threat to the Earth; written by an astronomer.

Willis, Connie "Schwarzschild Radius" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Haunting story combining episodes from the life of Karl Schwarzschild and black hole images.

Comets

Anderson, Poul "Pride" in Asimov, Isaac, et al., eds. *Comets.* 1986, Signet/NAL. About "Nemesis," the hypothesized star whose interaction with the Oort Cloud is supposed to result in "comet showers" coming into the inner solar system.

Asimov, Isaac, et al., eds. *Comets.* 1986, Signet/NAL. A collection of stories about comets and their interaction with humanity.

Baxter, Stephen "Sunpeople" in *Vacuum Diagrams.* 1997, Harper Prism. A human expedition on a Kuiper Belt object finds a life-form made of ice with liquid helium for circulation.

Benford, Gregory & Brin, David *Heart of the Comet.* 1986, Bantam. About a 2061 expedition to Halley's Comet.

Benford, Gregory & Carter, Paul *Iceborn.* 1989, Tor. Proposes a form of life that can survive on Pluto and in the Oort Cloud.

Hoyle, Fred *Comet Halley*. 1985, St. Martin's. Life is found in the famous comet.

Latham, Philip "The Blindness" in Clarke, Arthur, ed. *Time Probe.* 1966, Dell. A 1946 story by astronomer Robert Richardson: Halley's Comet disrupts our ozone layer.

Lunan, Duncan "The Comet, the Cairn, and the Capsule" in Asimov, Isaac, et al, eds. *Comets.* 1986, Signet/NAL. Several civilizations leave messages on the nucleus of an interstellar comet.

Reynolds, Alastair *Pushing Ice.* 2005, Ace. Humanity in the future captures comets in the outer solar system and sends them inward.

Sawyer, Robert *Illegal Alien.* 1997, Ace. Plot hinges on an alien race from a multiple star system being unaware of the existence of a close-in Kuiper belt, since theirs is cleared out.

See also under "Impacts"

Cosmology (The Origin and Evolution of the Universe)

Asimov, Isaac *The Gods Themselves.* 1972, Fawcett. Ambitious novel that "solves" the origin of the big bang and quasars.

Baxter, Stephen "Last Contact" in Dozois, G., ed. *The Year's Best Science Fiction, 25.* 2008, St. Martin's. Also available on the web.[3] In the near future, the acceleration of the universe's expansion increases to such a degree that even stars in our own galaxy begin to be carried away very fast. The protagonist witnesses the Big Rip.

Benford, Gregory *Cosm.* 1998, Avon/EOS. A Brookhaven physicist makes a universe in a particle accelerator and watches it evolve.

Benford, Gregory "Matter's End" in *Matter's End.* 1994, Bantam. Physicists in India find that protons do decay as predicted by some Grand Unified Theories, with dire consequences for reality.

Brin, David "An Ever-Reddening Glow" in Hartwell, D. & Cramer, K., eds. *The Hard SF Renaissance.* 2002, Orb. Very clever parable, which posits that it is the stretching of space by the general relativistic "metric surfing" (travel near the speed of light) of countless intelligent species that is responsible for the expansion of the universe, and that no species is willing to give up the thrill. (Very nice parallel with the ecological damage we all do to the Earth.)

Chiang, Ted "Exhalation" in Hartwell, D. & Cramer, K., eds. *Year's Best SF 14.* 2009, Eos. Fascinating parable about the heat death of the universe, described in terms of differences in pressure, instead of differences in temperature. Cosmological speculation by a protagonist who seems to be a mechanical being.

Martin, Mark & Benford, Gregory *A Darker Geometry.* 1996, Baen. A convoluted, brilliant novel of multiple universe, in which ours is manipulated by advanced beings from another universe about to enter Big Crunch.

Sawyer, Robert *Calculating God.* 2000, Tor. Two alien races join humans in trying to understand a God that survived the Big Crunch Big Bang and is manipulating evolution for its own purposes.

Updike, John *Roger's Version.* 1988, Fawcett Crest. A computer student and a professor of divinity grapple with questions of cosmology and religion.

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[3] `http://www.solarisbooks.com/books/newbookscifi/last-contact.asp`

Dark Matter

Baxter, Stephen *Vacuum Diagrams.* 1997, HarperCollins. Dramatic, complex history and future of the battle between dark matter and regular matter life-forms in the universe.

Brett, Alex *Cold Dark Matter.* 2005, Dundurn. A mystery novel whose plot turns on controversial observations of dark matter in a nearby galaxy.

Sawyer, Robert *Starplex.* (1996, Ace) Complex hard-science novel by a Canadian amateur astronomer with intriguing ideas about dark matter and even dark matter life forms.

Galaxies

Benford, Gregory "Exposures" in *Creations*, edited by Isaac Asimov, et al., 1983, Crown. A beautiful, multilevel story about an astronomer whose images of active galaxy NGC 1097 lead him to some important insights about the universe and himself.

Benford, Gregory "Relativistic Effects" in *In Alien Flesh.* 1986, TOR. A ram-scoop spaceship accelerates very close to the speed of light and flies between two galaxies about to collide, able to remove some of the interstellar matter that would have flown between them, due to relativistic effects.

Brett, Alex *Cold Dark Matter.* 2005, Dundurn. A mystery novel whose plot turns on astronomical observations of the effects of dark matter on the rotation of the Andromeda Galaxy.

Niven, Larry *Ringworld.* 1970, Ballantine. A cowardly alien species flees an explosion in the Milky Way's core by taking five planets at high speed toward the Magellanic Clouds (our neighbor galaxies.)

Galaxy (The Milky Way)

Benford, Gregory "Mandikini" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Humanity confronts the power of intelligent life consisting of machines, and the dangers of the black hole at the center of our Galaxy. (See next entry as well.)

Benford, Gregory *Great Sky River.* 1987, Bantam; *Tides of Light.* 1989, Bantam; *Furious Gulf.* 1994, Bantam; *Sailing Bright Eternity.* 1995, Bantam. All four books take place in the far future, near the super-massive black hole at the center of the Milky Way, with humanity being hunted by vast machine intelligences.

Hoyle, Fred & Geoffrey *The Inferno.* 1973, Harper & Row. The Milky Way becomes an active galaxy, but life on Earth is saved by a higher intelligence. Hoyle is a well-known astronomer.

Niven, Larry "At the Core" in *Neutron Star.* 1962, Ballantine. An explosion at the galactic center transforms the Milky Way into an active galaxy.

Reynolds, Alistair "Beyond the Aquila Rift" in *Year's Best SF 11,* Hartwell, David & Cramer, Kathryn, eds. 2006, Eos. Wonderful story, about a network of ancient pathways that delineate the structure of the Galaxy and allow faster-than-light travel. Portrays a sense of "alien"-ness and vastness.

Gravitational Lenses

Landis, Geoffrey "Impact Parameter" in *Impact Parameter.* 2001, Golden Gryphon. A newly discovered gravitational lens turns out to be a wormhole being used by an alien civilization to visit us. Nice astronomical touches.

Impacts (Asteroid & Comet)

Benford, Gregory & Rotsler, William *Shiva Descending.* 1980, Avon Books. A massive asteroid heads for our planet.

Carver, Jeff *Neptune Crossing.* 1994, Tor. An intelligent life-form on Neptune's moon Triton helps humans prevent a comet from crashing into the Earth.

Clarke, Arthur *The Hammer of God.* 1993, Bantam. An asteroid threatens to collide with the Earth.

Fodor, R. & Taylor, G. *Impact.* 1979, Leisure Books. A giant meteorite is headed our way; Taylor is a planetary scientist.

Gribbin, John & Chown, Marcus *Double Planet.* 1988, Avon Books. A comet heads for Earth; written by two scientists.

Morton, Oliver "The Albian Message" in *Year's Best SF 11,* Hartwell, David and Cramer, Kathryn, eds. 2006, Eos. 100 million years ago, predicting the K/T impact, aliens landed on Earth and preserved life on Earth at the time in a container on an asteroid at a Jovian Trojan point, leaving a message about it coded in the human genome.

Niven, Larry & Pournelle, Jerry *Lucifer's Hammer.* 1977, Fawcett. A giant asteroid or comet collides with the Earth. Among the first of the scientifically reasonable impact stories.

Sawyer, Robert *Calculating God.* 2000, Tor. When aliens finally come to Earth, they reveal that mass extinctions due to impacts happened simultaneously on three planets—which leads them to suspect that they were caused by a higher intelligence.

Jupiter (and its Satellites)

Benford, Gregory *Against Infinity.* 1983, Pocket Books. About terraforming Ganymede and trying to survive in that harsh environment.

Benford, Gregory "The Future of the Jovian System" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. Story about settling the moons of Jupiter and exploiting their resources.

Benford, Gregory *The Jupiter Project.* A coming-of-age story with a Jupiter setting.

Clarke, Arthur *2010.* 1984, Ballantine. Sequel to *2001*, featuring life under the ice of Europa, Von Neumann probes, and more.

Moffitt, Donald *The Jupiter Theft.* 1977, Ballantine. Aliens left homeless by a supernova explosion come to steal Jupiter's hydrogen for spaceship fuel.

Pohl, Fred & Carol *Jupiter.* 1973, Ballantine. A varied collection of stories about the giant planet, not all based on good science.

Stewart, Ian & Cohen, Jack *Wheelers.* 2000, Aspect/Warner. A mathematician and a biologist have written a novel that suggests an intelligent life form that can live in Jupiter's atmosphere.

Swanwick, Micheal "The Very Pulse of the Machine" in Dozois, W. & Williams, S., eds. *Isaac Asimov's Solar System.* 1999, Ace. An explorer on Io may or may not be discovering a global form of life powered by electrical forces. Good portrayal of Io.

Life Elsewhere (Plausible Examples)

Anderson, Kevin & Beason, Doug "Reflections in a Magnetic Mirror" in *Full Spectrum,* ed. L. Aronica & S. McCarthy (1988, Bantam). A plasma physicist and science writer explore a life-form that can exist within plasma anomalies, but on a different time-scale.

Baxter, Stephen "Cilia-of-Gold" in Dozois, W. & Williams, S., eds. *Isaac Asimov's Solar System.* 1999, Ace (and in *Vacuum Diagrams,* 1997, Harper Prism). Suggests a very clever ancient form of life that adapted (after crashing there) to live on Mercury.

Baxter, Stephen "Sunpeople" in *Vacuum Diagrams.* 1997, Harper Prism. A human expedition on a Kuiper Belt object finds a life-form made of ice with liquid helium for circulation.

Baxter, Stephen "Gossamer" in *Vacuum Diagrams.* 1997, HarperCollins. Suggests a life form that can thrive on and go between Pluto and Charon at perihelion.

Benford, Gregory *In the Oceans of Night.* 1977, Dell. Physicist Benford postulates a universe in which advanced machine intelligences confront (and often overwhelm) organic life. The story continues in *Across the Sea of Suns* (1984, Bantam) and in his novels that take place at the galactic center (*Great Sky River,*

1987, Bantam; *Tides of Light,* 1989, Bantam; *Furious Gulf;* 1994, Bantam; *Sailing Bright Eternity,* 1995, Bantam.)

Benford, Gregory "Dance to Strange Musics" in *Year's Best Science Fiction 4,* ed. David Hartwell. 1999, Eos/HarperCollins. First expedition to Alpha Centauri finds a planet-wide, collective life form that takes energy from pizo-electric effects enhanced by tidal stresses.

Brotherton, Mike *Star Dragon.* 2003, TOR. Suggests a life-form that lives in a cataclysmic binary star system.

Clement, Hal *Mission of Gravity.* 1962, Pyramid. Life on a massive, rapidly rotating planet. Clement is a high-school science teacher. (A new edition of all his stories about this planet was issued in 2002 by TOR, under the title *Heavy Planet.)*

Clement, Hal "Uncommon Sense" in *Space Lash.* 1966, Dell. About lifeforms with liquid metal blood that "see" by smell.

Crichton, Michael *The Andromeda Strain.* 1969, Dell. Doctors and scientists battle an extra-terrestrial microorganism; by a doctor.

Hoyle, Fred *The Black Cloud.* 1957, Signet. Intelligence develops in interstellar dust clouds which can move from star to star.

LeGuin, Ursula *The Left Hand of Darkness.* 1969, Ace. Award-winning story of contact with aliens who are alternately one sex and then the other.

Reynolds, Alastair *Pushing Ice.* 2005, Ace. Complex novel that includes a huge interstellar zoo that captures intelligent species; describes several intriguing alien races. The zoo, the story suggests, exists because its ancient builders, finding intelligent life rare and fragile, wanted to find an artificial way of bringing civilizations together.

Sawyer, Robert *Calculating God.* 2000, Tor. Suggests that most alien species will choose to upload themselves into a computer reality rather than deal with their own hostility and the isolation of the universe.

Sawyer, Robert *Illegal Alien.* 1997, Ace. Aliens with quadrilateral symmetry and the ability to hibernate for very long times come to Earth, to wipe out any threat to them while they sleep for 400,000 years.

Sheckley, Robert "Specialist" in Keyes, N., ed. *Contact.* 1963, Paperback Library. Proposes the idea that life in the universe is all specialized by function, except on Earth.

Sheffield, Charles *Between the Strokes of Night.* 1985, Baen Books. Proposes a life-form that can thrive in intergalactic space.

Sterling, Bruce "The Swarm" in Silverberg, R., ed. *The Nebula Awards 18.* 1983, Bantam. A form of life that absorbs other life forms and converts them to symbiotic components. Nice discourse on whether intelligence has value in the long run.

Stewart, Ian & Cohen, Jack *Wheelers.* 2000, Aspect/Warner. A mathematician and a biologist have written a novel that suggests an intelligent life form that can live in Jupiter's atmosphere.

Swanwick, Michael "Slow Life" in Hartwell, David, ed. *Best SF 8.* 2003, Eos. Suggests a form of life that can survive deep under Titan's seas.

Tiptree, James "Love is the Plan the Plan is Death" in Goldin, Stephen, ed. *The Alien Condition.* 1973, Ballantine. Haunting, complex story of a truly alien lifeform.

Varley, John *The Ophiuchi Hotline.* 1977, Dell. Ambitious novel about interstellar communication and the idea of a struggle between life-forms that develop on terrestrial and Jovian planets throughout the universe.

Light and Radiation

Bester, Alfred "The Pi Man" in *Star Light, Star Bright.* 1976, Berkley/Putnam. Story of a man sensitive to many bands of the electro-magnetic spectrum (and much more); not very scientific, but can help students see how lucky we are that our senses filter out so much information.

Mars

Aldiss, Brian "The Difficulties Involved in Photographing Nix Olympica" in Dozois, Gardner & Williams, Sheila, eds. *Isaac Asimov's Solar System.* 1999, Ace. A poignant little story about a future army sergeant who longs to take Ansel Adams-like photos of Olympus Mons.

Anderson, Kevin *Climbing Olympus.* 1994, Warner Books. A novel about Mars in the midst of being terraformed.

Bova, Ben "Olympus Mons" in Hartwell, David & Cramer, Kathryn, eds. *The Hard SF Renaissance.* 2002, Orb/TOR. Astronauts explore the caldera of the giant volcano and make a surprising discovery about microscopic life on Mars. Has lots of realistic detail.

Bova, Ben *Mars.* 1993, Bantam. Features scientifically realistic Mars exploration.

Hartmann, William *Mars Underground.* 1997, TOR Books. Exploration of Mars in the next century, by a noted planetary astronomer.

Hipolito, Jane & McNelly, Willis, eds. *Mars, We Love You.* 1971, Pyramid. Eclectic collection of fiction and nonfiction about Mars, some based on current science, some not.

Landis, Geoffrey *Mars Crossing.* 2000, Tor Books. A trek across the Martian surface, written by a NASA scientist.

Pesek, Ludek *The Earth is Near.* 1970, Dell. About a realistic expedition to Mars and the problems they face.

Pohl, Fred *Man Plus.* 1976, Bantam. Humans biologically engineered to survive on Mars.

Pohl, Fred *Mining the Oort.* 1992, Ballantine. The Oort cloud of comets is mined for material to terraform Mars.

Reynolds, Alastair "Angel of Ashes" in *Zima Blue and Other Stories.* 2006, Night Shade Press. A terraformed Mars with an atmosphere is the setting for a novel about a religion based on a supernova and a neutron star.

Robinson, Kim *Red Mars.* 1992, Bantam. *Green Mars.* 1993, Bantam. *Blue Mars.* 1995, Bantam. Complex story involving a Mars of the future which is being made ready for increased human habitation.

Sparhawk, Bud "Olympus Mons" in *Dancing with Dragons.* 2001, Wildside Press. About a race down the flanks of the giant Martian volcano.

Varley, John "In the Hall of the Mountain King" in *The Persistence of Vision.* 1978, Dell. Ingenious story about Mars adapting to Earth colonists.

Mercury

Anderson, Poul "Life Cycle" in Silverberg, Robert, ed. *Earthmen and Other Strangers.* 1966, Manor Books. Suggestion of a lifeform that can survive on Mercury.

Baxter, Stephen "Cilia-of-Gold" in Dozois, Gardner & Williams, Sheila, eds. *Isaac Asimov's Solar System.* 1999, Ace. Suggests a very clever ancient form of life that adapted (after crashing there) to live on Mercury. (Also appears in Baxter's *Vacuum Diagrams.* 1997, Harper Prism.)

Varley, John "Retrograde Summer" in *The Persistence of Vision.* 1978, Dell. Life on Mercury in an era of easy biological engineering.

Meteorites

Innes, Michael *The Weight of the Evidence.* 1943, Harper/Perennial. A somewhat ordinary murder mystery, but the murder was committed using a meteorite in a university setting.

Moon, The

Hartmann, William "Handprints on the Moon" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. A touching story by an astronomer about international cooperation as the Moon is colonized.

Landis, Geoffrey "Walk in the Sun" in his *Impact Parameter.* 2001, Golden Gryphon Press. An astronaut stranded on the Moon in a solar powered suit must keep walking to keep up with the Sun.

McAuley, Paul "How We Lost the Moon" in Crowther, Peter, ed. *Moon Shots.* 1999, Daw. A glitch in a fusion experiment on the Moon creates a mini black hole that ultimately consumes our satellite.

Weinberg, Gerald "The Moon is a Harsh Pig" in Brotherton, Mike, ed. *Diamonds in the Sky.* 2009, On another planet, two students make a bet about the cause for the phases of the moon, which leads to a surprise.
`http://www.mikebrotherton.com/diamonds/?page_id=47`

Neptune (and its Satellites)

Carver, Jeff *Neptune Crossing.* 1994, Tor. An intelligent life-form on Neptune's moon Triton helps humans prevent a comet from crashing into the Earth.

Eklund, Gordon *A Thunder on Neptune.* 1989, Morrow. Exploring Neptune and Triton and finding a life form.

Neutrinos

Clayton, Donald *The Joshua Factor.* 1986, Texas Monthly Press. A novel by an astronomer involving intrigue and neutrinos from the Sun.

Neutron Stars (Remnants of Exploded Stars)

Baxter, Stephen *Flux.* 1994, HarperCollins. Portrays life on a neutron star.

Forward, Robert *Dragon's Egg.* 1981, Ballantine. Also proposes a lifeform that can live on the surface of a neutron star. Sequel is called *Starquake* (1985, Ballantine).

Niven, Larry "Neutron Star" in *Neutron Star.* 1986, Ballantine. A space traveler gets too close to a neutron star and experiences enormous tidal forces.

Niven, Larry *The Integral Trees.* 1984, Ballantine. Takes place in a thick ring of gas, stripped from a Jovian planet, in orbit around a neutron star. Sequel is called *Smoke Ring* (1988, Ballantine.)

Silverberg, Robert "The Iron Star" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Involves two supernova explosions, a neutron star, and a black hole.

Physics, Particle

Preuss, Paul *Broken Symmetries.* 1983, Pocket Books. A novel of science, politics, and intrigue surrounding the building of a giant particle accelerator in Hawaii. (A 1997 sequel is entitled *Secret Passages*.)

Benford, Gregory "Matter's End" in *Matter's End.* 1994, Bantam. Physicists in India find that protons do decay as predicted by some Grand Unified Theories, with dire consequences for reality.

Pluto

Baxter, Stephen "Gossamer" in *Vacuum Diagrams.* 1997, HarperCollins. Stranded astronauts discover a life form that can thrive on Pluto and Charon at perihelion.

Benford, Gregory & Carter, Paul *Iceborn.* 1989, Tor. Proposes a form of life that can survive on Pluto and in the Oort Cloud.

Niven, Larry "Wait it Out" in *Tales of Known Space.* 1975, Ballantine. Protagonist is marooned on Pluto and discovers a form of life that use superfluidity to survive.

Silverberg, Robert "Sunrise on Pluto" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. A form of life that could exist on Pluto.

Quantum Mechanics

Bear, Greg "Schrodinger's Plague" in *Tangents.* 1989, Warner. A scientist repeats the Schrodinger's Cat experiment in such a way that not just a cat but all of humanity is at risk.

Coover, Robert *The Universal Baseball Association: J. Henry Waugh, Proprietor.* 1968, Random House. Works out some of the philosophical consequences of Einstein's remark about "God playing dice" with the universe.

Egan, Greg *Quarantine.* 1992, Harper Prism. A sophisticated detective mystery that addresses serious ideas in the interpretation of quantum mechanics.

Hoyle, Fred *October the First Is Too Late.* 1966, Fawcett. Fascinating working-out of the many-worlds interpretation of quantum mechanics.

Lem, Stanislav *The Investigation.* 1959, Avon. A novel that considers the philosophical implications of quantum mechanics: what if a mystery is unsolvable in principle?

McCormach, Russell *Night Thoughts of a Classical Physicist.* 1982, Harvard U. Press. A fictional physicist muses on the transformation of classical physics in the early years of the twentieth century; written by a historian of science.

Niven, Larry "All the Myriad Ways" in *All the Myriad Ways.* 1971, Ballantine. Works out some of the implications of the many-worlds interpretation for solving murder mysteries.

Niven, Larry "For a Foggy Night" in *N-Space.* 1990, TOR. Humorous story in which the fog in San Francisco turns out to be a blurring effect of meeting world lines in many-worlds quantum mechanics.

Pohl, Fred *The Coming of the Quantum Cats.* 1986, Bantam. A novel of parallel universes based on the many-worlds view.

Reynolds, Alastair "Angel of Ashes" in *Zima Blue and Other Stories.* 2006, Night Shade Press. A priest of a future religion loses faith when a miracle involving a supernova turns out to have a quantum mechanical explanation.

Schmidt, Stanley *Newton and the QuasiApple.* 1975, Popular Library. In another star system, Earth visitors introduce notions from 20th-century physics to an alien civilization just as their Newton publishes his ideas.

Quasars

Asimov, Isaac *The Gods Themselves.* 1972, Fawcett. Ambitious novel that "solves" the origin of the big bang and quasars.

Martin, Mark & Benford, Gregory *A Darker Geometry.* 1996, Baen. Complex novel, suggests quasars are points through which another (closed) universe dumps excess energy into ours before its Big Crunch.

Relativity, (The Special Theory of)

Benford, Gregory "Relativistic Effects" in *In Alien Flesh.* 1986, TOR. A ram-scoop spaceship accelerates very close to the speed of light and flies between two galaxies about to collide, able to remove some of the interstellar matter that would have flown between them, due to relativistic effects.

Forward, Robert "Twin Paradox" in *Indistinguishable from Magic.* 1995, Baen. One twin travels to the stars at relativistic speed, the other stays on Earth but stops aging. So traveling twin gets to be older.

Haldeman, Joe *The Forever War.* 1974, Ballantine. Awardwinning novel of an interstellar war involving concepts from both special and general relativity.

Haldeman, Joe "Tricentennial" in *Infinite Dreams.* 1978, St. Martin's. Traveling near speed of light and the effects of time dilation.

Masson, David "Traveler's Rest" in Silverberg, Robert, ed. *Voyagers in Time.* 1967, Tempo. Intricate, brilliant story; relativistic time dilation becomes a function of latitude.

Sheffield, Charles "The Long Chance" in *Vectors.* 1979, Ace. Traveling into the future using relativistic space travel and suspended animation.

Stith, John *Redshift Rendezvous.* 1990, Ace. Explores the effects of a voyage in a "hyperspace" where the speed of light is 30 meters per second.

Varley, John "The Pusher" in *Blue Champagne.* 1986, Berkley. Poignant story on loneliness of relativistic space travel; time dilation makes it difficult to have a family on Earth.

Note: For stories involving the General Theory of Relativity, see under "Black Holes" and "Cosmology"

Saturn (and its Satellites)

Clarke, Arthur "Saturn Rising" in *Tales of Ten Worlds.* 1962, Signet. Story of a man who is driven by childhood trauma to build a hotel in Titan. (Dated science, but good for its time.)

McDevitt, Jack "Melville in Iapetus" in *Cryptic: The Best Short Fiction of Jack McDevitt.* (2009, Subterranean Press) Also on the web.[4] An alien statue is discovered on this moon of the ringed planet and a human expedition wonders at the motivation of the artist. Nice descriptions of Saturn as seen from a tidally locked satellite.

Reynolds, Alastair *Pushing Ice.* 2005, Ace. Saturn's moon Janus turns out to be an alien craft, comes out of orbit, and takes a human spaceship on a remarkable interstellar adventure.

Swanwick, Michael "Slow Life" in Hartwell, David, ed. *Best SF 8.* 2003, Eos. About the first expedition to Titan. Suggests a form of life that can survive deep under Titan's seas.

Varley, John "Gotta Sing, Gotta Dance" in *The Persistence of Vision.* 1978, Dell. Symbiotic humans and plants adapt to life in the rings of Saturn and make unearthly music.

Zelazny, Roger "Dreadsong" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. Life forms that could live in Saturn's atmosphere.

Science in General

Benford, Gregory *Timescape.* 1981, Pocket Books. An excellent novel that is one of the best depictions of the nature and pressures of scientific research; features astronomers such as Fred Hoyle and Geoffrey and Margaret Burbidge as characters.

Benford, Gregory *Cosm.* 1998, Avon/EOS. A Brookhaven physicist makes a universe in a particle accelerator. Has excellent (and often caustic) portrayals of how big science is done today in physics and astronomy.

Chiang, Ted "Exhalation" in Hartwell, D. & Cramer, K., eds. *Year's Best SF 14.* 2009, Eos. A scientist, who is a mechanical being, tries to reason out his own anatomy by applying the scientific method.

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[4] http://www.webscription.net/chapters/1596061958/1596061958___7.htm

Sagan, Carl *Contact.* 1985, Simon & Schuster. Good portrayal of how astronomical research is carried out and an interesting attempt to work out some modern issues between science and religion.

Weinberg, Gerald "The Moon is a Harsh Pig" in Brotherton, Mike, ed. *Diamonds in the Sky.* 2009. On another planet, a bet about the cause for the phases of the moon leads a graduate student in astronomy to think more about how science is done.
`http://www.mikebrotherton.com/diamonds/?page_id=47`

SETI: The Search for Extra Terrestrial Intelligence via Radio Surveys

Baxter, Stephen "Last Contact" in Dozois, G., ed. *The Year's Best Science Fiction, 25.* 2008, St. Martin's. Also available on the web.[3] In the near future, the acceleration of the universe's expansion increases to such a degree that even stars in our own galaxy begin to be carried away very fast. Suddenly, SETI scientists pick up many messages: civilizations need to say goodbye.

Benford, Gregory "Dance to Strange Musics" in *Year's Best Science Fiction 4,* ed. David Hartwell. 1999, Eos/HarperCollins. First expedition to Alpha Centauri finds a planet-wide, collective life form that is sending out huge, information-rich SETI messages to one star after another.

Brin, David "Lungfish" in *The River of Time.* 1987, Bantam. Interesting contemplation of the many purposes to which alien civilizations might put self-replicating "von Neumann probes" and how conflicts between probes from different civilizations might arise.

Gunn, James *The Listeners.* 1972, Signet. Good early portrayal of a scientifically reasonable search. (Note that the author is not the James Gunn who is an astronomer.)

McDevitt, Jack *The Hercules Text.* 1986, Ace. Flawed, but interesting novel about radio communication with a distant civilization.

McDevitt, Jack "Nothing Ever Happens in Rock City" in *Nebula Awards Showcase 2004,* ed. Vonda McIntyre. 2004, ROC/Penguin. The first radio SETI discovery as seen from the perspective of the owner of the liquor store closest to the observatory.

Morton, Oliver "The Albian Message" in *Year's Best SF 11,* Hartwell, David and Cramer, Kathryn, eds. 2006, Eos. Suggests that the place to search for alien messages is in the human genome.

Sagan, Carl *Contact.* 1985, Simon & Schuster. The discovery of radio signals from extraterrestrial intelligence leads humanity to re-evaluate its self-image.

Sawyer, Robert *Factoring Humanity.* 1998, Tor. A radio message from Alpha Centauri helps humanity get in touch with another civilization and itself.

Sawyer, Robert *Rollback.* (2007, TOR) A message from a civilization 19 LY away is received by SETI scientists, and turns out to be a survey on issues of morality for which they want many answers. We send a reply, and then their reply is eventually received, with instructions for incubating two baby aliens. Considers some of the issues of altruism and message construction that SETI researchers have been debating.

Spinrad, Norman "The Helping Hand" in *Full Spectrum 3,* ed. Lou Aronica, et al., 1991, Bantam. An alien message unites humanity, but turns out to be a benevolent lie.

Zerwick, C. & Brown H. *The Cassiopeia Affair.* 1968, Curtis. An exploration of the effects that an alien radio message might have on Earth. One of the authors is a geochemist.

Solar System: General

Asimov, Isaac, et al., eds. *The Science Fictional Solar System.* 1979, Panther/ Granada. A collection of short stories set on the planets and satellites of our solar system.

Preiss, Byron, ed. *The Planets.* 1985, Bantam. A collection of essays by noted astronomers about the planets in the solar system *and* science fiction stories inspired by our current understanding of each world.

Space Flight

Garn, Jake & Cohen, Stephen *Night Launch.* 1989, William Morrow. A technothriller about the hijacking of the Space Shuttle in space, written by the first Senator to fly on the Shuttle.

Space Travel (Realistic)

Anderson, Poul *Tau Zero.* 1970, Berkley. While the ending is fanciful, this novel very nicely portrays some of the issues involving relativistic space travel.

Benford, Gregory "Relativistic Effects" in *In Alien Flesh.* 1986, TOR. A ram-scoop spaceship accelerates very close to the speed of light and flies between two galaxies about to collide.

Brin, David "An Ever-Reddening Glow" in Hartwell, D. & Cramer, K., eds. *The Hard SF Renaissance.* 2002, Orb. Suggests that it is the stretching of space by the general relativistic "metric surfing" (travel near the speed of light) of countless intelligent species that is responsible for the expansion of the universe, and that no species is willing to give up the thrill. (Very nice parallel with the ecological damage we all do to the Earth.)

Haldeman, Joe "Tricentennial" in *Infinite Dreams.* 1978, St. Martin's. Traveling near the speed of light and the effects of time dilation for the traveler.

Reynolds, Alastair "Beyond the Aquila Rift" in *Year's Best SF 11,* Hartwell, David & Cramer, Kathryn, eds. 2006, Eos. Proposes a network of ancient pathways like black holes that allow faster-than-light travel. Local stations can be reached fast, but the protagonist winds up in the Magellanic Clouds.

Varley, John "The Pusher" in *Blue Champagne.* 1986, Berkley. Poignant story about the loneliness of relativistic space travel; time dilation makes it difficult to have a family on Earth.

Star Clusters

Anderson, P. "Starfog" in *Beyond the Beyond.* 1969, Signet. What life might be like in the middle of dense star cluster.

Stars

Asimov, Isaac "Nightfall" in *Nightfall & Other Stories.* 1969, Fawcett. On a planet in a multiple star system, night comes only once every 2000 years.

Benford, Gregory "Dance to Strange Musics" in *Year's Best Science Fiction 4,* ed. David Hartwell. 1999, Eos/HarperCollins. First expedition to Alpha Centauri finds a planet-wide, collective life form that takes energy from electric effects caused by the nature of the star system.

Brotherton, Mike *Star Dragon.* 2003, TOR. Story involves SS Cygni, a complex, violent binary star system. Brotherton is an astronomer.

Hoyle, Fred *Ossian's Ride.* 1959, Harper. Aliens come to Earth fleeing the disaster of their star having become a red giant.

McAuley, Paul "Rats of the System" in Crowther, Peter, ed. *Constellations*. (2005, DAW). Enigmatic advanced artificial intelligences dismantle and alter binary star systems with white dwarfs in them.

McDevitt, Jack & Shara, Michael "Lighthouse" in *Cryptic: The Best Short Fiction of Jack McDevitt.* (2009, Subterranean Press) Also on the web.[2] A deep survey of brown dwarfs (failed stars) reveals a large number whose composition defies all the rules of how stars work. They turn out to be artificial markers around single black holes that would have been a danger to travelers in the Galaxy. Shara is an astronomer.

Niven, Larry "Flare Time" in *Limits.* 1984, Ballantine. Life on a planet in a binary star system with a flare star.

Niven, Larry *Ringworld.* 1970, Ballantine. In this complex novel featuring an adaptation of a Dyson sphere, one element of the plot hinges on the motivations of a race of cowardly aliens whose star had earlier become a red giant.

Sawyer, Robert *Illegal Alien.* 1997, Ace. An alien race on a planet around Alpha Centauri A has to deal with a gravitational interaction among the three stars in the system that hands their planet off to a dimmer star.

See also: "Star Clusters," "Supernovae," "Neutron Stars", "Black Holes"

Sun, The

Benford, Gregory & Eklund, Gordon *If the Stars Are Gods.* 1977, Berkley. Proposes that the Sun might have an intelligence within.

Brin, David *Sundiver.* 1980, Bantam. Involves a trip into the Sun. Brin has a PhD in astrophysics.

Clarke, Arthur "The Wind from the Sun" in *The Wind from the Sun.* 1973, Signet. About the effect of a solar flare on a solar wind "sailing race" of the future.

Clayton, Donald *The Joshua Factor.* 1986, Texas Monthly Press. A novel by an astronomer involving intrigue and neutrinos from the Sun.

Clement, Hal "Proof" in Asimov, Isaac, ed. *Where Do We Go from Here?* 1971, Fawcett. About possible life-forms within the Sun.

Niven, Larry "Inconstant Moon" in *All the Myriad Ways.* 1971, Ballantine. A giant flare on the Sun wreaks havoc with civilization.

Supernovae (Exploding Stars)

Allen, Roger & Kotani, Eric *Supernova.* 1991, Avon. An exploding star threatens the Earth. (Kotani is the pen-name of a NASA astrophysicist; this book is the only science fiction story I have seen which actually features an H-R diagram.)

Anderson, Poul "Day of Burning" in *Beyond the Beyond.* 1969, Signet. An advanced race tries to mobilize the still feudal inhabitants of a planet whose star is about to go supernova.

Clarke, Arthur "The Star" in *The Nine Billion Names of God.* 1967, Signet. Classic story about a supernova that becomes the star of Bethlehem.

Cowper, Richard *The Twilight of Briarius.* 1974, John Day. An alien intelligence rides the shock wave of a supernova explosion to Earth.

Latner, Alexis "Listening Glass" in Brotherton, M. *Diamonds in the Sky.* 2009. A supernova goes off in a nearby galaxy, and the star that explodes happens to orbit a fast-pulsing pulsar.
`http://www.mikebrotherton.com/diamonds/?page_id=99`

Reynolds, Alastair "Angel of Ashes" in *Zima Blue and Other Stories.* 2006, Night Shade Press. A nearby supernova that was just asymmetric enough to miss the inner solar system and spare life on Earth becomes the basis of a new religion.

Sawyer, Robert *Calculating God.* 2000, Tor. The star Betelgeuse goes supernova, apparently through the actions of an advanced race of beings, and threatens the Earth.

Sheffield, Charles *Aftermath.* 1998, Bantam. Alpha Centauri A goes supernova, even though that kind of star is not supposed to. But the book has a good description of how the electro-magnetic pulse from the explosion wreaks havoc with modern civilization, especially computer chips. Written by a scientist. (A sequel, called *Starfire,* was published by Bantam in 1999.)

Silverberg, Robert "The Iron Star" in Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Involves two supernova explosions, a neutron star, and a black hole.

Telescopes

Brett, Alex *Cold Dark Matter.* 2005, Dundurn. A mystery novel whose plot turns on astronomical research; much of it takes place at the Mauna Kea observatories.

Ehrlich, Max *The Big Eye.* 1949, Doubleday. Parts of this early novel about the threat of the end of the world from a planetary collision take place at the Palomar observatory; written just after the 5-meter (200-inch) telescope was finished.

Latner, Alexis "Listening Glass" in Brotherton, M. *Diamonds in the Sky.* 2009. A radio telescope on the Moon is damaged and then repaired in time to observe radio waves from a supernova.
`http://www.mikebrotherton.com/diamonds/?page_id=99`

Landis, Geoffrey "Impact Parameter" in *Impact Parameter.* 2001, Golden Gryphon. Orbiting telescopes in the near future discover that a group of stars are out of place. Nice descriptions of how astronomy is done.

McDevitt, Jack & Shara, Michael "Lighthouse" in *Cryptic: The Best Short Fiction of Jack McDevitt.* (2009, Subterranean Press) Also on the web.[2] Fascinating story of future astronomical discovery using new kinds of telescopes in space and a space elevator to get to them. Shara is an astronomer.

Sagan, Carl *Contact.* 1985, Simon & Schuster. Main character is loosely based on radio-astronomer Jill Tarter; has lots of good descriptions of how astronomers use radio telescopes to search for signals from civilizations out there.

Thermodynamics

Chiang, Ted "Exhalation" in Hartwell, D. & Cramer, K., eds. *Year's Best SF 14.* 2009, Eos. A wonderful parable about the second law of thermodynamics, expressed in terms of changes in air pressure in a closed-system world inhabited by mechanical creatures.

Time (The Nature of and Travel Through)

Benford, Gregory *Timescape.* 1981, Pocket Books. A superbly crafted book about time communication using tachyons (faster-than-light particles).

Chiang, Ted "Story of Your Life" in *The Year's Best Science Fiction 4,* ed. David Hartwell. 1999, Eos/HarperCollins. Describes an alien approach to linguistics and thought which can alter one's perception of time, and see all of one's life at the same time. Interesting allegorical story.

Heinlein, Robert "All You Zombies" in *6 x H.* 1961, Pyramid. Not realistic science, but this famous story is perhaps the most outrageous exploration of what might happen if we *could* travel backward in time: a man becomes his own father and mother.

Lightman, Alan *Einstein's Dreams.* 1993, Random House. A fugue and meditation on the many different interpretations of time; portrayed as dreams a young Einstein is having.

Niven, Larry *World Out of Time.* 1976, Ballantine. Using the gravitational time dilation near a supermassive black hole to travel into the distant future.

Uranus (and its Satellites)

Landis, Geoffrey "Into the Blue Abyss" in Dozois, Gardner & Williams, Sheila, eds. *Isaac Asimov's Solar System.* 1999, Ace. An expedition descends into the deep atmosphere and ocean of Uranus and discovers life there. Written by a NASA scientist.

McAuley, Paul "Dead Men Walking" in Hartwell, David & Cramer, Kathryn, eds. *Year's Best SF 12.* 2007, Eon. Story of an android assassin on Ariel, Uranus' moon, which houses cities and a prison farm.

Nordley, G. David "Into the Miranda Rift" in Dozois, Gardner, ed. *The Year's Best Science Fiction, 11th Annual.* 1994, St. Martin's. Harrowing chronicle of trapped explorers on and in the jigsaw-puzzle satellite Miranda.

Sheffield, Charles "Dies Irae" in Preiss, Byron, ed. *The Planets.* 1985, Bantam. About adapting life to survive in Uranus' atmosphere.

Venus

Niven, Larry "Becalmed in Hell" in *All the Myriad Ways.* 1971, Ballantine. An astronaut gets stranded in the Venus atmosphere.

Sheffield, Charles "Dinsdale Dissents" in *Vectors.* 1979, Ace. Story involving the terraforming of Venus using algae. Sheffield is a scientist.

Varley, John "In the Bowl" in *The Persistence of Vision.* 1978, Dell. The discovery of a form of crystalline life that can survive on Venus.

A Few Collections of Stories with Good Science in Many Areas

Asimov, Isaac, et al., eds. *Great Science Fiction by the World's Great Scientists.* 1985, Primus. Twenty-one stories by writers with advanced degrees in science or engineering.

Conklin, Groff *Great Science Fiction by Scientists.* 1962, Crowell Collier. Stories by scientists in many fields, not just astronomy.

Dozois, Gardner & Williams, Sheila *Isaac Asimov's Solar System.* 1999, Ace. Stories about different worlds in our planetary system.

Hartwell, David & Cramer, Katherine, eds. *The Ascent of Wonder: The Evolution of Hard SF.* 1994, TOR. Large-scale collection of stories, many with good science.

Hartwell, David & Cramer, Katherine, eds. *The Hard SF Renaissance.* 2002, ORB/TOR. Another collection, like the above, but with more recent stories.

Preiss, Byron & Fraknoi, Andrew, eds. *The Planets.* 1985, Bantam. Collection of science essays on each planet, followed by a science fiction story based on current science.

Preiss, Byron & Fraknoi, Andrew, eds. *The Universe.* 1987, Bantam. Collection of essays by leading astronomers and science fiction stories inspired by the science they describe.

Some Useful Web Sites

The Internet Speculative Fiction Database A remarkable site which indexes many stories and novels in science fiction. You can see what any author has written or find all the places a story you are interested in has been published.
`http://www.isfdb.org/cgi-bin/index.cgi`

Free Speculative Fiction Online A nice list of short stories that are available on line without charge. `http://www.freesfonline.de/index.html`

Teaching Astronomy with Science Fiction
`http://dx.doi.org/10.3847/AER2002009`