

# Exhibit M



## Who Invented Faster than Light Travel ?

by Sten Odenwald

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Why should we bother ourselves with the merits of fantasy worlds? Because sometimes it can be a good exercise to pull out the stops and let our minds enjoy unrestricted possibilities. From time to time, answers to great questions have accidentally emerged from the muddy waters of unbridled imagination. A light-hearted and playful romp through the world of science fiction might uncover interesting viewpoints to difficult questions.

Imagination is the engine that propels all of our many creative endeavors. It is a gift from an organ that compulsively asks 'How?', 'Why?', 'Where?' and 'What if..?' The human brain is relentlessly inventive. It constantly searches for patterns from the data its receives. Lacking data from the outside world, it will patiently bide its time by creating its own stimulation. Nowhere is this insatiable pattern searching more in evidence, and more volatile, than in the roller coaster journeys we take while asleep. Our waking state also benefits from this activity by sensitizing us to possibilities that we might not have anticipated. The structure of the benzene molecule was the product of a dream that the Chemist Kekule in which he saw a snake biting its tail and forming a ring. The principles of relativity were discovered when Albert Einstein imagined what the world would look like if you could ride on a light beam. The concept of the 'bubble chamber' was developed by Glaser while watching the suds form in a beer stein. These examples don't mean that unrestrained imagination always results in new ideas in physics, but surely a playful approach to understanding nature, together with the right technical background, can work wonders from time to time!

Science fiction authors have for decades created universes in which a bewildering variety of answers have been proposed to the dilemma of traveling to the distant stars and beyond. Surprisingly, these answers have followed an almost evolutionary sequence that runs nearly parallel to developments in 20th century physics. Of course, some authors have been more in touch than others with the reality and limitations of the physical world, but then again, we all understand that science fiction is only meant to be a plausible image of a future world. It is not supposed to be a slavishly literal extension of our present scientific knowledge. Of greater consequence to nearly all SF stories is how humans heroically resolve the old conflicts of the human 'condition' but in the context of new

environments. The environments often mirrored the political conflicts of their times with fierce, interplanetary battles dominating the SF of the 1930's and 40's.

It is easy to understand how SF got such a bad literary reputation in reading some of the stories that made it into print during the early 1940's. Hostile aliens from Mars and Venus fought interminable battles with earthlings. Earthlings traveled interplanetary space in ships shaped like missiles, footballs or dirigibles, powered by 'rocket tubes'. Nearly all the planets in the solar system were occupied by implacable and often belligerent aliens, or occasionally aliens would enter our solar system from distant worlds with colorful names like 'Boron' or 'Talpite'. Stories were often shallow, with little character development, serving only as frameworks for presenting some bizarre technical gimmick.

The physical principles underlying science fiction writing during this period were a complicated pastiche of ideas derived at least in spirit from the sweeping developments then occurring in relativity theory and atomic physics made during this time. Most of these developments were only partly understood by the authors of that time, which is probably why SF stories often hinged on outright errors even in some of the most elementary aspects of the physical world. For instance, believing that the Bohr atom in vogue during the early 20's with its planetary electrons was literally a microcosmic solar system. Our solar system was in turn simply an atom in a much larger universe. Several authors imagined people taking journeys to these other worlds within the atom by using machines that either shrank or enlarged their bodies by suitable scales as in S.P. Meek's *Submicroscopic* (1931), or G. Peyton's short story *The Man from the Atom* (1926). In the later instance, probably the earliest story of this kind, one Prof. Martyn builds a machine that subtracts or adds atoms to the human body until it has grown or shrunk to the desired size.

Between 1924 and 1927, the physicists Heisenberg, Schroedinger and Dirac had all but written the last pages of the modern theory of atomic structure based on quantum mechanics. The Bohr-Sommerfeld 'planetary' atom though conceptually simple was, nevertheless, invalid so that there was no longer a basis for thinking that electrons were miniature planets by this time. Yet SF based on this curious principle of 'worlds within worlds' persisted even as late as 1949 in Stan Raycraft's *Pillars of Delight* and in *He Who Shrank*.

With the establishment of the principles of quantum mechanics there came a minor resurgence of interest in the tantalizing properties of the atomic world. In James Blish's story *Nor Iron Bars* (1956). By some unknown, accidental means, the 'Haertel Overdrive' endowed the ship 'Flyway II' with negative mass. The ship was promptly ejected from normal space and took up residence within an atom. Presumably, this was the only place in the universe where negative mass could exist. In many ways this idea resembles the old Aristotelean notion that matter has an innate sense of its proper place in the universe, and like a stone falling to the ground, will seek out its natural resting-place. The ship could not logically exist in our universe, so it found a place where it could. The captain also sets foot on the surface of an electron described as "... a swirling, opalescent substance...covered with fine detail and rills rather like mercury...its boundary trailing off into space indistinctly [since] the electron never knows exactly where it is..." The electron was clearly assumed to have a finite size, though in deference to quantum mechanics, there was a haziness about its boundary.

The passengers of Flyway II, meanwhile, were having difficulties of their own, experiencing telepathic effects also forbidden in the real universe. The author raises the possibility that telepathy and quantum mechanics might be related in some unknown manner. This idea that psychic phenomena are in some way a consequence of the quantum world also appears in Colin Kapp's *Lambda I* (1962). In this short story, a passenger ship travels directly through the earth in something called Tau-space. The idea is that if you vibrate a mass just right, it can be made to pass directly through any matter including the entire earth. Unavoidably because of the inhomogeneities in the strata that it passes through, upon arrival at its destination, a tauship re-materializes in some harmonic vibration of the proper mode and must be 'kicked' into the correct oscillatory mode for recovery. Evidently, mode slips can also be triggered by extreme emotional or psychic states, and like *Lambda I*, cause the ship arrive in the unrecoverable 'omega' state. An earlier short story *The World Beyond* by Guy Archette in 1947 describes the principle behind this vibratory model for matter as "Everything is made up of atoms, and there are spaces within the atom fully as vast as those between the planets in the solar system. The spaces ... may be occupied by the components of a hundred other atoms, each possessing a different vibration rate, and

each vibration rate constitutes another world." It is difficult to believe that Colin Kapp and Guy Archette were not drinking from the same tap in inventing this unusual world view!

James Blish's second attempt at utilizing quantum effects to drive spacecraft appears in his epic novel *Cities in Flight*(1958) which is based on a collection of novelas written between 1950 and 1957. As the story unfolds, we learn that during the first decades of the 21st century, western scientists had discovered the 'Dillon-Wagoner gravitron polarity generator' which immediately became known to the engineers as a 'spindizzy'. The basic operating principle as described in *Earthman Come Home*(1950) is that all rotating bodies produce magnetic fields whose strength is proportional to their rate of spin, their mass, and the constant of gravity. What a spindizzy does is to alter the magnetic moment of every atom within its field thereby changing the constant of gravity. *Cities in Flight* is one of the few stories I've read that actually gives an equation, identified as the fictitious Blackett-Dirac Equation, claiming to show how 'G' can be altered by changing a particle's spin, to wit :  $G\text{-squared} = 8 P c /U$  where P is the magnetic moment of the body, c is the speed of light, and U is the angular momentum! Evidently, by increasing U for every particle in a body, the constant of gravity is reduced, ergo the name spindizzy. A space drive based on this principle, for reasons not made clear by the author, has no practical upper limit to its speed, and can break the light speed barrier by drawing less than a few watts of power. Entire earth cities were soon equipped with spindizzies and set-out to colonize the galaxy. The story contains several amusing anachronisms. For example, although much of the action of the novel takes place between 3000 and 4000 AD, the engineers are still using slide rules!

Another story mentioning an association between magnetic phenomena and gravity is found in George O. Smith's *Meddler's Moon*(1947). The so- called 'Hedgerly Effect' proved that there is a relationship between magnetism and gravity which led to the electromagnetic control of gravity. Artificial control of gravity fields allows the gravitational mass of any particle to be altered at will. This does away with rockets that have to throw lots of reaction mass out their tails, since mass approaches infinity near the speed of light. Since mass can now be controlled, it can be reduced so that travel near the speed of light is possible.

Although interplanetary travel by conventional rockets was the mainstay of most SF during the 1930's and 40's, traveling through space to the distant stars has long been known to entail lengthy journeys and posed a whole host of other problems: Problems that were generally so challenging that SF authors tended to stay away from interstellar travel during much of this time. The most straightforward way to shorten the travel time is simply to increase the velocity of your rocket. Sometimes, exotic new rocket fuels were invoked like 'mercuron' in Robert Willes' *Orbit XXIII-H*(1938), capable of producing exhaust velocities of 65 km/sec. For long journeys to mars and beyond, the crew would take various combinations of sleeping drugs.

With the coming of the Atomic Age these pure, brute force methods were upgraded by invoking the mysterious deus ex machina of 'atomic motors'. Velocities up to and including light speed could now be reached as in Richard Tooker's *Moon of Arcturus*(1935) but without the travelers experiencing any time dilation effects. The spaceship 'Meteor III' powered by the energy of "disrupting carbon atoms" takes 26 years to travel to Arcturus with its 18-man crew. This is a remarkable story since much of the work on atomic energy, specifically the fission mechanism, was not readily accessible to the popular press. The mysterious concept of 'atomic drive' also appears in A.E van Vogt's 1940 classic *Slan*, but is not described other than to note that it is based on anti-gravity propulsion. Anti-gravity is an illusive principle in SF, a catch-all for achieving nearly unlimited velocity by mysteriously canceling the force of gravity. Murray Leinster's *First Contact*(1945) also refers to a spaceship which can travel at 'speeds incredible multiples of the speed of light' to take pictures of a supernova explosion.

In general, rockets blasted off from earth under constant accelerations of 1- 2 gravities; the maximum that humans could comfortably endure for long periods of time. The arithmetic of constant acceleration is compelling when applied to space travel. At '1 G' boost, the travelers feel exactly like they are standing on the earth, yet the ship will achieve 50 percent of the speed of light in about 6 months after having traveled 0.1 light year! A trip to mars at this acceleration would take about one month with a terminal velocity of 10 percent of c. If you were willing to endure 2-Gs, you would get to mars in 10 days with a terminal velocity of 6 percent of light speed. Inertialess drives as they came to be known were often introduced to achieve even higher accelerations. If you had an 'acceleration compensator'

that allowed the ship to move at 1000-Gs but canceled all but 1-G for the humans, even faster trips could be made.

For many years 'souped-up' rockets violated nature's prohibition on material bodies traveling faster than light (FTL). Some stories took great relish in how badly they could break this speed limit. Edward E. Smith's *Grey Lensman*(1939) describes how spaceships travel at speeds of 60 parsecs/hour ( 2 million times  $c$  ) in interstellar space and up to 100,000 parsecs/hour ( 3 billion times  $c$  ) in the more rarefied intergalactic space by using 'cosmic energy'. These ships used the inertialess drive developed by Bergenhlom and which opened up commerce throughout the Galaxy. The sequel to this story *Second Stage Lensman* also mentions a race called the Medonians who installed an 'inertia-neutralizer' on their home world and moved it to Lundmark's Nebula, also known as The Second Galaxy. Robert Heinlein's *Methusala's Children*(1941) describes a "spacedrive that uses light pressure under conditions of no inertia to travel just under the speed of light.

Other mechanisms were also advocated such as the one found in Rog Phillip's short story *Starship from Venus*(1948). A mysterious starship from Venus lands on earth and earthlings soon learn the secret of interplanetary travel. We learn that electrons and protons have opposite inertia. By shooting protons out of one end of the ship and electrons out the other, the net impulse is magically in the forward direction at 1/3 the velocity of light.

*Rogue Ship* by A.E van Vogt tells the tale of the 'Hope of Man' and its crew who were boosted to nearly the speed of light in order to take advantage of the time dilation effect promised by Lorentz-Fitzgerald Contraction Theory. The ship was supposed to eject reaction mass at near light speed so that it gained mass, which according to the "strange physics" in this story, multiplied the effectiveness of the reaction mass so that "...a thimble full of mass could give almost infinite reaction power". The expected effect never materialized and the Hope of Man wound-up taking ... decades to reach ... There was also the claim that at the speed of light, mass becomes infinite but the volume of a particle vanishes so that matter ceases to be subject inertia. Both stories claims are of course invalid, but the stories themselves are entertaining. Another story that bases its propulsion on an imaginary twist to relativity theory is Ross Rocklynne's *The Moth*(1939). A 'reverse contraction' device shrinks a ship by collapsing electron orbits, this is necessary because "...if you decrease the length of a ship to zero, it automatically assumes the speed of light...". To gain any speed without acceleration, "...you just shorten its length commensurate with the speed you want."

Poul Anderson's novel *To Outlive Eternity*(1967), followed the edicts of special relativity with some fidelity, and explored a very important limitation to relativistic travel: where do you get the reaction mass to continuously accelerate the ship? The answer is that instead of bringing it with you, you scoop it up the interstellar medium as you go! This story followed the exploits of a hapless crew in an interstellar ramjet ship whose deceleration mechanism had failed. Their only solution was to drive the ship ever faster to within a stones throw of the speed of light. At these speeds the time dilation effect would allow them to outlive the collapse of the universe. They continuously picked up speed by first passing through dense interstellar clouds in the Milky Way, then upon leaving the galaxy, heading for other galaxies, which they would pass through in a matter of minutes. Eventually, they managed to avoid the recollapse of the universe. Artistic license enters the story with a vengeance when, during the universe's reexpansion at nearly the speed of light, the crew coasted along with developing galaxies and solar systems at nearly zero relative velocity, until they found a suitable earth-like planet to colonize.

The first test flight of an FTL ship using a hydrogen drive is described in Walt Sheldon's 1950 short story *The Eyes are Watching* in which no one really knew what would happen when a ship surpassed the speed of light. Some of the scientists are acknowledged to have their doubts that this velocity barrier could be broken, and even speculate that " you might warp over into another dimension". An earlier story by George O. Smith *Pattern for Conquest*(1946) refers to something called the 'superdrive' which allows space ships to accelerate to very nearly the speed of light, but understandably enough, the details are not presented. In the same story, we also hear of 'tractor' and 'pressor' beams which can be used to 'tear the guts' out of an enemy ship. This technology is based on something called the 'space constant adaptor' and is described in Murray Leinster's *Adaptor* and in *The Ethical Equations*(1945). An earlier story *Redevelopment* written by Wesley Long and published in 1944 talks about a round trip to Sirius in 6 months using 'gravitic generators' and particles called alphans which are used to propel the ship past the light speed barrier.

This mechanism, by the way, was also termed 'superdrive'. P. Schuyler Miller's short story *Gleeps*(1943) refers to 'warships' which are used in interstellar and possibly inter-universe travel. Generally, the development of FTL technology is seen as prohibitively difficult. Usually, humans stumble upon its secrets accidentally, or a super civilization gives this knowledge to us. This generosity is not always without major misgivings.

*Rendezvous in Space* by Guy Archett in 1949 described the discovery of an alien spaceship beyond the orbit of Saturn capable of interstellar travel. But the aliens who own it refuse to tell the earthlings the secret of how it works. Earthlings are still too warlike to be allowed to learn of such a powerful technology. This notion that giving earthlings the secret of interstellar travel would be disastrous for galactic civilization is also found in Robert Moore Williams *Star Base X*(1944). In this story, aliens known as Ahrneds ( rymes with 'airheads'? ) refuse to give up this secret because they realize the inevitability of interstellar war once the aggressive and competitive earthlings get out among the stars. *Homo Sol*(1940) by Isaac Asimov also describes how a galactic federation of civilizations invited earth to join after humans had discovered the secret of interstellar travel and arrived at Alpha Centauri with the intent of colonizing its fifth planet. Human inventiveness actually had outdone the rest of the galaxy by developing an improvement on 'hyperatomic' drive that was superior to anything that the Federation had. Operating principle: Unknown. In a short time, humans had also managed to transform many benign devices used by the Federation into astonishingly lethal weapons!

Then came a fascination with the properties of anti-matter. John Bridger's *I'm a Stranger Here Myself*(1950) refers to a method for FTL travel called "multi-phase travel" which is based on transforming terrene matter into contra-terrene matter, what we now call simply matter and anti-matter. For some reason, anti-matter is claimed to travel faster than light. But again, this is not a trick that earthlings discovered, instead they learned it from a benevolent galactic supercivilization whose emissaries visited us. Then again, even some super civilizations are not omniscient.

Michael McCollum's *Life Probe* (1983) and *Procyon's Promise* (1985), for example, have earth visited by a ship from a very old civilization called The Makers. After millions of years the Makers had given up trying to develop a FTL drive, even though they had developed several independent theories that showed FTL drives were, nevertheless, physically possible to build. They turned to making contact with other civilizations in the galaxy that might have stumbled on the right engineering ideas. Thousands of automated 'slow boats' driven by fusion engines, powered by 'l-mass' Hawking Singularities, and traveling at sub-light speed, were dispatched into the galaxy in search of more cleverer civilizations to tell them the secret of FTL travel. One of these 'Probes' wound up in our solar system and becomes the center of interplanetary intrigue. Eventually, earthlings take up this quest, and find the pieces to a derelict FTL ship in the Procyon system. They discover that the Makers had already learned the secret to FTL travel centuries before the Probe entered the solar system, and had abandoned their home world. This idea that FTL travel is already known to some other civilization can also be found in *Nomad* written by Wesley Long in 1944.

There may also be a technical problem with developing FTL travel. Asimov's *Paradoxical Escape*(1945) describes the search for the secrets of interstellar travel in which a mechanical brain is fed everything we know about astronomy, physics and something called 'space warp theory'. The 'Brain' eventually figures out the secret, unfortunately such trips would be fatal to humans. This is why previous attempts by other mechanical brains had failed. Since a robot cannot create anything harmful to humans, previous robots literally fried themselves rather than break this 'First Law of Robotics'.

A new entry into propulsion technology appeared in 1986 and is found in Arthur C Clarke's *The Songs of the Distant Earth*. Once again, FTL travel is assumed to be impossible, and is flatly disavowed by Clark in the books preface as fantasy not science fiction. However, a virtually unlimited energy supply for sub-light travel is tapped in the quantum fluctuation of space at the Planck scale. In the 36th century, the ship 'Magellan' draws its boost energy directly from the energy of 'empty' space so that it no longer needs to carry reaction mass with it. Interstellar travel faster than 20% of light speed is acknowledged to be dangerous because the stray atoms the ship encounters act like miniature hydrogen bombs as they strike the ship. Each ship is equipped with an ablative 100 kiloton cap of ice on its forward edge. Conveniently, not even the ships captain or its crew members really know how the quantum drive works, but such delightfully cryptic explanations as "fluctuations in the geometrodynamical structure of 11 dimensional superspace" can be found in the novel. A similar tale of tapping the energies inherent in space is found in William Lawrence

Hamilton's Planet of Duplicates(1945). This energy is in the more prosaic form of the exhalations of matter and energy from all the stars in the Milky Way.

Several stories such as Gordon Dickson's Mission to Universe(1965) and Poul Anderson's Door to Anywhere(1966) are hard to classify since they attempt to use the vagaries of quantum mechanics and antiquated cosmologies to find shortcuts through space involving 'Phase shifting' or a modification of Hoyle's Steady State cosmology in 'jumpgates'. Jumpgate technology as explained in Door to Anywhere is highly suspect. A similar access way to distant worlds can also be found in Oliver Saari's The Door(1941) in which a gateway is found among the ruins of an ancient city in the Sahara Desert. Stepping through, the traveler is shifted to the surface of a planet in a binary star system. Unfortunately, the origin and function of this gate are not as important to the story as the search for it.

Phase shifting is described in Mission to Universe at least in interesting terms that sound plausible if you don't think about them too deeply. Heisenberg's uncertainty principle states you can never know both a particle's position and velocity with absolute precision. In phase shifting, the velocity of a ship is measured precisely so that the ship's wave function spreads out over interstellar distances. By some magical process, the ship's wave function is encouraged to 'peak up' at some target position several light years distant. When the wave function collapses, the ship then shifts and takes up residence at the target position without having moved through space. The implication is that the mere knowledge of the ship's precise velocity, as determined by the shipboard computer, is enough to change its wave function, much like the act of observing an electron automatically places the electron in a definite state, were before it could have been anywhere.

Among the technological innovations by the superrace known only as the Puppet Masters were 'stepping disks' and 'transfer booths' as described in the 1970 novel Ringworld. These were, evidently, teleportation devices of some kind. The related technology of matter transmission is also used and described in the stories by Alexander Blade such as The Vanishing Spaceman(1947). Clifford Simak's Way Station(1964) utilizes a galaxy-wide network of 'transfer booths' also developed by a mysterious supercivilization. The operating principles are not described, but resemble teleportation (materialization) chambers. The extensive references to 'telepathic' aliens and the manipulation of aspects of the physical world entirely unsuspected by humans, resembles magic in all but direct citation. George O. Smith in Special Delivery(1945) describes how matter transmitters scan matter atom by atom and then disassembled the body, storing its raw atoms in a 'matter bank'. Matter itself isn't transmitted, but the information and energy released in the disassembly is beamed to a second station which uses the raw materials in its matter bank to re-create the body atom by atom. A.E. van Vogt's The Mixed Men(1945) also refers to matter transmission, this time in two distinct modes. Earth is the center of a 3 billion solar system empire where ultrawave radio provides instantaneous communication. People move about either by electronic image transmission followed by reconstruction from local organic material, or conversion of the body into a flow of electrons transmitted through space and then rebuilt at the destination.

An interesting twist on teleportation devices is found in Robert Abernathy's The Canal Builders(1945). Although 'teleports' are the standard means for moving around in the solar system, a thrill-seeking earthling builds a space ship to travel through space to Mars, just to be unconventional. The trip takes two weeks, and upon arriving he discovers the ruins of a long dead civilization at the spot where an earth city should have stood. It turns out that in the 'interspace' that teleportation operates, there is also a timeshift involved. Rocket travel lands you on Mars in 'now plus two weeks' but teleportation takes you to Mars in 'now minus 2000 years'. The ruins were those of the earth colony built 2000 years ago!

Since matter-transmission and teleportation are more the stuff of ESP and ghost stories with no obvious physical mechanism or science behind it, we will not pursue this avenue further. In The Sins of our Fathers(1976) written by Stanley Schmidt something called a paratachyon drive can boost the ship to any velocity faster than light without expending much energy, but travel within a few percent of the speed of light using this 'Rao-Chang Drive' requires the expenditure of enormous quantities of energy. No one knows how the drive works because the operating principle was discovered accidentally. The younger generations of physicists are, furthermore, not interested in overhauling physics in order to accommodate it! It is not clear from the SF technology in the story whether the ship is converted into 'tachyon matter' in ordinary space, or whether the ship enters some other continuum where tachyon physics is valid.

Although FTL travel might be impossible, and travel to other stars difficult or out of the question, some authors over the years have proposed staying right where we are in space. Time travel or travel to parallel universes have been in recent years become viable alternatives to what has always appeared to be the inevitability of interstellar travel. These modes of travel violate no principles in relativity since they take place in a completely different arena than ordinary space-time. Time travel based on 'the fifth to tenth dimensions' is referred to in *Rescue into the Past* by Ralph Milne Farley(1940). From time to time, there have also appeared a variety of even more spectacular stories that aggressively push at the very meaning of Reality. As early as 1915 in *A Drop in Infinity* written by Gerald Grogan, a scientist named Hubble-Bubble creates a machine based on electricity that projects a person into the 4th dimension. According to Dr. Hubble-Bubble, certain waves run along the 4th dimension which is somehow counteracted by other waves that run the other way, and that we perceive as electricity. By tuning the chamber, the electrical field inside lets you experience these other dimensions. The traveler can then visit what can only be called parallel earths. These worlds mysteriously coexist with ours, spatially like the rungs on a single, but infinite, ladder. This idea that the proper application of electrical fields might open a magical, inter-dimensional gateway re-appears almost word for word in Charles Recour's 1949 short story *The Swordsman of Pira*, in which we hear that "if an object were suddenly thrust into a strong electric field, it would be rotated through a warped space into a fourth dimension" Space is warped by strong electrical fields so that a human can use this to travel into other parallel 'timestreams'.

This 'parallel earth' idea is also explored in George Scheer Jr's *Another Dimension*(1935) where a spaceship sent to Mars is caught in a 'whorl in space' that hurtles the ship into another dimension. There they discover another earth and solar system at the same location as ours, but not at all like the earth they left behind.

Interesting stories have also been developed around the idea that although FTL corporeal travel may be prohibited, the psyche may travel at what ever velocity it chooses. Certain mixtures of psychotropic drugs such as morphine or belladonna could send a voyager's psyche into higher dimensions as in Stanton Coblenz's *Beyond the Universe*(1934). This story describes a journey into a higher dimension to space that seemed to have taken years and centuries, but in fact the traveler had actually been in a coma for 6 months. During his journey he watched as the universe shrank to a point and directly experienced the 'nothingness at the boundary to space'. A similar story of psychic travel occurs in Charles Eric Maine's *Timeliner*(1955), in which the psyche of a physicist is propelled out of normal space-time into a 'hyperspace' where time becomes one of the spatial dimensions. In a process termed 'psycho-temporal parasitism' he timetravels into the future entering the mind of one human after another.

It has also been proposed that it may be easier to get massless particles like photons, neutrinos or 'exotics' to give us images or messages from other times and worlds. Donald Bern's *Three Wise Men of Space*(1940) described beings who communicate with rays that travel faster than light since they possess a knowledge far beyond that of Einstein. Light rays are used in Richard O'Lewis' *Adam's Eve* to obtain images through the fourth dimension of past ages, including an image of Eve starving in the Garden of Eden! Edmund Hamilton in his short story *The Star Kings*(1947) describes earthlings from 200,000 years in the future who communicate with 20th century earthlings via thought waves, which are the only things that can pass through time because they are not material objects. Interstellar travel in this future age is by means of 'sub-spectrum' rays of the 'minus 30th octave' which are produced in atomic turbines. Also in that age, the relativistic increase of mass with velocity has been circumvented so that 'star-ships' equipped with artificial mass (inertia) control can travel 1000's of times the velocity of light. A recent entry into this genera is James P. Hogan's *Thrice Upon a Time*(1980).

*To Follow Knowledge*(1942) by Frank Belknap Long portrays the universe as a superposition of time frames; one for each body in motion. If you moved at the speed of light, everything stands still, but at FTL speeds even time begins to undo itself. All events take place in a 5 or 6-dimensional time track that connects the 'nows' of every frame of reference moving in space. Even the use of mental powers to 'warp space-time' and return to the past has been considered, and can be read about in the 1943 story *Shock* by Lewis Padgett.

So you see, science fiction is filled with clever ideas about faster than light travel. If physics and understanding the cosmos were only a matter of cobbling the right words together, we should have been building these kinds of ships buy now. But the frustrating

thing is that we have gained considerable experience in the last 100 years boosting matter to 99.999...% the speed of light. In no experiment devised so far have we found anything that defeats Einstein's special relativity, and its injunction that the speed of light is the maximum speed limit for energy and information, or any other 'thing' that has zero rest mass. You may have heard about the weird quantum 'tricks' that have been uncovered that seem to defy special relativity, but when you look closely at them, you discover that again special relativity is not violated, even in the case of so-called 'quantum teleportation'. Also, you cannot get something for nothing. Any proposal to 'warp space' so that a ship can step across vast distances without traveling the distance in between, nearly always requires as much energy as actually boosting the ship to near-light speed, to set up the conditions in the first place.