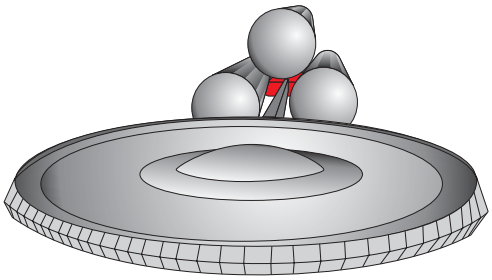
SPRINGSHIPS

Suggested design possibilities for long range interplanetary mission spaceships.

by Michael Bond



- Use of Centrifugal forces.
- Resistant to long term flight damage.
- Pretty ship design.

Introduction - "Pulses" and "Springs"

A few years ago I wrote a short science fiction story called "Pulses". Part of the story had my leading character travel amongst a series of space stations and a term I coined for them was "Spring Stations".

To me the term "spring" comes from the image of a spinning ring. A ring is used to create artificial gravity through centrifugal forces. I imagined that the term "spinning ring" would eventually shorten to "spring". A spring invokes images of life amidst the desert, a place of rest and relaxation in the midst of the barren desert of space. Ever since I have used the term to define any design of object, ring, cylinder, sphere that might use spin to create gravity.

I would like to introduce you to a variant of this image for future space travel; and, if I'm right, you may soon see "SpringShips" sailing amongst the planets and stars.

Background

I won't go into too much detail, you are probably reading this because you already have some knowledge and interest in the ideas of interplanetary, eventually interstellar, voyages. I will also assume that you are aware of the dangers to human health of long journeys in freefall, without gravity to stimulate muscle and bone strength, making it difficult to travel far unless we find a way around this problem.

One solution is to go fast and reduce time spent in space. Another way is to create the effect of gravity en-route. Ideally we ought to be doing both.

The solution we have at our disposal with current technology is the use of spin forces to simulate gravity by rotating a portion or all of a spacecraft whilst on a voyage.

There have been various notable illustrations of the concept in science fiction and fact, but they don't seem to address other problems inherent in space travel - especially the threats from micrometeorites and solar radiation.

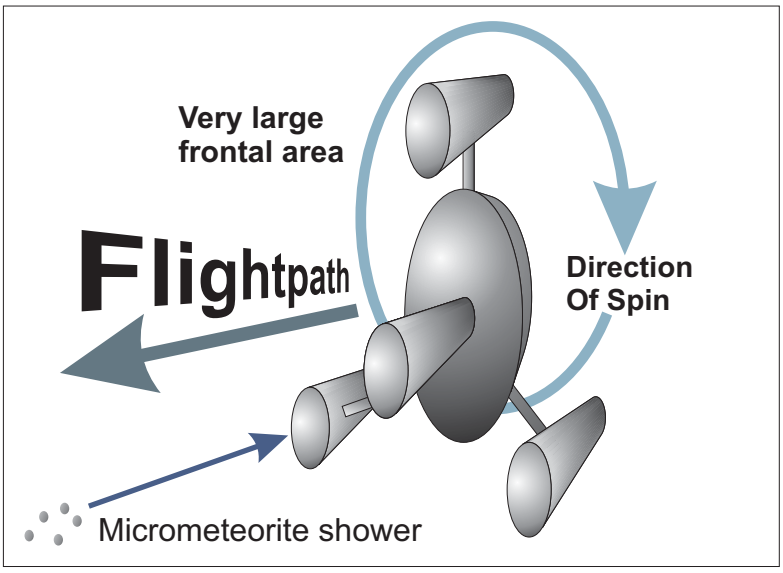
It is my believe that a single form of vessel can be created to deal with all three problems: freefall hazards to human health, physical impact from micrometeorites and exposure to solar radiation during periods of soar flares - the SpringShip is that solution.

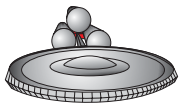
Design - A Disc

If we begin with the basic principle of the spring - a disc or ring shape - then we have another feature inherent in its shape which presents either a hazard or a help.

My earliest thought on the issue of ship design were concerned with the nature of the disc and its alignment. Whenever I saw other designs I noticed a tendency to adopt what I would call the "face forward" form of spacecraft.

In the "face forward" form the ship is spun along its axis to create spin and gravity is created





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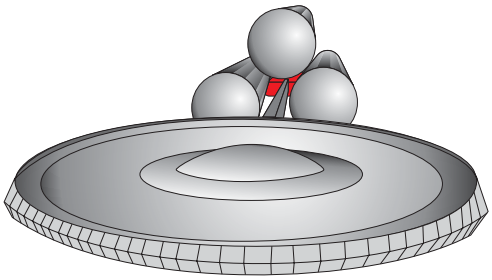
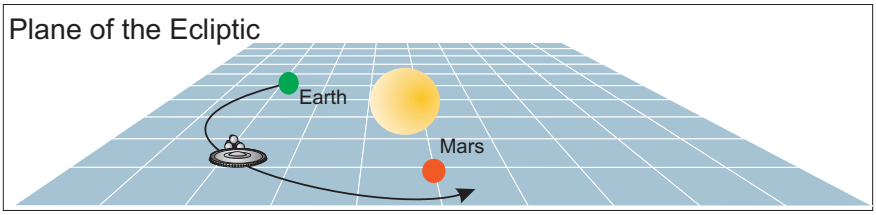


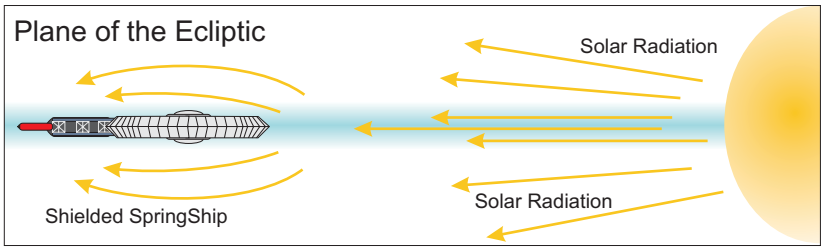
in effect in one or more chambers or a ring on arms extending out from an axial core. As these arms are perpendicular to the axis and main body of the ship the end result is that the disc is presented face-onwards to the line of flight - presenting the maximum surface area to the front - not very healthy for the crew under any condition. *(see illustration on p.1)*

My solution to this was to tilt the ring or disc into an edge-onwards alignment. This alignment in turn automatically leads to the solution of the second problem. If a "face forward" position threatened the ship and crew from micrometeorites it could conceivably threaten them, at some points along their journey, to exposure from solar radiation. However, by tilting the ring into a horizontal position the design offered comparable protection to radiation as it does to micrometeorites.



Courses & Alignments

Most, if not all, journeys throughout the solar system will entail movement along the plane of the ecliptic - the horizontal plane on which the planets orbit the sun. This means that whenever following a course around the solar system a ship will, in most cases, present a side to the sun. By adopting my alignment for the SpringShip it becomes effective in dealing with solar radiation as only the edge of the ship is directly exposed to radiation and charged atomic particles emitted by the sun.

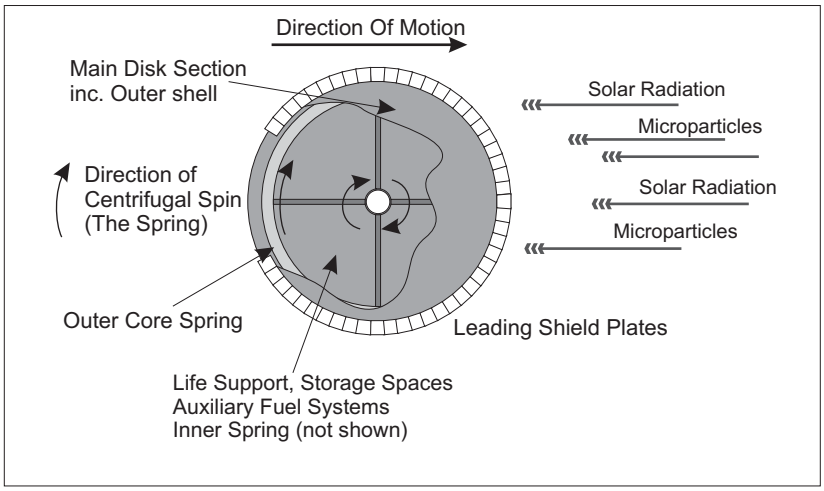


Shielding

As my illustrations show there is a key benefit of an edge-on orientation for a SpringShip - only the edge has to carry the heaviest shielding.

To shield a crew against both micrometeorites and radiation would require substantial weight of material. Whatever material is eventually adopted must be heavy and dense enough to deflect or absorb the impacts of micrometeorites and their effects on the structure of the ship, and absorb or deflect radiation from the sun.

I imagine that this shielding will eventually be a mixture of physical structure and electromagnetic forces. In a manner similar to the Earth's magnetic fields, a shielding field could be broadcast around the ship, conducted by shielding plates along the rim of the disc or aerials protected from the hull at key positions.



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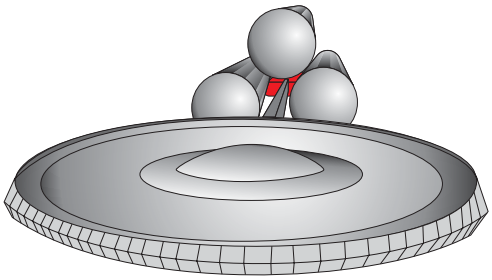

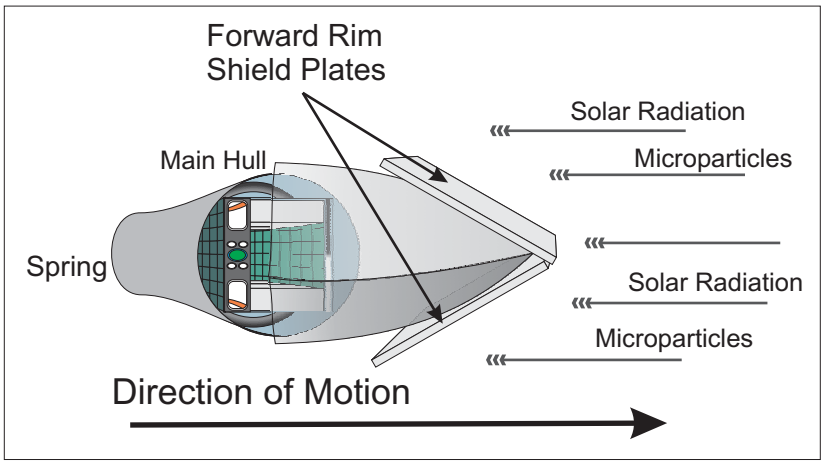

Construction

How do you build it?

A SpringShip has as its core feature a spinning ring to produce the effect of gravity for long term, deep space flight. That's going to be expensive, or so some people would say, so let's see what can be done about reducing some of the costs.

I have already proposed one cost saving - place the disc horizontally to the plane of the ecliptic and you can reduce the level of shielding required for frontal and side exposure to micrometeorites and solar radiation. Although shielding will still be required the amount of this material relative to the size of the vessel becomes much smaller when compared to shielding a "face forward" design - it is a small target area as opposed to large target area.

The main protective rim would be made of a series of simple protective plates, not unlike the engineering and management requirements for the American Space Shuttle's heat shield tiles, albeit of a superior, long endurance material with electro-conductive properties.

Within this rim I would estimate that only a modest structural envelope might be required for a variety of technical purposes including: decoration, mounting solar panels for electrical generation, mounting radar and other sensory arrays, side shielding from minor impacts and radiation. etc., etc. This ought to be relatively easy to fabricate and build.

The Springs

There is one important feature of the ship that will require most of the effort on design and construction - the spinning rings. The springs need to deal with a number of issues, not least of them being reaction torque.

Torque

So, you have a ring spinning in space. That's all right when the ring spins on its own and you have set it spinning by some action such as small rocket jets. However, when you mount the ring inside a larger vessel you have to deal with torque - the counterforce that occurs when you cause the ring, or any wheel to spin in a direction.

You know how a helicopter works? When the main rotor spins one way the natural tendency of the fuselage is to rotate in the opposite direction in reaction to the mechanical forces used on driving the main rotor around. To prevent this all helicopters have an extended tail boom and small tail rotor to push against this torque. There is a way that this can be done onboard a SpringShip - a second ring.

Two Rings

To counter torque a SpringShip has two

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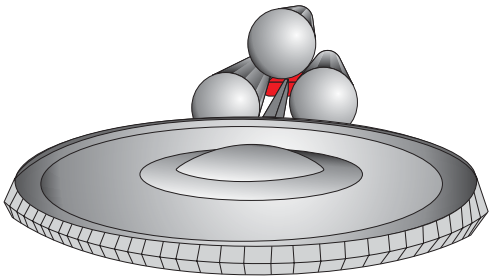
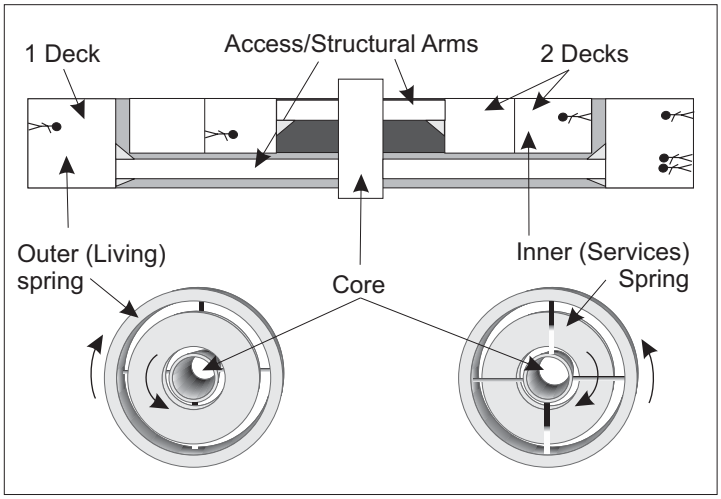




main rings rotating in opposite directions. They don't have to be the same size, only the same mass and force on the common axis they would share.

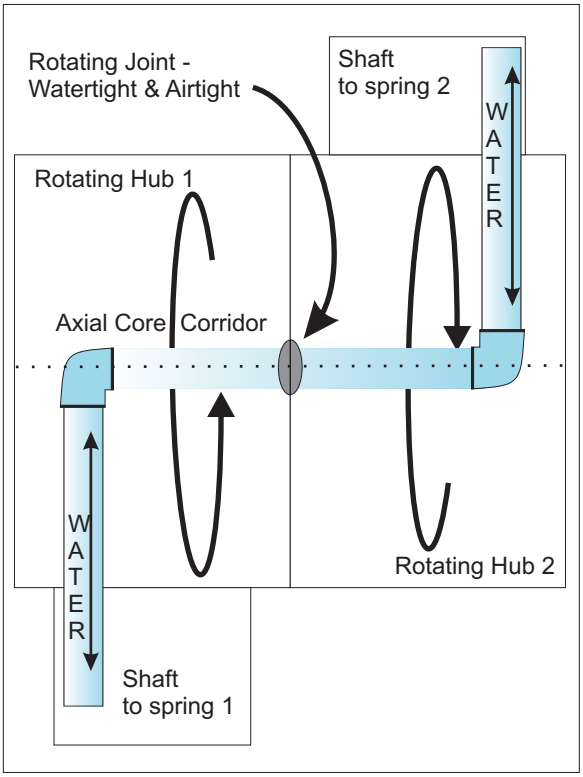
With the freedom to vary the size of the rings the obvious solution to saving on space and weight is to have one ring smaller and seated inside the circle of the other. While the larger rings of a SpringShip would be used for accommodation and working spaces around the outer rim of the ship, a smaller ring would rotate nested inside the space closer to the axis. The key to saving weight and cost is in reducing the length of axis required to serve both rings, shortening the circumference of the inner ring and shortening its support arms, etc.

Balancing The Torque

Although the two rings exist to counter the effects of torque on the ship their masses also have to be balanced to prevent the ship drifting out of alignment.

One way (illustrated here) is with a mass of water stored in the two rings, transferred from ring to ring when needed to adjust mass for added people, supplies, machinery.

This requires suitable pipes moving water through the axis. These pipes must retain an air and water seal tight against any leakage when they are in use, and the ability to flush them dry when not needed, to prevent leakage when not in use.



further thoughts on this, and alternative viewpoints are discussed on page ten (p.10).

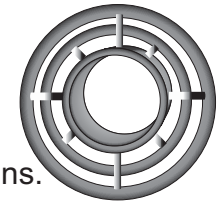
Constructing SpringShips

Now, how do you save money on construction costs, after all such rings require substantial engineering, lots of time to design, construct the components, assemble in space, all the man hours, all the resources, right?

Well, perhaps not.

A very quick, and simple way to create and build a ring for a SpringShip is to use an inflatable tube just like a bicycle inner tube.

"Inflatable Tube" Springs.
Simpler to assemble for first generation ship designs.



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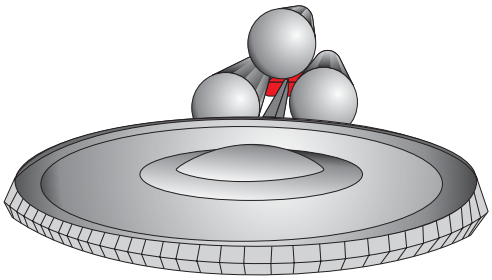


Such a tube can be constructed on Earth in one unit, packed for shipment and inflated into position in just a few hours. Compare that to the idea of assembling a pair of rigid structural rings over several weeks or months.

The properties of this tube can be very beneficial to spacecraft design and construction. The shape of the tube is predetermined. The inflation of the tube will automatically make it rigid when in space. Modern materials will easily allow for the construction of a tube resistant to micrometeorite impact, and will be flexible enough to absorb far more shock than a rigid structure.

Once the tube is inflated similar tubes are attached to form the structural arms joining the ring to the axis.

To provide all the normal working and living spaces within this tube you can fit some elements beforehand, such as flexible cabling and piping, and install the reminder in a series of simple support frames attached to hoops on the inside of the ring. This allows for the fitting of a rigid decking and other structures. However, unlike the construction of a solid ring these will be of lightweight composite materials designed to pack small, unfold big and stay solid under prolonged use.

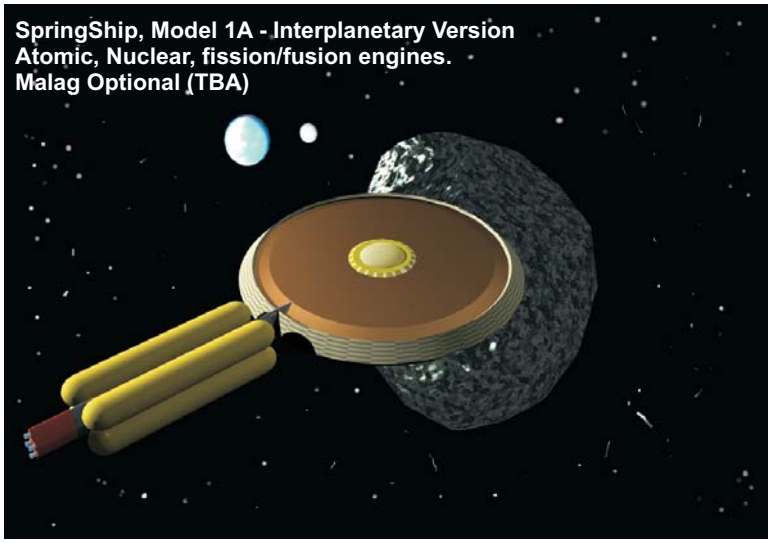
Propulsion

A SpringShip will be the product of a substantial investment, and it's going to be a complete waste of time and money unless comparable effort is made on a suitable means of propulsion.

Although chemical rocket motors have been accepted for decades this situation will not remain for much longer. Advances in engine technology and control of forces mean that the next generation of craft and their propulsion will use magnetic, atomic and/or nuclear motors as a matter of course.

The use of such forces means a faster vessel, longer ranges for a given load of fuel, heavier loads of freight and ship mass for a given journey, shorter durations for near-solar journeys (Mars, et al), reduced requirements of excessive loads of life support (food, water, etc) for crew, and the savings in costs from such shorter journey times.

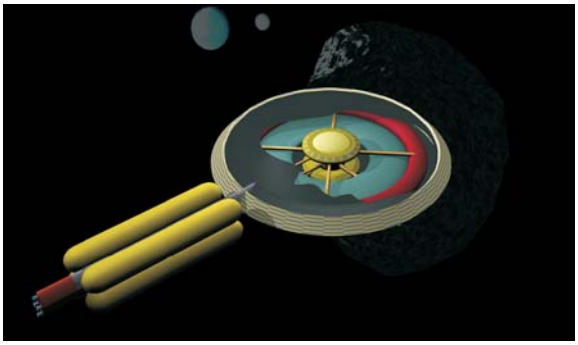
Quite simply a magnetic/atomic/nuclear



option has a vastly more cost-effective chance of commercial success than first generation chemical rocket technology.

Design Options

So what sort of designs can be produced with a SpringShip?



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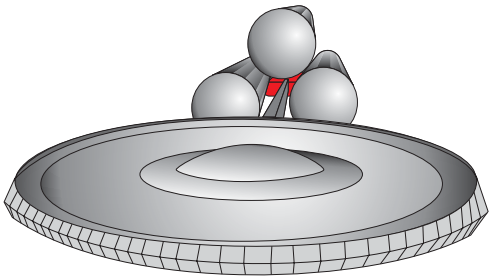
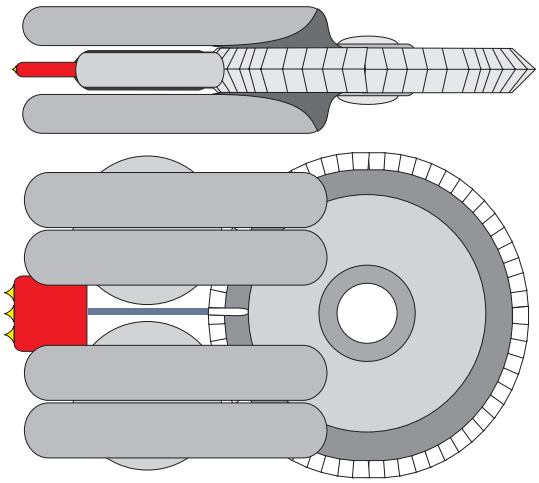
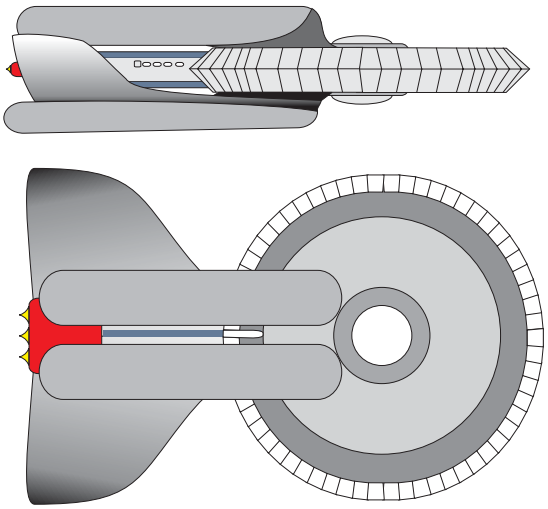


Speculative Design Configurations

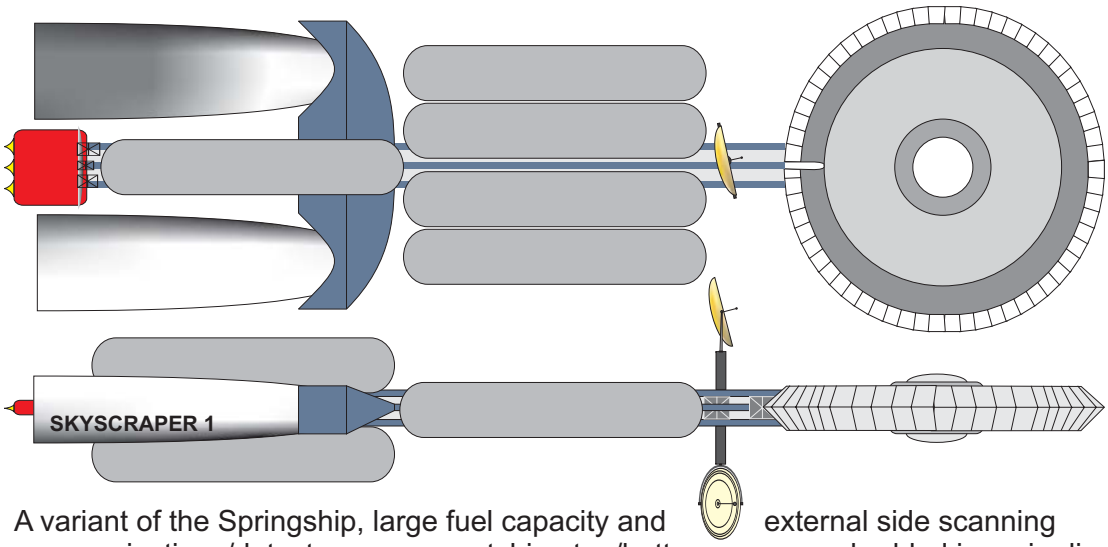
Here are three options for possible designs based on available resources and the kind of voyages you want to undertake.



Optional Shielded fuel tanks, cylinders or rings.



If you want a partially aerodynamic form for aerobraking or other manoeuvres then try this little option.



A variant of the Springship, large fuel capacity and external side scanning communications/detector arrays, matching top/bottom arrays embedded in main disc shell. Two auxiliary ships ("Skyscraper" designs) act as surface landing craft, lifeships, secondary engines and fuel tanks, resupply craft, etc.

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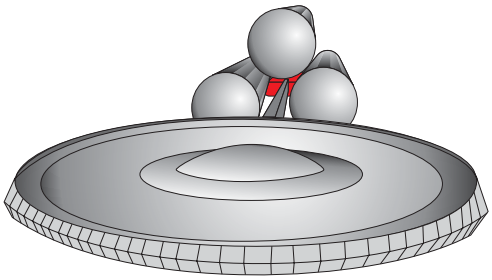
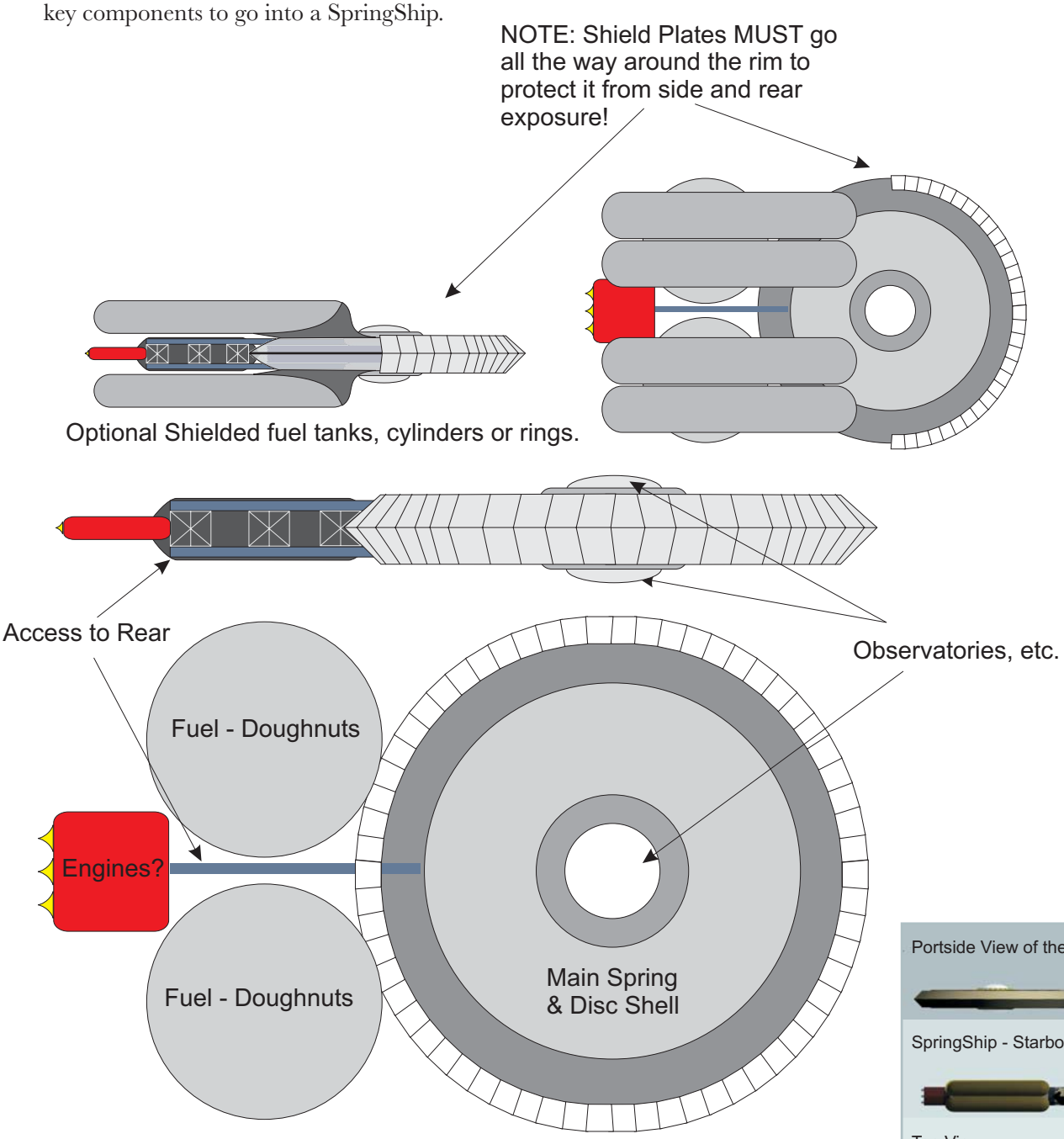
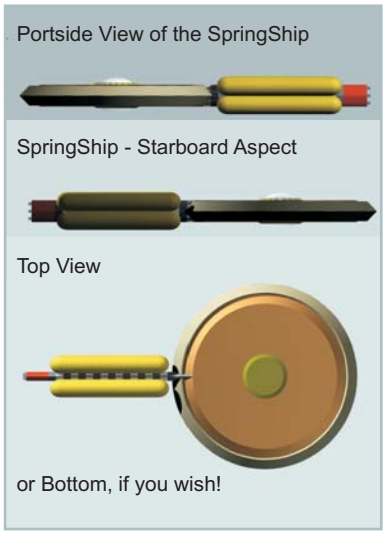


Key Components

Here is a brief description of some possible key components to go into a SpringShip.





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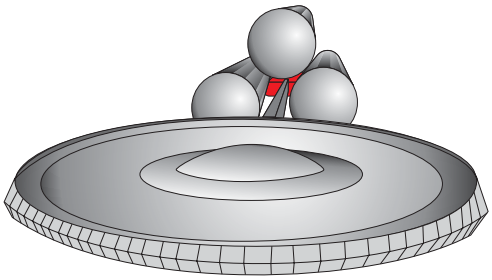


Other Features

1) Axial Core Design

The axis has three sections - top, bottom, central. Top and bottom sections comprise of docking chamber for landing ships, lifeboats, excursion vehicles, etc.

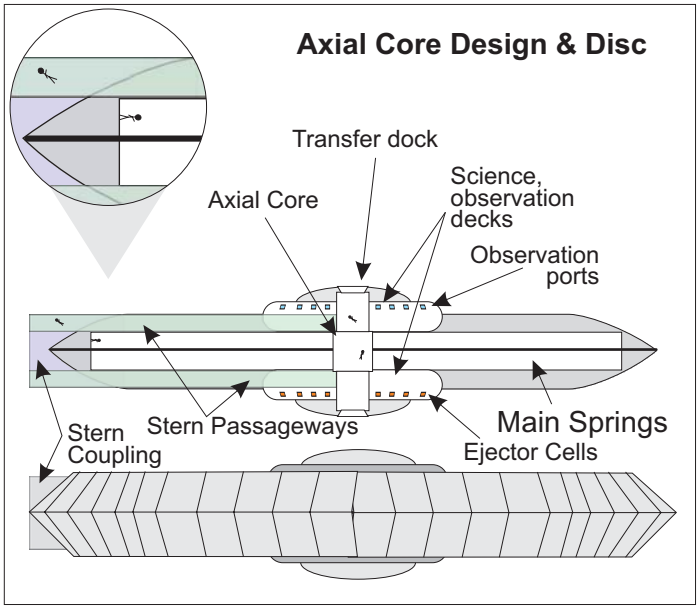
Around this is a freefall ring of chambers isolated from the main ship against damage, intrusion, infection, etc. All sample return missions deliver to these chambers NOT into the main springs or human occupied sections.

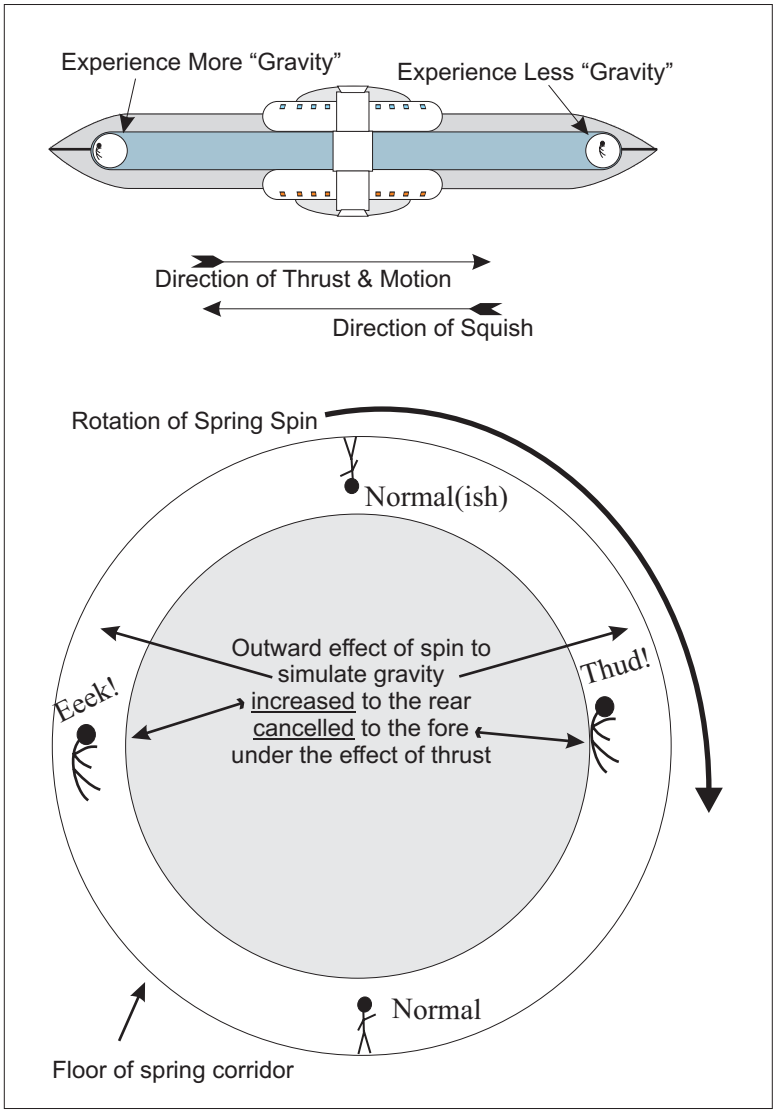
In this layout the top section is for science activities and observation work, while the bottom section is for sample laboratories. In this case the samples are always stored in isolated cells against the external hull. These cells can be ejected in the event that containment is breached (escaping Aliens, etc.).

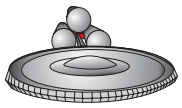
2) Rollercoaster In Thrust

The SpringShip is not perfect, and one aspect of this is the effect of thrust on the experience of crew occupying the rings. Under acceleration thrust the centrifugal effect in the ring is reduced or cancelled by the motion of the ship, creating a rollercoaster effect on anyone occupying the rings during this period, as they first experience heavier "gravity" then lighter "gravity" then back to heavier.

This can be dealt with by limiting the strength of thrust, such as via ion/magnetic propulsion, over prolonged periods of acceleration, or by using short intense bursts of thrust to attain high speed, while the crew occupy acceleration areas in central axial cabins or the attached auxiliary ships.







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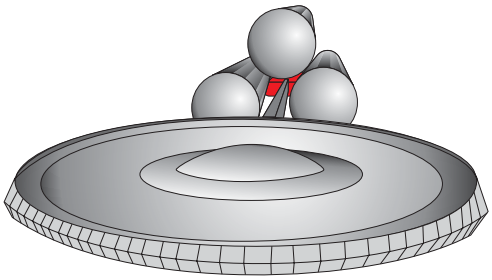


Other Features

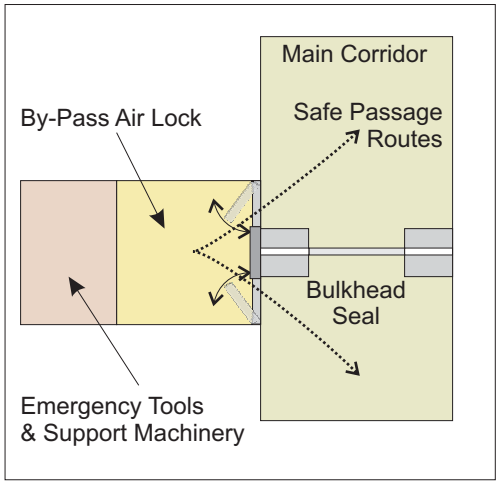
3) Bulkhead By-Pass Airlocks - Safelocks

A typical theme of some fictions is the danger of being locked inside a damaged section of your ship, the bulkheads closed against flooding of a ship or loss of air in a starship.

To solve this a SpringShip supports small emergency by-pass airlocks at each bulkhead.

In the event of an emergency, when the main bulkheads are sealed, through loss of air, fire, other events, a small locker in the side of the corridor functions as an emergency refuge, an airlock to escape the damaged section of the ship and a storage for emergency tools, supplies, machinery, etc.

For example, the emergency locker can hold spare spacesuits, security and disaster monitoring controls for cameras and public address systems, fire-fighting equipment, spare parts, tools, first aid, food, air, water, etc.

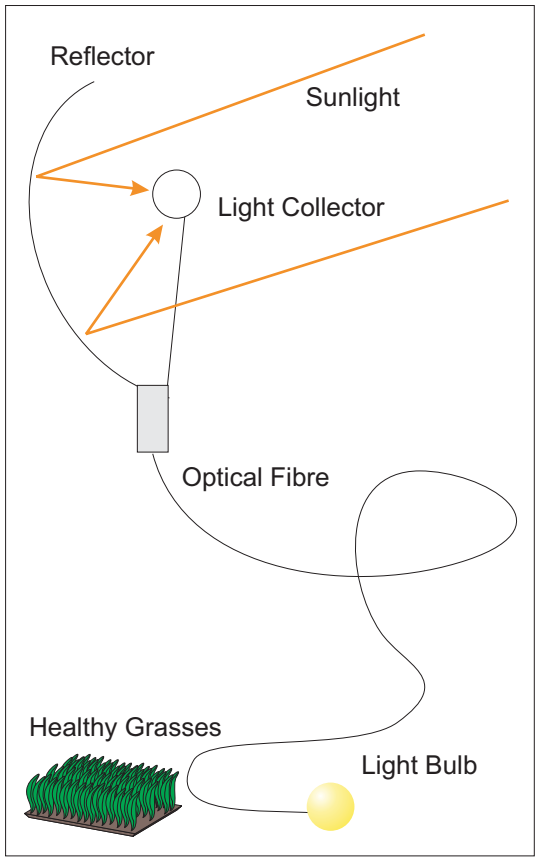


These lockers allow several people to move quickly and safely through from a damaged section into a safe one. This means a locker must have enough emergency air to support many people passing through quickly and allow a major loss of air when it's necessary to save time, rather than going through the normal process of evacuating air when you move into a vacuum.

An emergency locker is design to save lives on long range space vessels when there is no hope of outside assistance.

4) Sun lighting

A way to illuminate the interior of the Springship is through the collection of sunlight on external reflectors that focus light into collectors and along optical fibres, possibly through mirrors to enter the rings, and out through "lightbulbs" into key parts of the ship, especially its internal gardens and farm for healthy long term food supplies.



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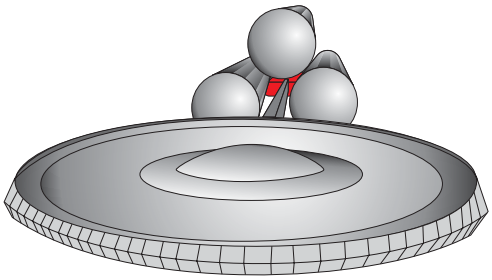


Other Features

5) Balancing Torque and Disc Layout

Earlier in this document I briefly mentioned one rudimentary way to balance the effects of torque on the ship, by moving masses of water between the rings.

However this is not an essential feature of the ship's design if the two counter-rotating rings are disconnected physically from the core and the main structure of the ship once they are spun up.

This can be achieved by using magnetic rings to connect the hub of the springs to the axis. Such magnetic rings allow a force to be applied to the springs to spin them, and remove any direct physical connection once spun.

Another issue that occurs in any vessel of a reasonable size is the problem of mass moving uncontrolled around the ship - the crew.

Should the crew gather in one part of a ring, or any large mass shift to one side of a ring, it sends the axis of the ring out of alignment from the core axis of the disc. This increases the problems of vibration against the axis core when the ring "wobbles" away from the central axis.

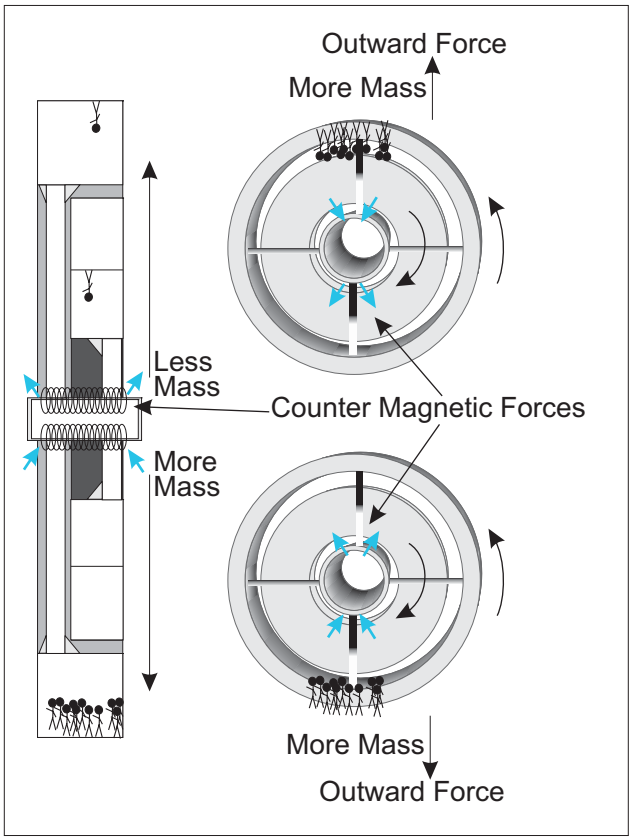
From the point of view of the crew this will be unnoticed - they continue to feel the effects of local "gravity" in the ring; but at the core axis the ring will rub against the axis unless it's imbalance is smoothed out.

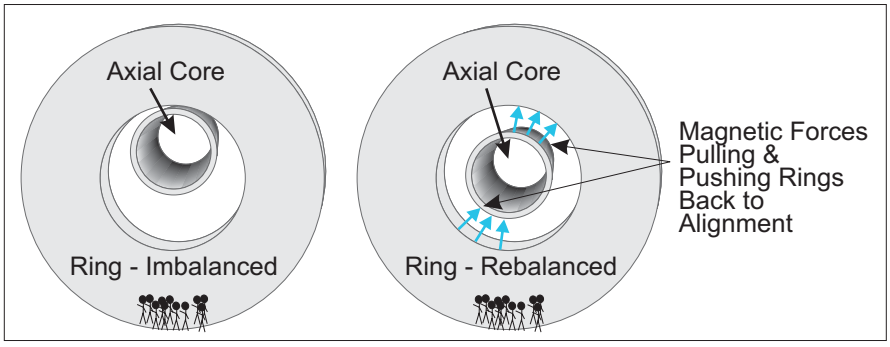
The magnets will achieve this.

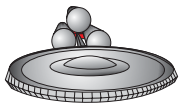
Using the same magnetic forces that help spin the rings up, any imbalance of a ring's axis, when there is more mass on one side than the other, will be countered by applying the magnets rapidly to counter the shift in mass and push the ring back to centre.

As the ring spins around the core the central magnets will act to either force the hub of the ring away from the axis or attract the other side of the hub back towards the axis.

Unfortunately regular movement of mass around the ship, and the resulting counteraction onboard, will send vibrations around the ship, with the potential to disturb any delicate observations, laboratory experiments, etc. But that's for another solution.



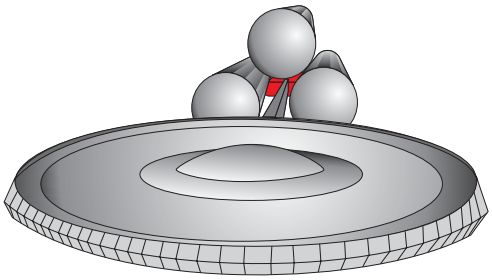




SPRINGSHIPS

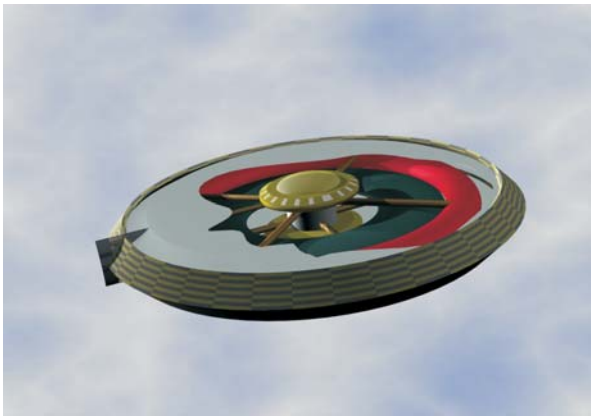
Suggested design possibilities for long range interplanetary mission spaceships.

by Michael Bond

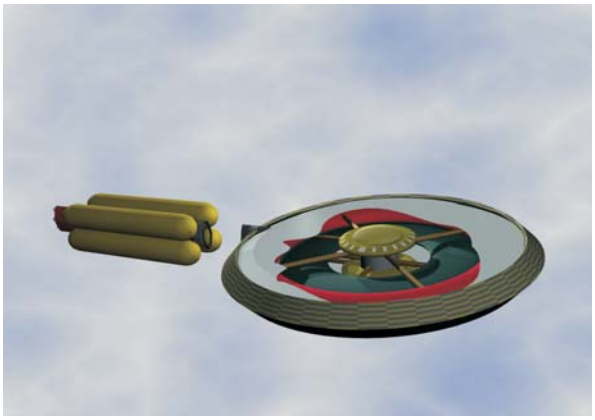


Future Speculations

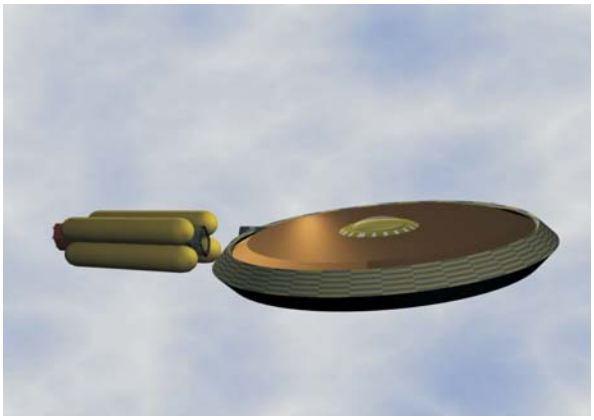
The SpringShip is not just a short term design proposal for the immediate future of long range space exploration. As science and technology progresses the concept will become suitable for a number of other applications - there will be more flexibility in its design and more opportunity to deal with many more kinds of environment, mission, etc.



One possibility to build into the design right from the beginning is for the dismounting of the disc from the engine/fuel tender. This permits the tender to be swapped at short notice, such as to carry out a fast transfer of main load from one tender to another - especially important if you have an urgent consignment needed in one place and want to refuel very quickly - just dump the tanks and collect a whole new tender with new engines, and life support supplier. I am sure the military (and Hollywood) will soon see the practicalities of such a practice.

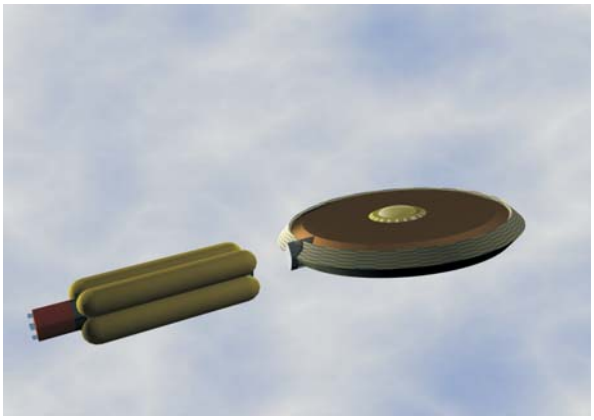


As technology progresses further then opportunity will come for the disc to make a landing. This is likely to come about as ion and plasma technologies improve to the point of being able to land a craft in atmosphere (it won't work on the moon - just add rockets).



If the disc and tender style remains in the long term then you have the design basis for an effective landing craft to reach the ground whilst leaving a more substantial auxiliary vessel in orbit, eventually complete with its own accommodation and other facilities - two ships in one.

Once mankind masters gravity the idea of the springs within will be replaced with a "true" flying saucer....?



SPRINGSHIPS

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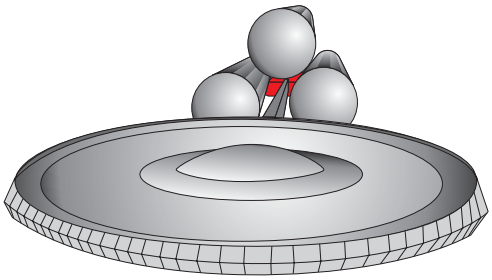

About The Writer

Michael is a long term science and technology, media and arts, business and finance enthusiast and professional. His background has taken him through many occupations and experiences, ranging through short film production, computer consultancy, to the founding of two companies, in media production and specialist international finance.

Following a year's work at Manchester University's Business Incubation Centre in 2001 he has founded a company to offer international traders secure transaction accounts to prevent international trading fraud. The service also improves the management of large-scale financial projects.

His current activities include pursuing the dream of a manned mission to Mars, and establishing his finance business as the premier financial security organization for worldwide trade services. This business will become the base for all financial management of the huge project funding required for his ambitious technological dream, offering full security for all backers, subscribers and members.

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http://www.worldmaker.org

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First edition (2002),
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"A dream to be fulfilled, let's put our mind to the task, and build."