SECTION TWO
DARKSTAR TECH

As a science-fiction setting, the *Darkstar* universe naturally relies on a detailed vision of new technologies. This section deals with the breakthroughs made over the past five centuries in the areas of power generation, computers, weaponry, defensive technologies, space and star travel, colonization, and communications. Getting a firm idea of what is and *isn't* possible in the *Darkstar* universe is one of the best ways to understand the setting's true character, as well as how and why the naval battles portrayed in *Darkstar* actually take place.

For openers, technology in the *Darkstar* 26th Century isn't nearly as advanced as some readers may expect. This may be because many people like to project historical progress as a perpetually-accelerating curve, using the last fifty, hundred, or even five hundred years as an example. In so doing, we wind up with overoptimistic scenarios such as those presented in *Star Trek*, *Space 1999*, *2001: A Odyssey*, *Space - Above and Beyond*, and others. The problem is that history doesn't always travel in a straight line. Human society, science, and technology has taken tremendous steps backwards in its time, and there's no reason to assume that just because we've made tremendous advances over the past 500 years means we'll make similar advances over the next 500 years. Look at where Europe was at the height of the Roman Empire, circa 200 CE, then again at 700 CE, and you get an idea of what can . . . and sooner or later *will* . . . happen in our own future. A smaller and more immediate example can be seen looking at America's space program. We had men on the moon just nine years after President Kennedy issued his historic challenge to the nation. Now, *forty* years after the last manned mission with Apollo 17, we still haven't been back, and won't be until at least the mid 2020s.

In *Darkstar*, the devastation of Earth's ability to support civilization has caused two centuries of horrendous plague, famine, and war. In effect, this set up a self-perpetuating downward spiral that only ceased when humanity hit rock bottom at the end of the 23rd Century. Mankind spent the next century or so regaining its former place, overcoming the stall brought on by global backlash of religion, and pushing through the conservative stagnation of a revived "Age of Imperialism." In the end, this has left only about a two hundred years of real progress. The idea that mankind has in that time unlocked such universal secrets as cold fusion and faster-than-light travel, expanded across four million cubic light-years of space, and already has the technology and infrastructure sufficient to wage sweeping wars across such a domain, is remarkably optimistic.

2.1 - POWER

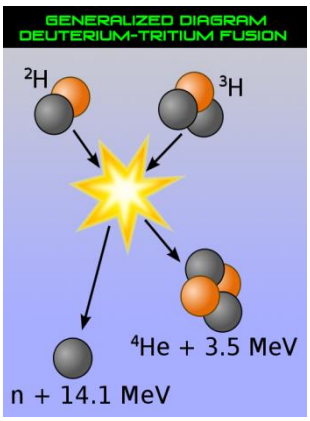
The eternal need for power was not only at the very heart of humanity's fall in the late 21st Century, but also the heaviest shackle binding him to the Planet Earth. Until real improvements could be made over chemical rockets and nuclear fission, mankind's chances for real expansion into space remained effectively zero.

Controlled Fusion Reactors

With the unlocking of controlled fusion in 2315, mankind finally had the clean and renewable energy source needed to live in long-term harmony with the Earth and expand permanently throughout the solar system.

The idea behind fusion is simple, merge two hydrogen atoms into one helium atom, thereby creating a small percentage of their combined mass purely into energy. This is the basic process that causes stars to shine, and is probably one of the most common, simple, and powerful forces in the universe. The problem is keeping the fusion controlled, or "cold." After all, "hot" fusion was unlocked as early as 1948 with the first H-bomb - in broad terms a tiny and momentary man-made star with the explosive power to level a city.

In the world of *Darkstar*, the secret lies in the manipulation and regulation of small enough amounts of magnetized hydrogen isotopes so the reaction remains controlled. The first step of this process is the synthesis of this magnetized hydrogen, usually based on naturally occurring isotopes like deuterium or tritium (sometimes called hydrogen 3). Usually, this magnetic charge is given to the hydrogen by pumping it through a highly-energized and pressurized plasma field until the isotopes gain a small magnetic charge. Naturally, this is a very difficult and expensive process because of the extremely simple structure of a hydrogen atom, even in deuterium or tritium isotopes.



Methods of accomplishing this magnetization have varied through the last 200 years, and of course different types of reactors use different types of hydrogen fuels (in fact the most advanced no longer use hydrogen at all, starting instead with magnetically-charged helium or even lithium). Also, naturally-occurring sources of magnetically-charged hydrogen, helium, and lithium isotopes are sometimes found in the lower atmospheric layers of very large gas giants (at least three times the mass of Jupiter), where extreme heat and pressure can produce this ionization naturally. Such planets can become "oil fields" of the 26th Century, and are often at the heart of a brisk *Darkstar* skirmish.

Suffice it to say that wherever it comes from or however its made, "magnetized hydrogen" is an extremely valuable commodity. Until the hydrogen fuel is somehow imbued with a magnetic charge, after all, it cannot be used in the accelerators or containment fields that are at the heart of all modern fusion reactors. Whole fleets of *Darkstar* warships can be assigned to escort one tanker convoy or protect one orbital refinery. However, once fueled, even the heaviest of warships can be expected to operate for years. This is especially impressive considering the vast amounts of power required to operate the sublight ion drives that propel these massive ships (described below), or produce the unthinkably-strong magnetic fields that dilate the very fabric of space-time in a Darkstar drive.

Once fuelled, a fusion reactor such as those found in a typical *Darkstar* warship can generate almost cosmic amounts of power. However, there's a little more to it than simply flipping a switch. Initially, only infinitesimal amounts of hydrogen (or other fusion fuel) can be magnetically accelerated into the core of the reactor, or else the reaction runs out of control and the ship turns into a 26th Century H-bomb. Also, since the reactor is not yet running, a "cold start" for the magnetic accelerators is

usually accomplished through the use of very large and very heavy superconductive batteries, and so the fusion input-output is naturally very small at first. However, as the reactor spools up (sometimes taking hours or even days), part of the reactor's energy output is fed into its own accelerators and especially its magnetic containment fields, which soon create gravity distortions almost equivalent in strength (if not in scale) to those found in the core of a small star. By keeping the power of these containment fields always ahead of the power straining to erupt from the reactor's fusion core, the power flow can be regulated and the fusion remains under control. In effect, the power output of such reactors is limited only by the conductive capacity of its magnetic containment coils and how powerful the magnets are that accelerate the hydrogen into the fusion core.

Ion Drives

Once the reactors generate the power, the question becomes what to do with it. The answer is simple, it's all a matter of electromagnetism.

The ion drives that propel a starship at sublight speed are really just extensions of the reactors that power the ship in general. The vast amounts of power produced by these reactors can be used to energize stored plasma to fantastic levels, housed in magnetic suspension fields because this plasma would vaporize any tank or valve. This plasma is then channeled through magnetic nozzles to provide thrust.

Note that most starship designs have these funnels directed both fore and aft, with the exhaust directed either way through more magnetic suspension fields. This way the engines can provide equal thrust both forwards and backwards, allowing equal amounts of acceleration and braking deceleration. Furthermore, the maneuvering thrusters that change ship's vector, yaw, pitch, and bearing are really just much smaller constructs of the same principle.

More advanced ion drives take this concept a step further. To begin with, we must remember that the fusion of hydrogen isotopes into helium or lithium isn't a perfect atomic or chemical process. Just as part of the combined atomic mass of the beginning isotope fuel is converted into relativistic energy, so too are subatomic particles broken loose into highly-charged plasma, most commonly in the form of "loose" reactant neutrons. These neutrons were radioactively dangerous in the early days of controlled fusion, and because they carry no electromagnetic charge, they could not be used to generate power or propel a ship. However, by housing the reactor's core in coils filled with simple but hyper-compressed gases (such as pressure-liquefied "heavy methane," argon, or xenon), these neutrons can be safely absorbed. Furthermore, the ionized particles they smash off the atoms of the "buffer gel" can be collected along the magnetic field lines of the reactor's containment unit and propelled through the sublight engines to provide thrust, or stored in more magnetic containment fields until needed.

What this means for the navies of *Darkstar* is that ships basically require two types of fuel. First, a primary fuel of magnetized light-gas isotope as described above, and a secondary supply of simpler but super-compressed inert gas to absorb reactant neutrons and serve as ionization propellant for the sublight drive. While this second fuel component is so common it's practically free (any gas giant planet would provide an essentially infinite supply), a ship's chief engineer must still ensure he has enough stowed in pressure tanks to sustain any prospective sortie.

As the ships, installation, buildings, or vehicles that require this power grow smaller, the idea of full-scale fusion reactors becomes more problematic. This is because the typical deuterium-tritium, helium, or lithium reactor is massive, as are the huge superconductive batteries required to give the initial start to its accelerators and containment fields. Thus, smaller ships and vehicles such as aerospace craft, tanks, assault boats, and other miscellaneous vehicles usually mount what's called a hydrogen processor (as opposed to a reactor). These devices can be much smaller, and although they work on generally the same principle as a full-scale

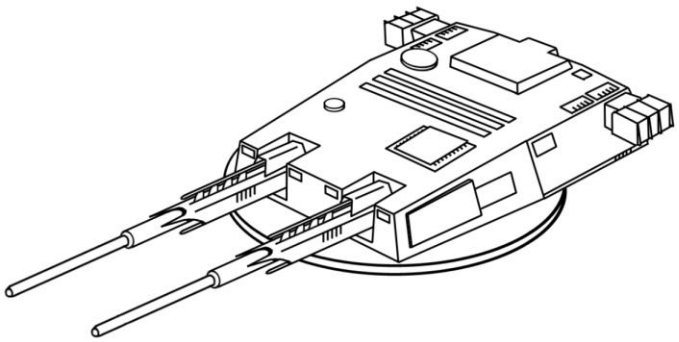
reactor, they cannot start themselves. Thus, they are usually "cold-started" by power couplings mounted in the hangars of their mother ships, bases, or other support facilities. Once ignited from an outside power source, these hydrogen processors then operate more or less like very small hydrogen reactors, providing the energy required for thrusters, antigrav drives, weapons, and other electrical systems. Such craft also tend to carry powerful superconductive batteries to provide short-term power to an ion drive should the magnetic hydrogen processor fail or take damage.

2.2 - WEAPONS

The starships portrayed in *Darkstar* are the most advanced engines of destruction available in the 26th Century. As such, the capacity of a ship's weapons is perhaps the most fundamental measure of the ship's worth, function, and purpose.

Rail Guns

Rail guns are perhaps the simplest and most ubiquitous weapons found on *Darkstar* warships. They are the invention that brought back the era of the "big gun battlewagon," and comprise the main punch of most of the larger classes of capital ships.



The concept behind a rail gun is very straight forward. With the tremendous electrical power provided by the ship's reactors, immense magnetic charges can be sent down a superconductive tube, rail, or spiral, thus accelerating projectiles with the opposite magnetic charge. Most navies use positively-charged bolts, since raw electricity carries a negative charge. Larger guns sometimes use a series of magnets rather than just one big one, synchronized to fire off in very rapid succession down the weapon's barrel.

Because of the extremely high velocities that can be attained with such projectiles, and the precision with which the electrical discharge can be managed, rail guns are extremely accurate at ranges up to and even exceeding 3000 kilometers. However, they remain "dumb" weapons, and cannot fire any kind of "guided" projectile. Nor do they need to. No ship ever made will ever be able to dodge, outrun, or sidestep a rail run bolt. When they hit, the unforgiving law of kinetic energy transfer ($Ek = \frac{1}{2}mv^2$) means that these guns will inflict tremendous damage upon impact. There are no explosives, no electronics to jam (after the initial target acquisition and firing, that is), just a bolt of very dense metal travelling at perhaps 15% the speed of light. Just for context, that's about 15,000 hexes per turn on the game board. It is this straightforward, hard-hitting simplicity that appeals to many captains and naval review boards, and why rail guns remain one of the oldest, most reliable, simplest, and most universal shipboard weapons in *Darkstar*.

Rail guns do have weaknesses, however. They are extremely heavy and draw enormous amounts of power. When damaged in combat, their powerful electrical coils can discharge in devastating internal explosions. They can never be guided and must always fire in a straight line, so if a ship's targeting system can't get through the target's ECM (or if the target is hiding behind an asteroid or moon), the guns are useless. And once again, rail guns are getting old. Advances in thorium plasma, laser emitters, electron particle accelerators, and other weapons are already making them the weapon of choice on smaller ships who can't afford the rail gun's weight and volume. Some navies are beginning to build destroyers, cruisers, and possibly even battleships without the time-honored rail gun. Still, other navies of *Darkstar* are nothing if not hidebound traditionalists, and we can expect to see the rail gun as a prime feature of naval combat for at least the next several decades.

Plasma Projectors

Plasma projectors are another formidable weapon found on many *Darkstar* capital ships. Like rail guns, they use immense electromagnetic pulses to accelerate material toward a target, but instead of a single bolt, plasma projectors hurl streams of hyper-accelerated protons, positrons, or other positively-charged ionized plasma isotopes. These "liquid" streams are energized to incredible temperatures, both before they are fired and during the firing process itself. The end result is a "splatter" of highly-charged, superhot, and radioactive

plasma that carves away armor in entire sheets.

Whereas rail guns drill into armor from a single point of impact, plasma weapons tend to "paint" their targets with a much wider spread of damage. Conversely, however, this means that plasma weapons have rather poor penetrative qualities. In other words, they hit wide but not very deep. This makes them a great tool for "softening up" a target's armor before hitting with more precise weapons like rail guns, lasers, or gravitic torpedoes. Some naval captains and gunners call this tactic "shallowing" an enemy's armor, "peeling" or "skinning" a target, "searing the pig" or "boiling an egg."

Effective as these tactics may be, however, another drawback to plasma weapons is their rather limited range. Since much of their damage transfer comes from the heat of the plasma, effective firepower tends to fall off rapidly over distance as the plasma cools in the frigid vacuum of space.

Laser Emitters

As a science, lasers are even older than rail guns, industrial lasers have been hard at work in factories as early as the 1980s. However, only more recently have the advances been made in materials, power supplies, targeting, and reliability to make these weapons devastating long-range weapons in "real life" tactical naval combat.

The secret lies in the lens that focuses and directs the laser. While spinning mirrors, crystals, and nano-constructed reflective ceramics have been used in the past, one major obstacle could never be overcome. By the time the laser grew hot enough to burn through starship armor at several thousand kilometers, it also burned through whatever apparatus was used to collect, reflect, focus, and direct the energy. However, a technique of ancient Earth astronomy finally showed the way.

In the early 20th Century, Albert Einstein first proved his Theory of Relativity during a solar eclipse, when he observed how the sun's gravity actually bent light to reveal background stars that were actually directly behind the sun at the time. Through successive decades, "gravitic lensing" became an indispensible tool for deep-field astronomy and mapping dark matter concentrations in intergalactic space. However, enormous amounts of gravity, the kind usually exerted by stars, was required to get this effect.

With the invention of controlled fusion and the Darkstar drive, however, enough artificial curvature in fourth-dimensional space-time (which is all gravity really is) could be created to allow the gravity-lensed laser. Furthermore, the immense electrical fields and currents that could be created by these deuterium-hydrogen reactors meant that the sheer power of lasers also saw an exponential leap forward.

Today's capital starship laser emitters are some of the most terrifying weapons in Known Space. While they don't boil off broad swaths of armor like a plasma projector, or blow immense craters in armor like rail guns, they burn perfect holes straight through a ship's armor with horrific efficiency. Because a laser is so focused, however, they naturally do damage only in a very tight, concentrated area. There is no blast, explosion, shrapnel, or shockwave, so the actual damage profile is actually quite small. However, these profiles are deep, and are usually the first weapon to reach the inner compartments of a starship in battle.

Accordingly, average starship crewmen tend to fear laser emitters more than any other weapon, because these are the weapons that will most quickly cause decompression and hull ruptures. For this reason, navies like to add a inert gases like argon or neon to their laser tubes, ensuring that their lasers have a dazzling color as they are fired. Technically, a laser would be invisible in space as the light is traveling through a vacuum, but purposefully showing the enemy what you're throwing at him, especially at an eye-searing intensity, has made laser emitters into a potent psychological terror-weapon.

Gravitic Torpedoes

Gravitic torpedoes are large, relatively slow, but very powerful guided missile-type weapons that a ship launches from torpedo tubes, usually at a very long range. Most modern models are guided not by radar, heat, or the electronic signature of its target, but by its gravity, the most basic (and unjammable) attractive force in the universe. Once a gravity torpedo locks onto the gravity well of its target, it *will* hit unless it is shot down, broken up by the target's shielding, or outrun by the target ship's bigger engines.

Most torpedoes have shaped-charge type warheads that cavitate upon impact. That is, the explosive cone of the penetrating charge implodes upon itself to burn a

small hole into the armor before the secondary, and much larger, warhead detonates within. Torpedoes thus cause tremendous damage. A single hit on an unprotected ship can blow it clean in half. The cavitation of a full internal blast can all but blow apart a destroyer from the inside.

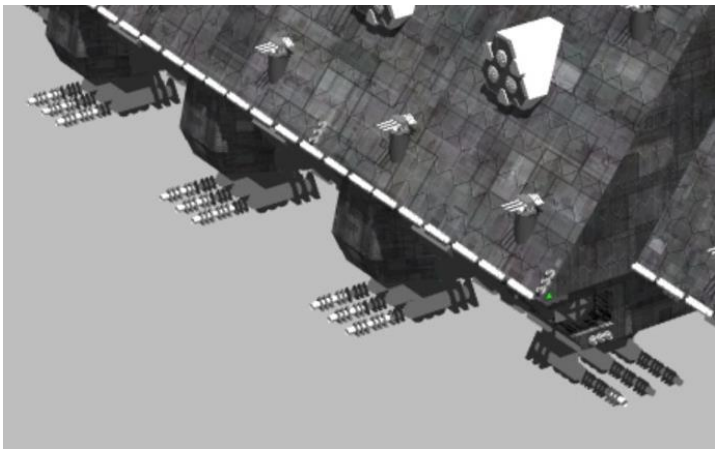
Their weaknesses, however, are just as significant. Compared to other weapons (or even some ships), they are relatively slow and take some time to hit their targets. They are vulnerable to being shot down by the point-defense or anti-aerospace mass drivers of the target ship, or other ships nearby. The can even be intercepted and shot down by daring (and lucky) fighter pilots. And while they never, *ever* miss, the intense gravitic shielding and ECM fields projected by most warships means that they can explode prematurely. Because of the way in which their shaped charge warheads are structured, a torpedo that detonates just fifty feet before the target is effectively wasted. Lastly, because of their size and weight, ships usually carry a rather limited number of these weapons, and can empty all their tubes in as little as eight to ten minutes. Only docking at a star base or a rendezvous with a tender ship can replenish the supply.

Still, torpedoes can be horrifying weapons, especially when used with imagination or in conjunction with other weapons types. Ship captains sometimes launch salvoes at the onset of an engagement, "parking" them in space and combining them with torpedoes subsequently fired from other parts of their ship or other ships altogether. These "swarms" are then sent at a target all at once, when the enemy's mass driver defenses cannot hope to intercept them all. Navies also deploy gravitic mines on much the same principle, which are basically modified torpedoes left "dark" in space until a passing ship's gravity well triggers its targeting system. Often they are used in conjunction with aerospace bomber or fighter attacks, since the target ship's mass driver defense will be so occupied with shooting down the incoming torpedoes, they often provide "cover" for the friendly fighter craft.

Speaking of aerospace craft, they can also carry their own specialized models of gravitic torpedoes. These are much smaller and faster than capital ship torpedoes, more likely to get through an enemy's fighter and mass driver defenses. However, they are also much shorter in range, usually about 2,000 kilometers at most, and do significantly less damage. But when one considers that most bomber models can carry at least two of these, and that big fleet carriers can launch dozens of bombers, the potential of these weapons becomes clear.

Mass Drivers

The final family of weapons carried by most *Darkstar* warships is broadly classified as "mass drivers." In fact this is something of a misnomer, mass drivers can actually be anything from miniaturized rail guns, plasma projectors, or more conventional chain guns, anything that throws up a hail of small, high-velocity projectiles. Put most simply, they are the ship's "machine guns," small-caliber weapons meant to protect against aerospace craft and incoming salvoes of gravitic torpedoes. They are usually mounted in large numbers, at least fifteen or twenty such guns are common on all but the smallest capital ships. Mounted in



turrets, barbettes, or embrasures, they can be found in double, triple, quadruple, or rotary "gatling gun" emplacements. These are typically housed around the primary weapons mounts, engines, landing bays, bridge, and other vital areas of the ship that enemy may specifically target.

In summary, mass drivers perhaps the least glamorous weapon on a *Darkstar* warship. A single game, however, will show that these may be the most important weapons a player can incorporate into a warship's design. Although they are far too small to engage even a gunboat (any craft or installation that can mount any kind of gravitic shielding is immune from these weapons), aerospace fighters, bombers, torpedoes, or a platoon of marines trying to dock in an assault boat will probably find mass drivers to be the most dangerous weapon in any battle.

The Future?

Even in the traditionalist neo-Victorian navies of *Darkstar*, technology never stands still. New weapons are always on the drawing board, and no commander can know with certainty what his enemy may be throwing at him in the battles of tomorrow.

Nevertheless, a few rumors, leaks, and espionage reports have trickled out of top-secret naval review boards to give us something of a clue. Some of these unconfirmed reports suggest a new class of beam weapon, no longer dependent on light but instead harnessing the higher energies of tighter electromagnetic wavelengths. Whether such ultraviolet, x-ray, or even gamma ray-based "graser" beam weapons have reached the testing phase is not known. Another rumor that just won't die is the so-called EMP torpedo, a projectile that uses the old thermonuclear blast to produce an electromagnetic pulse strong enough to shut down a ship's electronics. Despite the fact that computers now run on light instead of electricity, and the gravity shielding on any warship would protect against EMP waves, rumors persist that someone somewhere is working on a way. Theories include using quantum-level subatomic particles or neutrinos somehow modified to carry a minute atomic charge instead of the conventional radioactive particles released in a nuclear blast.

More exotic reports hint at weapons as such as "dimension guns," perhaps inspired by the tragic results of excess gravity shear seen in Darkstar drive accidents. Here, new designs of electromagnetic field generators could create such a focused implosion of space-time (as is formed in front of a ship using its Darkstar drive) that it carves off the very space in which part of the target exists, taking that part of the target along with it. Perhaps the strangest concept of all is the so-called "time cannon." As space, time, and energy are all relative, an unthinkable amount of energy focused just right could theoretically cause part of a moving target to slip into an ever-so slightly different rate of apparent time passage. Given the speed at which *Darkstar* ships travel, the idea that part of a ship could be even a tenth of a second behind the *rest* of the ship in the space-time continuum can be a terrifying prospect.

2.3 - DEFENSE

With such fearsome arsenals of weapons available to be carried by even the smallest of warships, it's no surprise that enormous investment has also been made into naval defensive systems.

Armor

This is probably the simplest, and yet often most effective, defensive feature on a starship. The last two hundred years has seen incredible advances in metallurgy, ceramics, and nanomolecular bonding techniques, allowing the hulls of even commercial and civilian ships to be built of lightweight materials with twenty times the strength of titanium. Even without the hazards of combat, such hull strength is vital for space travel. At the speeds typically undertaken by ships in *Darkstar*, incidental collision with a particle no bigger than a grain of sand can be catastrophic. Never mind the micrometeors the size of a golf ball travelling twenty kilometers a second. Add all the space junk that surrounds the typical orbital port, a debris cloud left over from a battle forty years ago, or the hail of cosmic radiation just belched up by a less-than stable star, and it becomes clear that it helps to have a thick hide in space.

While armor in *Darkstar* can be made out a wide range of materials, one of the most common is called quantanium. This is an isotope of titanium, with particles taken from the outermost electron shell so the atoms have to bond in tighter molecular patterns to stabilize their electromagnetic charge. The quantanium is then heated to astronomical temperatures so until it assumes a near-gaseous state, a liquid mist almost like heavy-metal aerosol. At this point, powerful magnetic fields are introduced on opposite sides of the metalized aerosol to pull the molecules into polar alignments, further locking them into still-tighter arrangements. The end result is a

synthetic alloy of incredible strength and reliability, all while keeping weight to a minimum.

The incorporation of this metal into a starship's frame isn't as simple as bolting sheets onto the bulkhead. Ceramic ablative elements are layered into the final product, chemically formulated to reflect light and absorb heat as defense against lasers. Armor is often spaced slightly, with gaps between successive layers to defeat the shaped charge of gravitic torpedoes. Nylon micromesh is woven through the ceramic and quantanium so the armor has "give," a slightly flexible property to help absorb the titanic impacts of rail guns. Layers of radiation-absorption material are also incorporated, not only to help protect against plasma weapons but also the brain-cooking amounts of cosmic radiation inherent in interplanetary and interstellar space. In the most advanced designs, armor is even electrified in combat, the passing current causing the slightly positively-charged molecules of quantanium to lock together even more tightly. Thus the ship's armor literally "flexes" like the muscles of a boxer expecting to be hit. Such electrical currents are also useful in designs where the armor is built in modular, easily-replaced sections. Such sections can be easily knocked loose unless a powerful current is supplied to superconductive magnets holding the sections in place.

Whatever the exact layout and composition, such armor is usually placed in thick belts right along the sides of the warship, so the captain can close with a target to deliver the maximum broadside while suffering the minimum damage in return. On the largest of battleships, this multi-layered honeycomb of complex armor systems can sometimes measure twenty *feet* thick. When one considers that similar layouts of internal armor also surround vital ship components like magnetized lithium fuel cells, magazines, the CIC, and primary weapons emplacements, and that some ships are built with completely independent "double hull" configurations, it becomes clear that these ships are designed to take tremendous punishment.

Some of the techniques used in the manufacture of quantanium have also been successfully applied to silicates and graphite carbons, allowing for the fabrication of transparent materials almost as strong as the ship's belted armor. This means that the viewports of starships can afford breathtaking views, often superimposed with dizzying heads-up tactical displays, all without presenting undue vulnerability to the ship.

Gravitic / Magnetic Shielding

Another common way ships defend themselves against the hazards of *Darkstar* combat is in the use of gravitic or magnetic shielding. Here, intense magnetic fields are focused around the ship, much in the same way a planet's magnetic field protects it from solar radiation. In a *Darkstar* warship, however, such shielding is naturally much smaller and much more intense, with magnetic force lines folded over and over themselves until they actually create a form of relativistic gravity.

Thus, the ship enters combat surrounded in its own miniature curvature of space-time. While this is never a *Star Trek* or *Star Wars*-style "force field" strong enough to prevent a ship or weapon from actually flying through, it can cause an enemy weapon systems to fail to lock on, torpedoes to detonate prematurely, plasma particles to scatter, and lasers to refract like a beam of light shining at an angle through a glass of water. Even nudging the course of a rail gun bolt by one percent *of one percent* is usually enough to cause the projectile to miss, given the size of the average warship in relation to typical combat speeds and engagement ranges.

When we say "miniature" curvature of space-time, what we're talking about here is a bubble perhaps a dozen kilometers across. Even the incredible power of a deuterium-hydrogen or lithium fusion reactor can only bend space-time to a certain extent. Thus, the actual hull of a warship actually occupies only a tiny percent of the volume encompassed in its shield. More power actually creates a *smaller* shield, but the smaller the "bubble," the

more pronounced the space-time curvature, the more difficult it is to penetrate.

Still, even the most powerful shields are by necessity spread over vast distances. This is rarely a factor, however, when one considers that a single *Darkstar* game hex is a sphere 180 kilometers in diameter (this works out to be about 3 *million* cubic kilometers, by the way), and even if a player stacks five warships in a hex, those ships are still assumed to have at least twenty kilometers of space between them.

Because of this large relative area of shielding projected by each ship, the idea naturally occurs that ships can stick very close and "stack" their shields into each other for a greater combined effect. However, this doesn't work for several reasons. Warships in combat don't keep their distance merely by choice, after all. Even if it wasn't a good idea to keep a safe distance from other violently maneuvering space objects weighing hundreds of thousands of tons and travelling at dozens of kilometers per second, getting too close to another shielded ship can actually *negate* the shield of both ships. This is because the magnetic polarities that create these curvatures in the first place have been shown to effectively cancel out each other's charges. While the rest of a ship's shields remain up, those shields directly facing each basically evaporate into nothing. There is no ill effect (assuming these ships aren't shooting at each other, in which case the move is suicidal for both ships), but the shields in no way complement each other, and have no effect on *Darkstar* game play (except during certain types of attempted boarding actions).

While only warships tend to have combat shields, even the lowliest of harbor tugs have what's called a navigational shield. This is a low-power, low-intensity mag-grav shield that clears particles of dust, dark matter, space trash, and micro-asteroids from in front of the ship as it travels. At even modest sublight speeds (modest by *Darkstar* standards, that is), a chance encounter with even a small piece of such debris can cause severe damage, and such navigational shields are vital for safe space travel.

Electronic Counter Measures

Another way in which *Darkstar* ships defend themselves is through a vast and ever-expanding spectrum of electronic countermeasures and counter-counter measures, often called ECM/ECCM. The variety of equipment, tactics, and technology is far too broad to describe exhaustively here, suffice it to say that *Darkstar* warships invest great amounts of internal volume, power, crew complement, weight, and money into this field. Efforts include jamming the enemy's targeting array, sensor suites, communications, even navigations . . . all while keeping your own electronics from being jammed in turn. False signals can be sent, sensor returns can be refracted, scattered, or absorbed. Pulses of gamma radiation can be aimed to overload enemy transceivers, viruses can be downloaded into enemy computers. The magnetic field lines of an enemy's shields can be tangled or depolarized, even while friendly emitters break up the enemy's attempts to do the same. The frequency

modulations of enemy targeting systems can be targeted for blasts of white noise even while friendly modulations randomly hop around the spectrum, controlled by central computer. The list, quite simply, is endless.

The end game is to see and hear all you can, while not being seen or heard yourself. In summary, ECM is considered such a powerful element that in game play, it's incorporated into the ships mag-grav shielding to provide an aggregate measure of the ship's active defenses (passive defenses being its armor). Assume that about half of a ship's "ECM/Shielding" factor is produced by its ability to conduct this high-tech electronic warfare.

Compartmentalization and Damage Control

The last measure of a ship's defense comes in the design and structure of the ship itself. Since the construction of the first HMS *Dreadnought* in 1906, steel-hulled ships of the ancient blue-water navies used compartmentalization to contain the effects of fire, collateral damage, and flooding. Basically, when a certain part of the ship is opened to space, it is sealed off to protect the rest of the ship.

Other features of ship design can be a little more complex. Many ships are double-hulled like the nuclear missile submarines of old. Some *Darkstar* warships are double, triple, or even quadruple-keeled, meaning that their primary "backbone" of structural integrity is spread along multiple redundant axes, almost like a traveling skyscraper.

Compartmentalization can save lives even in the event of a complete ship explosion. In such an event, sections of the ship are designed to break cleanly away from others, each equipped with its independent (if short-term) life support apparatus and energy supply in the form of superconductive ion batteries. Thus, even if a ship "goes nova," there a reasonable chance that at least some of the crew may survive (assuming they can be rescued in 24-36 hours). Thankfully, such explosions are somewhat rare even in the heaviest of combat, and of course the crew can fall back conventional lifeboats and escape pods in less dire situations.

One of the most vital functions of a ship in combat is damage control, elite teams of fearless firefighters, engineers, and paramedics who strive to mitigate the immediate effects of damage even while the starship remains locked in combat. Methods range from putting out fires with conventional chemicals to bolting emergency stress supports and temporary bulkheads in place to prevent catastrophic decompression. In extreme cases, areas of the ship may be vented into space to suffocate a fire burning out of control. In a method called "counterventing," an area of the ship may be vented directly opposite the exposed area to help stabilize the ship's center of mass or inertia. Needless to say, these damage control crews regularly train and operate in full EVA gear, since they often have to work very quickly in areas of the ship that may already bee ripped open and exposed to raw space.

Of course, there are no rules for this in *Darkstar*, such a system would drag the flow of game play down to an unacceptable crawl. However, the effect of damage control teams is "baked into" the way in which damage is applied and effects assessed. Note that for almost all components in a starship's internal damage chart, the entire component has to be completely filled into for that component to become inoperative. This, of course, isn't the way real technology works. A single crack in a TV screen renders it useless, one nail can puncture a whole tire, a single bullet through a laptop makes it an interesting dinner tray. One hardly has to completely smash the complete physical body of a piece of gear to make it useless. By requiring this in *Darkstar*, however, what the game is simulating is the brave, tireless, and expert work of damage control teams as they patch bulkheads, extinguish fires, assist casualties, and hotwire critical systems to keep the ship in action until the battle is won . . .

. . . or the order comes to abandon ship.