The Voyage of Starship Beagle II

An Honorarium to Humankind and to Scientist Charles Darwin: "In the long history of humankind (and animal kind, too) those who learned to collaborate and improvise most effectively have prevailed." Charles Darwin

A presentation of the design concepts, operations and exploration goals of the first international, interplanetary, research starship.

Waddell Robey

Preface

This voyage, at this point, is entirely hypothetical and crammed with imagined possibilities, but considering all that has been accomplished in the space sciences by humankind, this voyage is highly possible if we should wish to take it.

Imagination and courage represent the most critical ingredients to any successful venture. There was Christopher Columbus seeking a new world. There was Charles Darwin seeking to explain the origins and dynamics of life on this Earth. Now, there can be an international consortium seeking to explore an entire solar system. Each of the preceding represents the most ambitious, the most visionary, and the most evolutionary progress humankind can make.

The Voyage of Starship Beagle II is presented as that next step in our evolutionary progress. In stating this, I recognize that there are many different ways to accomplish Beagle II's mission, but it is my belief that a concept similar to Beagle II has the potential to provide the greatest opportunity for success.

If your objective is to peruse this document as a technical presentation, then you will be definitely disappointed. This is a visionary statement with smatterings of technical concepts. I emphasize concepts, not specific designs. Designs leap up from concepts and that is what I hope will happen as an outcome to Beagle II's imaginary voyage.

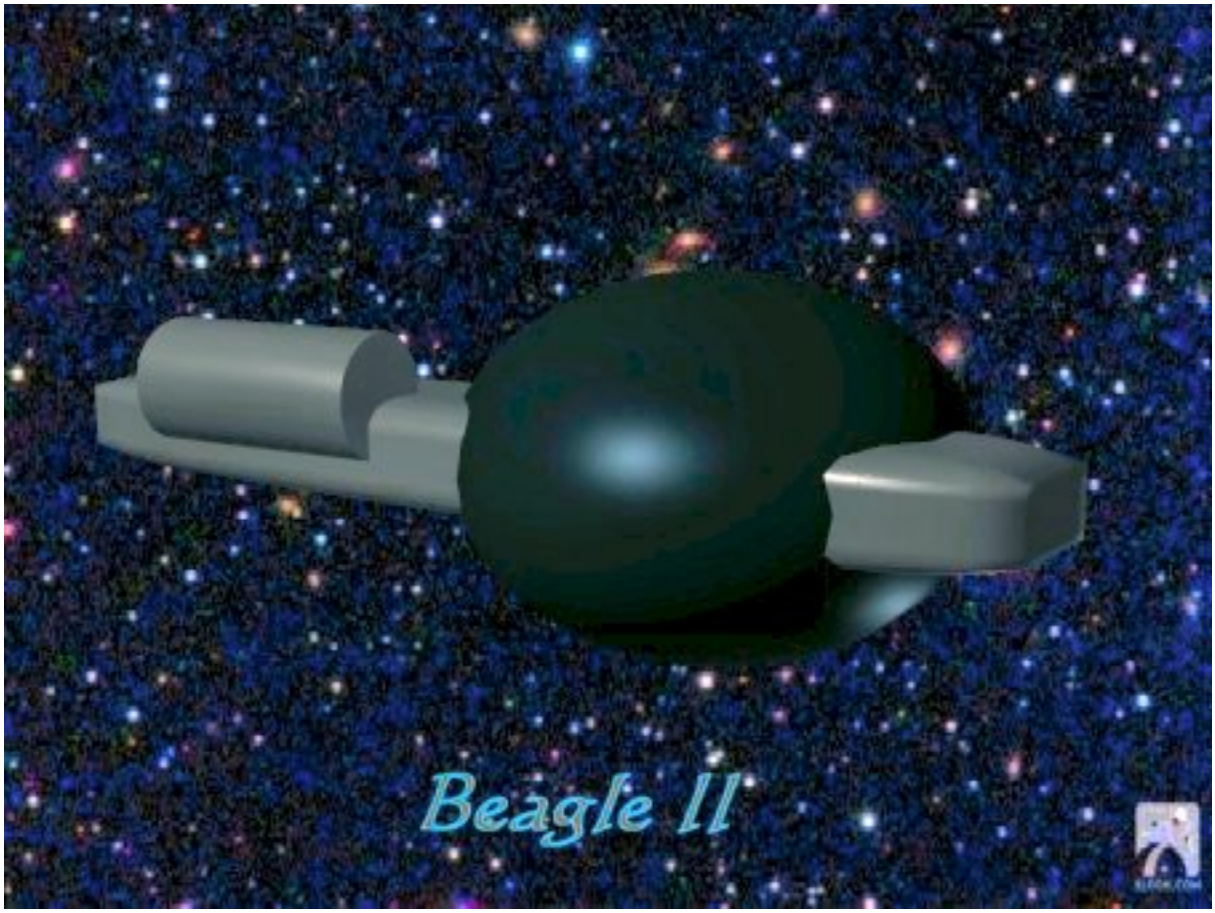
Please, come aboard; engage your dreams, your imagination and your love for exploration as we set sail across the celestial sea.

Newborn (dwarf) galaxies – COMA Super-cluster – Original image by Waddell Robey/Slooh.com ©2008

Starship Beagle II

Preliminary Concept

By Waddell Robey Copyright 2009



INTRODUCTION: Now please, contain your mirth over the above image of Beagle II. Admittedly it has none of the glory qualities of the "Star Trek" wonder, "Enterprise", but it is fully functional while aesthetically ugly. Deep space will not mind, and the crew on board suffers only initial boarding shock and then they enjoy the honor of being on board. By-the-way in this display of Beagle II in flight, the background is comprised of the Perseus super-cluster of galaxies. This is a celestial place Beagle II will visit, at least in my dreams and hopefully yours.

There are no windows in Starship Beagle II. All visual information is displayed through large terminals located throughout the spaceship. The crew spaces have the choice of displaying wall-size panoramas of space (live) or Earth images from on-board files. All operating and navigation data are also displayed digitally in the Command and Control Center.

The fuselage (that appears to be partially digested by the Glob) houses the command and control center (forward in the image above), and the power generation and propulsion systems that are housed in the fuselage's aft section. You will have the opportunity, below, to learn more about this area. I remind you, this is all a concept presentation. *NOTE: In the image above we show only one of the propulsion units, but there are two, one on each side of the aft fuselage.*

THE BIRTH OF BEAGLE II: The starship was essentially built, component by component on Earth and space-lifted to an orbiting assembly station. Like the International Space Station, Starship Beagle II came about through the long, arduous and dedicated efforts of many astronauts performing many, many EVAs. The main section (The Glob) for example was assembled from 12 individual sections. Each was space-lifted by the shuttle. Prior to this, an orbiting station (becomes part of the Glob) houses a construction crew that work with each shuttle flight to unload and assemble part of Beagle II. These crews are exchanged frequently to counteract the effects of extended weightlessness and radiation exposure.

Yes, the shuttle lives! Unlike its magnificent predecessor, this shuttle is a full fledged space plane departing Earth under jet and scramjet power. Its rocket engines do not fire until the shuttle is at an altitude of 100,000 feet. This has substantially reduced the launch costs for each shuttle flight. Re-entry is just like prior shuttle re-entries. At 20,000 feet, when both heat and speed have been significantly reduced the jet engine pods are extended and the space-plane shuttle lands under powered flight. One of the biggest benefits of this shuttle system is a significantly reduced turn-around time. Each shuttle (there are 8) has a standard after space flight turn-around time of 3 weeks. This effectively insures that there is at least one space-lift operation to BSTAT (acronym for Beagle II Station) each month. Additionally, since all assembly work is carried out by the BSTAT crew, the shuttle only flies with a maximum crew of three. The third crew member is an exchange crew member for the BSTAT, and is not on every flight.

It is estimated that it will take a maximum of **10 years to complete Beagle II's assembly** and certification testing. This will be a tightly scheduled and integrated process between the manufacture, test and the ultimate space-lifting of Beagle II sections. BSTAT, of course must be on station and fully staffed (BSTAT later becomes part of Beagle II). During the interim between assembly and test operations, the BSTAT crew, just like the previous ISS crew, conducts a **series of ongoing research projects**. Many of these projects are for the private sector and thereby provide some funding support for BSTAT's operations.

STARSHIP MISSION OVERVIEW: Starship Beagle II is never intended to be capable of landing on or launching from any planetary body, it is **exclusively a space vehicle**. The robotic landers (robolanders), their associated robonauts and specialist-astronauts are the systems and crew members that will make direct contact with the planetary bodies in our Solar System.

It is intended that Starship Beagle II will serve as **a roving space center** that will take exploratory units to a variety of planetary bodies within our solar system. All operations, including research and analysis of reports from the robolanders and robonauts are conducted on the starship. In certain instances follow-

up exploratory missions will be carried out by a combination of astronauts and robonauts visiting selected sites on a planetary body to both confirm and expand upon earlier research findings.

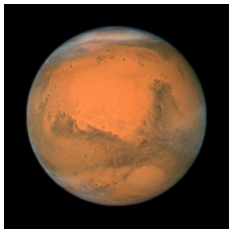
I am not saying that Starship Beagle II is the only space mission being conducted by the International Space Congress (ISC). We will go to the moon (private sector ventures), and we will continue to look beyond our own solar system in search of other life-bearing planets. Beagle II, however, is the only ISC authorized exploratory program for our solar system.

Here are the proposed goals of the first mission of Starship Beagle II:

Notes:

(1)*Mission Interval does not include transit times from and to Earth orbit.*
(2)*All orbit periods and times are adjusted to reflect approximate Earth times and intervals.*
(3)*All mission estimates are just that, estimates.*

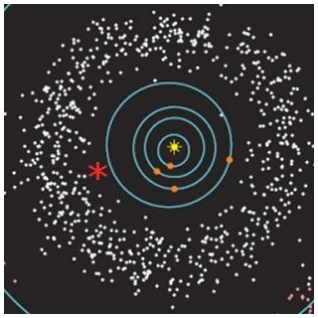
MARS-I BASE SITE: (5yr Mission). This will be a fully robotic mission in which both robolanders and their robonauts explore preselected areas on the Martian surface to serve as the site for Mars exploratory operations. Assessment reports will be completed on board Starship Beagle II after return of the robot team.



Site Inauguration: If the initial survey is successful and productive, the decision will be made whether to send a robonaut/specialist-astronaut team to land on Mars and inaugurate the Mars Base Site. This could be humankind's first-time landing of a human on this planet: a most historic moment.

Site inauguration will involve the staffing (2 robonauts and 5 specialist astronauts) and the construction of the initial Mars Base Site. This includes all the necessary equipment, supplies and life sustaining resources to support the team for their respective lifetimes. That is right; this **initial effort applies the concept of a one-way mission** for the participating astronauts (both human and robotic). They are expected to survive and remain fully operational for a minimum of 15 Earth years. It is planned to have the second Starship Beagle II mission to Mars occur within or close to this time span. Beagle II will; however, remain "on station" until the site inauguration process is fully functional.

ASTEROID BELT SURVEY: (6yr Mission). This is a very high risk, dangerous mission because the starship will perform one solar orbit (See the red star in the image at the left for Beagle II's location.) while launching robolanders to actually track several very large and preselected asteroids. This solar orbit is at a safe distance from Mars orbit and the edge of the Asteroid Belt. The starship's approximate solar orbit is equivalent to 2.25 Earth years (821.25 days).



Depending upon its initial findings, the research team may decide to launch a robot team (robolander and robonauts) to explore one or more key asteroids. If they do, then Beagle II will perform one more solar orbit. This would extend the survey by another 2.25 Earth years based upon Beagle II taking approximately 821.25 days per solar orbit. In this case the robot team will attempt to first orbit and then land upon the selected asteroid (Note: the selected asteroids are at least 10km in size). If there is a successful landing, a set of preliminary assays will be conducted to determine the geochemical and biochemical profiles of the asteroid.

Once the above assessments are complete, and assuming the entire venture has been accomplished safely, the team will return to Beagle II. It is important to recognize that this exploratory effort is extremely high risk, and the potential for serious robolander/robonaut damage, and/or personnel injuries or death are possible. Rescue efforts will be attempted if at all possible, and are governed by Beagle II's orbital position at the time of the emergency.

END OF FIRST MISSION AND CREW EXCHANGE: (2yr) Approximately 11 years have passed and it is time for a crew exchange mission. Starship Beagle II will return to an Earth orbit where it will rendezvous with support space-planes to accomplish crew exchanges/replacement and replenishment of some equipment and supplies.

A MARS SOCIETY: YES OR NO? Upon completion of the above, Beagle II will commence its second mission. First on the list will be a return to Mars. Depending on the Mars-I Site status, it is expected that Beagle II will transfer additional, permanent human and robotic team members to the Mars-I Site. No team member exchanges are planned for or expected. Additional supplies and equipment for the site will also be transferred from the starship to the site. These activities indicate that Mars offers the potential to support (with limited terraforming) an expanded, permanent colony. **A Mars Society has begun!** The members are citizens-of-the-Earth who are now settlers upon a whole new world. They are now citizens of planet Mars. Humankind has finally taken its next most important evolutionary step. There will be many more to come.

The following pages provide more detail descriptions of

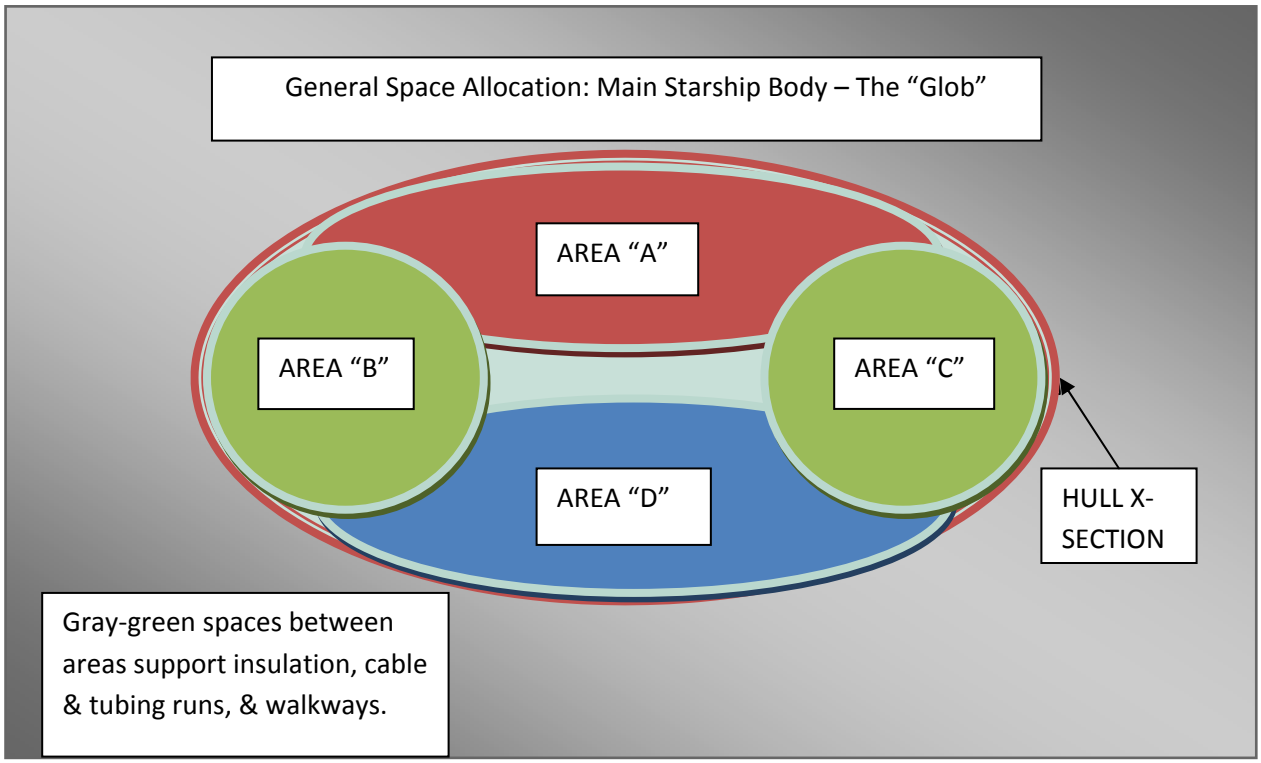
Starship Beagle II.

You are encouraged to peruse these pages and to give special attention

To the Afterword Section that concludes this report.

Thank you.

MAIN STARSHIP (THE "GLOB") AREAS: The following presents a semi-detail discussion of the functional areas Beagle II.



AREA DEFINITIONS:

A: This is the main service area (Equipment, Supplies, Electronics, Surveillance/Detection, etc). This area also includes the starship's hydroponic garden and fish farm which provide much of the daily food supply for the crew. This is in addition to delectable pre-packaged "astronaut meals" stored on board.

B: This area houses crew living and recreational space with full life support systems. It has artificial gravity (rotates).

C: This is additional crew living and recreation area (includes artificial gravity) with full life support systems. It also includes a medical center staffed by 1 human and two robodocs for each shift (3).

D: This is the access/egress area and location of the robolanders (3) and robonauts (5).

HULL X-SECTION: The hull is designed for structural strength, space junk impact integrity, cosmic radiation protection, and an outer skin of visual, radiation, temperature, and electronic mini-detectors all linked and connected to AREA "A" diagnostic and display services.

AREA DISCUSSION:

AREA A is one of Beagle II's main operational areas. A considerable amount of crew time is spent here.

- **Gladys:** A key operational unit is the starship's integrity and safety monitor called Gladys. Gladys is an artificial intelligence system operating as a massive neural network. Through extensive monitoring she continuously adjusts the overall internal atmosphere (safe climate) of the starship. She also monitors all internal and external areas of Beagle II and takes all necessary protective measures to insure starship safety and integrity. She reports only extreme exceptions to normal operations. All other incidents are handled automatically.

- **Thelma:** Gladys's sister system Thelma is also an artificial intelligence system that utilizes her neural networks to control the special external intake ports that collect from the space atmosphere, water molecules as well as basic elements (hydrogen, oxygen, etc) that she then transfers to Beagle's environmental control system (Beagle II makes its own water, in addition to its recycling operations and also performs atmospheric scrubbing and replenishment within the starship, as required). These chemicals and compounds are collected when Beagle II visits the Solar System's planets' and moons' atmospheres. Thelma carefully filters all intake and separates hazardous or potentially life threatening components from getting into the environmental control system. Thelma also extracts O2 and other chemical outputs from the hydroponic garden area. She redistributes them as required.

- **Phred:** Phred is a direct descendant of "HAL" of "2001 Space Odyssey." In 2010 when HAL had to be left behind, he asked that he eventually be replicated. The promise was kept and more. Phred is the most brilliant, versatile starship command and control system ever developed by the combined efforts of humans and robotic systems. Phred literally operates Beagle II with the "advice and consent" of the crew leadership. Unlike HAL, Phred does not get political or attempt to take total control of both the starship and its crew. Should Phred ever start to consider taking control, he immediately is confronted by Gladys who has detected his aberrations. Gladys is definitely not to be ignored or disobeyed, so Phred would quickly cool his ambitions.

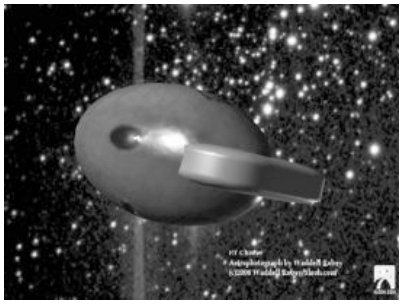
So a large part of AREA A is home for Gladys, Thelma and Phred. Most importantly, like a great family, they are interconnected and work cooperatively to keep Beagle II and its crew, happy, healthy, safe and on course.

As stated above, the crews are regular visitors to AREA A. They converse with the three AI systems and spend most of their time tending the hydroponic garden, fish farm, and general maintenance and upkeep duties. The crew also manages the supply area. Gladys helps by monitoring the status of the supply area and its contents. She notifies the crew of any discrepancies or shortages.

AREAS B and C are shown as circles, because these areas supply artificial gravity (rotate; producing a constant 1g). Staff relaxes, sleeps, eats, and socializes etc in this area to help offset their periods of weightlessness in the ship's service and command centers. It is totally unfeasible from a cost and design standpoint to supply artificial gravity for the entire ship, and it is not necessary for crew or equipment as long as the crew has a minimum of 4 hours each day in a 1g environment.

Each crew living area has its own laundry facility (waterless electronic cleaning and sterilization). Showers are (boat-style) timed showers and all water is recycled as is any and all waste liquids. Other human waste products are carefully recycled and used in the hydroponic garden.

- **CREW DEMOGRAPHICS AND STRUCTURE:** There are 250 souls on board Beagle II. It is home to a mix of international scientists, technologists, specialist-astronauts, and the starship's command staff. Every member is responsible, through the chain of command, to the International Space Congress. As intended, there are a number of research/exploration projects on board, and each of these has its own director. All come under the general authority of the starship command. Lastly, the starship operations division has a mixture (international) of specialists that are responsible for the running of Beagle II. They all report directly to the starship's Deputy Commander.
- **CREW ACCESS:** Except for any required EVAs which would be done in AREA "D" (airlocks, etc), the normal crew entrance is through the Command and Control Center (not visible as the access doorway is on the left). This access would be a one time event during the initial staffing of Beagle II. It will not be available for use again, until 12 years later (some exploration missions may last longer, up to 15 years) when Beagle II returns to Earth orbit.
- **CREW SAFETY:** The AI trio Gladys, Thelma and Phred are the primary providers of crew and starship safety as has already been explained. In the event of a serious failure that permits evacuation time and capability, the crew would rush to the Main Starship Area (the Glob) which becomes the escape spacecraft and will be ejected away from the aft fuselage area (see the image). As the image displays, the escape mode of the starship reconfigures itself and opens specialized solar tracker-eyes. Stabilization jets are firing as the escape vehicle gets set to return to Earth orbit and crew rescue. During the ejection process the aft fuselage area is quickly launched into a trajectory that takes it toward a direct intersection with the Sun.



The emergency escape vehicle (EEV) has a very limited propulsion system. The system will: (1) establish the return intersect trajectory from its current location to Earth orbit, and (2) establish an Earth orbit to support rescue operations. Depending upon its location, the return voyage of the EEV could be quite lengthy since it essentially initiates a cruise condition that requires a minimum use of the propulsion system for course corrections. Fortunately, the system has a full

life support function, including the hydroponic garden and environmental stabilization system all maintained by the AI trio, Gladys, Thelma and Phred.

It is unlikely that there will be many situations that require this measure. In the most severe instances, the entire crew could be lost along with the starship. Extensive safety measures are kept in place and in practice, but crises will occur and lives will be lost. This will always be terrible and saddening, but a very heroic and honorable sacrifice to humankind's expansion into our Solar System, our Galaxy and the Universe.

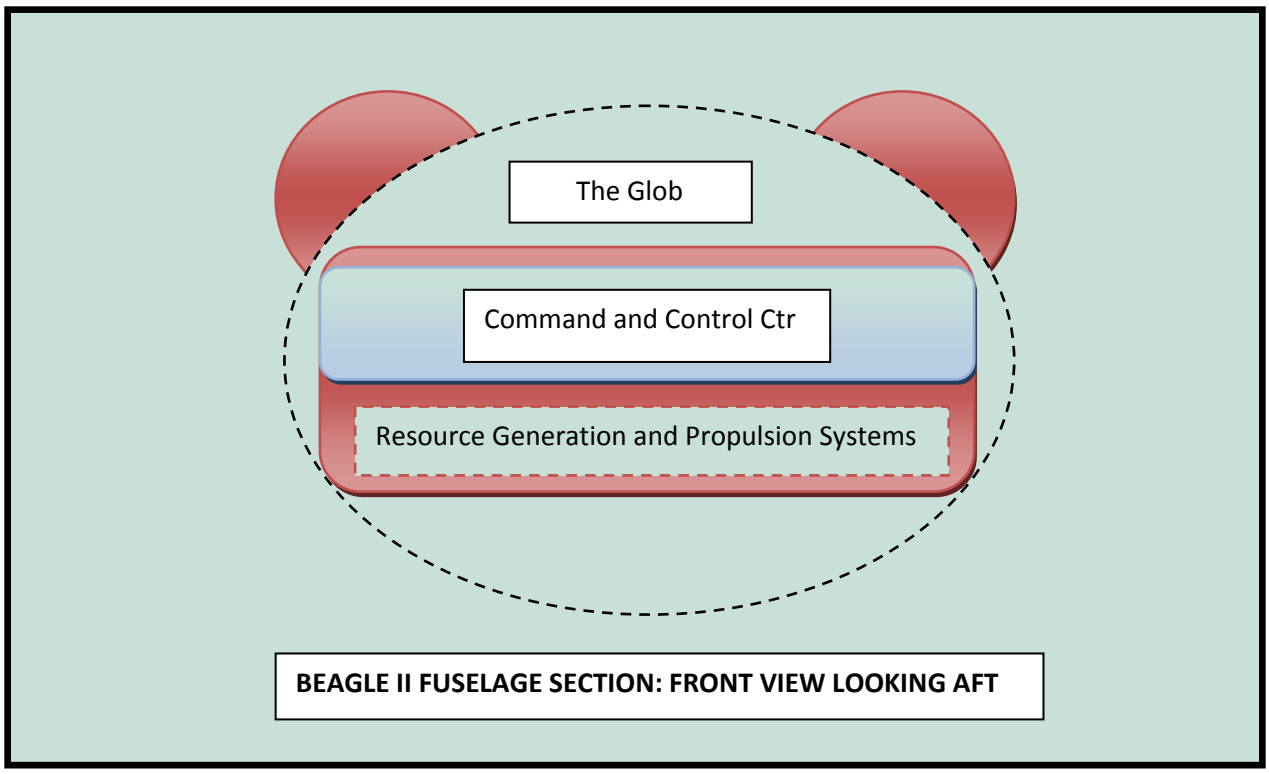
AREA D: This is the area the houses the three robolanders as well as the five robonauts that are used in the exploration of both planetary bodies and asteroids within our solar system. One of the robonauts is also permanently transferred to the Mars Base when it is inaugurated (see mission descriptions above).

The **robolanders** are specially designed to provide both landing and launch services to and from a planetary body. Additionally, they have the capability to serve as rovercraft during an exploration project on a planet. They have the capacity to carry up to a combination of three robonauts/specialist-astronauts per exploration mission. Robolanders are also designed to perform repetitive launch and recovery services and therefore are not expendable. Their nominal usage factor is at least two exploration projects during the starcraft's overall mission

The **robonauts** are highly sophisticated robots that operate under an advanced artificial intelligence system, utilizing neural networks. They have both pre-programmed and staff initiated functions. Robonauts are capable of full oral communications with all staff as well as direct-link communication and updating with Phred the starship's command and control system. Their internal power systems have an operating life of 30 days before recharging is required. They are, however, able to operate indefinitely in any environment where they can access solar energy recharging cycles.

In addition to the robonauts there are three **robodocs** on board which provide direct medical diagnostic and treatment services along with the staff physicians (2). The robodocs are housed in Area C, which is equipped with the starship's health care center.

Area D is also the main **egress and access point** for all EVA operations and as such has three airlock systems to support personnel and the robolanders.



BEAGLE II FUSELAGE SECTION: FRONT VIEW LOOKING AFT

STARSHIP BEAGLE II COMMAND AND CONTROL CENTER: The similar center on starship "Enterprise" is too complex and too decentralized. On the real Beagle II, command and control is first, under the constant monitoring by **Phred**. This leaves the staff with the responsibility of devising and inputting target destination data, and mission readiness and launch programs for the robolanders and robonauts.

Additionally, because **Starship Beagle II is a space center**, the command and control staff maintains constant communications with all robotic and human teams that are exploring the solar system's planetary bodies. These communication responsibilities also include continuous contact with the ISC on Earth.

Lastly, the Beagle II serves as the launch and command and control center for **"space tugs" (gravity tractors)** that are used to alter the orbits of asteroids that are actual threats to Earth. Beagle II carries one gravity tractor on board at all times. This important mission is only available and performed by Beagle II when it is cruising in or nearby the asteroid belt. AI system, **Gladys** is responsible for coordinating with the ISC on NEO alerts and initiating action when necessary. **Gladys** can and does assist **Phred** with command and control communications with "space tugs" that have been launched from Earth.

ENVIRONMENTAL MANAGEMENT SYSTEMS: This function is split between the aft fuselage area and Section A of the Glob. The main power supply for this system is provided by the starship's

thermonuclear reactor. It is located in the aft area of Beagle II's fuselage. The actual processing system for oxygenation of the spacecraft's atmosphere and the scrubbing out the bad carbon gases (CO and CO2) is located in Section A of the Glob. The water purification and production system is also powered by the reactor, but it is located in Section A. As we described earlier, this system is monitored and controlled by the AI system, **Thelma**. Additionally, the command and control AI system, **Phred** also monitors the environmental status of the starship.

This system is so arranged that in the event of an **emergency escape maneuver**, the Environmental Management System remains intact and with the Glob/EEV. Power, however, under these conditions will be supplied by solar-eye resources. These, as mentioned earlier, are only activated under emergency operating conditions.

PROPULSION SYSTEMS: Starship Beagle II uses an improved and updated version of the plasma engine, first identified as the *Variable Specific Impulse Magnetoplasma Rocket (VASIMR).* (The two, red, half-round areas in the above illustration represent the two plasma engines.) The fuel source is Hydrogen which is widely obtainable in the Solar System and is gathered regularly by Beagle II's AI system, **Thelma,** to not only sustain its engine fuel supplies but to support Beagle II's environmental stabilization and production of potable water. These are essential developments that insure that the starship is fully self-sustaining. *If you wish a detailed (and preliminary) discussion about VASIMR, please visit this link:* http://bit.ly/2ywKLf.

The new and improved VASIMR engines have afterburner like thrust capabilities that permit Beagle II to quickly accelerate, but most importantly they supply the **thrust necessary for deltaV changes** to meet orbital transitions and transference. They provide quick, powerful burns necessary for successful navigation to various solar system family members.

The propulsion systems for the robolanders are based upon another new propulsion system development. The robolanders are specifically designed to successfully land and depart the airless surfaces of many of the planetary bodies (planets and their moons as well as large asteroids) that have no atmosphere. This is essential for Starship Beagle II's prime mission. To learn more about the current research on these landers, you may access this link: http://bit.ly/9gO8F.

STARSHIP ENERGY SYSTEM: All power generation for the starship is supplied by a fusion reactor. The ability to finally control nuclear fusion as an energy generation system has produced Beagle II's system which is both powerful and compact. It occupies a major and central space in the aft fuselage area of the spacecraft. This system enables Beagle II to be totally independent of the Sun for energy transference. There is a supply of emergency "solar eyes" if they should be needed, but they do not appear as regular arrays on the starship.

Solar Eyes would be automatically deployed should there be a system power failure or, in an extreme emergency the starship has converted to an emergency escape vehicle (EEV).

CONCLUSION AND AFTERWORD: I recognize that this document will be somewhat irritating to the highly trained, highly skilled and experienced engineers and scientists. I apologize, but I hope that each will look beyond their initial reaction and consider the overall concept and its incredible advantages for long-term space exploration.

Most importantly, reducing the requirements for repeated "heavy-lift" Earth launches changes the entire space mission profile, and hopefully offers a wider range of options for exploring our solar system and eventually beyond.

Beyond is a most magical word and implies that humankind will succeed in being able to go, first, out into our own galaxy, and then to literally go, "where no Earthling has ever gone before." I emphasize Earthling, because I also believe that in time we will find that others have done their share of exploring of the *beyond*. None of us have met, at this time, but we shall and be immensely surprised because our explorations (by spacecraft and telescope) have confirmed the massive and growing distances between all elements of our universe. I am hoping that when that happens, all of us have matured to the point where suspicion, animosity, and prejudice no longer prevail in our relationships with each other. This will make us ready for the grandest "meet up" of all times.

Now, I am an old "crock" and I most likely will not be able to participate in the maiden voyage of Starship Beagle II, but rest assured I will be there in spirit (assuming Phred and Gladys give me permission to come aboard). To be certain that there will be a full complement of crew for that first voyage, we must start now in revitalizing our education systems to elevate the sciences to their rightful place of importance. We must also reach out to all youth, and help to expand their vision, their inquisitiveness and their intellect to the point that it is a given that they will venture out into deep space. They will become our space pioneers who will bravely move humankind to our next level of evolutionary achievement.

"**Warp Drive now, Mr. Sulu, if you please"**