Ultra High Energy Cosmic Ray Interstellar Travel

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Abstract:

Recently there have been a number of interstellar drive proposals, these include using worm holes, anti-mater, fission, fusion, nuclear pulse drive and many others. Here a technically possible interstellar drive is described. This drive only requires a modest budget (by NASA standards) and some in-depth knowledge of naturally occurring energy streams within the cosmos.

Overview

Regarding interstellar travel, from our current technological standing, there are four areas that require additional expertise. These are: 1. A greater knowledge of the interstellar environment, 2. A propulsion system that does not require an on-board fuel supply,[1] 3. Overcoming the time constraints of interstellar travel. 4. Cheap access to space.[2]

A greater knowledge of the interstellar environment could facilitate a propulsion system that does not require an on-board fuel supply. Ultra High Energy Cosmic Rays (UHECR) are cosmic ray particles with very high energy (10E18 electronvolts,) traveling at nearly the speed of light (SOL.) These cosmic ray particles are mostly protons, ranging from hydrogen ions to ions as heavy as iron (Fe.) There are in the solar system, streams of these particles that could be used to propel an interstellar nanoprobe. Since the UHECR travel are nearly the SOL, there is the possibility that the vehicle(s) could also travel at nearly the SOL.

The cosmic rays arrive at very high altitudes in the atmosphere and collide with atmospheric particles. These form showers of sub-atomic particles. These particle showers are continuously detectable at the earth's surface.[3] There is a good amount of research on the subject, with ground and subterranean data collection efforts. These can measure energies, amounts and types, but not information on origin or source. There are efforts to measure the movement of the cosmic rays through the atmosphere. These use very sensitive photomultiplier tubes to detect the Cerenkov radiation, generated as the cosmic rays flow through the atmosphere. This directional information along with the ground base information can be used to approximate the sources of the cosmic rays.

The sources of these cosmic rays are high energy stellar events, such as super novae, collapsing/merging stars, high-energy galactic events or pulsars. From earth, these could be seen as point sources. Baring chaotic events, like magnetic interactions, crossing system boundaries, dust or close approaches to stars, some of the cosmic rays arrive as streams of particles. Those cosmic rays (particles) arriving as UHECRs, contained within streams, could provide energy to power small or possibly large space craft.

These UHECR are a sub-set of Galactic Cosmic Rays (GCR.) This is because GCR are generated outside the Milky Way galaxy and arrive with very high energy levels. It is likely that streams of the UHECR transverse the solar system and continue to another galaxy. The ultimate goal would be to identify streams that pass through our solar system and that travel towards good research possibilities, i.e. exoplanets that are in the Goldielocks Zones of their solar system and not oo distant.

Extreme Energy Cosmic Rays (EECR) have, somewhat rarely, been detected with energies of 10E21 electron volts. This is equivalent to about 50 joules of energy or about the same as a baseball thrown at 60 miles per hour.[4] Likely, streams of EECR with these energetic particles, are capable of driving larger space craft and possibly at extreme speeds.

Much of this expertise is obtainable with nanoprobe missions within the solar system. A large number of the nanoprobes could be dispersed above and below the solar ecliptic. A stream of UHECR detected on one side, might also be detected on the other side, then the victor could be determined. With this data, a nanoprobe or a train of them could be inserted into an appropriate UHECR stream. The UHECR might be used to accelerate the probes toward a near-by planet.

The UHECR and EECR particles would transfer momentum to the craft and the speed of the craft would increase to a point where the energy input is equal to the ambient resistance of the movement. Since the particles are moving at nearly the SOL, the craft would have a very great rate of speed. Not all the momentum of the particles would transfer to the craft. The particles would strike a surface and rebound with the resultant loss of energy. The energy that the rebounding particles carry off could be contained within the craft if the rebounding surface could retain the particle and all the energy. This might be possible if the surface is absorbent and electrically charged. The particles are positively charged ions and would be attracted to negatively charged surfaces. These particles could be collected and used as reaction mass.

The structure of the craft would be cone-shaped, with the apex pointed in the direction of travel. The cone would be somewhat shallow, This would allow the impinging particles to rebound several times and transfer more of the energy before being absorbed. The absorbing material could be an aerogel, that would allow some movement of the captured particles. The craft is likely to be subjected to continuous, although minor, vibrations.

The internal vertex of the cone would have a negative charge and would attract the positively charged particles. Minor vibrations within the craft, would help the particles to move from the aerogel to a staging area. The strength of the negative charge at the vertex needs to be weighed against the effect on the in-coming positive particles.

The width of the cosmic ray stream would determine several design options. The stream (beam) width is likely to be broad and therefore the base could be as wide. If the beam width is broad enough there is the possibility of generating electrical energy from charged particles passing near the edges of the cone.

NASA attempted a tethered space flight to investigate the possibility of generating electrical power in the magnetic fields of earth. The satellite jettisoned a payload attached with an electrical conducting tether and measured a 3,500 volt potential before the tether broke. This was in the magnetic field surrounding earth. The described interstellar craft would rely on charged particles passing by or through conducting coils to generate electrical energy.

With motive energy derived from particles pushing the craft from the opposite direction of travel and particles impacting the craft from the direction of travel, there is a design dichotomy. At some point in the acceleration of the craft another design possibility might be considered. Eventually, the forward pressure will equal the rearward resistance. To obtain maximum speed, the craft would need to be re-configurable from, perhaps, a nearly flat facing surface to a very shallow cone-shape.

Interstellar space is thought to have a mass/volume of approximately one particle per cubic meter. This is the resistance to increasing momentum. While most of this matter consists of hydrogen, the leading edges of the craft might need some protection or resistance to the wear from the interstellar environment.

The term "reaction mass" was mentioned. If the impacting particles are collected and can be moved to the vertex of the cone, these particles might be used to further increase the momentum of the craft. A magnetic rail (tube) gun could be powered by the ambient electrical fields or radioisotope power. The particles are moved to the breech of the rail gun and magnetically accelerated through the tube and ejected as thrust. This would provide additional propulsion. Very high speeds have been obtained with earth base magnetic rail guns. As of 2014, seven times the speed of sound (Mach7) had been obtained in the atmosphere[5]. The technical problems include; capturing the particles, moving them to the breech, loading them into the breech and designing a minimum mass rail gun.

Reference:

1. Wikipedia, "Interstellar Drive."

2. Vixra, Cheap Access To Space by Kenneth Ramsey.

3. See YouTube @ "Cloud chamber: Radioactive particles in 4K 60 FPS."

4. Wikipedia, Extreme Energy Cosmic Rays.

5. Wired, 4-29-2014