International Journal of Astrobiology 12 (4): 312–313 (2013)
doi:10.1017/S1473550413000153

Information-driven societies and Fermi's paradox

Michael Lampton

Space Sciences Laboratory, University of California, Berkeley, CA 94720, USA
e-mail: mlampton@SSL.berkeley.edu

Abstract: Fermi's paradox is founded on the idea that one or more Galactic extraterrestrial civilizations (ETCs) existed long ago and sustained exploration for millions of years, but in spite of their advanced knowledge, they could not find a way to explore the Galaxy other than with fleets of starships or self replicating probes. Here, I question this second assumption: if advanced technology generally allows long-distance remote sensing, and if ETCs were motivated by gaining information rather than conquest or commerce, then such voyages would be unnecessary, thereby resolving Fermi's paradox.

Received 26 March 2013, accepted 4 May 2013, first published online 12 June 2013

Key words: extraterrestrial civilizations, Fermi's paradox, information societies.

Introduction

Fermi's paradox contrasts two observational facts. First, our Galaxy hosts numerous potential sites for intelligent life to have arisen long ago. Second, our corner of the Galaxy is apparently devoid of waves of explorers, self replicating probes, or visible artefacts. Why is that? A variety of explanations for this contrast have been discussed – see for example Hart (1975), Brin (1983) and especially Webb (2002). These explanations however share a common blind spot: they assume that our known 'Earth-2000' knowledge is complete in the sense that there are no subtler ways to physically explore the Galaxy other than the ways we presently imagine: brute force fleets of starships or self replicating probes. On the other hand, we have plenty of evidence that Earth-2000 physics is profoundly incomplete: our mastery of physics and technology is expanding on a very rapid time scale – far faster than our time scale for mounting a vast interstellar campaign. Moreover, our society is increasingly focused on information. If ETCs shared a similar growth pattern, and if advanced physics allows easier exploration, then no fleets would ever be mounted.

Earth-2000 physics is incomplete

Is there new physics beyond the Earth-2000 level? Modern widely accepted cosmology combines two mysterious components: dark energy (symbolized by the Greek letter Λ) that produces a uniform repulsive force responsible for accelerating the expansion of our Universe in recent cosmic times, and Cold Dark Matter (CDM) responsible for rapid aggregation of matter at earlier times. Certainly, modern ΛCDM cosmology can be made to fit an amazing variety of observations. However, there are cracks in its foundation: why does ΛCDM require at least six fundamental parameters (Komatsu *et al.* 2011) and appear to suffer from bizarre coincidences (Carroll 2004) that, so far, remain unexplained? Why are general relativity and quantum mechanics seemingly irreconcilable? Can wormholes be made useful? Why do efforts to unify physics often lead to descriptions in higher-dimensional spaces? (howevert see Tegmark 1997). Are there ways to extract information from the interior of our past light cone, as opposed to viewing only events on that cone's surface? Can super telescopes be built that show us vastly more detail of distant worlds than we presently have? The answers to these and many more puzzles may open new ways to explore our Universe. If this advanced physics exists and the technology is feasible, it would certainly be accessible to ETCs that are likely to be millions of years older than we are.

Time scales

The oldest stars in the Milky Way have ages $\sim$13 Gyr, and when a few Gyr are allowed for intelligent life to evolve, the earliest ETCs might be 5–10 Gyr old. This age is far greater than the 1–100 Myr exploratory expansion phase that an ETC would need to mount a hardware exploration of the Galaxy (Sagan 1963; Newman & Sagan 1981; Landis 1998; Bjoerk 2007; Haqq-Misra & Baum 2009; Cotta & Morales 2009; Bezsudnov & Snarskii 2010; Maccone 2010; Wiley 2011). This wide discrepancy is often taken as proof that ETCs do not exist (Tipler 1980) or that self replicating probes do not exist (Sagan & Newman 1983) – otherwise our corner of the Milky Way would be littered with discarded monoliths. Another interpretation is that only very long-lived ETCs could hope to pursue such a program and these may be rare or nonexistent due to evolution or other life-limiting factors. Indeed, Prantzos (2013) argues that colonization is the only realistic option for long-lived ETCs.

Here, I point out that there is an even faster time scale at work, namely the time we Earthlings have needed to produce and refine our ideas about our Universe. Galileo's discoveries go back only 400 years; special and general relativity go back only 100 years; the Big Bang hypothesis was confirmed by discovery of the cosmic microwave background only 50 years ago; the accelerating universe and ΛCDM concordance cosmologies go back barely 20 years. On the technology side, Moore's law and other indicators of hardware and software development show even more rapid growth. Tools for further discovery – space telescopes and radio interferometers – are in a phase of rapid advancement. This pace is enabled in part by instant global communications and increasingly powerful tools for observation, modelling and data processing.

The transition

Here, on Earth, information is becoming increasingly important in its own right. A list of the world's billionaires reveals a trend away from tycoons in railroads, land, coal and oil, towards innovators in the information sector. On the multi-megayear time scale of species evolution or interstellar travel, this change is rapid enough to be regarded as a step-function transition to an information-driven society. In our recent past, world exploration was motivated by trade, colonization and conquest. In our information-rich future there will be no need to go to China to fetch tea leaves: they will be fabricated on the spot, far more conveniently, using local matter, local energy and local information. When Capt. Picard orders 'Tea; Earl Grey; hot!' he gets it there and then. In our future, what will be the value of prime ocean-front real estate in a remote star cluster? Land, if needed, will be far easier to build or simulate locally than to occupy on some far-distant shore. Shostak (2009) has pointed out that – even today – exploring Solar System planets via telepresence has become an enormously powerful and practical tool. The relative advantages of remote sensing compared with manned exploration can only increase with improved telepresence information technology and with increasingly distant targets.

Here, I am not speculating about a cataclysmic conversion of humanity into something else, as in Teilhard de Chardin's 'Omega Point' or von Neumann's 'essential singularity' or Vinge's 'technological singularity' – see Webb (2002) Chapter 4 for a discussion of these. Instead, I am pointing out that our young bright minds will build careers faster by mining information than by mining coal. This trend has already begun and appears certain to continue, with the result that an increasing proportion of mankind's activity will become centred on the information sector. That's where the money is!

Beyond the transition

To truly answer the Fermi Paradox, this explanation requires that post-transition societies generally abandon starship-fleet Galactic exploration. Three questions might be raised in connection with this issue. First, in what sense can 'being there' be interpreted for a society that has a complete but remote knowledge of 'there?' It seems likely that advanced simulation – augmented with detailed remote-sensing data – could deliver a very high-quality visit, with its vast advantages in time, energy, safety and accessibility. Second, how do motives of post-transition civilizations evolve? Does an increased emphasis on abstract objectives reduce the territorial imperative, or shift it into cyberspace? Third, why, exactly, would a post-transition society mount a Galaxy- or Universe-wide expansion using flight hardware?

Conclusion

The Fermi paradox arises from ascribing pre-transition motives and technologies to post-transition societies. If societies generally transition on a time scale short compared with the interstellar expansion time scale, the paradox disappears.

Acknowledgements

The author wishes to thank the anonymous referee for his/her constructive comments on an earlier version of this manuscript.

References

Bezsudnov, I. & Snarskii, A. (2010). Where is everybody? – wait a moment… new approach to the Fermi paradox. *Preprint*, arXiv:1007.2774.

Bjoerk, R. (2007). Exploring the Galaxy using space probes. *Intl. J. Astrobiology*. **6** #2, 89–93. *Preprint*, arXiv:astro-ph/0701.238.

Brin, G.D. (1983). The great silence – the controversy concerning extraterrestrial intelligent life. *Q. J. R. Astron. Soc*. **24**, 283–309.

Carroll, S. (2004). Why is the universe accelerating? *Carnegie Observatories Astrophysics Series 2*, ed. Freedman, W.L., Cambridge University Press; *Preprint*, arXiv:astro-ph/0310342.

Cotta, C. & Morales, A. (2009). A computational analysis of galactic exploration with space probes: implications for the Fermi paradox. *J. Br. Interplan. Soc*. **62**, 82–88.

Haqq-Misra, J. & Baum, S.D. (2009). The sustainability solution to the Fermi paradox. *J. Br. Interplan. Soc*. **62**, 47–71.

Hart, M. (1975). Explanation for the absence of extraterrestrials on Earth. *Q. J. R. Astron. Soc*. **16**, 128–135.

Komatsu, E. *et al.* (2011). Seven-year Wilkinson Microwave Anisotropy Probe (WMAP) observations: cosmological interpretation. *Astrophys. J. Suppl*. **192**:18, 1–47. *Preprint*, arXiv:1001.4538.

Landis, G.A. (1998). The Fermi paradox: an approach based on percolation theory. *J. Br. Interplan. Soc*. **51**, 163–166.

Maccone, C. (2010). The statistical Fermi paradox. *J. Br. Interplan. Soc*. **63**, 222–239.

Newman, W.L. & Sagan, C. (1981). Galactic civilizations – population dynamics and interstellar diffusion. *Icarus* **46**, 293–327.

Prantzos, N. (2013). A joint analysis of the Drake equation and the Fermi paradox. *Int. J. Astrobiol*., *Preprint*, arXiv: 1301.6411.

Sagan, C. (1963). Direct contact among galactic civilizations by relativistic interstellar spaceflight. *Planet. Space Sci*. **11**, 485–499.

Sagan, C. & Newman, W. (1983). The solipsist approach to extraterrestrial intelligence. *Q. J. R. Astron. Soc*. **24**, 113–121.

Shostak, S. (2009). Boldly going nowhere, NewYork Times, 14 April 2009.

Tegmark, M. (1997). On the dimensionality of spacetime. *Class. Quant. Gravit*. **14**, L69–L75.

Tipler, F. (1980). Extraterrestrial intelligent beings do not exist. *Q. J. R. Astron. Soc*. **21**, 267–281.

Webb, S. (2002). Where is everybody?. *Fifty Solutions to the Fermi Paradox*. Copernicus Books, New York.

Wiley, K. (2011). The Fermi paradox, self-replicating probes, and the interstellar transportation bandwidth. *Preprint*, arXiv:1111.6131.