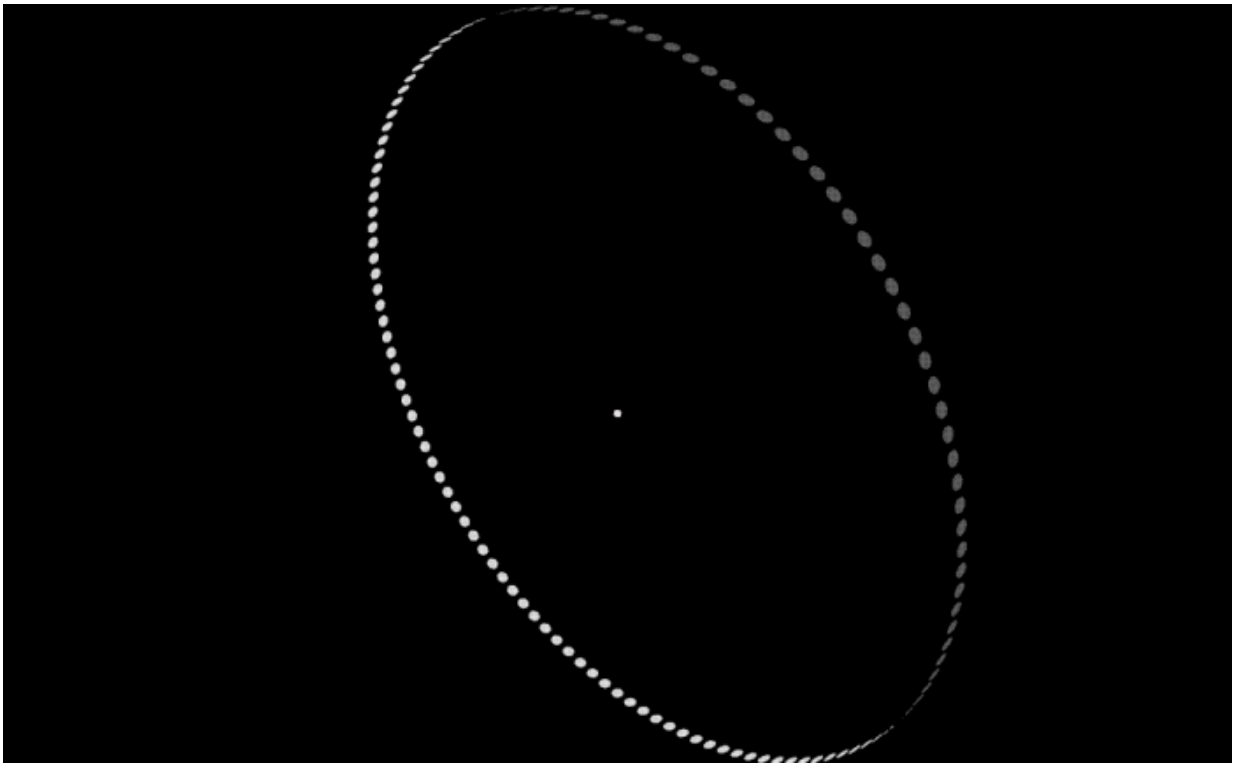
Finding alien megastructures around nearby pulsars

May 16 2017, by Matt Williams



Artist's representation of a Dyson ring, orbiting a star at a distance of 1 AU. Credit: WIkipedia Commons/Falcorian

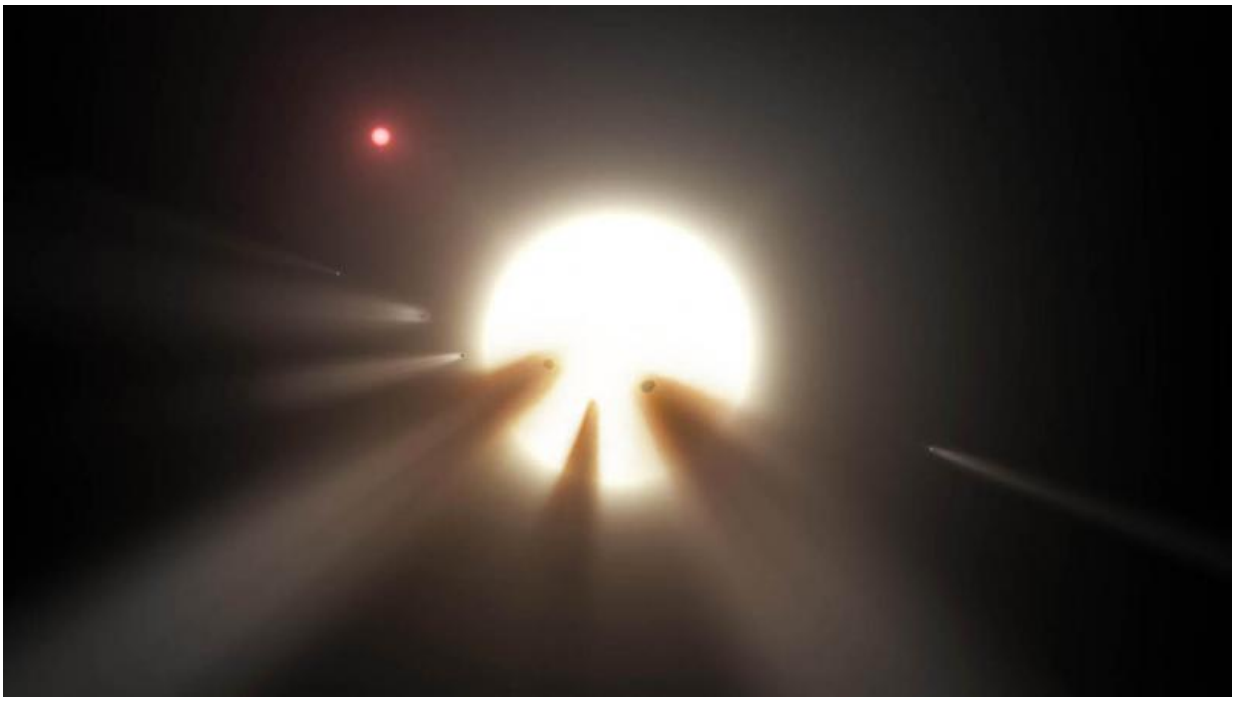
During the 1960s, Freeman Dyson and Nikolai Kardashev captured the imaginations of people everywhere by making some radical proposals. Whereas Dyson proposed that intelligent species could eventually create megastructures to harness the energy of their stars, Kardashev offered a

three-tiered classification system for intelligent species based on their ability to harness the energy of their planet, solar system and galaxy, respectively.

With missions that are now capable of locating extra-solar planets (i.e. the Kepler Space Observatory) scientists have been on the lookout for signs of possible alien megastructures. Unfortunately, aside from some very arguable results, no concrete evidence has yet come to light. Lucky for us, in a study from the Free University of Tbilisi, Professor Zaza Osmanov offers some new insight on why megastructures may have eluded us so far.

While fascinating, the idea of alien megastructures invariably suffers from the same problem as all other attempts to find signs of intelligent life in our Universe. Basically, if intelligent life exists, why have we consistently failed to find any evidence of it? This conundrum, which was summed up by Enrico Fermi in the 1950s (thereafter known as the Fermi Paradox), has hung like a shadow over all our efforts.

For example, in the summer of 2015, a team of astronomers announced that they found what might be an indication of an alien megastructure around Tabby's Star (KIC 8462852). However, they were quick to point out that any number of possibilities could explain the strange dimming pattern coming from the star, and subsequent studies offered even more plausible explanations – such as the star having consumed a planet at some point in its past.



Artist's impression of an orbiting swarm of dusty comet fragments around Tabby's Star. Credit: NASA/JPL-Caltech

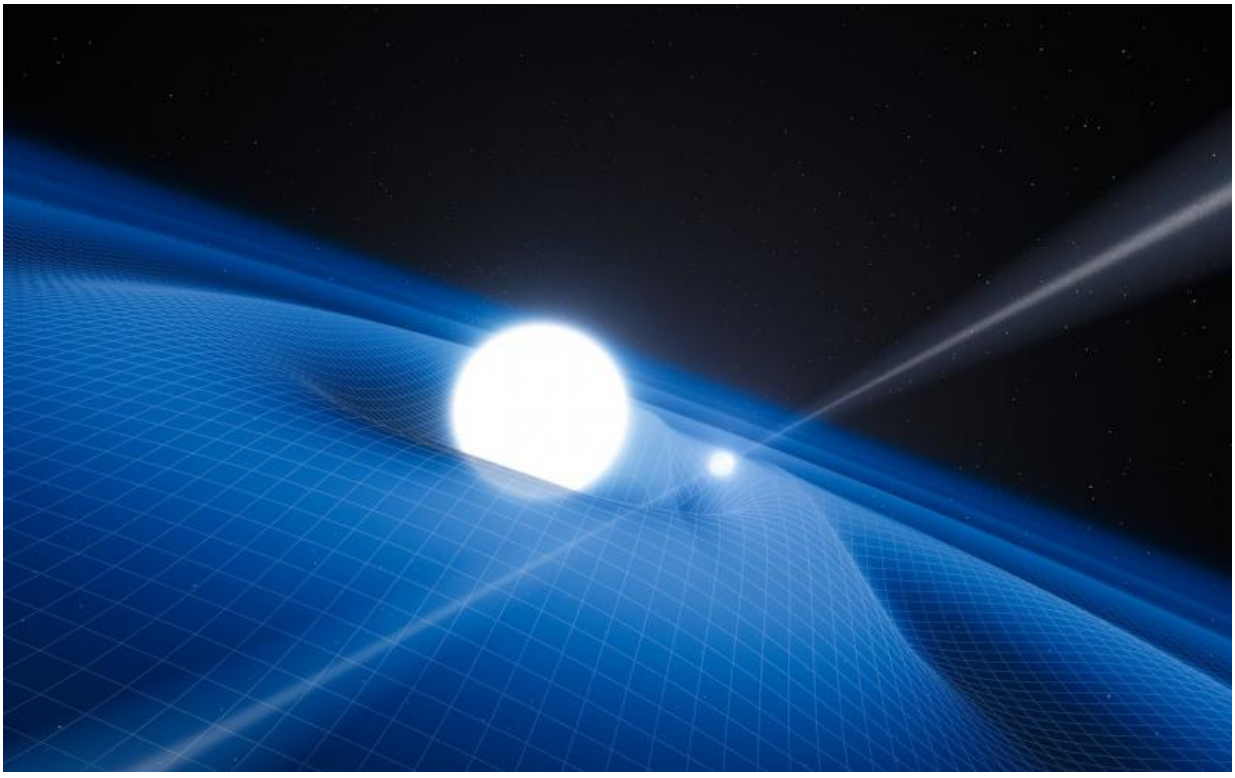
To this, Osmanov has argued that the problem is that we are looking in the wrong places. Last year, he wrote a research paper in which he ventured that an alien super civilization – i.e. one that was consistent with a Level II Kardashev civilization – would likely use ring-like megastructures to harness the power of their stars. This is in contrast to the traditional concept of a "Dyson's Sphere", which would consist of a spherical shell.

Furthermore, he argued that these Dyson Rings would likely be built around pulsars rather than stars, and offered estimates on their dimensions which were dependent on the rotational speed of the pulsar. According to Osmanov's latest study, titled "Are the Dyson rings around pulsars detectable?", Osmanov extends the problem of spotting alien

megastructures to the observational realm.

Specifically, he addressed how alien megastructures could be spotted by identifying their infrared energy signatures, and at what kinds of distances. By examining how such structures would vary in terms of the amount of IR radiation they would emit, he believes that they could be spotted within our local Universe using existing instruments.

Once again, it comes down to the diameter of the structures, which would in turn depend on the type of pulsar they orbit. As he states in the paper:



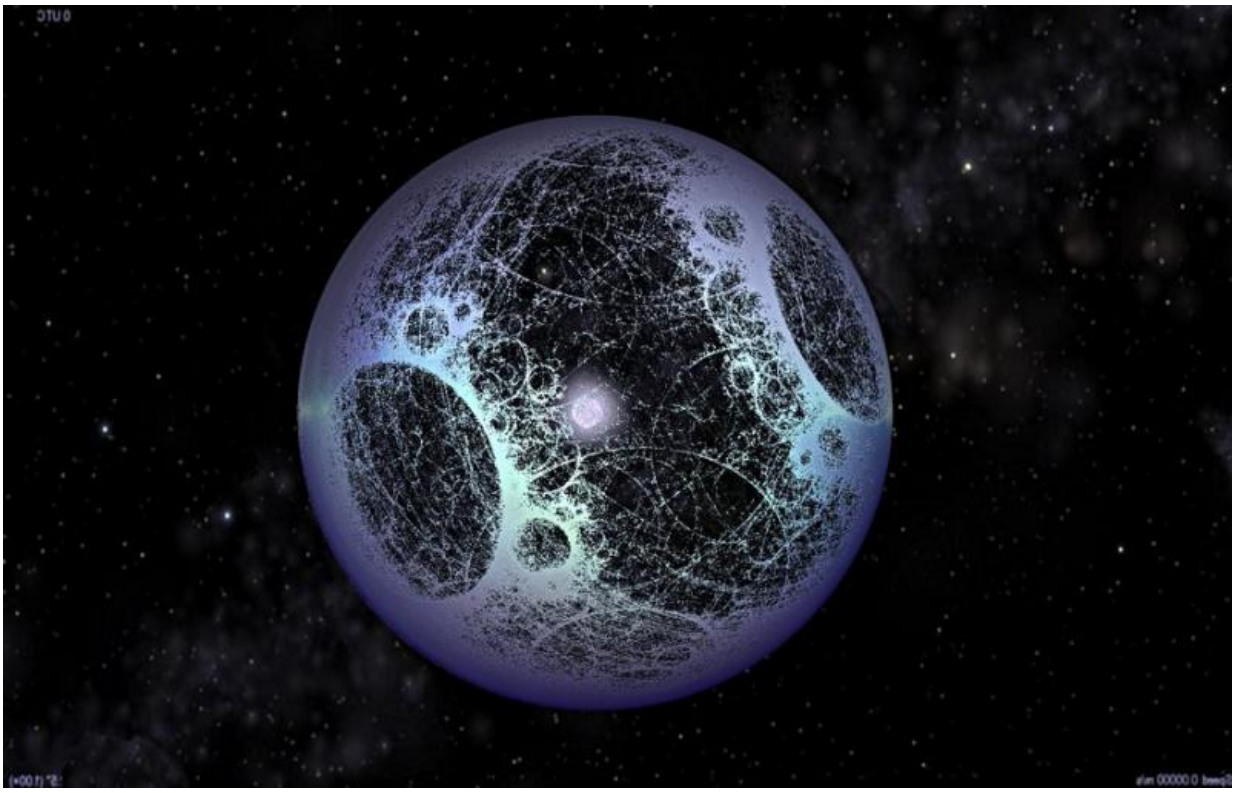
rtist's impression of the exotic double object that consists of a tiny neutron star orbited every two and a half hours by a white dwarf star. Credit: ESO/L. Calçada

"A couple of years earlier before publishing the paper of Kardashev, the prominent physicist Freeman Dyson has suggested that if such superadvanced (in the terminology of Kardashev, Level-II) extraterrestrials exist, for increasing efficiency of energy consumption they can construct a thin spherical shell with radius ?1AU surrounding a host star (Dyson 1960). It has been argued that for such distances the sphere will be in the so-called habitable zone (HZ) and therefore the sphere will have the temperature of the order of (200 – 300 K), making this object visible in the infrared spectrum."

Extending this to pulsars, Osmanov estimates that the habitable zone around a relatively slowly-rotating pulsar (with a period of about half a second) would be on the order of 0.1 AU. According to his calculations, a ring-like megastructure that orbited a pulsar at this distance would emit temperatures on the order of 390 K (116.85 °C; 242.33 °F), which means that the megastructure would be visible in the IR band.

From this, Osmanov concludes that modern IR telescopes – such as the Very Large Telescope Interferometer (VLTI) and the Wide-field Infrared Survey Explorer (WISE) – would have the necessary capacity to monitor nearby pulsars for signs of alien megastructures. He further concludes that for this purpose, these telescopes would have an effective range of up to 200 parsecs (~652 light years).

In addition, he goes on to state that within this volume of space, multiple candidates could be found and examined using these same existing instruments:



Ever since it was first announced in 2015, there has been speculation as to what could account for the dimming of KIC 8462852. Credit: Eburacum45/SentientDevelopments.com

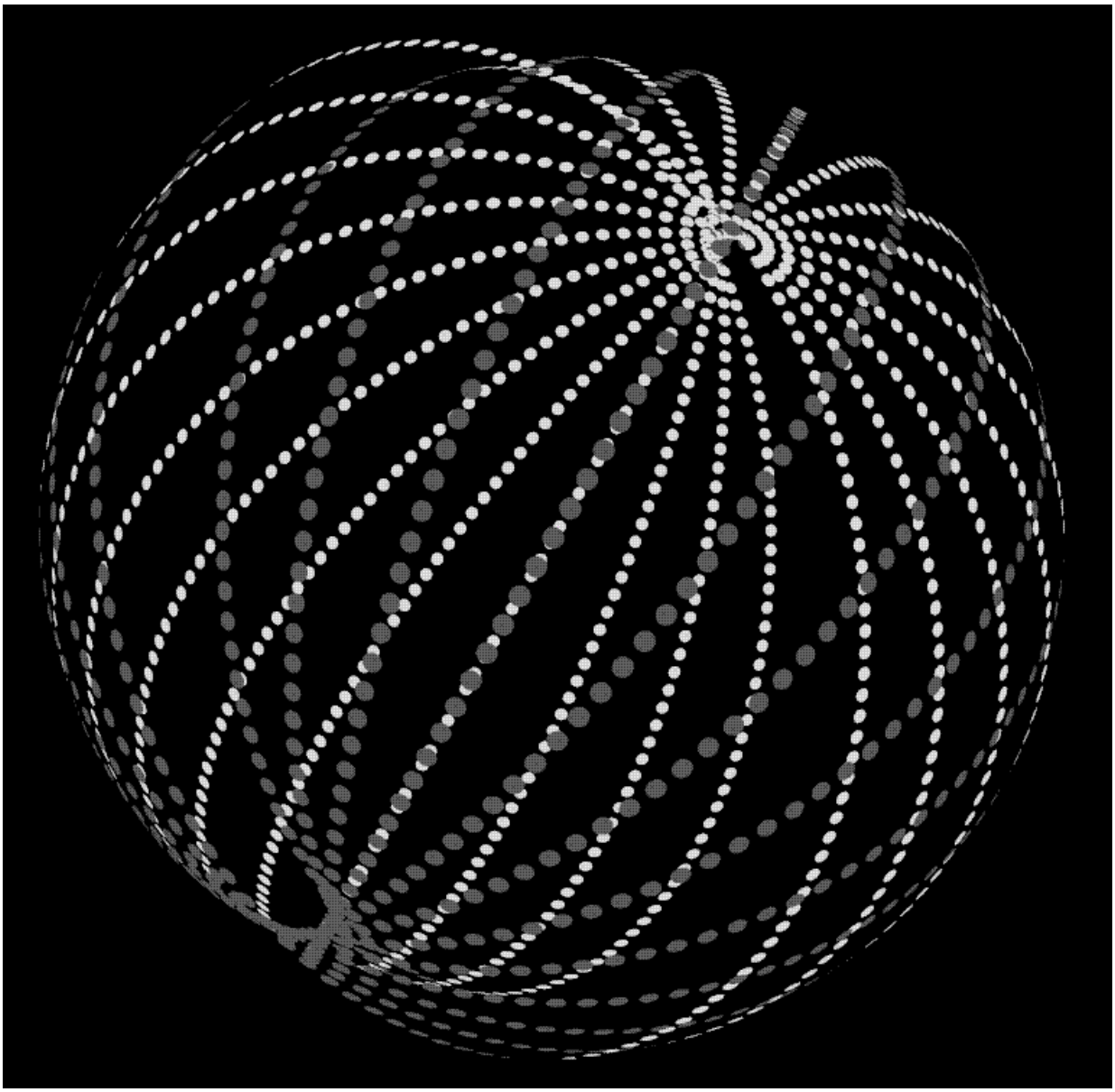
"We have considered the sensitivity of VLTI and by taking into account its higher possible angular resolution, 0.001 mas, it has been shown that the maximum distance ~0.2 kpc leads to the IR spectral density of the order of 7.4 mJy, which in turn, can be detected by the VLTI. We have argued that by monitoring the nearby zone of the solar system approximately 64 pulsars are expected to be located inside it."

Beyond these distances, up to the kiloparsec range (about 3260 light years), the angular resolution of these telescopes would not be enough to detect the structure of any rings. As such, finding megastructures at this

distance would require telescopes that can conduct surveys in the UV band – which corresponds to the surface temperatures of neutron stars (7000 K). However, this would have to wait upon the development of more sensitive instruments.

"As we see, the search of infrared rings is quite promising for distances up to -0.2 kpc, where one will be able to monitor potentially 64 ± 21 pulsars by using the IR instruments," he concluded. "Observation of distant pulsars (up to -1kpc), although will significantly increase the total number of potential objects – to 1600 ± 530, but at this moment the UV instruments cannot provide such a level of sensitivity."

So while the range would be limited, the opportunities for testing this hypothesis would not. All told, between 43 and 85 candidates exist within the observable volume of space, according to Osmanov's estimates. And with existing IR telescopes – and next-generation telescopes like the James Webb Space Telescopes – up to the task, some surveys could be conducted that would yield valuable information either way.



There are Dyson rings and spheres and this, an illustration of a Dyson swarm. Could this or a variation of it be what we're detecting around KIC? Not likely, but a fun thought experiment. Credit: Falcorian/Wikipedia Commons

The concept of alien megastructures remains a controversial one, and for good reason. For one, the potential evidence for such structures – i.e. the

periodic dimming of a star – can easily be explained by other means. Second, there is an undeniable degree of wishful thinking when it comes to the search for extra-terrestrial intelligence, which means that any findings could be subject to bias.

Nevertheless, the search for intelligent life remains a very fascinating field of study, and a necessary one at that. Not only would finding other examples of life in our Universe put to rest one of the most burning existential questions of all time – are we alone? – it would also allow us to learn a great deal about what other forms life could take. Is all life carbon based, are there other possibilities, etc? We would like to know!

In the end, the Fermi Paradox will only be resolved when we find definitive evidence that there is intelligent life out there other than our own. In the meantime, we can expect that we will keep searching until we find something. And anything that make this easier by telling us where we should (and what specifically to look for) is sure to help.

More information: Are the Dyson rings around pulsars detectable? arxiv.org/abs/1705.04142

Source: Universe Today