Question 1:

Dear Cheap Astronomy – Alien diplomacy

A recent paper by John Gertz called Interstellar Diplomacy suggests some kind of contact with aliens is inevitable, which seems reasonable with respect to some kind of radio transmission, but the paper then goes on to suggest that contact might involve a robotic scout vehicle sent here from an a distant alien civilization, which seems somewhat less inevitable and then it descends into farce by further suggesting such scouts might have flown through our atmosphere already, you know like those UAP things that the US Airforce and NASA are investigating. Yikes.

But anyway, if you can get past that bit, the paper starts getting interesting again. After all, it's not completely implausible that an advanced civilization could send out scout vehicles to likely life-harbouring stellar systems like ours – or at least the scouts might cruise past and stop for a closer look if they detect re-runs of I Love Lucy. Anyway, if such a robotic scout did enter our Solar System with some kind of dynamic AI aboard, then a 2-way conversation could ensue. It's assumed the alien AI will be able to figure out our language, if not languages and also interpret the broader dynamics of our behaviour – including our enthusiasm for 2 way conversations. It could then engage with us and we with it and we'd engage knowing the scout would be relaying its findings about us back to its home world, even though that message might take hundreds of years to get there.

So, the implication is that we'd better make a good impression and the paper optimistically proposes that whatever is said to the scout should be agreed to in advance by three quarters of the United Nations. Now, maybe that could work if the aliens are far away enough that contact is only possible through large government-owned broadcasting antennae like the 70 metre dishes of the Deep Space Network. But otherwise, it seems highly unlikely that everyone on the planet is going to agree to let the UN decide what to say to aliens that are in general hailing distance. And if you can just use a backyard transmitter, then it's almost inevitable that someone is going to send the aliens a picture of their butt.

To avoid such an outcome, the paper proposes criminal charges and imprisonment should be the result of such unauthorized instances of METI – that is, messaging extra-terrestrial intelligences. This does seem a little draconian, not to mention almost impossible to enforce since you've somehow got to weed out that one butt picture from the current cacophony of terrestrial radio noise that surrounds our planet.

If it does eventuate that communication is limited to government-controlled antennae, the paper proposes that the UN should also reserve the right to redact any information received from an alien source, ostensibly to withhold the location of its source and hence prevent butt picture transmissions, but at the same time – really? We're all going to agree that a privileged oligarchy will determine what the general populus should and shouldn't know about whatever the aliens decide to tell us.

In any case, the whole premise of sending alien scout ships to multiple stellar systems is possible the way lots of things are possible, but not actually all that likely given there's not much in it for the aliens to invest such a massive amount of infrastructure. If they've got the technology to fly AI robot scouts out to lots of stellar systems, they also have the technology to just broadcast the specs of a 3d printer along with the specs of an AI scout we could just build and then put on a table to have a conversation with. Indeed this may be a preferred solution for an advanced civilization that has already contacted some nearby neighbouring civilisations and received some unreasonably close-up pictures of their anatomy in response. So instead their galaxy-wide transmissions would be saying that if you're smart enough to interpret this message and follow the instructions, then have a chat with the bot and we'll get back you later if it seems worthwhile.

Question 2:

Dear Cheap Astronomy – The ultraviolet habitable zone

Current lists of potentially life-bearing exoplanets are determined by them being in their star's circumstellar zone in which temperatures would allow liquid water to form – also known as the Goldilock's zone. The other main required feature is that they be rocky rather than gaseous, which is determined through measurement of the planet's mass and its likely size – so a large mass planet with a small diameter suggests a expecting to find life on planets and systems most like the Earth and the Sun, since we're assuming all life we automatically follow the one and only example that we know of. But at the same time there is an Occam's razor logic to it. Why chase a bunch of speculative solutions when you know there is one solution that works. In other words, the assumption that stellar systems most like the Earth-Sun system might have life is a safe bet.

But, is being rocky and being in the right temperature zone all there is to it? Well, apparently not according to a June 2023 article by Spinelli et al in the Monthly Notices of the Royal Astronomical Society. They have proposed that you need a minimum level of ultraviolet light to generate photochemical reactions that lead to abiogenesis – that is life from lifelessness, more specifically the generation of ribonucleic acid RNA from chemical pathways known as cyanosulfidic chemistry, which may also generate proteins and lipids, that is fats. The key reaction involves UV light acting on hydrogen cyanide – which is composed of hydrogen, carbon and nitrogen and given that it's all happening in an aqueous solvent – that is, water – you also have a source of oxygen nearby. These are the core chemical ingredients of life as we know it.

Again, this is us naively assuming that all life in the Universe will follow the same chemical pathways that led to life on Earth, but also again – it does make sense to look for environments that might support such chemical pathways, given that we know for a fact that those pathways have generated life at least once.

Anyway, putting all this together, you not only need liquid water, which can only happen in a narrow temperature range, but also you a minimum amount of UV light to drive abiogenesis – but you also can't have too much UV radiation since too much has disruptive effect on biochemical structures. So, there's a definable ultraviolet habitable zone. The paper's authors then calculate that for a star to have a circumstellar habitable zone – that is where water is a liquid – that coincides with its ultraviolet habitable zone, that star will need a minimum surface temperature of at least 3900 Kelvin, which on the OBAFGKM stellar classification by surface temperature means at least a K star – where M type stars at the lower end of the scale are red dwarves, then there's K type stars and then there's G type stars, which are the Sun-like stars.

After that you getting into a range of too hot stars, where even in circumstellar temperature zones where water might form there's still too much UV radiation – which is not only unfriendly to life, but also unfriendly to atmospheres, which would be strongly ionized by the UV light as well as likely being blown away altogether by the stronger stellar winds associated with those hotter stars.

So the paper offers a way of constraining likely exoplanets with life, if we except its key premise that you need a minimum level of UV radiation to have life. If that is really the case, then the planets around red dwarves are out of the picture – noting they are a big chunk of the exoplanets discovered so far, since red dwarves comprise 75 per cent of all the stars in the Universe. It could be that those red dwarf exoplanets are lifeless, but are also habitable – since they are rocky and watery and aren't being blasted by high energy ionizing radiation. So, perhaps someone could move in without violating the prime directive. Perhaps.