For my PHYS 1040 signature assignment, I have chosen to focus on the American military science fiction media franchise known as *Halo.* The series focusses on an interstellar war between humanity and an alliance of aliens known throughout the series as the Covenant.

In the *Halo* science-fiction franchise there are a group of megastructures/superweapons known as the Halo Array throughout the series. This is also where the franchise gets it's namesake from. The Halo Array consist of ringworlds which were created by a hyper-intelligent alien species to contain and study the "Flood", an infectious alien parasite. Each Halo ring is capable of sustaining its own weather and wildlife, as well as artificial gravity, which is why they were chosen to house the parasitic species.

While in the *Halo*-universe this seems perfectly plausible, would a ringworld be feasible in ours?

The ringworlds have been stated to range from 10,000 kilometers to 30,000 kilometers in diameter, but we will only focus on the 10,000 kilometers ringworlds because these are more common and relevant in the *Halo* storyline. With a width of 5.37 kilometers and a thickness of 22.3 kilometers, the total volume of a ringworld would be around $224\ million\ km^3$. In comparison that is a bit more than 0.02% of the volume of Earth. Each ringworld's surface area is roughly 10 million square kilometers, which is slightly larger than the surface area of Canada and about 2 percent of the surface area of Earth.

As in most science fiction franchises, the actual base materials of what compose these super structures is classified as "unobtanium." This is just a stand in for any hypothetical, fictional, or impossible material. However, let's say that this ring did exist in our solar system then what materials would it possibly be comprised of?

Let's look at what materials would logically be present if the Halos existed in our universe. Due to the numerous asteroids in our system, it is safe to assume that iron, nickel, and carbon would be available for building materials. While not as common, nickel and magnesium could also be present which, when combined with iron and carbon, will create a very strong and relatively light steel alloy. We know that the average density of steel is

$7.7\ grams\ per\ cm^3$, so by doing some simple math we can determine each ring will weigh about $1.7 * 1{,}017kg$, or 1,700 million billion kilograms. As to where these materials would come from, you would have to take the entirety of the Asteroid Belt between Mars and Jupiter to have just enough mass to construct a singular ringworld.

Now that we know just how massive these megastructures are, let's more on to how gravity would actually work on one.

The way gravity works on these spinning rings is through tangential vectors. As the ring spins, your body us pulled away from that vector at a constant rate, which mean you will constantly feel a change of direction over time, or $\frac{\Delta V}{Time}$ or acceleration. You can control the amount of gravity by changing the rotational speed, so speeding up will increase gravity and slowing down will lessen gravity, simple as that.

This wouldn't seem so bad if the Rings obeyed the same gravitational constant of $9.8m/s^2$ as Earth does. However, because these are giant super structures in space, this would be unwise to follow in a practical sense. According to the math done by the Game Theorist in his video about the *Halo* ringworlds (7:38), the actual gravity on the ringworlds adds up to be approximately $15.17m/s^2$ or about 1.55Gs. To maintain this type of force, each ringworld will need to rotate at a speed of 23.95 rotations a day. While this may seem slow in relations to the ringworld's size, your tangential velocity would be almost $8{,}711m/s$ $(31{,}359.6\ km/hr)$! If you were already on the surface of a ring to begin with, then this wouldn't be so terrible. But remember how the ringworlds have no gravity of their own? This means any spaceship wanting to land on the surface would have to match that rotational speed without crashing into the ringworld itself at speeds that exceed MACH 25. This would be a serious problem considering humans can only withstand up to 4-6Gs.

Having established the speed at which the ringworlds would need to be rotating, let's see if it would be possible to sustain weather. For weather to be possible let's assume there is an atmosphere created by large magnetic fields the ringworlds produce. Instead of the typical four-season type weather one would see on earth and in the *Halo* series, it would be completely opposite. Each of the ringworlds rotate perpendicular to Earth's rotation, triggering

a much more intense Coriolis effect than would happen on Earth. This would cause massive thunderstorms and tornados to be a common weather state on the ringworlds. Because of the perpendicular rotation, these storms would be rotating vertically. In short, a tornado on the surface of a ringworld could suck you into it without even touching the ground you are standing on.

To wrap things up nice and neat, would a ringworld be feasible in our universe today? Given that the *Halo*-series is set in the twenty-sixth century and we currently live in the twenty-first century, it may be safe to assume that in 500 years technology would be advanced enough for space travel to be a common and advance circumstance. But, sadly, it needs to be stated that with the speeds needed to maintain the ringworld's artificial gravity and extreme weather state it would not be the same ringworld as seen in *Halo* and therefore not possible. Perhaps if there were some change in materials or a way to manipulate magnetic waves to generate gravity instead of relying on such intense rotation speeds then it would more closely match the ringworld seen in *Halo.* In conclusion, no, a ringworld from the *Halo* series would not be feasible in our current standing universe.

Sources

The Deadly Physics of the Halo Rings! - https://www.youtube.com/watch?v=UrLey-pX7Bc

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