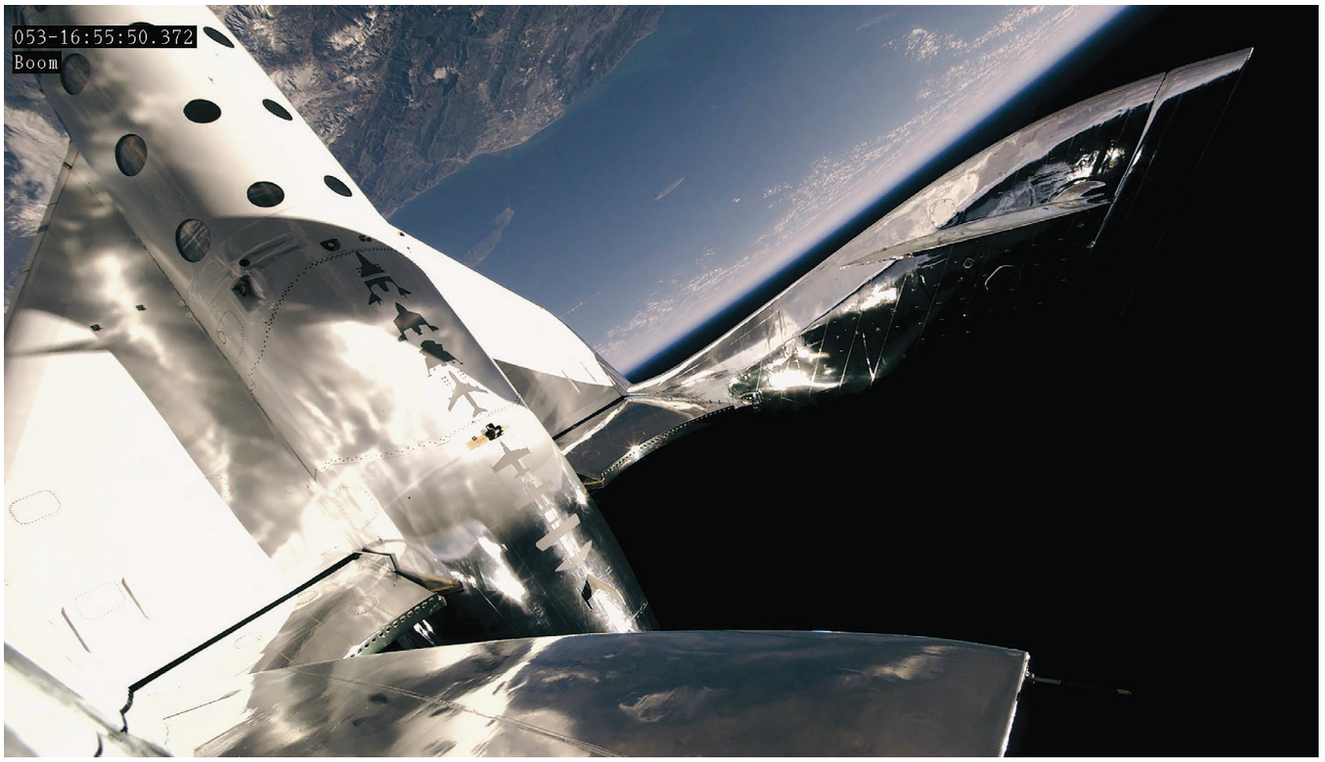
COMMENTARY Timothy G. Nelson



VIRGIN GALACTIC

Where does space begin? The decades-long legal mission to find the border between air and space

Although very few people have been to "outer space," virtually everyone has some conception of what it is. We have seen TV reports of astronauts (or cosmonauts) in orbit. Our popular culture – in film, books, art and even music – is suffused with images of space. We conceive it as a place beyond the Earth's physical limits, where there is no atmosphere, where things are "weightless" and where spacecraft operate (and where, according to the promoters of the 1979 film *Alien*, "no one can hear you scream").

As lawyers, we know that there exists a thing called "space law," governing the peaceful uses of "outer space." Many may be surprised, therefore that there is, at present, no agreed definition on where "outer space" actually begins. Stranger still, perhaps, many of the leaders in space exploration (the United State, in particular) have vigorously opposed any attempts to fix such a definition.

The result is that no one at present can say with certainty – from a legal perspective – where the "Earth" ends and where "outer space" begins.

This definitional gap is evident in the main repository of space law, the 1967 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, otherwise known as the Outer Space Treaty. This treaty, which has been ratified by over 100 countries (including the major spacefaring nations), lays >

SpaceShipTwo, with its tail booms raised in the feathered position, near the 89.9-kilometer peak altitude the vehicle achieved during its Feb. 25 suborbital spaceflight.

< > down a series of basic rules about the use of "outer space," but does not define "outer space."

A paradox thus arises. While the Outer Space Treaty lays down a series of widely accepted principles about "outer space," – for example, "outer space" must "be free for exploration and use by all States,"... "is not subject to national appropriation by claim of sovereignty," and must be used peacefully (such that "nuclear weapons or any of kinds of weapons of mass destruction" may not be deployed in outer space) – the boundary between Earth and "outer space" is not defined, because the Outer Space Treaty's drafters could not agree upon this issue.

This has practical implications for entities engaged in ultra-high altitude navigation, because there is a split in the rules for "aviation" (intuitively, flight through air) and space flight. Aviation law (as laid out, for example, in the 1944 Convention on International Civil Aviation) is based on the principle that "every State has complete and exclusive sovereignty over the airspace above its territory." So a vehicle traveling in a nation's "airspace" is subject to that nation's aviation regulations, as well as its right to deny access. By contrast, once it enters "outer space," that vehicle is no longer subject to any national sovereignty – and enjoys the navigational freedom accorded by the Outer Space Treaty, much as a ship enjoys freedom of the seas. But neither system (aviation law or space law) tells us where that freedom begins.

The international rules governing liability for flight in the two regions are very different, too. For example, passenger aircraft are subject to a panoply of treaty rules governing aviation safety and liability, largely focusing on the carrier's potential liability, whereas spacecraft are subject to different treaty rules, largely focusing on the liability of the state from which "space objects" are launched. These treaties were negotiated when (at least in the minds of the drafters) air and space travel were very distinct, but with the growth in suborbital fight technologies, and the growing interest in space tourism, the functional distinction between air flight and spaceflight is less easily drawn.

X-15 test pilot Bill Dana was one of eight U.S. pilots to earn astronaut wings for flying the hypersonic rocket-powered aircraft to suborbital altitudes. X-15 reached 81 kilometers or higher 13 times in the 1960s.

Over the last 50 to 60 years, commentators and countries have been unable to reach consensus on how to draw the boundary between airspace and "outer space." A similar impasse is evident within the U.N.'s space law working group in Vienna that has been attempting since 1984 to resolve the issue. Among the various competing methods that have been proposed are:

• **A distance rule,** using a simple, fixed upper altitude boundary. Australia, Denmark and Kazakhstan, for example, take the position that airspace ends at 100 kilometers above sea level. Some other countries have followed this approach. In 2017, the chairman of the U.N. space law working group (perhaps to break the current deadlock) supported this approach "as an official position."

• **The Von Kármán Line –** treating airspace as ending (and space beginning) at the point where it is impossible to fly an aircraft – an attractive approach in theory, but subject to changes whenever technology itself changes. The line was recently revisited in an important new study by astrophysicist Jonathan C. McDowell of the Harvard–Smithsonian Center for Astrophysics. He observed that, while some have said that 100 kilometers is the "line," the U.S. Air Force awards astronaut wings to any pilot who has gone above 80 kilometers, apparently on the basis that aircraft that fly above that altitude (such as the rocket-powered Bell X-15) have no aerodynamic control.

• **Orbiting line.** McDowell notes that, under this view, airspace ends (and outer space begins) at the lowest perigee of an

NASA

U.S. Transportation Secretary Elaine Chao pins FAA astronaut wings on SS2 pilot Frederick "CJ" Sturckow during a Feb. 7 ceremony in Washington as Virgin Galactic founder Richard Branson looks on.

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orbiting satellite – perhaps as high as 160 kilometers, but arguably lower; because a satellite with an elliptical orbit can sustain a perigee of 100 kilometers for long periods, whereas a satellite with a circular orbit can operate at 125 kilometers

Every proposal, however, has drawn some criticism. Some fear that if a line is drawn relatively low, there will be a host of activities above the line that would potentially go unregulated. For example, some of the submission to the U.N. working group have warned that because the "near-space" area, of up to 160 kilometers from sea level, is subject to growing use (e.g., from spent rocket stages and/or suborbital vehicles), there is a legitimate need to regulate that space as a separate zone. A too-low boundary may also raise security concerns.

Equally, if the boundary between air and space is drawn too high, then this might obstruct space launches and satellite traffic – and will also clash with the existing role of the International Telecommunication Union, which is responsible for allocating satellite orbital slots, including in commercially vital geostationary orbits. An extreme example of boundary-drawing is the Bogota Declaration of 1976, in which a group of equatorial states laid claim to the geostationary orbit areas above them. This claim, however, was met with widespread skepticism at the time and is not widely accepted.

There are also technical uncertainties associated with measuring the line. Satellite and aircraft capabilities may change over time, meaning that the Von Kármán or orbiting line may also change. Even if the line is fixed at a given distance such as 100 kilometers, technological advances may render that border unsound. Above all, the concept of the Von Kármán Line ignores that there are apparently several layers of space with different characteristics. McDonnell's study, for example, tells us that above the stratopause there is the mesosphere , the thermosphere and then the exosphere. Particles in these layers are said to behave differently.

These and other arguments have motivated some countries, such as the United States, to urge that no attempt should be made to define the boundary between airspace and outer space. To quote the U.S. State Department in a 2001 statement to the U.N.:

Our position continues to be that defining or delimiting outer space is not necessary. No legal or practical problems have arisen in the absence of such a definition. On the contrary, the differing legal regimes applicable in respect of airspace and outer space have operated well in their respective spheres. The lack of a definition or delimitation of outer space has not impeded the development of activities in either sphere.

The U.S. position of remaining deliberately agnostic on this issue might not be sustainable in the long run. As the use of space grows, the number of countries interested in regulating it may also grow. There are advantages to reaching consensus on the issue: If countries can agree upon a workable boundary, they may also be able to agree on related issues, such as clear rights of peaceful passage through other countries' airspace, to the extent necessary to enter (or return from) space.

It is also unsafe to assume that, if no boundary delimitation is agreed upon, the issue can be left open indefinitely. The two zones (air space and outer space) indubitably exist, and are recognized by international law. It follows that a boundary must exist somewhere. By not defining it themselves, countries run the risk that, in the event of a future dispute, an international adjudicative body will define it for them.

Furthermore, the regulatory areas of friction are likely to grow. While, at present, the practical debate has tended to focus on the differing rules of navigation and safety, there is a host of other policy areas – taxation, intellectual property, national security and privacy, to name but a few – where a clearly defined boundary between air and space may be useful in the long run. We can all talk about boldly going into space, but the sticklers among us would like to know where space actually begins. **SN**

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