# Space and Time are Emergent Even in Special Relativity

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https://youtu.be/TAhbFRMURtg&lc=UgxdEbVDZ-VUgocsqBN4AaABAg

A Comment on the WIRED YouTube post:
*Theoretical Physicist Brian Greene Explains Time in 5 Levels of Difficulty* (Apr 19, 2023)
https://youtu.be/TAhbFRMURtg?t=27m16s

27:16 BG *"Many people have begun thinking about the possibility that space and time may be so-called 'emergent' quantities, that they're not as fundamental as perhaps Newton or Einstein would have thought."* Recognizing that distance-like separations occur only between *events,* not "objects," is the most straightforward proof that space and time are emergent. Even worse, the resulting set of length and time metrics have meaning *only* to the observer, not to the universe as a whole.

The light I see from an object 0.3 kilometers away tells me that *something* existed at that location 1 microsecond ago. However, the universe gives me *no* proof at the time of my observation that the object still exists. Even worse, if I happen to be moving towards the object at 0.707 of light speed, my measured distance drops by half, and the duration between observation events doubles. Thus neither length nor duration units for observation events are stable since both depend on my local state of motion.

On the other hand, hmm: The *product* of my metrics for observing events — that is, 0.3 km times 1 microsecond — *is* stable. No motion I can do changes that metric, meaning it gives a better understanding of the *invariant* degree of separation of two events in the universe. And, again, only *events* count since object stability is nothing more than a statistically sound assumption of brains. It helps us survive but is not fundamental since all things can and often do disappear, even at the particle level.

The point is this: Once you stop assuming that "object-ness" is a *fundamental* property of the universe, all separations become events whose only stable separation has units of length times duration. How we parse that area-like distance into length and duration becomes a local choice that depends on how we move when taking the measurement. This local flexibility in how we *create* length and duration from the more invariant metric of length-duration is the deeper source of observer relativity. The 4.25 lightyear distance to Proxima Centauri thus varies depending on how fast we try to get there, but its stubborn Lorentz-product *event separation* stays invariant at 18 lightyear-years. No matter how fast you go, that metric has no free lunch or shortcut.