

The Unity of SpaceTime

*What I'm really interested in is whether God could have made the world in a different way; that is, whether the necessity of logical simplicity leaves any freedom at all. —
Albert Einstein*

Relativity describes Nature from quark to cosmos. Relativity empowers its user to ponder deeply, to analyze widely, to predict accurately. It is a theory of fantastic innocence, simplicity, and power.

Yet "relativity theory" is a misleading term, a term Albert Einstein avoided for years. True, he recognized and revealed to the world that the time between two events is typically different as recorded by Earth observer or spaceship commander. Time between events is relative. Relative too is the distance between events. Yet behind these differences Einstein discerned unity: concepts and quantities on which everyone in the universe agrees. What concepts and quantities?

Events. An explosion is an explosion. A birth is a birth. Whether it is the birth of a star or your own birth, everyone agrees that it happens.

Wristwatch time. Carry a wristwatch directly from one event to a second event, so that both take place at the wristwatch. Or lay a rod between two events that occur at the same time. Everyone, correctly predicts the wristwatch reading and this rod length.

The path connecting events. Were you, there, at the first event? Yes. And at the second? Yes. And the last? Yes. Does everyone in the universe agree that you were present at every event in this string? Yes. Does everyone agree on the advance of your wristwatch time from event to event along this entire string of events? Yes!

Conservation laws. Everyone agrees that momentum is conserved in a collision of particles. It is also conserved when particles are created, transformed, or annihilated in that collision. Energy, too, is conserved in the same collision, everyone agrees. -

Agreements of these four kinds bear witness to a powerful and simple unity, the unity of space and time: *spacetime*! Special relativity explores the unity of spacetime. General relativity recognizes that spacetime is not just a passive stage on which events occur; spacetime is an actor that takes part in physical events. All of relativity comes in a single simple sentence: *Spacetime grips mass, telling it how to move: and mass grips spacetime, telling it how to curve.*