

## Secret Clocks: The U.S. Military, Einstein's Relativity, and the Global Positioning System

*Tuesday, August 8, 2023 9:00 AM (25 minutes)*

For nearly a decade, beginning in the mid-1970s, a debate unfolded among physicists and engineers over how best to include effects from Einstein's general theory of relativity in the new military technology now known as the Global Positioning System (GPS). Although some exchanges were published in the open scientific literature, much of the debate played out behind the scenes, in memos, reports, and special review sessions arranged by the U.S. military. Theoretical physicists who had no relationship with the project criticized early efforts to incorporate relativistic effects within GPS designs, complaining that significant information was not shared by military contractors. Other experts in relativity, who consulted more closely with the U.S. Air Force while GPS was under development, responded that the outside critics had little relevant experience with real-world engineering applications, and that their criticisms amounted to mathematical irrelevancies. Throughout the debate, few doubted that relativity—with its counterintuitive notions of space and time—needed to be taken seriously in the design and operation of GPS. Rather, they disagreed over how best to incorporate deep lessons from relativity in an engineering-relevant way, at a time when the stakes for the new military technology loomed large.

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