Measurement of Differences and Relativity between Speeds of Light from Various Stars

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In 1905, Einstein published the Special Relativity based on these two postulates: 1. The laws of physics are the same in all inertial frames. 2. The speed of light in vacuum is constant regardless of any reference frame [1]. However, in the last decades there were also some hypotheses and observations which are inconsistent with the second postulate.

In order to test the constancy of light speed, we design a system to directly compare the travelling time intervals of several starlights and a terrestrial white light from the transmitter end to the detector end. Such that simultaneity and definitions of dimensional units problems can be avoid. At the transmitter, we use a telescope to collect the starlights from Capella and Aldebaran which are far away and have various relative radial velocities with respect to the Earth. In other words, the starlight sources have relative motion with respect to the detector. Then we modulate the starlights, the terrestrial 635 nm red light and 1550 nm infrared into pulses by a rotating mirror simultaneously. After travelling 4.32 km, these pulses are detected by the detector. We also employ a terrestrial white light to calibrate the system and track stability.

We carefully minimize the errors during the measurement and the data processing, and get some reliable results in these years. The average time delays of the starlight pulses from Capella and Aldebaran with respect to the terrestrial white light pulses are 2.65 ns and 3.12 ns, respectively. The results show that the speeds of starlights are different from the speed of terrestrial light, and are likely related to the relative radial velocities between the star and the Earth.