Progress of Laser Time Transfer at Chinese Space Station

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The Mengtian lab experiment module will be installed onboard the CSS (China Space Station) at the end of this year. And Shanghai Astronomical Observatory (SHAO) is responsible for the laser time transfer link, cooperated with Technology and Engineering Centre for Space Utilization, which is used to assess the stability of space-board atomic clocks and carry out tests of fundamental physics such as the gravitational red shift. The onboard hardware consists of a laser retro-reflector, a single photon detector package, and an event timer.

In addition, two new SLR stations with high stability are also included, aiming to achieve laser time transfer between CSS and the earth. To overcome lots of difficulties such as low orbit, fast range variation, and short overpass time, the payload is designed with specifications such as 58 high repetition rate of 10 kHz, large field of view up to 128 degrees, compact design, low noise, and high stability. A low-temperature drift detection circuit and input optical system with stable transmittance in various incident angles are applied, combined with ground laser emission energy control, to achieve low time walk in photoelectric detection. To realize all-day observation, we use two small pinholes, a super narrow-band filter, and range gate generator to reduce strong background noise. The frequency division clock signal was measured to calibrate the measurement epoch of the event timer in real-time.

The fly module of the laser time transfer payload was submitted in April of this year and its stability (TDEV) is better than 0.1ps@300s and 1ps@1day. Two SLR systems with an aperture of 40cm have been constructing. At the beginning of next year, the laser time transfer link will provide the scientific data for assessing the onboard atomic clock, and welcome your stations to participate.