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A Proposal of workgroup for Space Time-keeping System

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Space Time-keeping System is defined a kind of time unification system that is built on the coordinate of barycentre of solar system, to measure proper time based on definition of International Units System (SI) second and cesium atomic clock, and to unify the coordinate time based on pulsars. The current time keeping system on earth thinks the standard time to be unique and absolute, the technology of time dissemination or time service can unify whole human being's time, this thinking is called absolution viewpoint of time keeping. The instruments for measuring time synchronized by standard time, they have none ability and duty to do reproduction of SI second, because their time unit were trained by the dissemination single, and only the atomic clock groups which mission were time keeping have ability of reproduction of SI second. Now, there are about 500 atomic clocks to keep the International Atomic Time (TAI) by means of weight average, local on the earth geoid, and TAI is a kind of proper time on geoid. The earth geoid is actually an ideal ellipsoid surface, and each one atomic clock could not be placed exactly on geoid. In the future, human being will set bases on planet or satellite for long term, and space craft will do exploration task for long term, if still maintains the viewpoint of absolution time keeping, hold the earth standard time and deliver far away to the bases and space craft by the technology of time service, it will be seriously restricted by long distance in time-space. Einstein's theory of relativity told us that the effect of relative speed makes 'moving clock become slower', and the effect of red-shift makes 'clock in weak gravity field become faster', and the effect of Sagnac makes 'temporal metric in non-inertial coordinate depend on rotation rate', therefore, the time is also relative. The theory of space metrology based on General relativity put forward 4 viewpoints that 1) the absolute definition of SI second is a common convention by whole human being, it must be applied to any local and wide area; 2) Simultaneity is only valid in the same coordinate, different coordinates cannot get synchroneity, dissemination time between difference coordinate cannot get high accuracy; 3) the unification of time unit and unification of time measurement are conflict, therefore, the navigation by earth satellite and the navigation by pulsar are two different ways of unifying time; 4) the cesium atomic clock and the pulsar will be micro- and macro- primary standard. Our workgroup continues researched the definition and concept of Space Time-keeping System (STKS) base on the theory of space metrology, and put forward the viewpoint of relative time keeping. First choose the barycentre of solar system as origin of coordinate, this point and infinite far away point, where pulsar is situated, both have the characteristic that their proper time equal coordinate time. Only from origin to observe pulse signal of pulsar, the period is even, time dose not influence by effect of relativistic. Besides origin, from the others point with relative speed and gravity potential to observe pulsar, the result of period is non-even. However, once we take the relative speed and gravity potential as known parameters, and measure proper time by cesium atomic clock which unit follows the SI second, and then transform the proper time into coordinate time by a general relativistic formula, and we can unify time by means of coordinate time in space. In that way, pulsar's period expressed by coordinate time is unified. Within whole frame of solar system, different time from different local area can only compare by the means of their coordinate time. Pulsar can be looked as common tele-primary standard. The signal of pulse is actually plane electromagnetic wave, by giving it sequence number and the time arrived to origin, a feedback system can be built as a stable time keeping system in space. In the viewpoint of relative time keeping, human being needs two conventions, that one is absolution definition of SI second, another one is initial epoch of sequence number of pulsar's signal. The first one had been unified by CGPM, and the second one need scientist's effort. So we put a proposal that establish a workgroup to discuss how to get time rule in space, especially, how to define initial epoch of pulsar's signal. A local workgroup of URSI Commission A in china has built in June 2019. We hope our Commission A to join more scientists for this topic.

References

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