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Swiss Space Office

Atomic Clock Ensemble in Space (ACES), Factsheet April 2025

Overview	The Atomic Clock Ensemble in Space (ACES) is a European facility that will be positioned outside of ESA's Columbus module on the International Space Station ISS. It will remain there during 30 months to collect data. The mission aims to create a "network of clocks", linking ultra-precise clocks in space with the most accurate clocks on Earth and comparing them to measure the flow of time. ACES includes two cutting-edge atomic clocks: PHARAO (Projet d'Horloge Atomique à Refroidissement d'Atomes en Orbite) and SHM (Space Hydrogen Maser). Their signal will be transmitted to clocks located in ground terminals in Europe, the US and Japan. It is a time signal so precise ACES would lose just one second in 300 million years, according to ESA.
Objectives	The data gathered by ACES will offer scientists new insights into the relationship between gravity and time, advancing our understanding of fundamental laws of physics. It enables to test Einstein's gravitational time dilation effect, search for time variations of fundamental constants of physics and hunt for dark matter. It also opens new opportunities for geodesy applications and global timekeeping.
Scheduled Launch	21 April 2025, from Kennedy Space Center/Cape Canaveral, Florida, on a SpaceX Cargo Dragon spacecraft, with a Falcon 9 launcher.
Swiss Contributions to ACES	1. One of the two atomic clocks in the ACES facility, the SHM (Space Hydrogen Maser), is produced in Switzerland by Safran Time Technologies. SHM is an active hydrogen maser that uses hydrogen atoms to tell time. Its operation resembles that of passive masers used onboard the Galileo satellites, but ten times more stable. 2. ACES is planning to use a ground terminal in Switzerland to carry out clock comparisons. 3. The development and construction of SHM was funded through several ESA Programmes in which Switzerland is -participating. It builds on a long-standing expertise in and support by Switzerland.
Source/ Useful link	ESA's website on ACES: ESA - ACES: Atomic Clock Ensemble in Space

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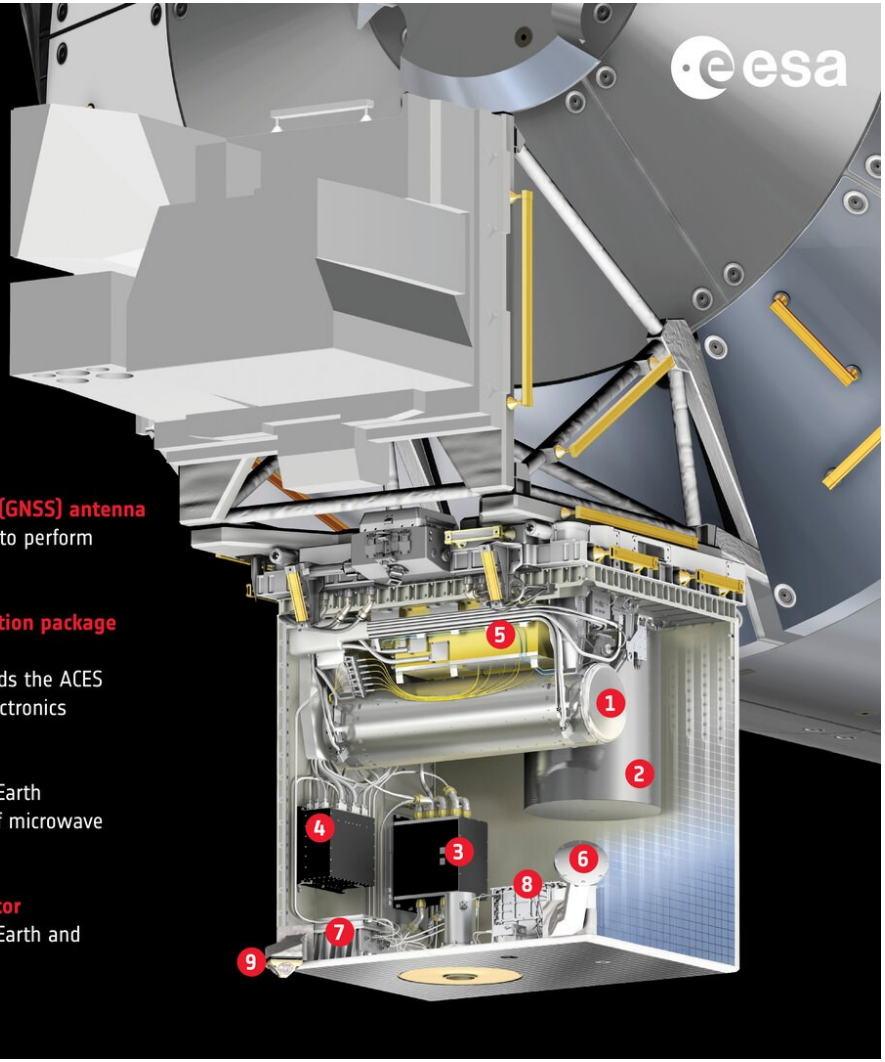
ACES

Atomic Clock Ensemble in Space

A European facility to test fundamental physics from outside ESA's Columbus module on the International Space Station. By creating a "network of clocks", ACES links its own precise timepieces, PHARAO and SHM, with the most accurate clocks on Earth to compare them and measure the flow of time.

1. **PHARAO**
   a clock which uses laser-cooled caesium atoms
2. **SHM**
   Space Hydrogen Maser, a clock which uses hydrogen atoms
3. **External payload computer (XLPC)**
   ACES computer
4. **PHARAO on-board management unit (OMU)**
   PHARAO clock's on-board computer
5. **PHARAO laser source**
   cools caesium atoms for the PHARAO clock
6. **Global navigation satellite system (GNSS) antenna**
   provides orbit determination of ACES to perform fundamental physics tests
7. **Frequency comparison and distribution package (FCDP)**
   compares PHARAO and SHM and sends the ACES clock signal to the microwave link electronics
8. **Microwave link (MWL)**
   enables the comparison of clocks on Earth and in space through the exchange of microwave signals
9. **European Laser Timing (ELT) reflector**
   enables the comparison of clocks on Earth and in space by using laser pulses



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