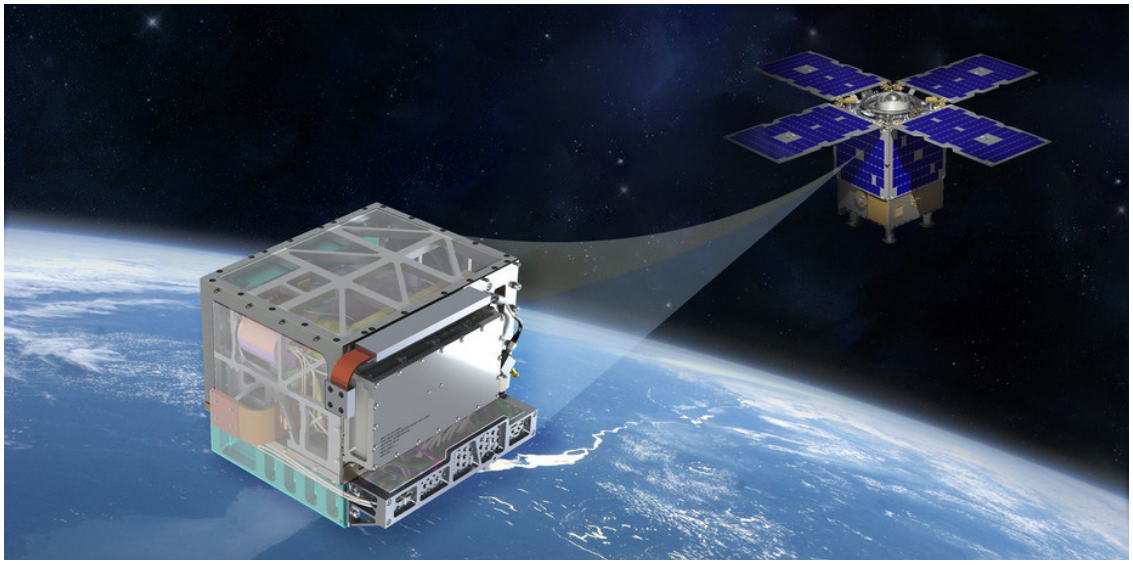
NASAfacts

Deep Space Atomic Clock

A New Frontier in Ultra-Precise Space Navigation



JPL's Deep Space Atomic Clock will fly aboard Surrey-US's Orbital Test Bed satellite as a hosted payload and launched in 2017 as part of the USAF's Space Technology Program 2 (a SpaceX Falcon Heavy rocket).

Know Your Place in Space Via Time

Since nautical ships first carried spring-wound chronometers, accurate timekeeping has been an essential part of navigation. Exact measures of time are especially critical for spacecraft, which journey far into the solar system. The Deep Space Atomic Clock (DSAC), designed and built at NASA's Jet Propulsion Laboratory, represents an enormous advance towards improving deep-space navigation.

It's Atomic!

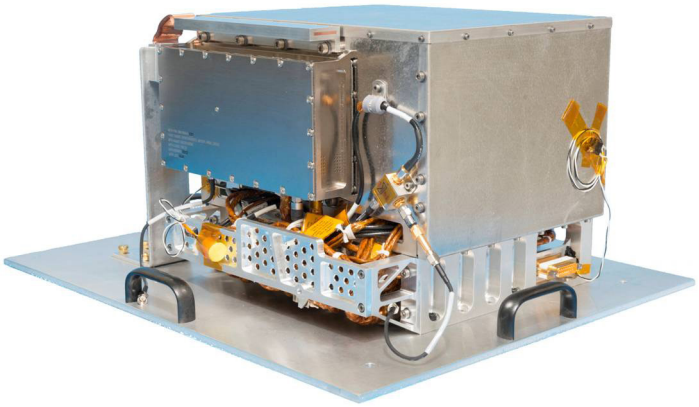
Since the 1950s, the gold standards for timekeeping have been ground-based atomic clocks. They are also the cornerstone of deep-space navigation for most space missions because of their fundamental role in navigation measurements. These clocks measure very stable and precise frequencies of light emitted by specific atoms, using them to regulate the time kept by more traditional mechanical (quartz crystal) clocks. This results in a clock system that can be ultra-stable over decades. The new DSAC timepiece will use mercury ions to provide a measure of time that is stable to better than one microsecond per decade.

Making It Portable

Ground-based atomic clocks are phenomenally accurate, but their designs are too bulky, power-hungry and sensitive to environmental variations to be practical for spaceflight. They need to be miniaturized and toughened in order to venture off our planet. DSAC greatly enhances the performance of current space clock designs, and can virtually eliminate spacecraft clock errors. DSAC will enable a shift to a more efficient, flexible and scalable clock architecture that will benefit future navigation and radio science.

Launch in 2017

The DSAC project is building a demonstration unit and payload that will be hosted on the Orbital Test Bed spacecraft provided by Surrey Satellite Technologies US LLC, Englewood, Colorado. It will launch in 2017 into Earth orbit aboard the USAF Space Technology Program 2 rocket. NASA's DSAC Technology Demonstration Mission will operate for at least a year to demonstrate DSAC's functionality and utility for space navigation.



The DSAC Demonstration Unit (shown mounted on a plate for easy transportation).

DSAC mercury ion trap housing with electric field trapping rods seen in the cut-outs. This is where DSAC interrogates and measures the mercury ion resonance that is used to discipline a quartz crystal clock.

Key Facts

- Promises to be the most precise atomic clock ever flown in space — stability of better than one microsecond in a decade.
- Uses mercury ions (fewer than the amount found in two cans of tuna fish) to create a clock that is orders of magnitude more stable, while being less sensitive to magnetic fields and temperature changes than its predecessors.
- Will provide vastly improved navigation for traveling to and landing on other worlds.
- Accurate enough to measure the effects of gravity and relativity of other worlds — can measure the effects of Jupiter's massive gravitational pull on its moons in much less time than required by current approaches.
- Enabling device for onboard radio navigation for future exploration of our solar system by astronauts.

Mission Specifics

MISSION NAME:	Deep Space Atomic Clock (DSAC) Technology Demonstration Mission
LAUNCH DATE:	March 2017
MISSION DURATION:	One year
MASS OF INSTRUMENT:	16 kg/35 lbs
SIZE OF INSTRUMENT:	29 cm x 27 cm x 23 cm / 11 in x 10 in x 9 in

The DSAC project is sponsored by the NASA Space Technology Mission Directorate and managed by NASA's Jet Propulsion Laboratory in Pasadena, California.

National Aeronautics and Space Administration

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California Institute of Technology
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www.nasa.gov

For more information about the Deep Space Atomic Clock, visit:
www.nasa.gov/mission_pages/tdm/clock/index.html

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