Deep Space Atomic Clock
A New Frontier in Ultra-Precise Space Navigation

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 mea-sure of time that is stable to better than one micro-second per decade.

JPL’s Deep Space Atomic Clock will fly aboard the General Atomics Electromagnetic Systems Orbital Test Bed satellite as a hosted payload and launched in 2019 as part of the U.S. Air Force’s Space Technology Program 2 (a SpaceX Falcon Heavy rocket).

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 2019
The DSAC project is building a demonstration unit and payload that will be hosted on the Orbital Test Bed spacecraft provided by General Atomics Electromagnetic Systems, Englewood, Colorado. It will launch in 2019 into Earth orbit aboard the U.S. Air Force 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.
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 on-board radio navigation for future exploration of our solar system by astronauts.

Mission Specifics

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<thead>
<tr>
<th>MISSION NAME:</th>
<th>Deep Space Atomic Clock (DSAC) Technology Demonstration Mission</th>
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<tbody>
<tr>
<td>LAUNCH DATE:</td>
<td>2019</td>
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<tr>
<td>MISSION DURATION:</td>
<td>One year</td>
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<tr>
<td>MASS OF INSTRUMENT:</td>
<td>16 kg/35 lbs</td>
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<td>SIZE OF INSTRUMENT:</td>
<td>29 cm x 27 cm x 23 cm / 11 in x 10 in x 9 in</td>
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The DSAC project is sponsored by the NASA Space Technology Mission Directorate and managed by NASA's Jet Propulsion Laboratory in Pasadena, California.

For more information about the Deep Space Atomic Clock, visit: