

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Gravity and Fundamental Physics (1)

Author: Dr. Giuseppe Reibaldi
International Academy of Astronautics (IAA), France, giuseppe.reibaldi@iaaemail.org

Mr. Rosario Nasca
European Space Agency (ESA), The Netherlands, rosario.nasca@esa.int
Mrs. Elena Daganzo
European Space Agency (ESA), The Netherlands, elena.daganzo-eusebio@esa.int
Mr. Stephen Feltham
European Space Agency (ESA), The Netherlands, stephen.feltham@esa.int
Dr. L. Cacciapuoti
European Space Agency (ESA), The Netherlands, lcacciap@rssd.esa.int
Mr. Rudolf Much
European Space Agency (ESA), The Netherlands, rudolf.much@esa.int
Dr. Didier Massonnet
Centre National d'Etudes Spatiales (CNES), France, didier.massonnet@cnes.fr
Mr. Christophe Delaroche
Centre National d'Etudes Spatiales (CNES), France, christophe.delaroch@cnes.fr
Mr. Pascal Rochat
SpectraTime, Switzerland, rochat@spectratime.com
Mr. Marc Peter Hess
Astrium Space Transportation, Germany, marc-peter.hess@airbus.com
Mr. Roland Stalford
Airbus DS GmbH, Germany, roland.stalford@airbus.com
Mr. Sylvere Froidevaux
T4Science, Switzerland, froidevaux@t4science.com
Mr. Luca Stringhetti
Airbus DS GmbH, Germany, heso.stringhetti@airbus.com

ESA ATOMIC CLOCK IN SPACE EXPERIMENT ON THE ISS: GETTING READY FOR FLIGHT

Abstract

The Atomic Clock Ensemble in Space (ACES) is a European Space Agency (ESA) payload to be deployed externally to the Columbus Laboratory on the International Space Station (ISS). ACES is one of the most challenging ISS experiments under development.

It consists of two high precision atomic clocks, namely the Cs cold atom clock PHARAO (Projet d'Horloge Atomique par Refroidissement d'Atomes en Orbit) and the active Space Hydrogen Maser (SHM). PHARAO is developed by the French National Space Agency (CNES) and the SHM is developed in Switzerland by Spectratime. The excellent short-term performance of SHM is combined with the long-term stability and accuracy of the PHARAO clock to generate an on-board ACES time scale with fractional frequency instability and inaccuracy of a few parts in 10¹⁶.

A MicroWave Link (MWL) ensures stable and accurate time and frequency transfer for direct comparison of atomic clocks both space-to-ground and ground-to-ground. In particular, comparisons of ground

clocks down to the 10-17 frequency uncertainty level will be possible using both common view and non-common view techniques. The MWL Ground Terminals (GTs) will interface with the ACES payload, ground segment and a world-wide network of ground clocks operated by cooperating research institutes.

The ACES Ground Segment (GS) will be integrated into the overall ISS ground architecture providing the communication links between ground and space through the Columbus Control Centre and NASA ground segment.

The funding for the ACES flight model was secured at the recent ESA Council at Ministerial level in November 2008. This included funding for the SHM development. CNES also recently indicated its commitment to deliver a flight model of PHARAO.

This paper will review the status of the ACES payload and ground segment development activities. It will also highlight recent progress and outline the future activities necessary to achieve flight readiness for the ACES payload.