Contribution ID: **36** Type: **not specified**

A two-stage torsion pendulum for ground testing free fall conditions on two degrees of freedom.

Thursday, 7 July 2016 10:20 (20 minutes)

A torsion pendulum with 2 soft degrees of freedom (DOF), realized by off-axis cascading two torsion fibers, has been built and operated. This instrument allows simultaneous measurement, of force and torque acting on the suspended test mass, approaching free-fall condition down to a few mHz. It was developed for ground testing on two DOFs, before the launch, of the Gravitational Reference Sensor of the LISA-Pathfinder mission. We will report on the results of some measurement campaigns devoted in particular to the characterization of force to torque and torque to force actuation cross-talks. We will also discuss further possible upgrades of the facility for application for ground testing of future space gravitational wave antennas or other space experiments requiring drag-free control.

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Session Classification: Gravitational Waves