



GAUGE

GrAnd Unification and Gravity
Explorer

Consortium

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Scientific Motivation

GAUGE (GrAnd Unification and Gravity Explorer) is a proposal to the Cosmic Visions programme at ESA. The proposal is for a drag-free spacecraft platform onto which is attached a number of modular experiments. The possible complement of experiments is designed to address a number of key issues at the interface between gravity and unification with the other forces of nature. At present we are considering

- a test of string-dilaton theories using a high precision equivalence principle experiment
- a G measurement
- a $\frac{1}{r^2}$ test of extra dimensions
- an axion-like mass-spin coupling search
- measurement of quantum decoherence from space-time fluctuations at the Planck scale

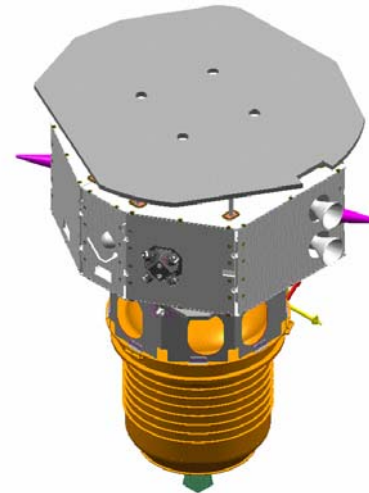
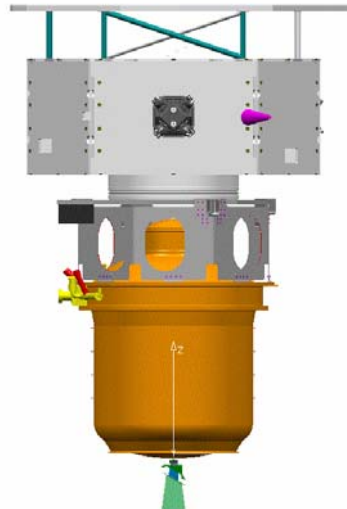
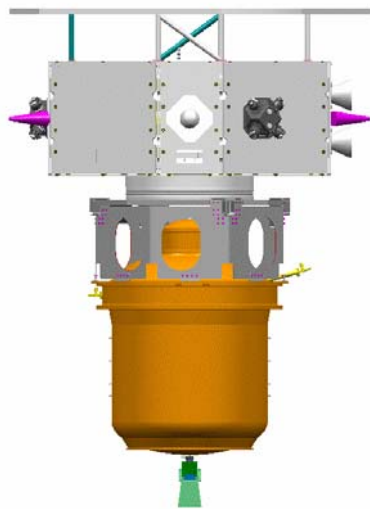
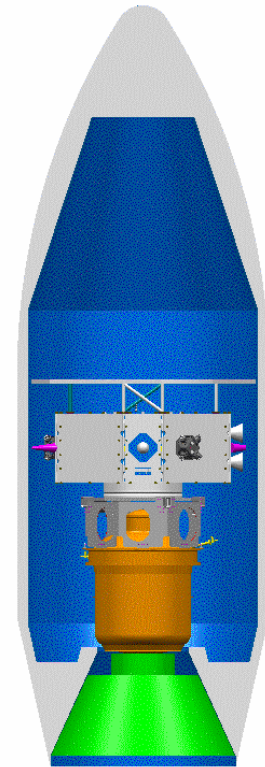
Common technologies

All potential experiments require

- Drag-free environment
- Precision displacement sensing of proof-masses
 - Magnetic (SQUIDS)
 - Electrostatic (Capacitive sensing)
 - Optical (Interferometry)
 - Cold atoms (Interferometry)

Mission Concept

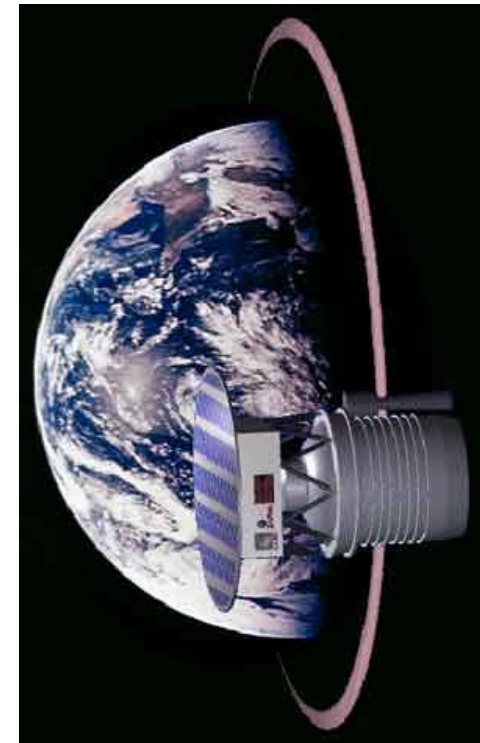
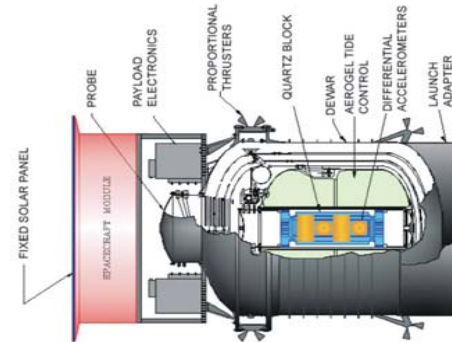
- Provide drag-free environment using LISAPF bus with LTP sensor
- Modular experiment bays
- Launch into LEO sun-synchronous orbit with VEGA



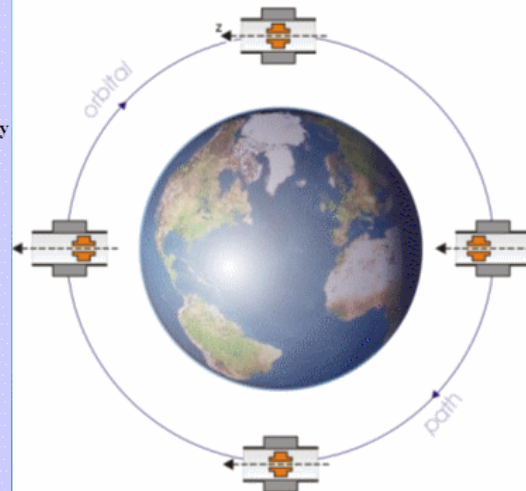
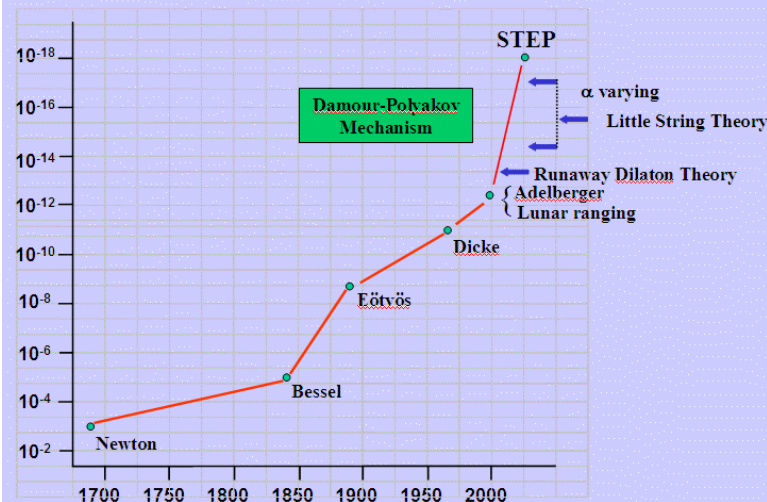
Experiment concepts

(to be selected from ...)

- EP measurement – STEP – studied at ESA Assessment and Phase A for M2 and NASA/ESA SMEX
 - 1 part in 10^{18}



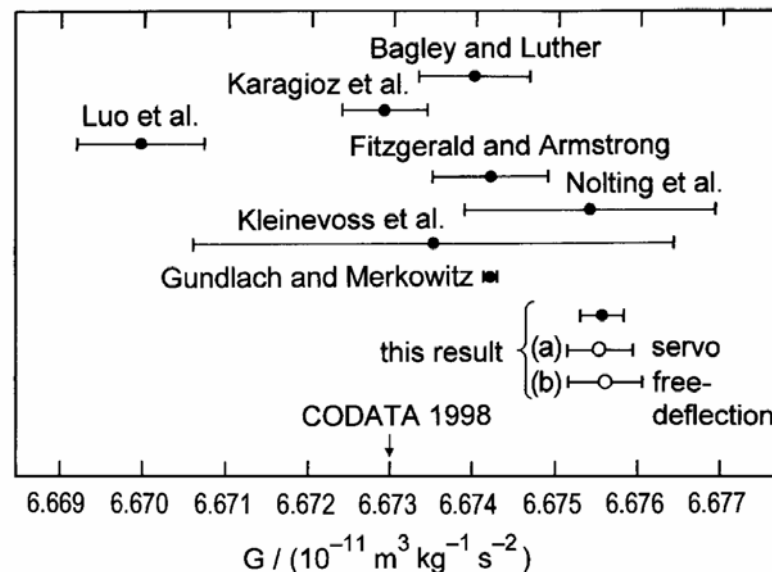
Space > 5 orders of Magnitude Leap



Experiment concepts

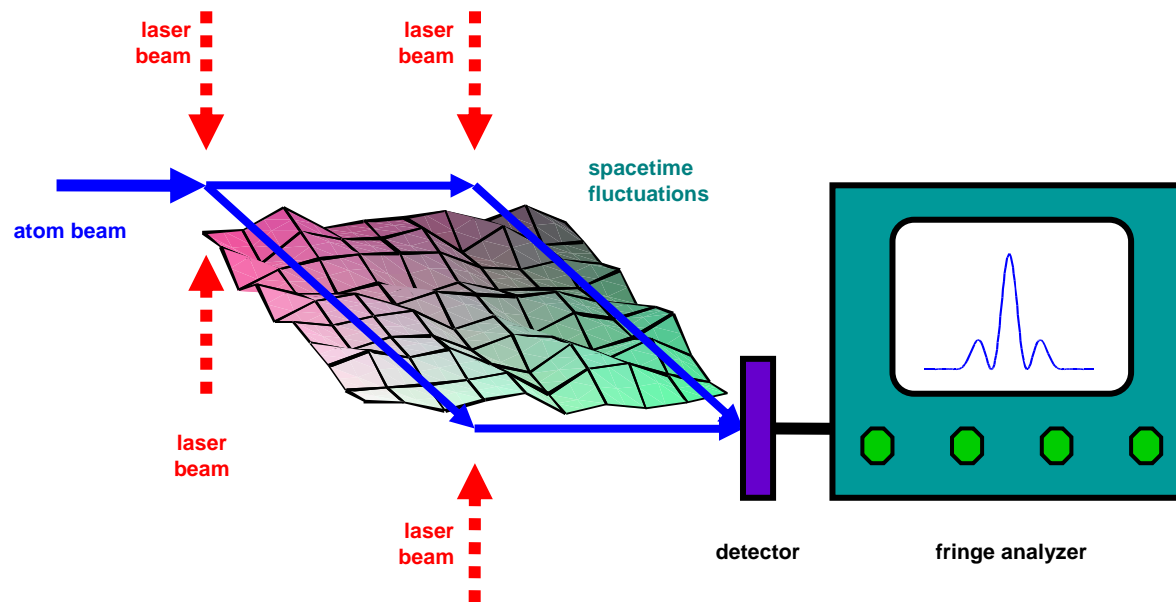
- G and $1/r^2$ – STEP, ISLAND – precision monitoring of motion of test body through defined mass distribution (i.e. sphere through a mass loop) – parts in 10^6

Quinn et al. 2001



Experiment concepts

- Spin-coupling – SSPIN
- Quantum decoherence - HYPER



Heritage

- Readout
 - Magnetic GP-B
 - Optical/Capacitive LISAPF
 - Cold Atom HYPER(Study) + ground
- Spacecraft
 - Bus – LISAPF
 - Drag-free – LISAPF + LTP
- Space Experience within team
 - Astrium/RAL/Onera/ZARM/Birmingham/Imperial/Trento/Stanford

Summary

- GAUGE is a mission at the interface of gravity, unification and extra dimensions
- Mature technology
- Experienced team
- Fits into small/medium mission cost envelope

