Questions to the "Galileo Galilei" Team

I. *The breakdown of the WEP is sought in the framework of the response of test matter to terrestrial Newtonian gravitation. The source of terrestrial Newtonian gravitation is independent of the earth's (non-uniform) rotation while in general relativity the gravitational field of a rotating source depends on its angular momentum. Furthermore, the test cylinders in the proposed experiment are rotating and the motion of extended spinning test matter in an external gravitational field may depend on its rotation rate.*

Q1: Based on general relativity what are the expected effects of the earth's rotation and cylinder rotation on the motion of each spinning cylinder and their relevance to the interpretation of any non-null signal?

II. *Since no explicit mention is made of the elasto-dynamic constitutive properties of either cylinder they appear to be treated as perfectly rigid.*

Q2: What is the possibility that a small time dependent axial, lateral or torsional deformation of the cylinders (e.g. transmitted by bearing reactions to tidal forces or torques) could induce a differential motion between the cylinders that could mimic a signal arising from any differential couplings of terrestrial gravity to them?

Q3: Furthermore it is known that in some circumstances whirling motions can become chaotic. Could such motions in the experiment be initiated and how would they then be eliminated in space? Please provide details of how such motions are modelled in the simulator.

III. *The error budget in section 3.3 is critical for the expected accuracy claimed for the experiment. The figures appear to be based on GGG tests and an end-to-end simulator. In particular the proposal refers to a " WEP Inertial Frame" that "does not spin". However it is difficult to ascertain from section 3.2.1 precise details of the modelling assumptions behind many of the simulation results.*

Q4: Please provide more information on these details and explain how the results in columns 2 and 4 in Table 12 and those in Table 8 are obtained? In particular provide the differential equations for the model used to ascertain the motion of each (spinning) cylinder in the earth's gravitational field?

IV. *The laser gauge readout plays a critical role in achieving the predicted performance. Please clarify the overall design of the laser gauge device and state clearly how it will be made fully operational in time for a possible flight and indicate the role that the gauge plays in the final target sensitivity.*

Q5. In particular:

a) What is the effect of satellite acceleration on the predicted performance of the laser gauge measurement system?

b) Do the cited laser gauge demonstrations include the masking technique that would be used on GG?

c) There is no discussion of cross-talk between the two masked beams. How precisely does the wavefront need to be divided given that diffraction effects would cause cross-coupling between the two readouts?

d) Please describe the laser power requirements and the level to which power fluctuations can be tolerated to prevent the introduction of cylinder tilting.

e) How sensitive is the interferometer to beam alignment jitter induced by temperature fluctuations and relative motions of the two cylinders?

V. *The executive summary states "...confirmation would strongly constrain physical theories."*

Q6. Could you give explicit examples of theories that would be constrained by a null result?

VI. *About the ground-based GGG experiment*

Q7. What progress has been made regarding the sensitivity of this experiment since the 2012 publication?