

Comments on:

Tajmar et al:
**Measurement of Gravitomagnetic and Acceleration Fields
around Rotating Superconductors**

Presented at STAIF 07

G. Hathaway, Feb 27, 2007

- 1) If “Dark Energy” is found to be fictitious, how would that affect your hypothesis?
- 2) Can you give a reference for the calculation of B_g for Nb ($3.9E-6$)?
- 3) How was the mechanical braking/acceleration done using the air motor? If there was only one inlet air nozzle on the air motor (and not 2 or 4 diametrically opposed) there could be a nutating couple on the Nb ring depending on the quality of the bearings.
- 4) How was vertical movement of the drive shaft prevented? Can you provide a sketch of the placement of the bearings?
- 5) How is the Nb ring mounted to the shaft? Was “run-out”, ie non-concentricity of the Nb ring and field coil measured while in motion?
- 6) If there was a silicon diode temp. sensor drilled/embedded inside the Nb ring, how was the ring balanced? Would the presence of this small hole and corresponding diametrically-opposite balance mass be enough to cause a larger normal London moment or other effect?
- 7) Was the cryostat attached to the lab floor via struts of some kind with 1.5 tonnes (?) of sand surrounding the whole assembly, or was the cryostat “floating” in the sand?
- 8) I presume that the cryogenic bearings were of the filled-graphite “Graphalloy” journal bearing type? If so, I know that they are problematic regarding proper fit at LHe temperatures. I’m not surprised that you limited yourself to ~ 350 rad/sec!
- 9) What vacuum was the “Faraday cage” normally operated at?
- 10) I presume that the “flexible tubes” mentioned are rubber (?) bellows which keep cold He gas from leaking where you do not want it to go. If so, did they become stiff upon contact with the cold He gas (and thus make a better mechanical connection)? How was He gas vented? Wouldn’t pumping on it increase the boiling rate?
- 11) How were the control and sensor wires from the sensor chamber thermally anchored to prevent them stiffening and increasing the mechanical connection between the chamber and the cryostat? Were they effectively shielded from spurious pickup (either magnetic or electric)?
- 12) Were the slip-rings (“collector rings”) for the temp. diode and field coil mounted well away from the cold He gas (so as not to cause spurious signals due to thermal effects on the brush/ring assembly)?

- 13) It is not clear whether the Nb ring (and co-rotating field coil) was always started into rotation while immersed directly in LHe or whether they were just above the (boiling) surface of the LHe? What (hollow) shaft material was used to enable the Nb ring to maintain $< \sim 9$ K?
- 14) I presume that differential accelerometer measurements could have been performed for all axes of all accelerometers instead of just the tangential ones but this would require too many nanovoltmeters! How accurately are all the nanovoltmeters “strobed”, ie pulsed, to take readings at precisely the same instant?
- 15) You used the field coil and BSSCO HTSC ring (?) to produce a 20 mT field. Where was this measured – near the coil or at each accel.? Was the 10 ug offset within the specifications of the accelerometers?
- 16) The normal London mag. field may be nT at full speed constant velocity. What about during acceleration?
- 17) You state: “For the first time, the tangential accelerometers showed signals...” Did any of the other axes show signals also?
- 18) You state that the peaks were proportional to the accel. Can you show how? I cannot see this immediately from Fig 6, for instance.
- 19) Regarding the 0.2 s time delay in Fig 8, I would have thought your explanation about Cooper pair density and warming would make the sensor data lag the acceleration, rather than the other way around.
- 20) You state (pg 1079) “Fig 11 shows the above-ring and reference gyro versus...” Do you mean “Fig 11 shows the difference between the above-ring and reference gyro versus...”
- 21) Were the amplifiers for the accelerometers and gyros also placed along side the sensors in the Faraday chamber? If so, are all the statements about magnetic field immunity etc true for the amplifiers as well as the sensors themselves?

Paraphrasing from my Notes on Tajmar et al “Experimental Detection of the Gravitational London Moment” of Mar 26, 2006:

- 22) (Notes #9) How was water ice etc. prevented from forming on the rotor during cool-down (and causing a mechanical imbalance)?
- 23) (Notes #11) How did you ensure that temperature variations inside the Faraday chamber did not affect the sensors/amplifiers? Did you monitor the temperature at various positions in the chamber?
- 24) (Notes #20) Did you try using the field coil to instantly kill the superconductivity (by going over the critical field strength) during some part of rotor acceleration? If the accel/gyro signal also died instantly, this would be a strong indication that the effect was due to some aspect of superconductivity, rather than an artifact. It could also possibly indicate if there is a time delay/relaxation effect/hysteresis between the instant of SC killing and the decrease of the accel/gyro signal.

All in all, this is a well-thought out experiment, with several good experimental points including:

- use of the field coil to confirm passage through T_c
- use of a curl configuration and differential measurements
- use of different rotation sense and two slope measurements to reduce noise
- the use of two types of sensors (accelerometer and gyro)
- correcting various aspects of the earlier experimental protocol.