Subject: Re: LARES 2 metal alloy URGENT
Date: Thursday, April 26, 2018 at 7:03:00 PM Eastern Daylight Time
From: David Arnold
To: Antonio Paolozzi
CC: Ignazio Ciufolini, Erricos C. Pavlis

Dear Antonio,

I thought the choice of the copper alloy had already been made. This comes as a surprise.

I prefer the copper alloy because it keeps the satellite at a more uniform temperature. This reduces the variations from cube to cube. I agree that reducing the thermal thrust is important to the basic experiment. A 12 K temperature difference seems like a lot. The fact that the nickel alloy has been used before seems like a weak argument.

My understanding was that you would provide a temperature distribution for the copper alloy case. You first need to compute the satellite temperature. Then compute the temperature distribution in the cube at that temperature. I can compute the pattern from the temperature distribution to determine the accuracy.

I do not have the ability to compute the temperature distribution for the LARES-2 cube corner. I have crude thermal models that are good for parametric studies but not for providing an accurate model of the actual cube corner.

I do not have the physical parameters for the two metals. Can you provide the physical parameters for both metals and the other parameters needed to compute the satellite temperature, including the solar constant, infrared flux, the surface area of the cube corners, retaining rings, and the remaining surface area of the sphere? It should be possible to make some estimates of the satellite temperature fairly quickly from the physical parameters.

If Richard Matzner has computed the temperature difference for the two metals he must also have temperatures for the two metals.

Do you have any calculations of the satellite temperature for LAGEOS-1 and LAGEOS-2? How was the calculation done? Can you use the same method of calculation for LARES-2? What was the absorptivity and emissivity for each LAGEOS satellite?

How quickly can you provide a temperature distribution for the copper case? You said you could control the emissivity of the cavity by the surface treatment.

Best,

David Arnold

From: Antonio Paolozzi <antonio.paolozzi@uniroma1.it>
Date: Thursday, April 26, 2018 at 5:31 PM
To: David Arnold <david-arnold2006@earthlink.net>
Cc: Ignazio Ciufolini <ignazio.ciufolini@gmail.com>, ErricosUmbc Pavlis <epavlis@umbc.edu>
Subject: LARES 2 metal alloy URGENT

Dear Dave,
the two possible alloys for LARES 2 are Nichel based and Copper based. The best from the mechanical point of view is the Nichel alloy,However its conductivity is very low (about 10 W/(mK) wrt 170 of copper alloy). We estimated with Richard Matzner the following temperature gradients on the metal body of the LARES 2 satellite:
Nichel alloy Delta T= 12 K
Copper alloy Delta T = 1 K

This gradient will introduce an error in the thermal thrust that will reduce the accuracy of the Lense-Thirring experiment by about 0,1%. Erricos is also very worrried about the loss of ranging accuracy which although will not affect the general relativity test will be very important for all space geodesists which are looking tor submillimiter accuracy. So we kindly ask you if you could somehow evaluate what the accuracy loss would be for the two different alloys. Unfortunately ASI has informed us today that they have chosen Nichel alloy because of launch schedule and because the Nichel alloy has already beed used for space components. But we are not very happy about this choice.

It would be very important if you could send us, within tomorrow, an estimate of the accuracy loss in the ranging so that in case this loss would be higher than a mm we could try to convince ASI to change from Nichel to Copper alloy tomorrow morning (Italian time) before they order the alloy.

Thank you and best regards
Antonio e Ignazio