The influence of Jupiter's orbit on the measurement of gravitational constant

Zhi Cheng

gzchengzhi@hotmail.com

Abstract: At present, the measurement accuracy error of the gravitational constant is relatively large. When I was thinking about the energy of the electrostatic field a few days ago, I had an assumption that the energy distribution of the electrostatic field is a basic factor of space-time composition. Therefore, the change in the energy distribution of the electrostatic field directly means that the structure of spacetime has changed. The change of space-time structure directly affects the gravitational constant. We can notice that the distribution of the electrostatic field energy in the entire solar system is directly related to the orbits of the planets. Among them, Jupiter has the greatest influence on the energy distribution of the electrostatic field on the earth's position. The mass of Jupiter is approximately one thousandth of the mass of the sun. If only the gravitational influence is considered, experiments on the earth to measure the gravitational constant can offset Jupiter's gravitational influence through technical means. But if the energy distribution of Jupiter's electrostatic field changes, it will cause changes in the space-time structure around the earth. This change in the space-time structure directly leads to a change in the gravitational constant, which results in different values of the gravitational constant measured by experiments completed at different times. **The purpose of this article is to remind experimental physicists who measure the gravitational constant that their experimental results may be related to the orbital position of Jupiter.**

Keywords: gravitational constant; space-time structure; Jupiter orbit

In various calculations in physics, the electrostatic field energy of electrons and protons are not considered. From the point of view of the extremely small radius of the electron, the electrostatic field energy carried by the electron is quite huge. Therefore, a few days ago, I assumed that the electrostatic field energy of electrons and protons has cumulative characteristics. When the electrostatic field energy of a large number of electrons and protons is accumulated together, an extremely wide-range electrostatic field energy distribution area will be formed. And such an electrostatic field energy distribution will definitely affect our daily calculations. After careful consideration, I think this electrostatic field energy distribution is actually what we usually call "space-time". In other words, "space-time" is the electrostatic field energy distribution of electrons and protons [1].

With this hypothesis, I believe it will be illuminating for us to deeply understand the characteristics of spacetime. Under this assumption, spacetime will no longer be absolute, or just a parameter used to measure particle motion. The space-time structure is the energy distribution of the electrostatic field, so the space-time structure can also be changed. And this change directly affects the gravitational constant.

Looking back at the history of human measurement of the gravitational constant, although compared to many other physical constants, the gravitational constant was measured as early as the eighteenth century. But more than two hundred years have passed, and the accuracy of the gravitational constant has not improved as much as other parameters. This makes people inevitably questionable, that is, there must be other factors that affect the accuracy of the measurement of the gravitational constant. It is generally believed that the exact value of the gravitational constant is $6.67384 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$

In fact, with the advancement of measurement technology, there are currently more accurate measurement values [2]. In 2018, the team of LUO Jun et al. used two methods to determine the value of the gravitational constant as $6.674184 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$ and $6.674484 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$

However, in the work of LUO, we found that the values measured by the two measurement methods are still somewhat different. This shows that the exact value of the gravitational constant that can actually be determined should be approximately $6.674 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$.

It seems that the accuracy of the gravitational constant is indeed very low. What is even more surprising is that some teams use the same set of devices, and the results measured at different times will still be contradictory. It is said that from 2011 to 2013, a French team tested different gravitational constant values with the same device in two years [3].

For the influence of other planetary motions on the device for measuring the gravitational constant on the earth, if only consider the influence of other planets, such as Jupiter's gravity. Although Jupiter is very massive, its gravity must have an impact on the Earth’s orbit. But when experimenting on the earth, Jupiter's gravity can completely cancel each other out through technical means.

But if we consider the electrostatic field energy distribution of electrons and protons in Jupiter's matter, the situation is different. According to the estimation in my last article [1], Jupiter's electrostatic field energy distribution radius can also reach a range of about 1 light-year, so it can also affect the space-time structure on the earth. In particular, Jupiter's orbit around the sun is different from the Earth's orbit around the sun, and there is a shortest distance and a longest distance. Therefore, the changes in the space-time structure caused by the energy distribution of Jupiter's electrostatic field acting on the earth in different time periods will also be different. Since the structure of spacetime directly affects the value of the gravitational constant, the values of the gravitational constant measured on the earth in different time periods will also be different.

So how much influence does Jupiter's motion have on the earth's space-time structure? Considering that we are still unclear about the specific principles of the space-time structure formed by the energy distribution of the electrostatic field, so here is only a rough estimate.

The mass of Jupiter is about 1/1000 of that of the sun, and the space-time structure formed by the energy distribution of the electrostatic field of the sun is the foundation of the earth's movement. Therefore, it can be roughly determined that Jupiter's disturbance to the energy distribution of the electrostatic field (or space-time structure) around the earth is about 1/1000 of the exact value. Therefore, the measurement error of the universal gravitational constant is about 0.007. Of course, considering that the energy distribution of Jupiter's electrostatic field will always affect the space-time structure around the earth, the actual error may be much smaller than 0.007.

In this way, the experimentally measured gravitational constant value plus this systematic error should be

$$(6.674 \pm 0.007) \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$$

From the current experimental measurement data, this value should be consistent with the experimental results.

However, because Jupiter's orbit is very regular, this is a systematic error. If we take this systematic error into account in the experiment of measuring the gravitational constant, perhaps we can get a more accurate value of the gravitational constant.

Of course, there may be more other factors involved in the electrostatic field distribution at the location of the earth. If you look at it in the entire Milky Way, the sun is a disturbance factor in the energy distribution (space-time structure) of the electrostatic field of the entire Milky Way matter. Perhaps the sun is regarded as an interference factor for estimation, and we can also obtain other systematic error values of the gravitational constant.

In addition, I would like to discuss the work of the LUO Jun team. They use two methods, namely TOC (Time Of Swing) and AAF (Angular Acceleration Feedback), and the results obtained by these two methods are inconsistent. LUO's paper [2] believes that there are systematic errors in measurement. However, I noticed that the measurement time of each of their methods lasted about 5 months. Therefore, if these two measurements are carried out in order, it means that the measurement process of the second method will be delayed by at least 5 months. During these five months, Jupiter's orbital position has changed significantly. At this time, the impact of Jupiter's electrostatic field energy distribution on the earth's space-time structure will be significantly different from that of 5 months ago. This may also be an important reason for the different results obtained in the two measurement processes of LUO.

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Chinese Version

木星运行轨道对引力常数测量的影响

程智

gzchengzhi@hotmail.com

摘要：引力常数目前来看，测量精度误差较大。前几天我在思考静电场能量的时候，我有一个假设，这就是静电场能量分布是时空构成的一个基本因素。因此静电场能量分布的变化直接意味着时空的结构发生了变化。而时空结构的变化直接影响的就是引力常数。我们可以注意到，整个太阳系的静电场能量的分布跟各大行星运行的轨道有直接关系。其中对地球位置的静电场能量分布影响最大的是木星。木星质量大约是太阳质量的千分之一。如果仅仅考虑引力影响，在地球上做测量引力常数的实验，是可以将木星引力影响通过技术手段抵消掉的。但如果木星的静电场能量分布产生变化，将引起地球周围时空结构产生变化。这种时空结构的变化直接导致引力常数产生变化，从而引起不同时间所完成的实验测量出来的引力常数数值会有所区别。**本文的目的希望能够提醒测量引力常数的实验物理学家们注意，他们的实验结果可能跟木星运行的轨道位置有关系。**

关键词：引力常数；时空结构；木星轨道

在各种物理学计算过程中，电子和质子的静电场能量都没有被考虑在其中。而从电子的半径极小这一点来看，电子所携带的静电场能量又是相当巨大的。因此在前几天我曾经假设电子和质子的静电场能量具备累加的特性。当大量的电子和质子的静电场能量被累加在一起之后，就会形成一个分布范围极其广泛的静电场能量分布区域。而这样的静电场能量分布又肯定会对我们日常的计算有影响的。经过仔细思考，我认为这种静电场能量分布实际上就是我们平常所说的"时空"。或者说"时空"就是电子和质子的静电场能量分布 [1]。

有了这样的假设之后，相信对我们深入认识时空的特性是有启发性的。在这种假设条件下，时空将不再是绝对的，或者不再只是一种用来测量粒子运动的参数而已。时空结构就是静电场能量分布，因此时空结构也是可以改变的。而这种改变直接影响的就是引力常数。

回顾人类对引力常数测量的历史，虽然相比其他的很多物理常数，引力常数早在十八世纪就已经被测量出来。但是已经过去了两百多年的时间，引力常数的精度并没有像其他参数那样提高很多。这让人不免产生疑问，就是其中一定还存在其他的因素影响引力常数测量精度的提高。目前一般认为引力常数的精确值为$6.67384 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$

实际上随着测量技术的进步，目前还有更精确的测量数值 [2]。在 2018 年，罗俊团队做的工作中，用两种方法测定了引力常数的数值为$6.674184 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$和$6.674484 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$

但是在罗俊的工作中我们发现两种测量方法测量出来的数值还是有一定的差别的，这说明，

实际上可以确定的引力常数准确数值应该是大约$6.674 \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$.

这样看起来引力常数的精度确实是非常低的。更让人感到奇怪的是一些团队用同一套设别，在不同时间测量的结果还会出现矛盾。据说在 2011 年~2013 年的时候有法国的物理学家用同样的装置在两年的时间中测出了不同的引力常数数值 [3]。

对于其他行星运行对地球上测量引力常数装置的影响，如果仅仅是考虑其他行星，比如木星引力的影响。虽然木星质量很大，其引力一定可以对地球的运行轨道产生影响。但是在地球上进行实验的时候，木星的引力是完全可以通过技术手段相互抵消掉的。

但是如果我们考虑到木星物质中的电子和质子的静电场能量分布情况就不同了。按照我的上一篇文章的估算，木星的静电场能量分布范围半径也可以达到大约 1 光年的范围，因此也是可以影响到地球上的时空结构的。特别是木星绕日运行轨道与地球绕日轨道是不同的，存在最近距离和最远距离。因此不同的时间段木星的静电场能量分布作用在地球上而引起的时空结构变化也将不一样。由于时空结构直接影响到引力常数的数值，因此不同时间段在地球上测量出来的引力常数数值也将有所差别。

那么木星的运行对地球时空结构的影响有多大？考虑到我们现在对静电场能量分布所形成的的时空结构的具体原理是怎么样的还不清楚，因此这里只做一个大致的估算。

木星的质量大约是太阳的 1/1000，而太阳的静电场能量分布所形成的时空结构又是地球运行的基础。因此这里可以粗略认定木星对地球周围静电场能量分布（或者时空结构）的扰动大约为精确数值的 1/1000. 因此万有引力常数的测量误差大约 0.007. 当然考虑到木星静电场能量分布始终都会影响到地球周围的时空结构，因此实际的误差可能会比 0.007 要小很多。

这样实验测量出来的引力常数数值加上这个系统误差之后应该就是

$$(6.674 \pm 0.007) \times 10^{-11} \mathrm{m}^3/\mathrm{kg} \cdot \mathrm{s}^2$$

从目前的各种实验测量数据来看，这个数值应该是符合实验结果的。

不过由于木星的运行轨道是非常有规律的，这是一个系统误差。如果我们在测量引力常数的实验中将这个系统误差考虑进去，或许我们可以得到更加精确的引力常数数值。

当然对于地球所在位置的静电场分布涉及到的可能还有更多其他的因素。如果放在整个银河系中来看，太阳又是整个银河系物质的静电场能量分布（时空结构）中的一个扰动因素。也许把太阳看作一个干扰因素进行估算，我们还可以获得引力常数的其他系统误差数值。

另外这里也想分析一下罗俊小组的工作。他们通过两种方法，分别是 TOC(Time Of Swing)和AAF(Angular Acceleration Feedback)，这两种方法获得的结果是不一致的。罗俊的文章中认为这其中存在测量上的系统误差。不过我注意到他们的每种方法的测量时间大约都持续了 5 个月左右。因此如果这两次测量是按照先后顺序来进行的，则意味着第二种方法的测量过程将推迟了至少 5 个月的时间。在这五个月的时间中，木星的轨道位置已经发生了很明显的变化。这时候木星的静电场能量分布对地球的时空结构所产生的影响，同 5 个月之前相比将有很明显的不同。这也可能是导致罗俊的两次测量过程获得不同结果的一个重要原因。

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