What kind of device can measure the viscosity of dark matter fluids

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Abstract

This paper explores how to detect the viscous force of dark matter fluids. In a microscopic environment like the Earth, the ideal measuring device is the gravitational constant measuring device. However, although the order of magnitude of the viscosity force of dark matter fluid is equivalent to the gravitational constant, due to the symmetry arrangement of the gravitational constant measuring device itself, it means that this symmetry arrangement needs to be excluded when detecting the viscosity force of dark matter fluid. The gravitational constant measuring device used in a general physics laboratory may not be accurate. It requires sophisticated professional equipment to complete. In addition, the direct measurement with other devices is not very good. The main thing is that the accuracy requirements are higher. In the interstellar range, the use of artificial satellites and spacecraft to make measurements may also be affected by gravity, and there are also some key problems to solve.

1 Device for measuring gravitational constants

Although the viscous force of dark fluid is a very macroscopic force, we can still measure it on Earth through very precise experiments. From the calculation results of the viscous force of dark matter fluid [1], its order of magnitude is actually about the same as the order of gravity. It's just that because gravity has a cumulative effect, that is, when the mass is relatively small, it is difficult for us to feel the existence of gravity. But if the mass is very large, this gravitational force produces a very considerable macroscopic effect. But this is not the case with the viscous force of dark matter fluids. Whether the mass is large or the mass is small, the effect of the force it produces is basically the same. That is to say, although the greater the mass, the greater the viscous force of the dark matter fluid, but by dividing the viscosity force by the mass, we can find that it is a constant value. It does not affect the acceleration effect of the viscous force of dark matter because of the size of the visible matter.

On Earth, it is now possible to measure the effects of gravity in the laboratory. This is mainly done through very precise gravitational constant measurement experiments. Since other factors, including electrostatic forces, the magnitude of the force far exceeds the gravitational force, a very symmetrical structure is used in the experiment of measuring the gravitational constant in order to eliminate the influence of these other factors on the measurement results. For example, two equal mass attraction balls are used, and the masses at both ends of the pendulum are symmetrical and equal. This makes it very effective to shield against the effects of various external forces. Of course, this can also shield the viscous force of dark matter fluids.

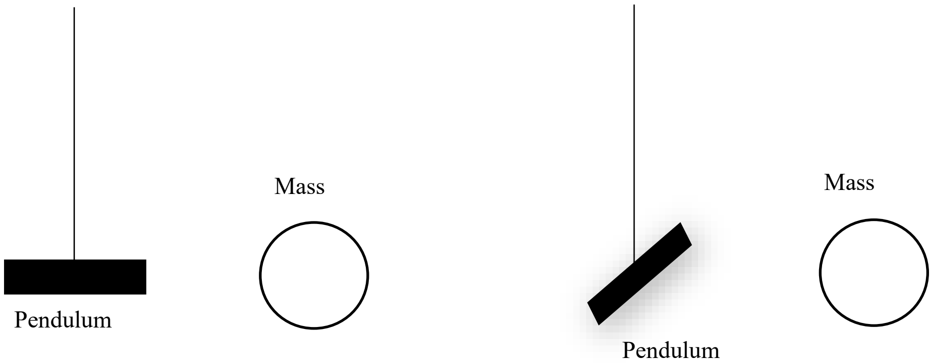
However, unlike the effects of other factors, the direction of the viscous force of the dark matter fluid is related to the movement of the earth and even the movement of the solar system, so if the gravitational constant measurement time is long enough, then this change in the direction of the dark matter fluid caused by the Earth's rotation will bring great uncertainty to the measurement results. Therefore, relatively speaking, the time-of-swing method is relatively less affected by the uncertainty of the direction of the viscous force of dark matter fluids. However, for the angular-acceleration-feedback method, due to the very long measurement time, the viscosity of the dark matter fluid may have a larger impact in this case, resulting in a larger deviation in the measurement results.

Therefore, in order to be able to measure the effect of the viscosity force of dark matter fluid on visible matter, we can do the following work:

The first is to reduce the symmetry of the gravitational constant measuring device. That means we can do without two or four balls. Let's just use one attraction ball to do the experiment. In this way, when the direction of dark matter fluid flow changes, we can accurately predict the effect of dark matter fluid viscosity on the experimental results. Then we measure according to the different positions of the Earth's rotation, which can be used to compare the difference in the measured results when the viscosity direction of the dark matter fluid is different.

The second is to choose different times to measure. In a relatively short period of time, the influence on the viscosity direction of dark matter fluid is mainly the direction of the Earth's rotation. From the analysis results of the paper [2], we can see that the direction of the viscous force of dark matter fluid is the most different between the two times of day and night. Therefore, a more varied gravitational constant should be obtained.

In this way, after the improved experimental device, we can choose the time-of-swing method to measure the single attraction ball. The experimental measurement device is shown in Figure 1. The two types of the placement position of pendulum is different according to the distance from the attraction ball, which is called near configuration and far configuration.



Near configuration   Far configuration

As can be seen from Figure 1, the two methods are consistent with the orientation of the time-of-swing method's device for measuring gravitational constants. Just reduce the attraction ball from symmetrical two to one. In this way, the two angular frequencies of the near configuration and the far configuration of the pendulum are measured, which are ω_n and ω_f

$$\omega_n^2 = \frac{k_n + GC_{gn}}{I}$$

$$\omega_f^2 = \frac{k_f + GC_{gf}}{I}$$

where k is the elastic coefficient of the pendulum hanging fiber and C is a coupling coefficient related to the attraction mass and the measured mass distribution. These two parameters are different in the two configurations. I is the moment of inertia of the pendulum.

The gravitational constant thus measured is

$$G = \frac{I\left(\omega_n^2 - \omega_f^2\right) - (k_n - k_f)}{C_{gn} - C_{gf}}$$

In both configurations, if the viscous force direction of the dark matter fluid is towards the attraction ball, the result is to increase the mass of the attraction ball. This corresponds to a slight increase in the gravitational constant. namely

$$F = \frac{GMm}{r^2}$$

$$F + f = \frac{(G + \delta G)Mm}{r^2} = F + \frac{\delta GMm}{r^2}$$

So

$$f = \frac{\delta GMm}{r^2}$$

Or

$$\delta G = \frac{fr^2}{Mm} = \frac{f_{1kg}r^2}{M}$$

Where

$$f_{1kg} = 6.71 \times 10^{-11}(N)$$

If

$$r = 0.16m$$

$$M = 0.78kg$$

Then

$$\delta G = \frac{f_{1kg}r^2}{M} \approx 6.71 \times 10^{-11} \times \frac{0.16^2}{0.78} \approx 2.2 \times 10^{-12}(\mathrm{m^3kg^{-1}s^{-2}}) \tag{1}$$

Of course, the direction of the viscous force of the dark matter fluid will deviate from the direction of gravity measured in the experimental device, but even if you consider this, it can be seen that the change in the gravitational constant is still considerable. By measuring over different time periods, it should be possible to obtain large differences in gravitational constants.

For example, in Wuhan, the minimum angle between the viscosity direction of dark matter fluid and the perpendicular direction of the experimental plane is -36.6 degrees. The maximum angle is 83.4 degrees. That is, if the gravitational constant is measured during the day, the measured gravitational constant will be reduced. namely

$$\delta G = -2.2 \times 10^{-12} \times sin36.6 \approx -1.31 \times 10^{-12}(\mathrm{m^3kg^{-1}s^{-2}})$$

After 12 hours of measurement, it was measured that the gravitational constant increased. namely

$$\delta G = 2.2 \times 10^{-12} \times sin83.4 \approx 2.19 \times 10^{-12}(\mathrm{m^3kg^{-1}s^{-2}})$$

From the calculation results, as long as the accuracy of more than 2% of the experimental device can complete this experiment. In addition, if the mass of the attraction ball is reduced or the distance between the attraction ball and the pendulum centroid is increased, the accuracy requirements of the experiment can also be reduced.

So which of the current devices used to measure the gravitational constant can measure this change in the gravitational constant? Let's first take a look at some parameters of the gravitational constant measuring devices that are currently commonly used in general physics laboratories. One of the typical devices has a distance of about $3cm$ between the attraction ball and the ball on the pendulum, and the mass of the attraction ball is about $1.5kg$. Substituting these parameters into Equation (1) allows us to find out the variation in the measurement of the gravitational constant caused by such parameters

$$\delta G \approx 4 \times 10^{-16} (\mathrm{m^3 kg^{-1} s^{-2}})$$

It can be seen that the error of this experimental device is too large to measure the effect of the viscous force of dark matter fluid on the measurement results of the gravitational constant.

Therefore, to measure the influence of the viscous force of dark matter fluid on the gravitational constant, it may still require more professional and high-precision measurement equipment. And these devices should be more expensive.

2 Pendulum

Use pendulum directly to make measurements. The main thing is to measure the magnitude of this pendulum shift to equilibrium position under the action of the viscous force of dark matter fluid. Since this deviation is very small, more sophisticated distance measurement tools may be required, and we can roughly estimate the distance traveled.

If the length of the pendulum's suspension fiber is $1m$, the gravity of the pendulum is mg. If the pendulum is simultaneously subjected to a dark matter viscosity force f perpendicular to the direction of gravity, then at this time we can calculate the angle of the pendulum fiber to deviate from the equilibrium position

$$x = \frac{f}{mg} \approx 6.71 \times 10^{-12} (m)$$

It can be seen that this deviation distance is very short. That's about 0.007 nanometers. Such a short distance is very difficult to measure even with today's very sophisticated laser interferometric instruments. So the only way to solve this problem is to extend the length of the pendulum line. But the longer the pendulum line, the longer it is, the more disturbed by the surrounding environment. So this approach is not very applicable on Earth.

3 Satellites

If we can manage to lengthen the length of the pendulum line to a very long length, this should alleviate the problem of measurement accuracy to some extent. So if we measure through satellites in space, this length can become very long. In addition, because the satellite is in a microgravity environment, the acceleration of gravity is very small, and the force of the entire satellite at this time is mainly the viscous force of the dark matter fluid. Then we can measure the distance of the satellite from the equilibrium position by laser interference, which should be able to obtain the observable effect of the viscous force of dark matter on the satellite.

We can calculate the acceleration of satellites due to the viscous force of dark matter. This acceleration is

$$a = \frac{mf_{1kg}}{m} = f_{1kg} = 6.71 \times 10^{-11} (m/s^2)$$

This acceleration is small, but if it is long enough, it can make the satellite's speed observable.

For example, if it can last for such a long period of four months, the speed generated by the moon due to the viscous force of dark matter can be reached

$$v = at = 6.71 \times 10^{-3} ms^{-1}$$

That is, a speed of 6*mm* per second, which is still easy to observe.

However, this method also has a problem, that is, the solar system and artificial satellites are actually in the same dark matter fluid. The viscous force of dark matter fluids causes artificial satellites to accelerate, and the same acceleration will occur throughout the solar system. Therefore, if we use the solar system, or any planet in the solar system, as a frame of reference, we should probably not be able to observe the acceleration effect of this dark matter fluid in general.

4 Instability of dark matter fluids

Considering that dark matter fluids may be unstable fluids, for example, we can see several galaxies like the Stephen Quintet galaxy group, whose rotation directions are different, it is believed that it should be due to the unstable flow of dark matter fluids caused by changes in the direction of galaxy rotation. Therefore, we can also try to use the instability of this dark matter fluid to detect the viscosity of the dark matter fluid.

However, this instability can occur at a more macroscopic scale. It is mainly manifested in the large spatial span and the long time span. Therefore, in a local environment like Earth, it may be difficult to detect the instability of this dark matter fluid. So we can look at a slightly larger environment to detect. For example, throughout the solar system, there should be some instability of dark matter fluids.

In this relatively macroscopic environment, if an artificial satellite is separated from the gravitational pull of the sun, it may bring different behaviors from the dynamic mechanism of the entire solar system due to the instability of dark matter fluids. For example, the current Voyager spacecraft is believed to have been separated from the gravity of the solar system. In this case, some of the Voyager behaviors may be different from those of planets in the solar system.

References

[1] Cheng, Z. Estimation of Dark Matter Fluid Parameters and Their Influence on Galaxy Motion. https://vixra.org/abs/2308.0081

[2] Cheng, Z. Effect of Dark Matter Fluids on Gravitational Constant Measurements. https://vixra.org/abs/2308.0153