How Quasars Created the Dark-Matter Structures of Present-Day Galaxies?

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Abstract: Here we described the mechanism of creation of the dark-matter (DM) structure in massive spiral galaxies by the initial quasars. Such mechanism moves the angular momentum of quasars to the outer regions of massive galaxies. We calculated that range of the DM structure in the Milky Way should be about 51.5 kpc. We calculated also the range of the DM structure for dwarf galaxies with initial baryonic mass equal to giga-solar-masses on the assumption that now in their centre is the lightest gravitational BH - we obtained 1.9 kpc. We as well answered following question: How can we detect loops of dark matter in the Earth experiments? Just we should mimic the mechanism in quasars - we should use strong magnetic field to create relativistic vortex of baryonic plasma. We explained also why the DM structures cannot interact electromagnetically.

1. Introduction

According to the Scale-Symmetric Theory (SST) [1], [2], the dark-matter (DM) structures are composed of entangled DM loops built of the entangled non-rotating-spin-1 Einstein-spacetime (ES) components which spins are tangent to the DM loops. The ES components in each resting DM loop are moving with speed equal to the speed of light in "vacuum" c. Such loops cannot interact electromagnetically – they interact gravitationally, due to quantum entanglement or confinement [1].

2. Calculations

Orbital angular momentum (OAM) of a part of baryonic-plasma (BP) accretion disc, $L_{OAM,i}$, which inspirals due to the gravitational interaction, is

$$L_{OAM,i} = \Delta m_i \, v_i \, r_i, \text{ where } v_i^2 = G \, M / r_i \, , \tag{1}$$

or

$$L_{OAM,i}^2 = (\Delta m_i)^2 \, G \, M \, r_i \, , \tag{2}$$

where Δm_i is mass of a part of accretion disc, G is gravitational constant, M is mass of central black hole (BH), and r_i is distance between BH and Δm_i.

According to SST, due to the inflows of dark energy and dark matter into the central BH of a quasar [2], with time, the outer shell of the BH transformed into baryonic plasma which was moved above the Schwarzschild surface of the BH. It leads to conclusion that with time, the orbital angular momentum of Δm_i decreases because M decreases – just baryonic matter (BM) leaves the region of BH and of its accretion disc via the jets [3]. On the other hand, angular momentum must be conserved. According to SST, some decrease in angular momentum of BM is possible due to creation of the dark-matter (DM) loops with increasing radius [4], [5]. Notice that the created DM loops are entangled with BM so whole object behaves as one coherent object.

Initial baryonic mass of most massive quasars/galaxies/BHs that transformed into spirals is $m_o \approx 8.525 \cdot 10^{11} M_{Sun}$ [6]. Initially, it was a BH – the DM loops were created on its equator with radius defined as $R_{Equator} = Gm_o/c^2$ and on the sphere with radius equal to the equatorial radius of the BH in planes perpendicular to the BH rotation axis so radii of them were smaller than the equator. We can see that the initial upper limit for radius of created DM loops is

$$R_{Upper\text{-}limit,initial} = R_{Equator} = G\, m_o / c^2 = 1.259 \cdot 10^{15} \text{ m} . \quad (3)$$

With time, the baryonic mass m_o has decreased. It means that orbital angular momentum of BP loops decreased so angular momentum of DM loops must increase – emphasize that the BP loops and DM loops were entangled. According to SST, due to the strong magnetic field produced by BH, on the equator of BH was created closed line of electric force. Such electric loop causes that orbital speeds of baryonic plasma is close to c and causes that spins of baryons are tangent to the loop – such orientation causes that the spin of relativistic baryons is conserved [1]. Moreover, due to the nuclear strong interactions, the BP loop is a coherent object. Such spinning BP loop, due to the much higher density of the electric charges of baryons than the Einstein spacetime [1], creates a spinning vortex composed of the entangled non-rotating-spin-1 Einstein-spacetime (ES) components which are moving with the orbital speed equal to c. Additionally, the spin polarization of the baryons in the BP loop forces the same polarization of the spins of the ES components in the DM loop. Such DM loop cannot interact electromagnetically, although it is composed of the carriers of photons [1]. It follows from the fact that to create electromagnetic wave, the spins of the carriers of photons (i.e. of the ES components) must rotate in plane perpendicular to their velocity c – such rotations in the DM loops are impossible.

Total squared orbital angular momentum of BP and DM loops must be conserved. From formula (2) follows that with time the baryonic mass M decreases so orbital angular momentum of BP loops decreases so of DM loops must increase. We can see that relative increase in radius of DM loops should be equal to relative decrease in baryonic mass of the central BH.

Consider the Milky Way Galaxy (MW). From formula in [6] we can calculate the present-day baryonic mass of MW: $m_{MW,baryonic} \approx 2.9 \cdot 10^{11} M_{Sun}$. On the other hand, the DM mass should be about $f = 5.389$ times higher [2] i.e. should be $m_{MW,DM} \approx 1.6 \cdot 10^{12} M_{Sun}$ i.e. the present-day total mass should be $m_{MW,total} \approx 1.9 \cdot 10^{12} M_{Sun}$.

Observational facts suggest that the present-day central-object mass is $M_{central,MW,present\text{-}day} \approx 4.31 \cdot 10^6 M_{Sun}$ [7]. It should be the baryonic mass of BH plus the mass of DM. There

should be 1 part of baryonic matter per 5.389 parts of DM [2] i.e. abundance of baryonic matter should be $X = 1 / (1 + 5.389) = 0.1565$. It means that baryonic mass of BH is about $M_{BH,MW,present\text{-}day} \approx X\, M_{central,MW,present\text{-}day} = 0.675 \cdot 10^6\, M_{Sun}$.

Calculate for MW the ratio Y of the baryonic mass of initial BH to the present-day baryonic mass of the central BH

$$Y = m_o / M_{BH,MW,present\text{-}day} = 1.263 \cdot 10^6 . \quad (4)$$

It means that upper limit for radius of the present-day DM loops (i.e. the range of the DM structure) in MW is

$$R_{DM\text{-}loop,MW,upper\text{-}limit} = Y\, R_{Upper\text{-}limit,initial} = 1.59 \cdot 10^{21}\ \text{m} = 51.5\ \text{kpc} . \quad (5)$$

Notice that according to SST, the orbital velocities of stars in spiral galaxies do not depend directly on mass of DM structures but follow from the advection that results from the interactions of the DM loops with stars/baryonic-matter via leptons [5], [6].

Calculate the range of the DM structure for dwarf galaxies with initial baryonic mass equal to $10^9 M_{Sun}$ on the assumption that now in their centre is the lightest gravitational BH i.e. the neutron black hole which mass is $24.81 M_{Sun}$ [2]. Applying formulae (3), (4) and (5) we obtain that the range of the DM structure for such dwarf galaxies is 1.9 kpc. Notice that for lower present-day baryonic mass in centre of such dwarf galaxies we obtain higher ranges of DM structure. Emphasize that we present here an averaged statistical picture.

3. How can we detect the DM loops?

We should mimic the mechanism of creation of the DM structures by quasars and investigate behaviour of cold baryonic matter in the region occupied by the DM loops. We can create a relativistic vortex of baryonic plasma using strong magnetic field. Such vortex should create DM loops. But what we should do to increase radii of the DM loops? We can increase intensity of the magnetic field – it should decrease the radius of the relativistic BP vortex i.e. should decrease its angular momentum. Next we should observe how behaves cold baryonic matter in the region occupied by the DM loops with increased radii. A physical separation of the region occupied by the DM loops and the BM vortex is not important because baryonic matter is transparent for the DM loops. The DM loops should create a spinning vortex of the cold baryonic matter.

4. Summary

Here we described the mechanism of creation of dark-matter structures in massive spiral galaxies by the initial quasars. We calculated that now the range of the DM structure in the Milky Way should be about 51.5 kpc. We calculated also the range of the DM structure for dwarf galaxies with initial baryonic mass equal to $10^9 M_{Sun}$ on the assumption that now in their centre is the lightest gravitational BH i.e. the neutron black hole which mass is $24.81 M_{Sun}$ – it is 1.9 kpc. We showed that for lower present-day baryonic mass in centre of such dwarf galaxies we obtain higher ranges of DM structure.

Emphasize that we present here an averaged statistical picture.

We as well answered following questions. How can we detect loops of dark matter in the Earth experiments? Why the DM structures do not interact electromagnetically?

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