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Generation of Radio Waves in the Plasma Environments of Regions close to the Event Horizon of Schiwartschild Black Hole

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1. Introduction Since 1984, the quest of radio wave pulses from the center of our Galaxy have currently been carried out in our studies. For the decameter and decimeter radio wave pulses it is concluded that these pulses are generated from the rotating black holes whose rotation periods supposed to be coinciding with the observed radio wave pulses. Furthermore it is proposed that the source positions are located in the region very close to the event horizon of the black holes being based on the lowness of the observed frequency and steadiness of the period. In the previous our works where the generation and amplifications of plasma waves near the event horizon of Schiwartschild black holes are theoretically considered being based on the general relativistic electromagnetism apparent possibility of generation of the electromagnetic waves has been verified contrary to the general criticisms that there may no generation of radio wave in the regions close to the event horizon due to depression effects of photon energy caused by the effects of general relativity. In the present works we have further completed the theory and calculated wave parameters which are observable ,as decameter to decimeter wavelength pulses, based on possible plasma condition in the region close to the event horizon of the super massive Schiwartschild black holes.

2. Theory The analyses are based on the 4-dimensional gauge potential equations where the source currents consist of wave components in plasma which are subjected to the momentum transfer from the resonated electron beams that are flowing towards event horizon being enhanced by intense gravity of BH. Improvement has been made to gauge potential equations instead of solving previously proposed 4x4 element matrix to solving the 5x5 elements matrix that are required to have non-trivial solution for the forth dimensional gauge potential equation in plasma. This is caused by consideration of more general constrain for the gauge potential. That is, a new variable should be introduced to obtain self consistent system of equations.

3. Results and Discussion Numerical analyses have been carried out mainly for angular frequency around decameter frequency, 20MHz which are kept as constant value through whole range of space of the present interest, near the event horizon whose position are expressed by the parameter R; R=1-rg/r where rg is Schiwartschild radius and r is the distance from the center of the black hole. Validity of the present new method has been checked by comparing with traditional dispersion equations of Appleton-Hartree in the non relativistic cases (R=1).The amplification of the waves are indicated for the case where the wave propagate with directional component towards the event horizon that is in parallel to the direction of the electron beam. Significant growth of the waves take place in the regime of the UHR branch that appears between local plasma frequency and upper hybrid frequency.The results give confirmation to the previous results that the wave make significant growth even in region deep inside or close to the event horizon R=1E-5 .

Investigations of plasma parameters in the region R=1E-2 to R=1E-6 indicate that local plasma frequency and electron cyclotron frequency are in the range from 1E11 to 1E14 Hz, when we consider the intrinsic values. That is we are observing these high frequency phenomena translated to the range of decameter to decimeter wave length range because of effects of general relativity.

4. Conclusion The present study on generation of the plasma waves based on the improved approach of general relativistic electromagnetic equations, considering together the beam plasma wave interaction, gives results that the region deep inside, toward event horizon, even at R=1E-6 ,for an example, there becomes the source region of the low frequency radio wave such as the case of decameter to decimeter wavelength radio waves.

Keywords: Black Hole, Shiwartzschild, General Relativistic EM Theory, Plasma Waves, Near Event Horizon