37(7): Quantized Energy from the Aharonov Bohm Spacetime

The Aharonov Bohm (AB) spacetime contains the W^μ potential of ECE2, defined by:

$$W^\mu = W^{(0)}\Omega^\mu \quad -(1)$$

where

$$W^{(0)} = \hbar / e \quad -(2)$$

is the quantum of magnetic flux and Ω^μ is the spin connection four vector:

$$\Omega^\mu = (\Omega^0, \underline{\Omega}) \quad -(3)$$

The energy / momentum imparted to material matter from the AB spacetime is defined by the minimal prescription:

$$p^\mu \rightarrow p^\mu + eW^\mu \quad -(4)$$

where a positive sign has been used to be consistent with eq. (2). Therefore the overall process is:

$$p^\mu \rightarrow p^\mu + p^\mu_{AB} \quad -(5)$$

where

$$p^\mu_{AB} = eW^{(0)} = \hbar(\Omega^0, \underline{\Omega}) \quad -(6)$$

is the energy / momentum of the Aharonov Bohm spacetime.

So

$$E_{AB} = \hbar c \Omega^0 \quad -(7)$$

and

$$\underline{p}_{AB} = \hbar \underline{\Omega} \quad -(8)$$

and define:

$$\omega_{AB} = c\Omega^0 \; ; \; \underline{\kappa}_{AB} = \underline{\Omega} \quad -(9)$$

2) where ω_{AB} is the angular frequency of the AB spacetime and $\underline{\kappa}_{AB}$ its wave vector.

Therefore the spin connection four vector defines the energy momentum four vector of the AB spacetime. The de Broglie Einstein equations of the AB spacetime are:

$$E_{AB} = \hbar\omega_{AB} = \gamma m_{AB} c^2 \quad -(10)$$

$$\underline{p}_{AB} = \hbar \underline{\kappa}_{AB} = \gamma m_{AB} \underline{v}_{oAB} \quad -(11)$$

where

$$\gamma = \left(1 - \frac{v_{oAB}^2}{c^2}\right)^{-1/2} \quad -(12)$$

Here m is the mass of a particle associated with the AB spacetime, and $\underline{v}_{oAB}$ is its velocity. Therefore the AB spacetime can be thought of as an ensemble of relativistic particles m_{AB}.

The AB spacetime is quantized according to:

$$\underline{p}_{AB}\psi_{AB} = \hbar\underline{\kappa}_{AB}\psi_{AB} = -i\hbar\underline{\nabla}\psi_{AB} \quad -(13)$$

where ψ_{AB} is the wave ~~..~~ function of the AB spacetime, and

$$E_{AB}\psi_{AB} = i\hbar\frac{\partial\psi_{AB}}{\partial t} \quad -(14)$$

The AB wavefunction ψ_{AB} obeys the relativistic

3) wave equation:

$$\left(\square + \kappa_{AB}^2\right)\phi_{AB} = 0 \quad -(15)$$

where

$$\kappa_{AB} = \frac{m_{AB} c}{\hbar} \quad -(16)$$

and

$$\phi_{AB} = \exp\left(-i\left(\omega_{AB} t - \underline{\kappa}_{AB} \cdot \underline{r}\right)\right) \quad -(17)$$

Eq. (15) is the limit of the ECE wave equation of the AB spacetime:

$$\square \phi_{AB} = R \phi_{AB} \quad -(18)$$

where

$$R = -\kappa_{AB}^2 \quad -(19)$$

Eq (15) is the quantized version of the Einstein energy equation of the AB spacetime:

$$\boxed{E_{AB}^2 = c^2 p_{AB}^2 + m_{AB}^2 c^4} \quad -(20)$$

Therefore the AB spacetime is understood as a relativistic particle of mass m_{AB}. The process of taking energy and momentum from the AB spacetime is:

$$E \rightarrow E + E_{AB} \quad -(21)$$

$$\underline{p} \rightarrow \underline{p} + \underline{p}_{AB} \quad -(22)$$