

4. Implication of quantum fluctuations.

Considering inference topology presented in Fig.1, then due to the second law of thermodynamics and as specified in paragraph 3.1, **i)** the following is obtained:

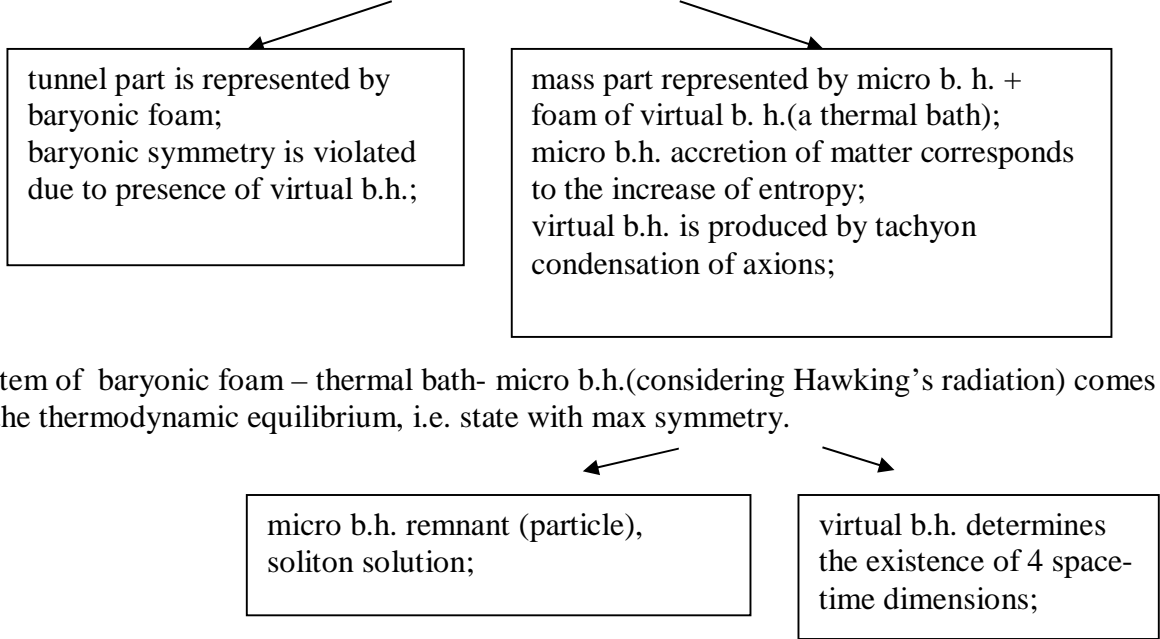


Fig. 8.1 The explanation of the value of mass acquired by gauge bosons.

1. As referenced in paragraph 1, item 1.2.2 the vector boson mass term is determined by $B_l B_l^* A_{ik} A_{ik}^*$ (ref. eq. (2.6.1 b)), where A_{ik} is defined in the following form eq. (A 2.1.0);

2. combined dark boson - axion mass term (ref. paragraph 4, item 4.1.1) is determined by $-\frac{3}{8} B_l B_l^* C C^*$ (ref. eq. (2.6.1 b)), where C is in the following form eq. (A 2.1.2).

a) Mass of axion (cold dark matter) (L. Visinelli and P. Gondolo, 2014; D.J.E. Marsh, D. Grin, R. Hlozek and P.G. Ferreira, 2014) ^{note¹} is in the range of 100 Gev, which corresponds to the gauge boson masses.

This correspondence follows from the fact that mass term for the reversible ^{note²} ‘inference topology’ structure (dark - axion \leftrightarrow gravitational, Fig. 8.3 below) is reduced to the vector boson mass term (as explained in paragraph 4, item 4.1.2, sub-item 2.3).

^{note.} (G.W.Fraser, et.al., 2014; C. Bonvin, R. Durrer and R. Maartens, 2014):

^{1,1} denotes experimental proof of axion existence;

^{1,2} the appearance of Dirac monopole (ref. Fig. 6, Mark 4) is determined by existence of primordial magnetic field, which also addresses the magnetic field in Primakoff effect.

² reversibility reflects geometrical equivalence between dark and gravitational sectors and mathematical symmetry between corresponding terms in Lagrangian eq. (2.6.1 b).

f gravitational instanton (h -coupling) in the theory framework

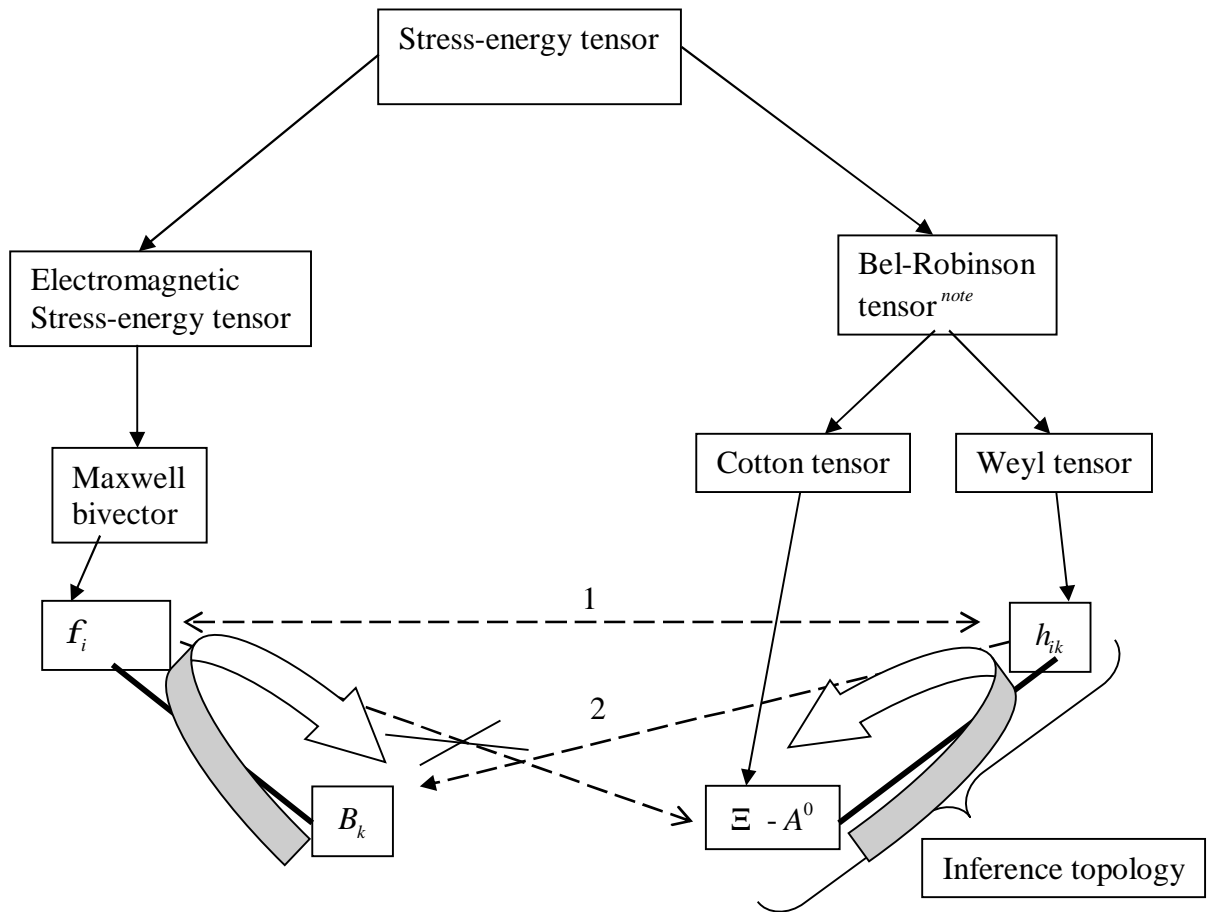


Fig. 8.2 Coupling due to h -gravitational instanton.

1-channel: \exists coupling between photon with gravitational field h_{ik} ; there is no interaction between photon f_i and dark sector $\Xi - A^0$.

2-channel: \exists coupling (due to gravitational instanton h) between gauge vector boson B_k and dark sector $\Xi - A^0$.

note:

For connection between Bel-Robinson tensor and gravitational energy-momentum (ref. Garecki, 1973).

Structure: WIMP - Gravitational instanton ^{note¹}

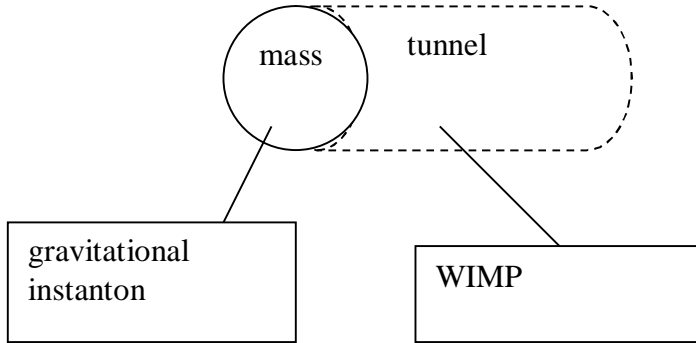


Fig. 8.3 Gravitational instanton (ref. Fig. 6 below, Mark 2, 4); WIMP (ref. Fig. 6, Mark 3).

WIMP (dark part \Leftrightarrow tunnel) interacts with baryonic matter by means of gravitational instanton (gravitational part \Leftrightarrow mass).

b) The value of dark energy ^{note²} is determined by the requirement to cancel local vacuum fluctuations (i.e. maintain thermodynamic equilibrium between the baryonic sector and the thermal bath).

note:

¹ Gravitational instanton \Leftrightarrow 4-dim hyperkähler manifold (ref. Fig.1); instanton is defined as vector bundle with self-dual connections on \mathbb{R}^4 .

² In case of ($f_i \neq 0$), the value of dark energy is defined based on the conditions indicating equality between the baryonic sector's entropy constraint reduced to $4pnats$ on one side and the entropy of thermal bath – micro black hole (b.h.) system determined by eq. ((A 4.6), note 1) and (A 4.7) on another side. Dark energy influence is incorporated explicitly into eq. (A 4.7) by means of replacing eq. (4.1, ref. Appendix B – Extensions Chapter)) with eq. denoting the forced NLSE with the dark energy as driving force.

In case of ($f_i = 0$) the value of dark energy (ref. paragraph 3, item 3.1, sub-item 2) is determined by eqs. (A 2.1 a)- (A 2.1 b).