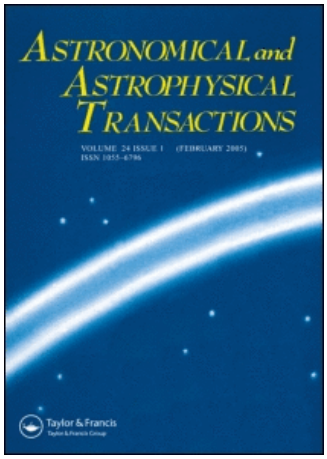

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Bose instability and photoionization of bound levels of cosmological black holes by Hawking radiation

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BOSE INSTABILITY AND PHOTOIONIZATION OF BOUND LEVELS OF COSMOLOGICAL BLACK HOLES BY HAWKING RADIATION

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Bose instability of rotating (Kerr) and charged (Reissner–Nordström or Kerr–Newman) Black Holes (BH) [1–3] is related to the increase with time ($\sim s^{\lambda t}$) of small perturbations of Bose mass field, corresponding to superradiative, quasi-bound states with energies $E \leq \{\mu, m\Omega_H\}$, where $\Omega_H = a/2Mr_+$ is the angular velocity of the BH [4]. The dumping of the angular momentum of the BH is due to the occurence of processes of self-induced production of boson pairs and accumulation of bosons in superradiative quasi-levels. The minimal time of the dumping of the angular momentum in the envelope $t_{\min} \sim 96\mu^{-7}M^{-8}\ln(M/M_{\rm pl})$ for $\mu M \ll 1$ (the system of units $c = h = G = 1$ is used) may be much less than the time of the dumping of the angular momentum by superradiation.

The analysis of boson (scalar) instability for charged BH's shows that

i) the Reissner–Nordström BH is stable, because there are not superradiative quasi-bound levels in this case;

ii) Boson instability of the Kerr–Newman BH is due exclusively to the rotation of the BH, implying the dumping of the angular mometum;

iii) Bose instability may cause an increase of the charge of a BH until the strong electrodynamical discharge by pairs production begins [5–6].

Using the well-known results of quantum electrodynamics for hydrogen-like atoms in flat space-time for the estimation of the cross section of photoionization for electrically charged particles on bound orbits near a black hole, one can obtain for the 2P level:

$$\sigma_A(\omega) = \frac{2^8\alpha}{3\mu}\frac{(I^{2p}_{\rm ion})^{7/2}}{(t_i\omega)^{9/2}}.$$

The ejection rate for such particles, accumulated near a rotating primordial black hole, as a result of superradiative instability, is estimated to be very high due to Hawking's electromagnetic radiation [7].

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