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Can Observations of 511 keV Line From the M31 Galaxy Shed Light on the AGN Jet Composition?[1]

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Positron annihilation line at 511 keV is a known component of the gamma-ray diffuse emission. It is believed to be produced in the Galaxy, but there could be possible extragalactic contribution as well. E.g., positrons can be produced in jets of active galactic nuclei (AGN) and after that accumulate and gradually annihilate in hot gaseous halos around galaxies. In this work we test this hypothesis in application to an individual object — the Andromeda galaxy (M31) which is close and has a supermassive black hole in its center, which powered an AGN before. We compute the growth history of the supermassive black hole in M31, relate it to the evolution of jet luminosity and estimate the positron content in its halo. We calculate the 511 keV photon flux due to positron annihilation which should be observed at Earth and find the value of around 10^{-4} photon $\mathrm{cm}^{-2}\mathrm{s}^{-1}$. It is very close to the observational limits ($< 10^{-4}$photon $\mathrm{cm}^{-2}\mathrm{s}^{-1}$) set by the INTEGRAL/SPI in the assumption of the point source, so further observations would be able to constrain leptonic models of the jets and propagation of cosmic rays in the circumgalactic medium of large spiral galaxies.

Key words: astroparticle physics, galaxies: active, galaxies: jets, gamma-rays: galaxies.

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