X-ray and gamma-ray radiation of cold neutron stars due to neutral interstellar gas accretion

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Effects of neutral gas (hydrogen and helium) accretion on a neutron star are studied. The neutral gas is captured by gravity into the neutron star magnetosphere. Then it is ionized by the surface thermal radiation and accelerated by the electric field at the light cylinder and in a tube of open magnetic field lines. Particles accelerated at the light cylinder generate gamma-rays; some particles move to the star and heat polar caps producing X-ray emission. These emissions are calculated. Their powers appeared to be sufficient to explain observations. It was shown that a neutron star with a magnetic field $B = 10^{12}$ G and a spin period $P = 1$ s radiates most efficiently when it has the surface temperature $T \approx 3 \times 10^4$ K (accretion of hydrogen) and $T \approx 4.5 \times 10^4$ K (accretion of helium). When the number density of the interstellar gas is 1 cm^{-3}, the temperature of polar caps appears to be $\sim 1.5 \times 10^6$ K and their X-ray luminosity $\sim 2 \times 10^{29}$ erg s^{-1}. Such a high radiation level cannot be provided by the reverse positron flux. Gamma radiation of the neutron star with such parameters due to accretion is $\sim 0.2 \times 10^{29}$ erg s^{-1} that is small in comparison with the radiation of the primary electron beam, $\sim 4 \times 10^{29}$ erg s^{-1}.

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