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Entropy and its conservation in expanding Universe

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We investigate properties of the conserved charge in general relativity, recently proposed by one of the present authors with his collaborators, in the inflation era, the matter dominated era and the radiation dominated era of the expanding Universe. We show that the conserved charge becomes the Bekenstein-Hawking entropy in the inflation era, and it becomes the matter entropy and the radiation entropy in the matter and radiation dominated eras, respectively, while the charge itself is always conserved. These properties are qualitatively confirmed by a numerical analysis of a model with a scalar field and radiations. Results in this paper provide more evidences on the interpretation that the conserved charge in general relativity corresponds to entropy.

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