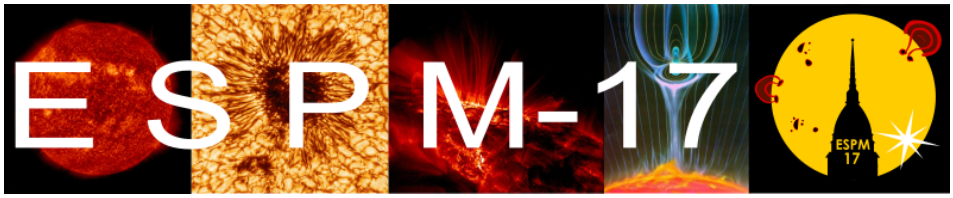

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Stellar Physics and General Relativity

As seen in most textbooks of astrophysics, most astronomical bodies such as main sequence stars have been investigated only by Newtonian gravity. This is presumably based on a belief that Newtonian physics could be sufficient to extract important physics of most astronomical bodies except compact stars and General Relativity would be too precise to be suitable.

In this talk, I will explain that this belief is not correct any more and General Relativity plays an important role in extracting new physics of luminous stars like the Sun.

I will explain it based on my recent work arXiv:2306.16647, in which I have investigated the relativistic extension of the classic stellar structure equations and proposed a closed set of differential equations as the basic relativistic structure equations for a hydrostatic equilibrium system with spherical symmetry.

The following characteristic results will be explained as much as possible within given time:

(i) The proposed structure equations are consistent with the expected local thermodynamic relation.

(ii) The exact forms of the relativistic Poisson equation and steady-state heat conduction equation were derived.

(iii) They were solved exactly or non-perturbatively in the Newton constant for a system consisting of ideal gas of particles with their number conserved, and thermal observables were exactly determined to exhibit the power law behavior.

(iv) This power law behavior is expected also inside the Sun, which is in tension with results in textbooks.

(v) The conventional argument using the Newtonian approximation in coronal region is invalid.

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