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A plasma activation function for deep neural networks

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The activation function is one of the most important building blocks in neutal networks. Since it brings nonlinerity and complexity, the deep neural networks have a rich variety of applications. Owing to its simplicity and backpropagation ability, the Rectified Linear Unit (ReLU) function is a de-fact-standard activation function. However, it may not be the best choice for some applications, because its derivative has a singularity at the origin. For this reason, modern functions have been recently proposed, such as GELU, Swish, and Mish functions. They are more favorable, but often computationally more expensive than the ReLU function.

The Kappa distribution is a popular form of plasma velocity distribution. It contains both a thermal Maxwellian core and a power-low nonthermal tail. It has long been discussed in heliospheric plasmas, but it draws growing attention in various settings throughout the Universe. Its mathematical properties have been extensively studied accordingly.

In this contribution, inspired by the Kappa distribution, we propose a new family of activation functions for deep neural networks. We call them t-Linear Units (tLUs), as the kappa distribution is equivalent to Student's t distribution. The new function exhibits favorable properties as other modern functions, whilst its mathematical form remain relatively simple. Results of benchmark tests will be presented.