Contribution ID: **21** Type: **not specified**

Phase transition thermodynamic parameters at high precision

Wednesday 17 May 2023 14:00 (35 minutes)

Together with the bubble wall velocity, uncertainties of the thermodynamic parameters of the electroweak phase transition can still be large and are subject to the finite-temperature scale hierarchy of gauge theories. While massless gauge bosons are rendered non-perturbative in the infrared, scalar bosons face slow perturbative convergence.

To reliably describe the phase transition thermodynamics, both perturbative and non-perturbative methods are needed. At the intersection between these methods, one can construct a three-dimensional effective theory that systematically includes thermal resummations to all orders. Focusing on generic scalar extensions beyond the Standard Model, I determine their dimensionally reduced theory and the corresponding effective potential using the in-house software package DRalgo [1]. Finally, I present a minimal approach [2] that reconciles both gauge invariance and thermal resummation suitable for precision computations of the thermodynamic parameters of cosmological first-order phase transitions.

[1] A. Ekstedt, P. Schicho, and T. V. I. Tenkanen, DRalgo: a package for effective field theory approach for thermal phase transitions, [2205.08815]
[2] P. Schicho, T. V. I. Tenkanen, and G. White, Combining thermal resummation and gauge invariance for electroweak phase transition, [2203.04284]

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