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Cosmological phase transitions and the swampland

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The Festina Lente (FL) swampland bound follows from demanding that charged black holes of cosmological size in quasi-de Sitter space evaporate in a consistent, non-singular way. The FL bound demands that all charged particles are heavier than a lower bound determined by the gauge coupling and vacuum energy. If one applies the FL bound to nonabelian gauge theories in de Sitter space, one finds that all nonabelian gauge theories must be either Higgsed or confined, with a characteristic scale above the Hubble scale. I will discuss an extension of these results to include finite-temperature effects. I will argue that accounting for a thermal background can significantly strengthen the constraints coming from FL. I argue that the confinement scale should be higher than a scale proportional to the vacuum energy, while Festina Lente without thermal effects only bounds the confinement scale to be above the Hubble scale. For Higgsing, I find that the magnitude of the Higgs mass should be heavier than a bound proportional the scale set by the Higgs VEV. A way to avoid the bound being violated during inflation is to have a large number of species becoming light. If one wants the inflationary scale to lie below the species scale in this case, this bounds the inflationary scale to be ≪10^5 GeV.

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