Towards modeling the quantum universe: History of the weakly interacting and baryonic sectors

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Abstract: Experiments have revealed new, beyond standard model physics associated with neutrino flavor and neutrino mass. This, coupled with anticipated future high precision observational cosmology measurements of the cosmic microwave background (CMB) and light element abundances, dictate that we "raise our game" in modeling the physics of the early universe. Hence, our ultimate goal has been to incorporate the new physics, especially the quantum mechanical (quantum kinetics) issues surrounding how neutrinos change their flavors (e.g., from electron flavor to mu and tau flavor or *vice versa*), into detailed simulations of the thermal history of the early universe. We seek to self-consistently follow neutrino flavor physics along with all weak, electromagnetic, and strong interaction reactions involving the neutrino, the electron, positron, photon component, and the baryons. The result will be a new "tool", allowing comparisons of the results of future high precision cosmological observations to our calculations to expand the space of discovery/constraint of beyond standard model physics. Here we will report on our progress on this task.