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Kaon superfluidity in the early Universe

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Previously, it was found that pion superfluidity could be realized in the quantum chromodynamics (QCD) epoch of the early Universe, when lepton flavor asymmetry jle þ lμj is large enough to generate a charge chemical potential jμQj larger than vacuum pion mass. By following the same logic, kaon superfluidity might also be possible when jle þ lμj is so large that jμQj becomes larger than vacuum kaon mass. Such a possibility is checked by adopting Ginzburg-Landau approximation within the three-flavor Polyakov–Nambu–Jona-Lasinio model. Consider the case with full chemical balance, though kaon superfluidity could be stable compared to the chiral phases with only σ condensations, it would get killed by the more favored homogeneous pion superfluidity. If we introduce mismatch between s and d quarks, kaon superfluidity would require so large s quark density that such a state is impossible in the early Universe.

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