On the critical temperature for the superconducting transition

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Recently it has been demonstrated that certain compounds under high pressure exhibit a more conventional Migdal-Eliashberg-BCS type of superconductivity, with remarkably high critical temperatures for the superconducting transition. Practically this has kindled new interest in the possibility of room-temperature superconductors, and more fundamentally has put a renewed focus on understanding the physics controlling the critical temperature for a transition to superconductivity in particular compounds. I will argue that there are two fundamental principles that govern the temperature of this transition in a given compound: (1) The intrinsic strength of the pair-binding coupling, and (2) the effect of the many-body environment on the efficiency of that coupling. Most discussions take into account only the first, but I will argue that the essential properties of unconventional superconductors are governed more by the second. Understanding the interplay of these effects is essential to charting a path to the highest-temperature superconductors.