

# A degenerate mixture of $^3\text{He}^*$ and $^4\text{He}^*$ with 3D single particle resolution

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We present our experimental realisation of a degenerate mixture of  $^4\text{He}$  [bosonic] and  $^3\text{He}$  [fermionic], with  $^4\text{He } T/T_c \sim 0.3$ , and  $^3\text{He } T/T_f \sim 0.1$ , both in the excited metastable state  $2^3S_1$ . In addition to characterising the thermodynamic properties of the mixture, we exploit the single-particle and 3D resolution capabilities of  $^3\text{He}$  and  $^4\text{He}$ , due to the large internal energy of the  $2^3S_1$  state, to investigate the possible correlations found in this system. This includes higher-order fermionic anti-bunching, and the correlations found in an  $s$ -wave scattering halo between a  $^4\text{He}$  Bose-Einstein condensate and  $^3\text{He}$  degenerate Fermi gas, which represents a non-trivial combination of fermionic anti-bunching and bosonic bunching. The possibility of measuring phase separation between the species is also discussed.