

# Physics & Astronomy Colloquium

## Presents



## Thomas Busch

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Thursday, October 8, 2020  
4:10 pm via Zoom

*Meet the speaker at 3:10 pm, join us in welcoming  
the speaker and for an informal chat!*

## “In-situ thermometry of a cold Fermi gas via dephasing impurities”

Being able to precisely measure low temperatures is a challenging yet fundamental task for understanding and controlling quantum mechanical systems. This is particularly true for cold atomic systems, where the ability to do in-situ thermometry can unlock their potential as many-body quantum simulators.

In this presentation I will show how the temperature of a non-interacting Fermi gas can be accurately inferred from the non-equilibrium dynamics of impurities immersed within it [1]. Our scheme uses an interferometric protocol and is based on established experimental methods. Adopting tools from the theory of quantum parameter estimation allows us to show that optimal precision can be achieved in the experimentally relevant temperature regime for degenerate Fermi gases.

Finally, I will present an intriguing trade-off between measurement time and thermometric precision that is controlled by the impurity-gas coupling, with weak coupling leading to the greatest sensitivities. This can be explained as a consequence of the slow decoherence associated with the onset of the Anderson orthogonality catastrophe, which dominates the gas dynamics following its local interaction with the immersed impurity.

[1] M. T. Mitchison, T. Fogarty, G. Guarnieri, S. Campbell, Th. Busch and J. Goold, Phys. Rev. Lett. 125, 080402 (2020).

*Host: Dr. Peter Engels*

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