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**The physics and technology of Nitrogen-vacancy centers<sup>1</sup>**

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The nitrogen-vacancy (NV) center in diamond is a leading platform for the development of quantum microscopy, computing and communication technologies. Its applications stem from its rich optical, spin and charge physics that is becoming well understood. Recently, a number of similar defects in diamond and other materials have been identified. These defects exhibit properties that are potentially superior to the NV centers for specific quantum applications, but are yet to be fully understood. In this presentation, I will briefly review the physics and applications of the NV center before reporting the development of new first principles techniques for modelling its optical, spin and charge dynamics and decoherence processes. These techniques support deeper understanding of the NV center and the design of NV quantum devices, as well as the rapid identification and characterization of emerging defects for quantum technologies.

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