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**Dr. XX**Editor in Chief

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**Submission the manuscript entitled “Predicting Solid State Material Platforms for Quantum Technologies” by O.L. Hebnes *et al*.**

Dear Dr. XX,

Please find enclosed a copy of the manuscript entitled “Predicting Solid State Material Platforms for Quantum Technologies” by Oliver L. Hebnes *et al*. submitted for publication as an original article in *Nature Communications*. There are two files in all: a Manuscript file and a Supplementary Materials file.

Quantum technologies (QT) have received massive attention in recent years with impacts on fields ranging from communication and cryptography to sensing and computing. Semiconductors are emerging as a promising alternative to the superconducting and trapped ion platforms, offering competitive characteristics combined with the possibility of room temperature operation and mature and scalable material processing and fabrication. Several semiconductors have already been identified as highly suitable for hosting quantum defects, including diamond, silicon carbide and silicon, however, additional materials and defects are urgently needed for the large range of potential applications. Moreover, a comprehensive understanding of the driving mechanisms behind the observed quantum compatible effects is lacking.

A vast number of semiconducting materials and their properties can be found in high-throughput databases. However, filtering among these materials to find novel candidates for quantum technology is a challenge. Therefore, in this paper we provide **a framework for the automated discovery of promising solid state material hosts using material informatics and machine learning methods**. We have developed data extraction tools for numerous material science databases, and proposed and implemented three data mining approaches to label data for supervised machine learning algorithms. We believe that both the topic and results are of **strong** **interest to the readership** of Nature Communications.

In contrast to previous studies, we have developed **a concept** and **methodology** that utilizes the semiconductor based QT experience so far to propose a substantially more manageable set of materials to pursue for further studies. Bringing together state-of-the-art data extraction, data mining and machine learning techniques with experience on quantum compatible defects has resulted in a **novel** study that reveals **new insight** into the important features for quantum friendly materials. In particular, our empirical approach singles out the importance of radial distribution and symmetry of the crystal atoms as essential for material hosts for quantum defects, in contrast to the conventional criteria focusing mainly on the material’s band gap, e.g., as set by Weber et al. [Ref 31]. Importantly, a distinct difference between suitable and unsuitable candidates can be achieved by only two principal components.

Our findings propose a set of materials for further studies, can have a significant **impact** on future material and defect investigations, and motivate future studies that combine machine learning and quantum technology. The proposed model can also be extended as new quantum compatible materials are confirmed and added to the training set. Ultimately, our results can **open a new line of targeted search and study** on quantum compatible materials and defects. Finally, the study reflects an increased attention on semiconductors as a quantum compatible platform, and the convergence and multidisciplinarity needed for further QT progress, and we believe it is **appropriate** for the readership of Nature Communications by being both timely and important.

Sincerely,

Prof. Morten Hjort-Jensen

University of Oslo

The editors consider Novelty, Potential impact, Appropriateness, conceptual and methodological advances and the potential interest to the readership!

Novelty:

* Some previous attempts to use Machine learning, but not in this scale
* Intuitive approach give distinct difference between suitable and unsuitable candidates
* Output is a manageable number of materials
* Novel insight into the important features for quantum defects
* Bringing state of the art concepts together

Potential impact:

* More targeted search for QT materials
* Open up considerable research towards new materials
* The majority of discoveries of QT compatible characteristics in semiconductors has so far happened by serendipity, this will give more targeted approach

Appropriateness:

* Timely
* Important

Conceptual and methodological advances

* Intuitive approach
* Developed approach for data mining

Potential interest to readership

* Cross-disciplinary
* Timely and important