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in order to develop fundamental scientific understanding needed to carry out quantum to quantum transduction through a bottom up synthetic approach that imparts atomistic precision to quantum systems the center for molecular quantum transduction cmqt explores the underlying interactions among relevant quantum spins excitons and vibrational nature chemistry spins in molecules provide a simple platform with which to encode a quantum bit qubit the elementary unit of future quantum computers this perspective discusses how molecular bose einstein condensates could help to provide the answers to fundamental questions or form the basis of new quantum computers hierarchical molecular design and synthesis from small molecules to supramolecular assemblies combined with new spectroscopic probes of quantum coherence and theoretical modelling of complex with the methods presented in this section the electronic properties e g energies forces and non adiabatic couplings can be efficiently computed with a quantum processor for a given molecular geometry that is for given positions of the nuclei the mission of the center for molecular quantum transduction cmqt is to develop the fundamental scientific understanding needed to carry out quantum to quantum transduction through a bottom up synthetic approach that imparts atomistic precision to quantum systems a molecular approach to quantum information science qis promises to enable the bottom up creation of quantum systems within the broad reach of qis which spans fields ranging from quantum computation to quantum communication we will focus on quantum sensing the center for molecular quantum transduction cmqt exploits recent breakthroughs from its team including landmark coherence times and stabilities of molecular qubits and quantum materials the ability to create hybrid qubits and resonant photonic architectures laser setup for cooling controlling and entangling individual molecules in a noteworthy first a team of princeton physicists has been able to link together individual molecules into special states that are quantum mechanically entangled our results show that it is feasible to use spin labeled peptides as a resource for a molecular qubit based network while at the same time providing simple optical readout of single quantum states through nv magnetometry molecular science is a key application area for quantum computing as the quantum dance of electrons and nuclei in molecules occurs on the nanometer scale and must be described by a quantum model qubits in a quantum computer are combined with the tensor product operation the idea to build a quantum system to simulate another quantum system that quantum simulates quantum is as self evident and simple as it is revolutionary molecular science is governed by the dynamics of electrons atomic nuclei and their interaction with electromagnetic fields a reliable physicochemical understanding of these processes is crucial for the design and synthesis of chemicals and materials of economic value molecular quantum computing explores the degrees of freedom of molecules that can be used to produce quantum coherence such as charge orbital opto spin interplay between optical excitation and spin vibration and rotation to process quantum information 1 the foundations of quantum mechanics 9 2 linear motion and the harmonic oscillator 43 3 rotational motion and the hydrogen atom 71 4 angular momentum 98 5 group theory 122 6 techniques of approximation 168 7 atomic spectra and atomic structure 207 8 an introduction to molecular structure 249 9 the calculation of electronic structure 287 in this paper we propose a hybrid quantum classical computational framework for molecular design that utilizes qc based learning and optimization strategies to efficiently navigate the new research demonstrates how the use of molecules in quantum computing leads to fewer errors the technology behind the quantum computers of the future is fast developing with several different approaches in progress prime platform for realizing integrated molecule experiments aims to establish primary quantum based realizations for both the radiometric watt and kelvin the present result demonstrates

the potential of using molecular systems as a quantum interface to store an oam embedded in ultrashort light such a coherent buffer memory is attractive for ultrafast local quantum processing where long storage times are not required new research demonstrates how the use of molecules in quantum computing leads to fewer errors molecules in quantum superposition could help in the development of quantum computers the

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molecular quantum computing explores the degrees of freedom of molecules that can be used to produce quantum coherence such as charge orbital opto spin interplay between optical excitation and spin vibration and rotation to process quantum information

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