

Plan Overview

A Data Management Plan created using DMPTool

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Title: Determining Fundamental Properties of Tritiated Hydrogen to Advance Fusion Energy Technology

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Template: Department of Energy (DOE): Generic

Project abstract:

Deuterium-tritium mixtures are employed as thermonuclear fuel in inertial fusion energy. Elementary physical properties of the fuels, such as their density and thermal expansion, have never been measured. This gap in our knowledge is due to the practical and technical difficulties of carrying out experiments upon condensed tritium under cryogenic conditions. For this reason, the properties of tritiated fusion fuels are currently estimated by means of semi-empirical extrapolations from the corresponding properties of the non-radioactive hydrogens. Here, the author proposes a coordinated theoretical and experimental study of deuterium-tritium mixtures with the goal of accurately determining physical properties relevant to inertial fusion energy. In particular, the team will employ a combination of thermodynamic measurements, neutron scattering techniques, and ab initio quantum Monte Carlo simulations to characterize the deuterium-tritium fuel. The proposed research will provide key technical data for the optimization of inertial fusion energy implosions, thereby supporting the DOE goal of an economically viable fusion pilot plant.

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Determining Fundamental Properties of Tritiated Hydrogen to Advance Fusion Energy Technology

Research results will be published in peer-reviewed journals to ensure their wide dissemination among the scientific community. After publication, experimental data will be shared and preserved through the DOE Data Explorer, a public, web-based repository. Neutron scattering data obtained at the NIST Center for Neutron Research are made available eighteen months after their creation date via ftp.ncnr.nist.gov, in accordance with their data management plan. Code written for this project will be shared publicly on GitHub, an open-source software repository. All technical information and software produced over the course of the proposed research will be released through the LLNL Information Management process.

The subset of experimental and theoretical data published in graphical form will be included in the DOE Data Explorer repository created for this project.

The raw data collected during the course of this research are not expected to exceed several gigabytes in size. Neutron scattering data obtained at NIST or ORNL are expected to fall within the normal data management resources provided by those institutions.

The proposed research will not involve the collection of confidential information or Personally Identifiable Information. LLNL has established standards and policies regarding the transmission, storage, and destruction of data to protect U.S. national interests, proprietary interests, and intellectual property rights. The Principal Investigator will conduct all work in accord with these requirements with support from LLNL's Office of Classification and Export Control, Industrial Partnerships Office, and Technical Information Department.

Planned Research Outputs

Dataset - "Hydrogen Vapor Characterization"

Vapor pressure and mass spectroscopy measurements of non-radioactive hydrogen isotopologues and their mixtures.

Dataset - "D-T Vapor Characterization"

Vapor pressure and mass spectroscopy measurements of liquid and solid D-T.

Dataset - "Hydrogen-Deuterium mixture data set"

Neutron scattering and PIMC data from solid H₂-D₂ mixtures of varying composition.

Dataset - "Crystal structure of solid D-T"

Powder diffraction data and PIMC simulations of solid D-T.

Software - "Path Integral Monte Carlo"

Extension of PIMC kernel to solid phase and the hydrogen isotopologues.

Planned research output details

Title	Type	Anticipated release date	Initial access level	Intended repository(ies)	Anticipated file size	License	Metadata standard(s)	May contain sensitive data?	May contain PII?
Hydrogen Vapor Characterization	Dataset	2029-12-30	Open	DOE Data Explorer		Creative Commons Attribution 4.0 International	None specified	No	No
D-T Vapor Characterization	Dataset	2029-12-30	Open	DOE Data Explorer		Creative Commons Attribution 4.0 International	None specified	No	No
Hydrogen-Deuterium mixture data set	Dataset	2029-12-30	Open	DOE Data Explorer		Creative Commons Attribution 4.0 International	None specified	No	No
Crystal structure of solid D-T	Dataset	2029-12-30	Open	DOE Data Explorer		Creative Commons Attribution 4.0 International	None specified	No	No
Path Integral Monte Carlo	Software	2029-12-30	Open	GitHub		Creative Commons Attribution 4.0 International	None specified	No	No