Initial Temperature-Dependent Validation of an ENDF/B-VIII.1 H-H_2O TSL

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ENDF/B-VIII.1 H-H_2O TSL
Motivation, Experimental Data, and Validation

- The proposed TSL is developed by North Carolina State University (NCSU) using LAMMPS molecular dynamics (MD) simulations optimized based on experimental thermophysical properties over a wide range of *T*.

- Refinement of the H-H_2O thermal scattering law (TSL) at elevated temperatures is of interest for operating reactor conditions. Validation historically focuses on room temperature performance (e.g., ICSBEP benchmarks).

- H-H_2O TSL evaluations depend on separately-defined temperature-dependent phonon and diffusion information. Validation at one *T* does not provide direct assurance of acceptable performance at a different *T*.

- Elevated-temperature pulsed-neutron die-away (PNDA) and static spatial flux decay simulations show improvement in prediction of the thermal diffusion length against experimental data compared to ENDF/B-VII.1 and ENDF/B-VIII.0 TSLs.

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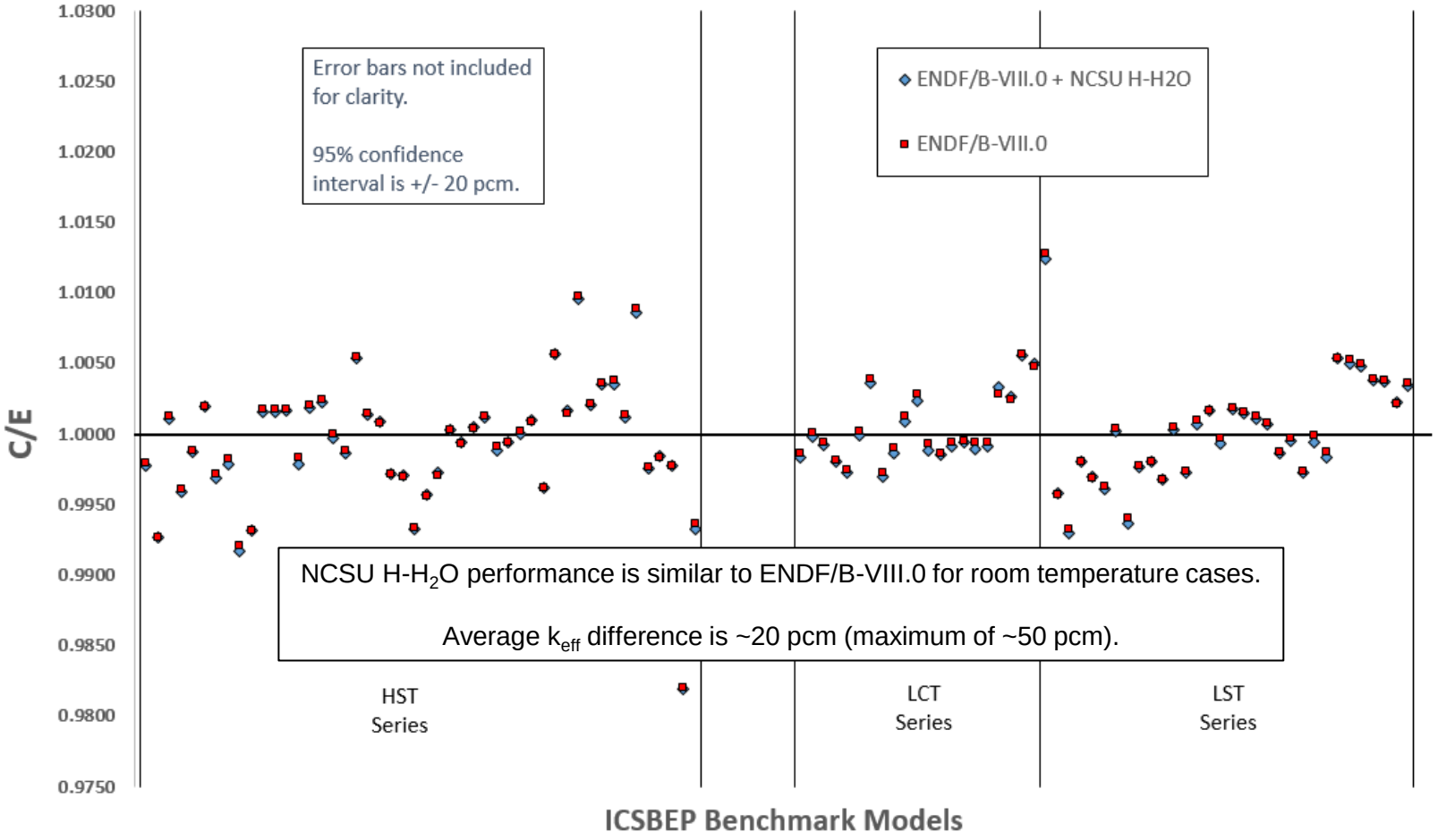
Selected ICSBEP Benchmarks (k_{eff} C/E)
(Room Temperature)



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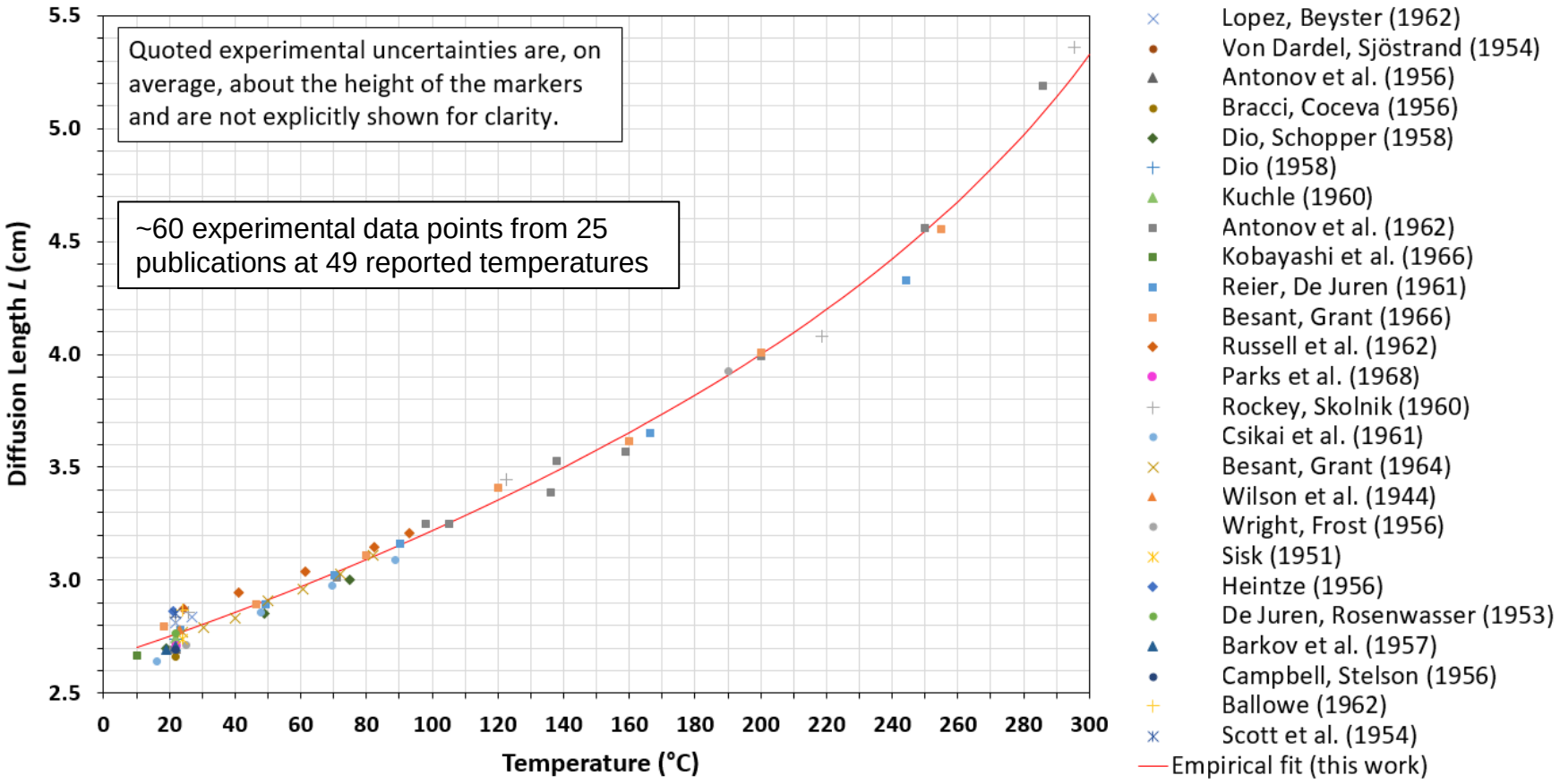
Compilation of Historical Thermal Neutron Diffusion Length (*L*) Measurements for Water



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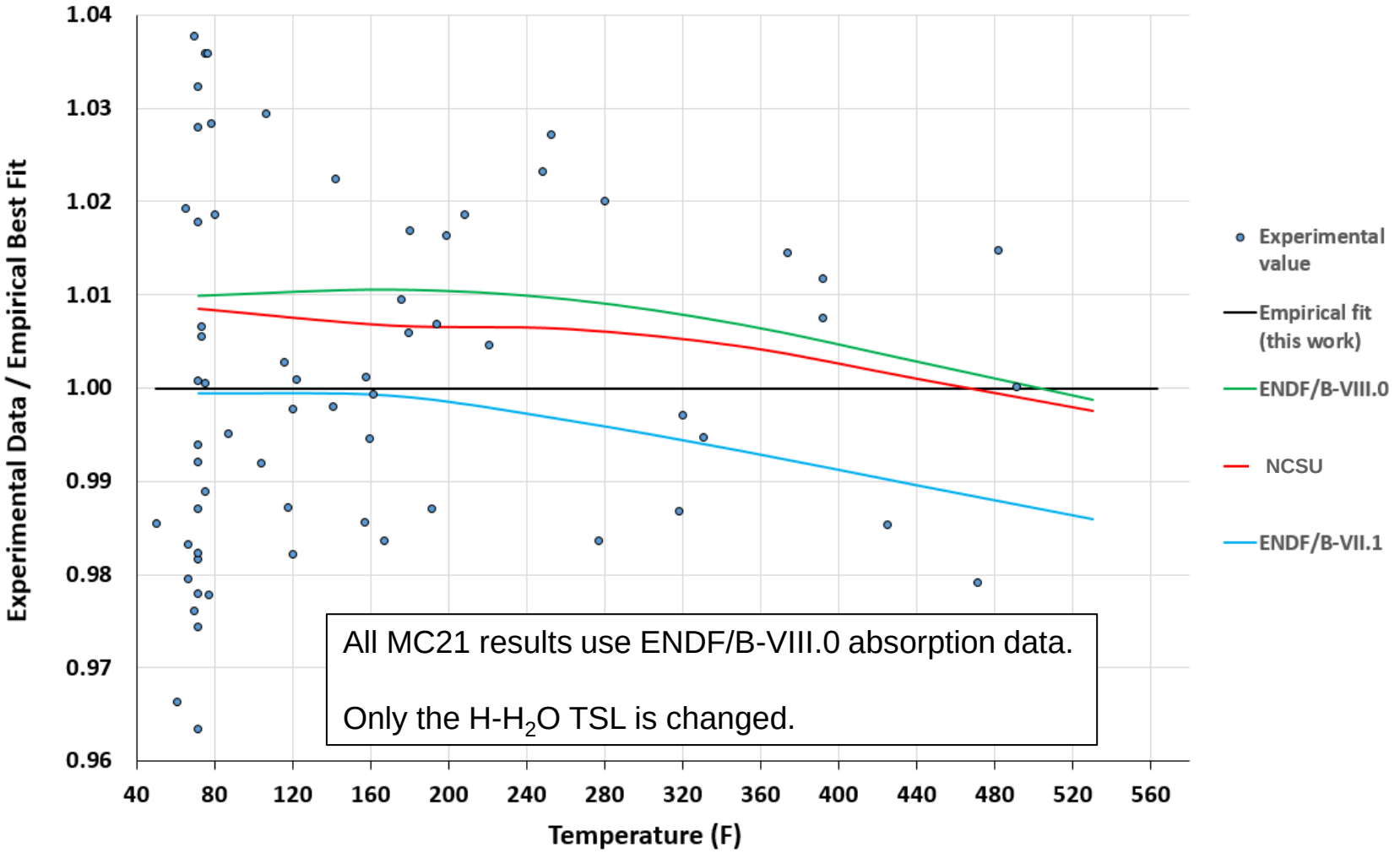
MC21 Diffusion Length Results in Empirical Ratio Space



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Conclusions / Future Work

- The thermal diffusion length L is an integral property of a single material's absorption and scattering cross sections (both differential and integral). No other neutron reactions or materials are involved.

- The MC21-calculated L for water is consistent with the spread of experimental data and is sufficiently sensitive to different H-H_2O TSL physics models to use the method as a TSL integral performance benchmark.

- Modern high-quality diffusion experiments at elevated *T* would allow direct low-cost physics benchmarking of water TSLs when public elevated-*T* critical benchmarks are limited. RPI and LLNL are developing a PNDA capability is coordination with NNL.

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