

REACTIVITY EFFECT OF NEW LIGHT AND HEAVY WATER TSL ON CRITICAL SYSTEMS

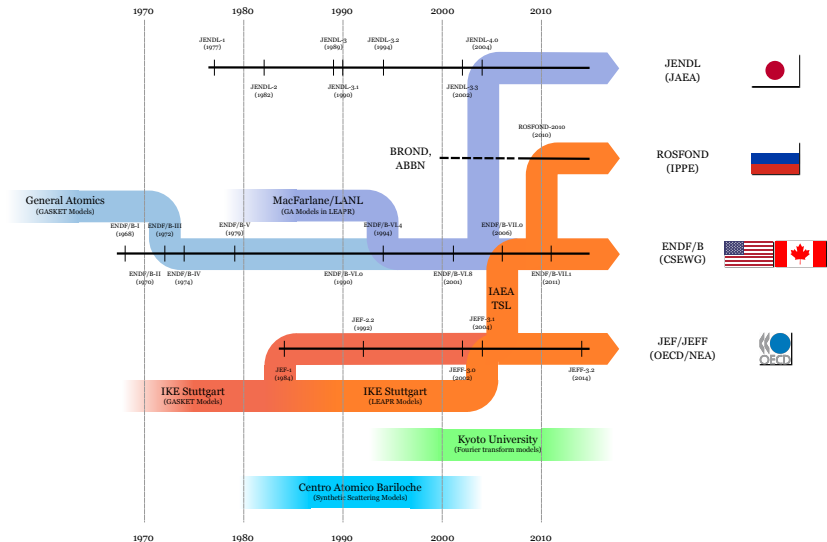
José Ignacio Márquez Damián

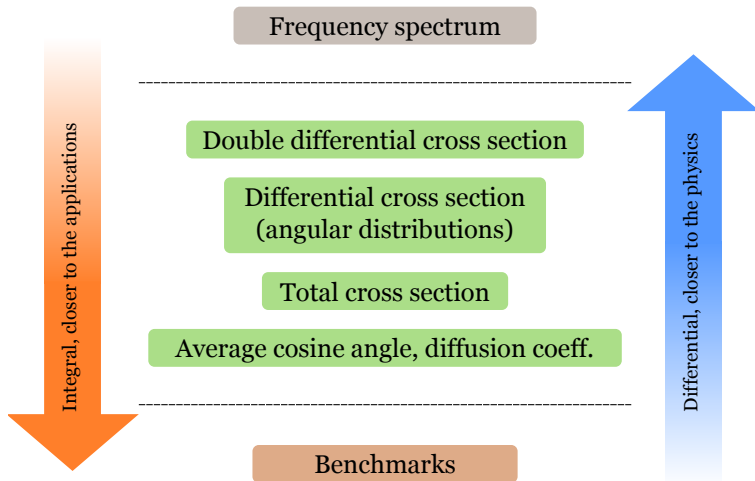
Neutron Physics Department
Centro Atomico Bariloche
Argentina

WPEC SG-42 kick off/SG-40 meeting
May 19 th, 2015
NEA Headquarters, Issy-les-Moulineaux, France



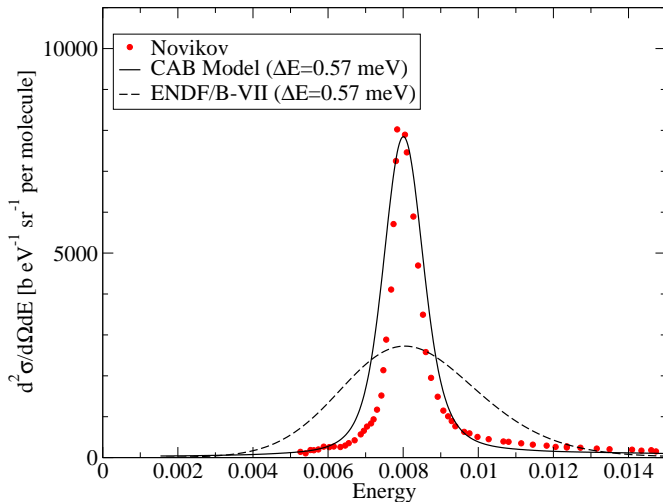
WATER MODELS IN THE EVALUATED NUCLEAR DATA LIBRARIES





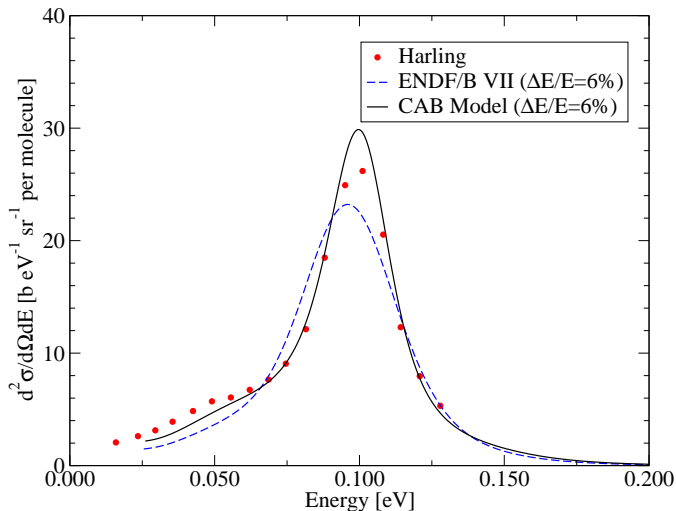
- Use of molecular diffusion instead of free gas for the low energy dynamics.
- Use of molecular dynamics to obtain the frequency spectra at each temperature.
- Use of detailed structure factors to calculate the coherent components in deuterium and oxygen.

VALIDATION: DOUBLE DIFFERENTIAL CROSS SECTION

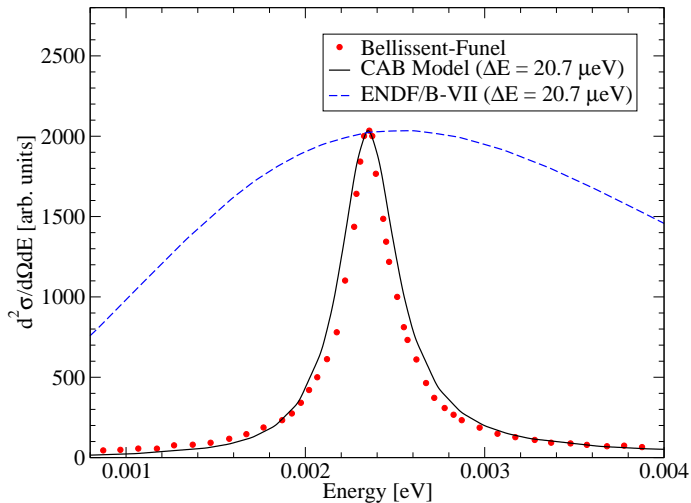


Double differential cross section for light water, with $E_0 = 8$ meV, $\theta = 37^\circ$.

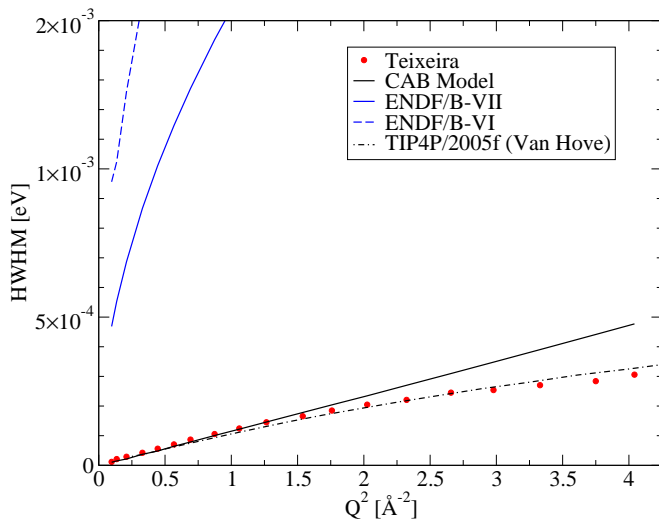
VALIDATION: DOUBLE DIFFERENTIAL CROSS SECTION (CONT.)



Double differential cross section for heavy water, with $E_0 = 101$ meV, $\theta = 60^\circ$.

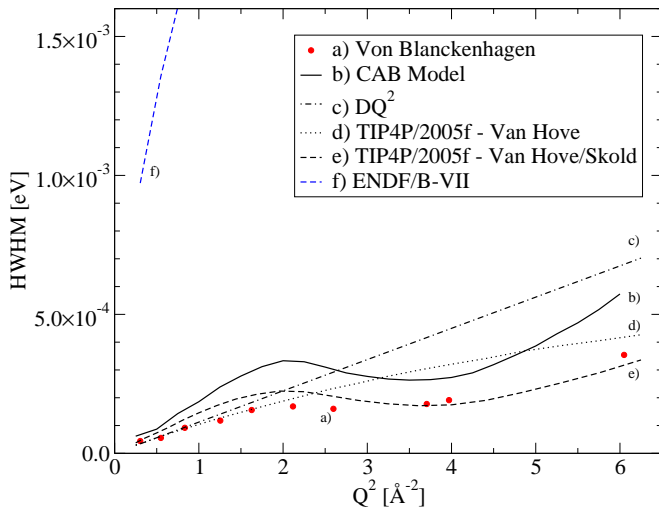


Double differential cross section for light water, with $E_0 = 2.35$ meV, $\theta = 64.20^\circ$.

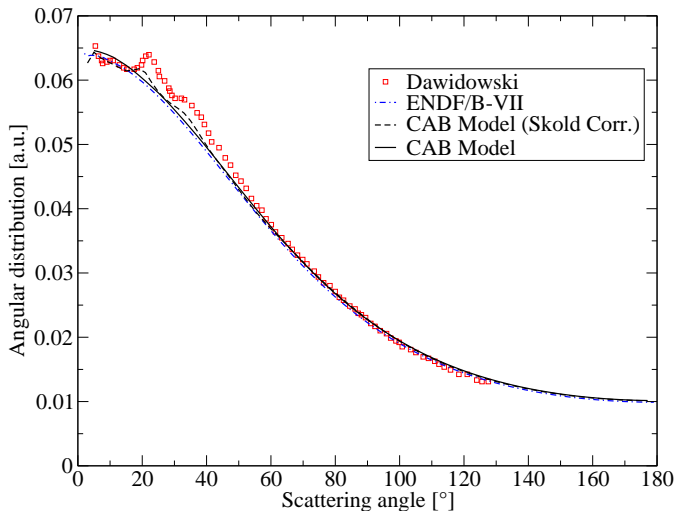


Half-width of the quasielastic peak for $E_0 = 3.15$ meV neutrons in H_2O .

VALIDATION: QUASIELASTIC NEUTRON SCATTERING (CONT.)

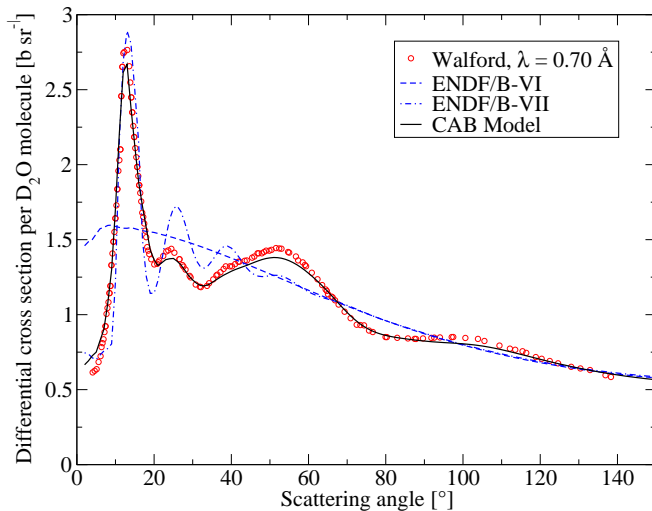


Half-width of the quasielastic peak for $E = 5$ meV in D_2O .

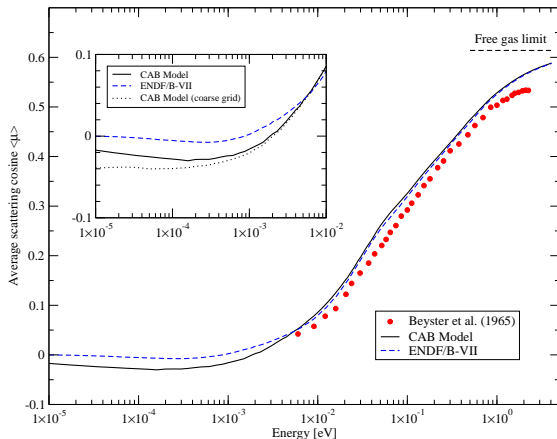


Angular distribution for $E = 161.4$ meV in H_2O , compared with measurements by Dawidowski et al.

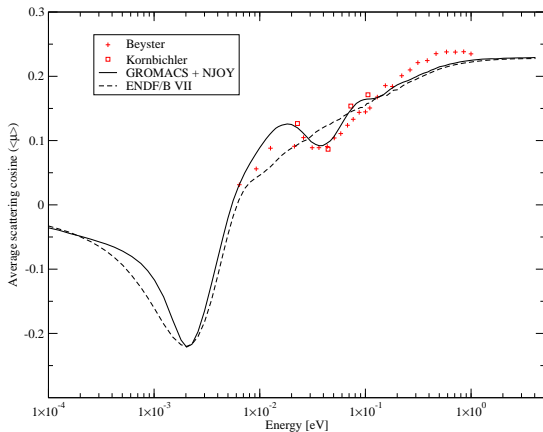
VALIDATION: DIFFERENTIAL SCATTERING (CONT.)



Angular distribution for $E = 170\ meV$ in D_2O in D_2O , compared with measurements by Walford.

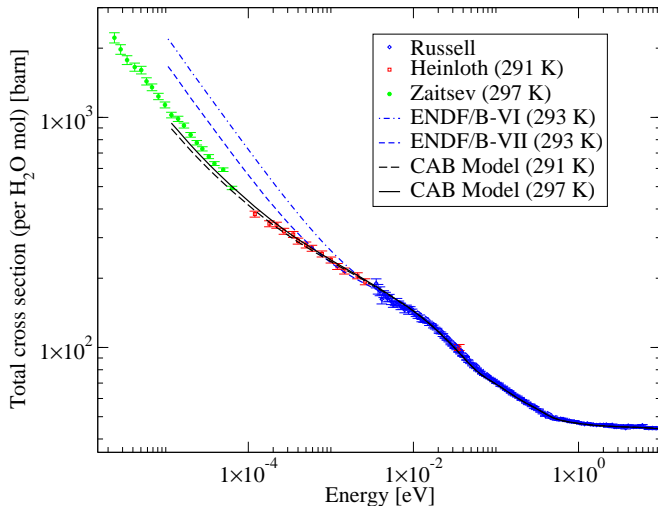


Average cosine of the scattering angle, compared with measurements by Beyster.



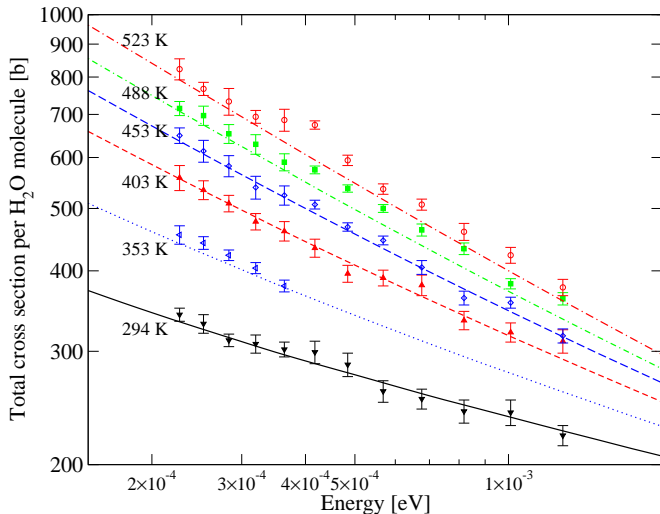
Average cosine of the scattering angle, compared with measurements by Beyster and Kornbichler.

VALIDATION: TOTAL CROSS SECTION



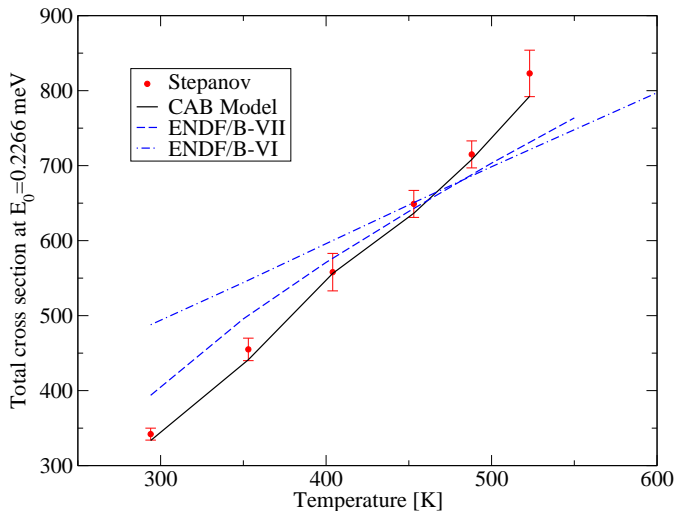
Total cross section per H₂O molecule.

VALIDATION: EFFECT OF THE TEMPERATURE



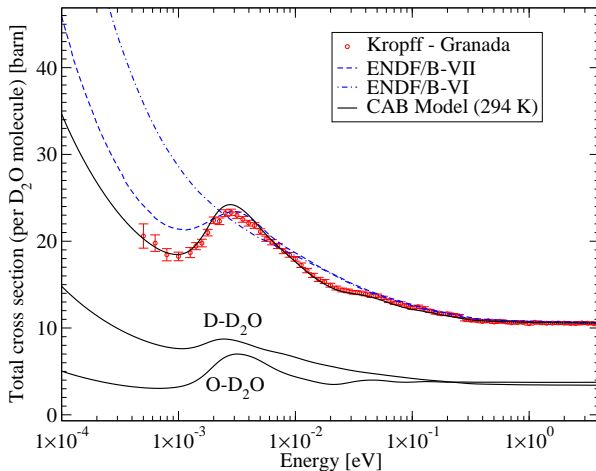
Temperature dependence of the total neutron cross section for H₂O calculated with the CAB Model, compared with measurements by Stepanov.

VALIDATION: EFFECT OF THE TEMPERATURE (CONT.)



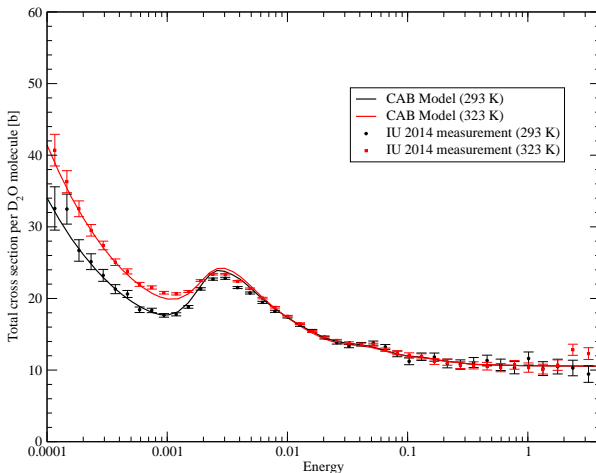
Temperature dependence of the total neutron cross section for H₂O at $E_0 = 0.2266$ meV.

VALIDATION: TOTAL CROSS SECTION IN D2O



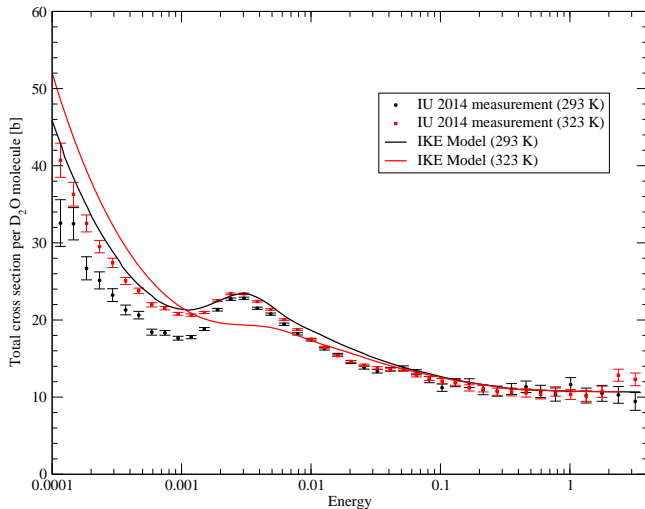
Total cross section per D_2O molecule.

VALIDATION: EFFECT OF THE TEMPERATURE IN D₂O



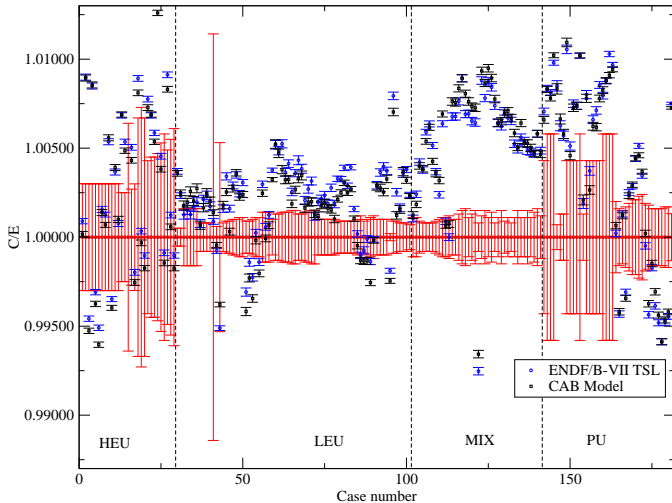
Measured total cross section of heavy water at 293 and 323 K, compared with CAB model calculations. See talk SG42-6 by David Baxter this afternoon.

VALIDATION: EFFECT OF THE TEMPERATURE IN D₂O (CONT.)

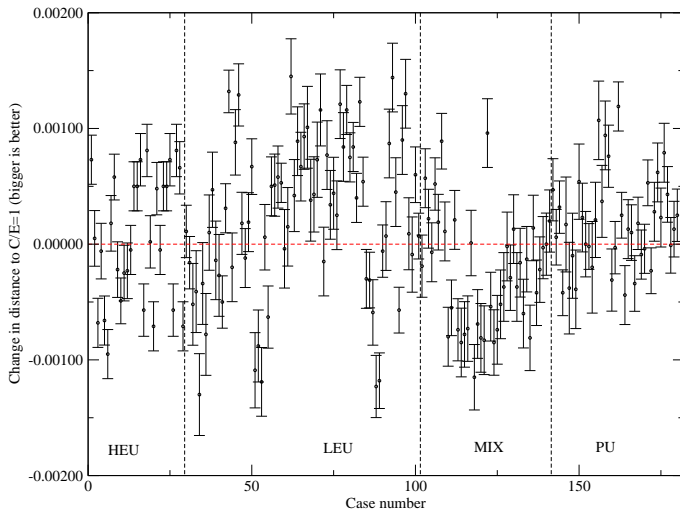


Measured total cross section of heavy water at 293 and 323 K, compared with IKE model calculations. See talk SG42-6 by David Baxter this afternoon.

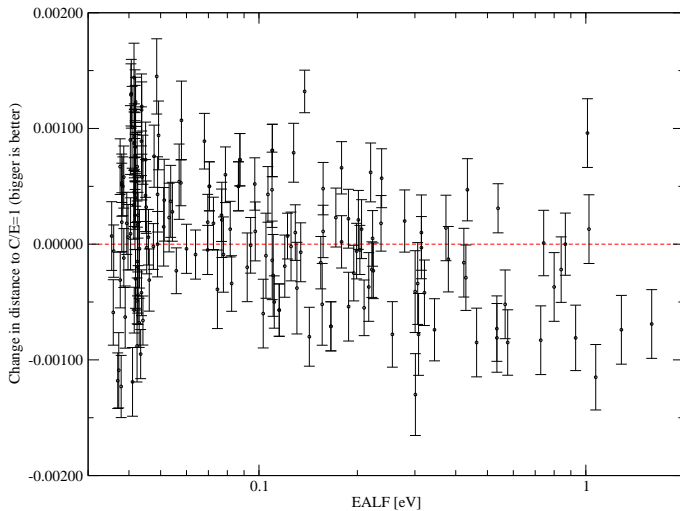
CRITICALITY BENCHMARKS: LIGHT WATER SYSTEMS

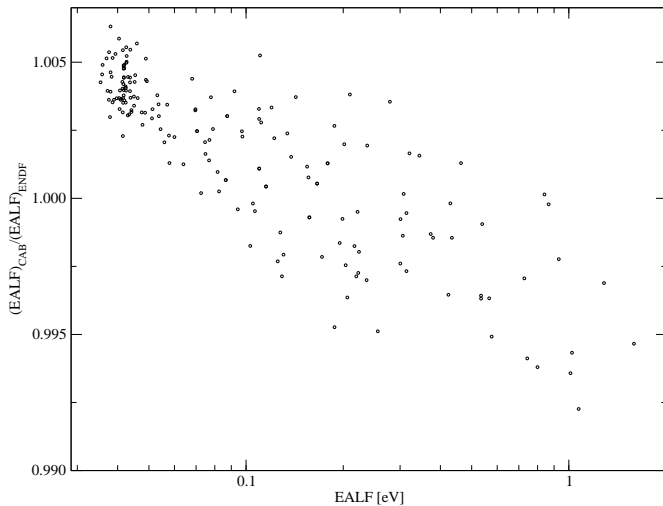


CRITICALITY BENCHMARKS: LIGHT WATER SYSTEMS

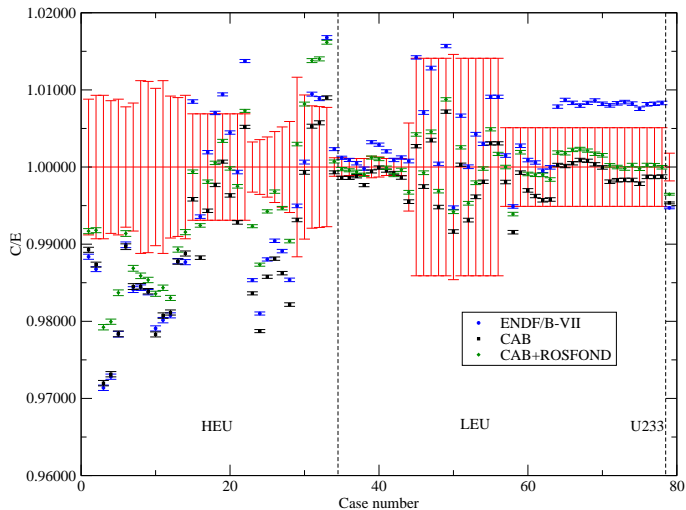


CRITICALITY BENCHMARKS: LIGHT WATER SYSTEMS

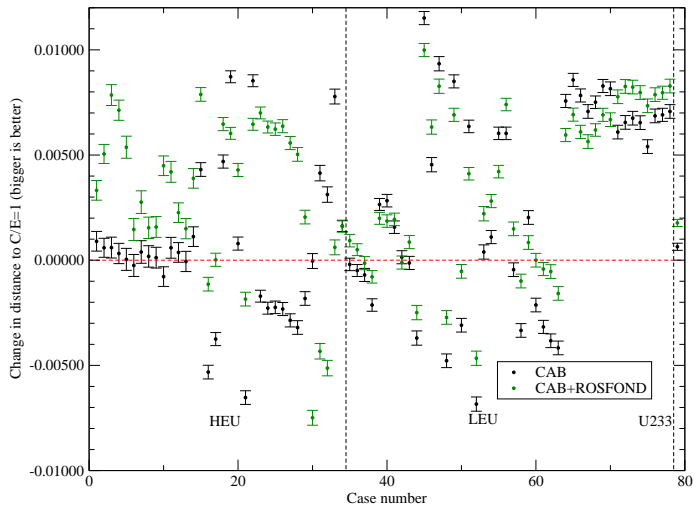




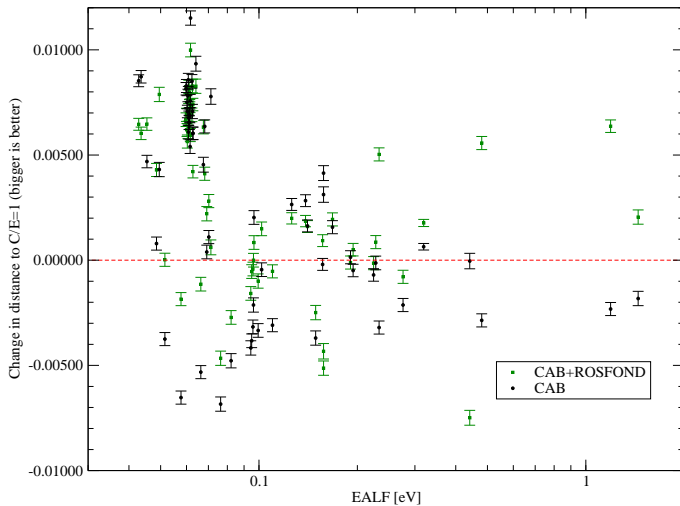
CRITICALITY BENCHMARKS: HEAVY WATER SYSTEMS

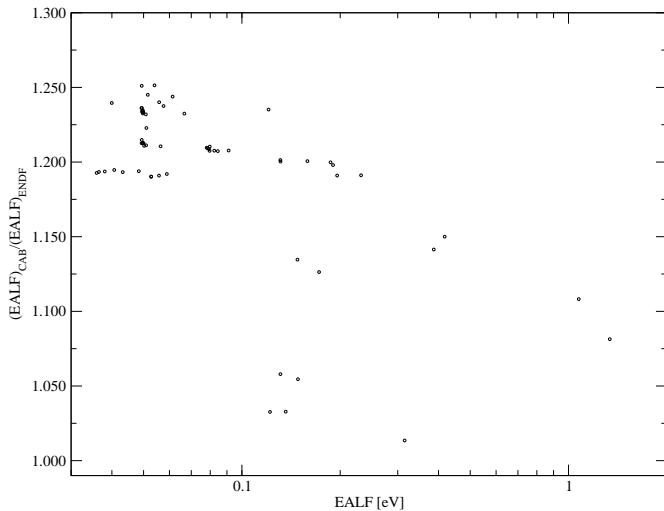


CRITICALITY BENCHMARKS: HEAVY WATER SYSTEMS



CRITICALITY BENCHMARKS: HEAVY WATER SYSTEMS





- The TSL for water presented here are an improvement over the models currently available in the evaluated nuclear data libraries.
- These improvements are more important in the case of heavy water.
- When we apply these libraries to the calculation of light water moderated critical systems, small changes in the range ± 150 pcm are observed. These changes can be traced to a slight hardening of the spectrum.
- In the case of heavy water moderated systems, the differences are more significant, with changes of ~ 1200 pcm. When the new TSL for heavy water is combined with the ROSFOND-2010 evaluation of deuterium, a significant improvement in the calculations is found.
- These results should be taken into account whenever heavy water moderated thermal benchmarks are used, particularly in CIELO oxygen benchmarking.

THANKS FOR YOUR TIME.



BARILOCHE, ARGENTINA