Reviewer #1: Two major comments for authors are provided to authors to improve the quality of the manuscript. Other minor comments are listed after those.

Major comments:
(1) Authors should provide some background description of how the NJOY generated thermal interaction cross sections (including Legendre moments) are used for reactor physics problems. This would give a link between the generated data and their usage in real applications. For general readers, this information can show the importance of the presented work to the reactor analysis. For example, how the different orders of Legendre moments are used in the reactor analysis.

(2) Would the reason that EPC method is not accurate in generating higher-order moments of differential scattering cross section be due to the approximation (Eq.(4))? Through the manuscript, authors have verified that EPC is fundamentally not as accurate as the Gauss quadrature-based method. However, authors didn't discuss the fundamental reasons for that. This is very important and authors should provide this discussion before the paper can be accepted for the publication. Specifically, authors should investigate the validity of the approximation Eq. (4) and show (by numerical results) that if Eq. (4) is responsible for the difference between EPC and the Gauss quadrature method.

Minor comments:

(1) In section 1.1, the last sentence of the second paragraph: "The difference between the Gauss quadrature and NJOY's results did not go away as the quadrature order is increased." This sentence seems implying that the NJOY's results are the benchmark (correct ones). Is this the meaning that authors want to say?

(2) In section 1.1, the second sentences of the third paragraph: "To produce the group cross sections, one needs to have a functional form of the phonon spectrum." I would add "thermal" before "group cross sections".

(3) Lines 25-27: "In order to test the efficacy of Gauss quadrature in this application, we derive benchmark models using simple scattering kernels, such as the free gas model." It is not clear what authors mean by "in this application". Please make it clearer, what "application".

(4) In section 2.1, the first sentence of the first paragraph: "The EPC method was developed to calculate CE Legendre scattering moments effectively by only calculating the zeroth order of the scattering moments and skipping the other orders." This reads like that EPC doesn't calculate other orders of the scattering moments except the zeroth one. This is certainly not true. Other orders of the scattering moments still need to be calculated. Please revise this sentence to remove the ambiguity.

(5) In Figure 1, please clarify the unit "meV"? What does "m" mean?

(6) At the beginning of section 3, line 55: "For those results using a single angular space, we chose 20 points as examples (e.g. \C++ 20 Gauss"). While for those which were generated by using multiple sub angular spaces," This is very hard to follow. What is "a single angular space"? What is "multiple sub angular spaces"? Authors should provide the details of how this is done (evaluation using Gauss quadrature sets) at the places where these phrases (terminologies) appear, otherwise, it is hard to understand what these phrases refer to. Please clarify these terminologies for better readability.

(7) At the beginning of section 4: "It is not possible to tell whether the discrepancies shown in the above figures come from the process of doing angular integration with either Gauss quadrature or EPC method

or from the process of synthesizing the scattering law." This reads weird. Authors declare that they use the same scattering kernels for both methods comparison (lines 51-52). Why the errors could be due to the process of synthesizing the scattering law? When the comparison is made, authors already start with the same scattering law (kernel), right? Otherwise, this comparison doesn't make sense.

(8) After Eq. (11): "It is difficult, though likely possible, to extend such analysis to other orders since in such a model." This sentence is not complete. Please clarify it.

(9) After Eq. (1), "and \cap{sigma}_b is the characteristic scattering cross section of the bound system. " This sentence should be removed.

(10) At the end of section 4, there is an error reference to figure "Also notice that in Figure ?? the EPC results have the opposite sign of the analytic results.".

(11) At the beginning of section 5, correct the sentence "This will also us to make more quantitative comparisons between the different methods." "allow", not "also" should be used.

Reviewer #2: Reviewer's notes:
This paper introduces a Gauss quadrature to integrate the Legendre moments of multigroup transfer cross sections. To verify the numerical aspects of the proposed methodology, semi-analytical scattering laws are derived using the symbolic mathematical software Mathematica. Differences between the NJOY's approach (equiprobable cosine bins, used in THERMR) and the one proposed by the authors (Gauss quadrature) using the semi-analytic results as reference.
There are numerous ways of defining the transfer cross sections and their Legendre coefficients; I would recommend the paper points to other works in this area:

* "Accurate Evaluation of Multigroup Transfer Cross Sections and their Legendre Coefficients", 80, 570-578 (1982), Nuclear Science and Engineering, 1982.
* Section 5-2, "Nuclear Data Preparation", Handbook of Nuclear Engineering, 2010, pp 279-425. The handbook points to numerous additional work in this area that might be of interest of the reader.

Reviewer's recommendation:
The paper is of interest for the nuclear data preparation community.
Miscellaneous:

* Line 9: "calculates" instead of "calculating"
* Line 23: the definition of the characteristics scattering cross section is done twice (one before equation (2) and one after).
* Note 2 page 5, "there is no explicit energy bound for which"
* Line 78: "to other orders in such a model" (no since)
* It is customary in papers to put adequate references when commercial software are used.A reference to Mathematica should be added.
* Latex error, Reference missing in Page 101
* Reference 4: Neutron instead of Netron, Institute instead of Institue