Reviewer #1: The manuscript by Beeler et al, Radiation driven diffusion in U-Mo, ms JNM\_2020\_807, uses MD simulations to determine the tracer diffusion coefficients of the alloy components and Xe in during irradiation of U-Mo alloys with fission fragments. The work, however, considers only the diffusion within energetic displacements cascades and thus it does not include the more challenging task of computing radiation enhanced diffusion. This topic is apparently currently under investigation. Nevertheless, the work is rather complete, in as far as it goes, considering the effects of alloy concentration and the irradiation temperature on cascade diffusion. The calculated diffusion coefficients in this important alloy should therefore be of interest to readers of JNM. In fact, little information is available currently on the temperature dependence of cascade diffusion; I am aware of only one very early MD study by Hsieh et al, PRB 1989). Some revisions, however, are in order:

The authors should provide comparisons of their results on U-Mo alloys with other studies of cascade mixing, both by MD simulation (e.g., recent publications by Nordlund et al) and experimental values. While most of this past work has been on pure metals, it would clearly be of interest to see if alloying had much influence on mixing. It would also be more convenient for readers if the authors reported their diffusion data in Table 1 normalized to damage energy as well as to fissions per second.

We thank the reviewer for their comments. We have included a comparison to the work of Granberg (Nordlund as co-author) on Fe and FeCr alloys. Regrettably, there are no experimental comparisons for the U or U-Mo system, but we certainly hope for such fundamental experimental studies in the future.

The data in Table 1 is a fit to data over all PKA energies (the term A includes the term eps\_B, which is the slope of the msd per energy deposited per unit volume), as such it cannot be normalized to the damage energy. The radiation driven diffusion coefficient is then this A term, multiplied by the fission rate. Thus, fission rate is not included in table 1, but is included in equations 3-5. We believe that the data included in table 1 provides insight into the relative magnitudes of the individual A coefficients, allowing for a comparison across elements of interest and composition. If the reviewer still believes that some display of data needs to be modified, we will take steps to make the data most applicable to the readers.   
   
While the paper is suitable for publication in its present form (with the minor revisions noted), the manuscript would have far more impact if the authors broadened the subject to include defect production and defect clustering. First, the data would be of broad interest in itself, second, it would provide a comparison for defect production in pure metals, which has been exhaustively investigated, and third, it would anticipate what the authors claim to be their future work on radiation enhanced diffusion. All of that data required should be readily available and it should be included.

We thank the reviewer for the suggestion and agree that a study on defect generation and clustering would be quite valuable. However, we believe that such a study is more appropriately paired with the radiation enhanced diffusion work that is on-going and planned for publication in the near future. If the reviewer feels very strongly that such a study is best suited for this manuscript, we will adjust course and include that study here.  
   
In summary, the manuscript is suitable for publication with minor revisions, but it is highly recommended that the authors include in this manuscript the complete primary state of state damage: defect production, cascade mixing, and defect clustering.   
  
  
Reviewer #2: The intended scope of the work is fairly clear, and the logic that the authors followed appears fine, however the mathematical implementation is likely not correct and hence major revision is warranted.  
  
(1) When performing MD simulations, the authors use an interatomic potential taken from literature. It would be appropriate to clarify whether the potential is applicable to this study, for example how well it reproduces the phase diagram of the alloy, and whether the defect structures that it predicts agree with those found in ab initio simulations.

We thank the reviewer for the comment. A discussion of the interatomic potential applicability has been included in the manuscript, and also included below.

“The Smirnova U-Mo-Xe interatomic potential is the only potential capable of describing the U-Mo-Xe system of interest. There are multiple other interatomic potentials that describe the U-Mo binary alloy, but none include interactions for Xe [31, 32]. This U-Mo-Xe potential was fit to ab initio data, tested on general properties of the U, Mo, Xe, U–Mo alloys and U2Mo systems, and is able to reasonably reproduce elastic constants, thermal expansion, melting temperature, and point defect formation energies in γU-Mo [29].”  
  
(2) When discussing simulations of cascades, it is appropriate to make it explicit that electronic energy loss effects are not taken into account, and that the simulations describe pure ballistic mixing, with electronic degrees of freedom not taken into account. Also, it is appropriate to note for the benefit of an interested reader that cascade simulations describe processes at relatively low energy (~20 keV)

It has been explicitly stated that electronic energy loss effects are not taken into account in MD, that simulations describe pure ballistic mixing, that electronic degrees of freedom are not taken into account, and it has been further emphasized that PKA energies in this work are much lower than that expected in fission events.   
  
(3) equation (1) attempts to address a limit very different from that described by the cascade simulations, and the use of the cascade data is not warranted. At very high energies, ~100 MeV, the fission reaction products initially propagate almost along straight lines, and it is in that limit that electronic energy losses dominate. Cascade ballistic phase of collisions develops much later, near the end of the trajectory, whereas it is the total length of the trajectory that enters the expression for the effective ballistic diffusion coefficient. Evaluating the diffusion coefficient in the limit of very high energy of fission reactor products has to be done differently and cannot be interpolated from simulations of low energy cascades. The correct expression for the diffusion coefficient should contain the square of the total length of the trajectory of the fission products, and a suitable procedure for performing the analysis is given on page 431 of  K. C. Russell, Progress in Materials Science Vol. 28, pp. 229 to 434, 1984. A hopefully helpful discussion can also be found in G. Demange et al., Journal of Nuclear Materials 486 (2017) 26. It is highly likely that the total fission fragment kinetic energy E\_F should enter the formula for the diffusion coefficient D\_{rad} quadratically, and not linearly, as in the current version of the paper.

We thank the reviewer for the comment and have read through the references indicated. We acknowledge that fission fragments are generated with approximately 100 MeV and travel along approximately straight lines. Our calculations showed that 95% of this energy is lost electronically. The residual energy being deposited ballistically is utilized to calculate diffusion of species that are already present within the matrix. Therefore, we are neglecting any potential displacements due to electronic energy deposition, and we are neglecting distance traveled of fission fragments due to their generation via a fission event. Assuming an effectively homogeneous fission rate, we are assuming an effectively homogeneous Xe population, due to the homogeneous source. These Xe atoms can *then* diffuse ballistically. The Xe is not considered as the PKA or as the fission fragment, but as a species in the matrix which is diffusing due to ballistic mixing. We have added a sentence emphasizing this in the manuscript. We hope that this discussion has answered the reviewer’s concerns, but if not, please resubmit your questions such that we may more fully resolve this comment.