Reviewer #1: This article describes two alternative closures for the slab geometry Pn equations which are similar to the flux limiters applied to diffusion simulations. This work adds to the limited body of work in this area and includes comprehensive references to the relevant prior work in this area aside from the omission of the following conference paper: http://www.osti.gov/scitech/biblio/22212912.

In terms of the paper, the current structure means that the more technical sections are rather confusing and the structure of this part of the paper could be significantly improved. Specifically, the section on the derivation of the Pn method is rather long winded and the use of the phrase cost function seems misleading - it should be more correctly referred to as an error functional. The section on the new closures would be better incorporated into the discussion on the zero closure and diffusive closure, rather than at the end of the derivation section.

The analysis of the new closure methods seems to be rather rudimentary and speculative, rather than reporting firm conclusions based on a detailed analysis - more concrete examples of estimates for the various terms could be provided based on assumed functional forms for the transport solution. These estimates could then be compared with those from the Dn and Pn (zero) closures.

The paper instead opts to attempt this through analysing the numerical examples, which do not appear until towards the end of the paper. This overwhelms the reader with a large quantity of data, whereas perhaps the plane source problem results should appear earlier on in the section of the paper which compares the different closures. The reader could then be walked through the results in a more logical order.

The plane source results should be presented on their own page in order to improve the overall readability. The embellishments to the model such as the introduction of the alpha parameter and the Larsen style closure could then be presented after the main results for the plane source problem in their own section where the modifications are described prior to including the results.

Overall, this article contains some interesting results and the new schemes reported may have significant merit. This is not so obvious from the results reported in the paper as they are restricted to slab geometry. The significance of the conclusions is therefore more limited in scope than they would have been had some preliminary three-dimensional examples been reported.

To summarize, I recommend that the section covering the analysis of the method is extended significantly and the article is restructured significantly in order to improve its readability; having the figures appear on every page is particularly distracting although I realise that this is not the final layout. Furthermore, some preliminary two- or three- dimensional results could optionally be included prior to resubmission to the journal; one possibility is to generate comparisons with the results for the problems presented in reference 19.

Note that there are also a significant number of minor corrections to the text, but in the interests of space it is recommended that these are addressed by more thorough proof reading prior to resubmission.

Reviewer #2: This article describes two new closures for the time-dependent PN transport equation in 1D. The work is well motivated, with the new methods being designed to address specific deficiencies in existing methods. The development of the methods is clear, logical, and thorough. I recommend this article for publication in JCP with only minor recommendations:

1) A discussion of the issues associated with extending these closures to higher dimensions would be beneficial. The motivation for the TPN closure in Section 3.3 seems to hint at difficulties with extending the MLDN approach, a more thorough discussion of this matter would be useful.

2) In the context of an implicit (or semi-implicit) time stepping approach, are there any notable differences (e.g. condition number) in the linear systems arising in the MLDN or TPN methods relative to the traditional closures? Given that the current implementation is in 1D, I'm guess a direct solver (e.g. LU) is used to solve these linear systems?

3) The presentation of results is somewhat confusing. Figures 2a and 2b, for instance, show solutions at different times, different moment orders. Also, Figure 2b shows results for the PN method while 2a does not. I think it would be easier to follow if these figures either had different moment orders at the same time or different times for the same moment order, and the methods presented should be the same for both cases. Why is TPN excluded from Figure 2, but both MLDN and TPN are included in Figure 3? Figure 3 claims to be a comparison of MLDN with TPN, but then the other methods are also included. If the purpose of the figure is comparing the two methods, perhaps exclude the other methods. This would also allow zooming in on the y-axis, showing more detail.

4) Several style-related features of the figures make them difficult to follow. Certain colors are difficult to distinguish, more constrasting colors might make it easier to read. For instance the purple for MLDN in 2b blends in with the other curves and the dark purple in Figure 7 looks nearly the same as the black. It would be helpful to use consistent coloring for different methods between figures, particularly when the text draws comparisons between the figures. As an example, the text in Section 5.2 compares the MLD8 curve in Figure 3b to the MLD4/MLD6 curves in Figure 2, but MLDN is represented by different colors between these figures, making a visual comparison difficult. What is the significance of the markers (e.g. the circles, stars, boxes, etc.) on the curves? They seem to be evenly spaced for a given curve, but not consistently spaced across different curves. The only merit I see is allowing the curves to be distinguished in a black-and-white print, but
Figures 4 and 8 already rely entirely on color. My opinion is that the markers only make the figures more confusing and should be removed.