

Dear Editor,

I compiled all of the points that each person made and listed them here with explanations about how they were addressed. I understand that the major points were supposed to be explained more than the minor points, however, I did not necessarily do it this way. I based the length of my explanation on how much was corrected and what the importance of the point was. For instance, if I needed to add a singular citation as stated by a major point, then I explained that I did, but that did not require too much explanation. There are also some minor points which caused me to realize that more things did need fixing, so I explained all of that under the minor point, causing some of those explanations to be a little bit longer. Nevertheless, I did address each point made and provided justification for if it was fixed or not.

**Other things I changed not from the reviews:**

- Changed “angular polarization” and “angular polarization dispersion” to just “angular dispersion” because I think it is more clear and consistent
- I redid the analysis when it came to the signal integration factor. I realized that I misunderstood something in one of the papers, so I changed the calculation of the magnetic field strength to correct for this. I added a big section explaining the signal integration factor.
- I added a percent error Table comparing the magnetic field values. I think that this was an important addition because it is easier for the reader to visualize the magnetic field strength comparison rather than that of angular dispersion.

**Major points made:**

1. In Figure 1 there must be a literature citation.
  - a. I added a literature citation to this figure, since I did not make it. It came from Guerra 2021.
2. With only the conclusion of the different angular polarization, the author does not have very strong evidence to explain why the two magnetic field strengths are different or which one is correct (as she stated, analysis on the data and other aspects is necessary). Therefore, the question addressed in the paper is not really answered.
  - a. The question in the paper was originally unclear and too broad, which is why it was not answered. There were also no conclusions and future work sections to discuss how this project will succeed in the future. To fix this, I changed the title to be more specific and I specified my goals in the introduction. I also added a conclusion section which talks about what will be done in the future. These are discussed in more detail below. What I do have, however, is strong evidence to suggest that a main problem to explain the discrepancy lies in the methodologies of angular polarization dispersion calculations.
3. In section 3, there needs to be an explanation as to how previous studies determined parameters such as the number of turbulent cells, the velocity dispersion, the average column density of molecular hydrogen, the uniform cloud depth and the mean molecular weight, all these values are obtained from previous studies with no mention of how they were calculated.

- a. I do not think it is necessary to talk about how they were calculated because they are not essential to the outcome of the project. Explaining all of these items would lengthen the paper by pages, and it would not even work towards my goal of the paper. Therefore, it would just be a lot of additional explanations which I think I do not need. I did add a sentence, however, stating that the reader can look to Chuss et al 2019 if they would like to see in more detail about how they were calculated.
4. It is not clear why the author is using these methods. Is the author implementing the methods used in the Hwang et al. paper on the data from the Guerra et al. paper? It is very unclear how using the boxcar method on the data will be able to determine the reason the studies report vastly different magnetic field strengths. I think part of this confusion is due to the fact that the methods employed by the previous studies are not well explained (as stated above). It needs to be clear to the reader how the methods employed will demonstrate the goals of the project.
  - a. I do think that this is a very valid comment and I hope that I elaborated on my goals better in the introduction. I clarified in the introduction that I am looking to see the difference that the angular polarization dispersion value makes in the magnetic field strength calculation so that I can determine if the method used to calculate that had a significant effect on the order of magnitude difference between the two groups. I also made a Comparison of Methods section, which focuses more on the methods used by each team.
5. Overall, the project is not finished. The correct kernel size needs to be determined (and a reason behind which size was picked needs to be given). After this, the author can determine if the difference in methods used to compute the angular polarization dispersion is the cause of the difference in magnetic field strength.
  - a. I do know that the project is not completely finished. The purpose of this paper was to discuss what came from completing this portion of the project. I do not think that determining the correct kernel size was completely essential to make the conclusion that the methods to determine angular polarization had an effect on the results, because as shown in the Tables, there were significant differences within all the kernel sizes compared to the results from Chuss et al. In order to correct this confusion, I have added a discussion about what will occur in the future so that the project can actually be finished. To summarize, I will be determining the correct kernel size and repeating the analysis the other way around, so using the data from Hwang et al in the dispersion function. Then, I can draw better conclusions about if the difference in methods used to compute the angular polarization dispersion is the cause of the difference in magnetic field strength.
6. Paper did not initially mention analysis was only on HAWC+ data from Chuss using Hwang's method. The abstract and the introduction imply a 2-way analysis between Hwang and Guerra.
  - a. I did fix the wording of the introduction to more clearly state my goals. I made sure it was clear that the analysis only involves using HAWC+ data on Hwang's

method. But I do think the abstract does not imply a 2-way analysis and is perfectly clear, so I will not be changing that.

7. Stokes parameters not described or cited.
  - a. I added this sentence: Polarized light is represented by the Stokes parameters I, Q and U, where I is indicative of intensity and U and Q are indicative of polarization angle. I think this describes what the Stokes parameters are well enough to understand the observations. I think that people in the field have an idea of what these are already, and when looking at other papers that mention them they do not describe what they are, so additional explanation is not necessary.
8. The comparison of the two studies should not be in the intro but saved for a later section that compares them more in detail. The procedures that they used are all over the paper and are hard to follow. It would be good if a new section was made just comparing the methods and calculations done in each study. The author could then clearly explain the differences to help the reader better understand the goals.
  - a. I definitely do agree with this comment. What I did not realize before is that the description of what Hwang did in the introduction is very similar to what I wrote in the methodology section, and I think that this is unnecessary. To fix this, I increased the description of the calculation of the angular polarization component in the Comparison of Methods section in the introduction, to cover nearly everything that I describe in the methodology. I then give in the methodology a brief summary of the whole process again, and say how the process described in the introduction was followed. I also include in this section a few more specific details about the process as it pertains to my analysis. This limits the disorganization and repetition of the descriptions in the paper.
9. Table descriptions are vague, must give more detail about what is in the tables
  - a. I added more detailed captions in each table to provide some more context about what the tables are showing. I did not realize this before, but my table descriptions were definitely vague and did not do a good enough job of explaining what was in them.
10. Observations section does not mention data used by Hwang
  - a. There was no data used by Hwang et al in this analysis, so that is why it was not included. I mentioned in the introduction what the data was though so that the reader could better compare Hwang et al and Chuss et al. In my Comparison of Methods section, I added this sentence: "Because the observations from the Hwang et al are not utilized in the methodology for this study, this is the extent to which they will be discussed. See Hwang et al for a discussion of more details about the SCUBA-2 observations taken." I think that this sentence clarifies that the SCUBA-2 data is not used in my analysis so there is no need to add it to the observations section.
11. Comparison seems to be more about Chuss and Hwang, not Guerra and Hwang
  - a. I ended up using the results that came from Chuss et al rather than Guerra et al. The main difference is that Guerra et al continued the analysis to look at the mass to magnetic flux ratio, which is important when considering the role of

magnetic fields in star formation. However, in order to keep consistency between where the observations came from and where the results came from, I think it is wise to use everything from one paper, Chuss et al.

12. The purpose for research stated at the end of the introduction sets up the paper as though the author plans to investigate various components of the previous studies until finding the cause of the difference between past results. This contrasts with the first claim in the discussion stating that the purpose was to determine if a single component ( $\sigma\phi$ ) of the previous studies caused the difference. This needs to be specified in the introduction for the procedures to match the purpose of research.
  - a. I agree with the fact that the end of the introduction was unclear. In order to be more clear, I added the following sentence: The analysis presented incorporates the results of the HAWC+ data obtained by Chuss et al used in the angular polarization dispersion calculation method from Hwang et al, combined with the velocity dispersion and volume density calculations from Chuss to produce magnetic field strength values. I think that this sentence adds clarity to the paper and fixes this issue. It aligns with what happens in the methodology and discussion sections.
13. In methodology, explain the reasons for checking the data, the volume density component, or the velocity dispersion component in future studies (last sentence of section 4).
  - a. This is addressed below, when I discuss the future and conclusions section.
14. Telescopes and collaborations need citations.
  - a. For both the HAWC+ and the SCUBA-2 telescopes, I added citations. I did not know that they needed citations before, but when I look back on previous published papers, they all have citations, so I fixed this.
15. Future work and conclusions section needed
  - a. I added a future work section which discusses how this project will continue in the future. This was definitely an important part to add, especially since what I have done so far would majorly contribute to additional research.
  - b. I also added a conclusion section which summarizes the work and the main conclusion found. It talks about the purpose of what I did, a summary of the method used, restates the conclusion, and briefly mentions what is to be done in the future.

**Minor points made:**

1. Would be helpful to use the same units for B in the abstract.
  - a. I have made all of the magnetic field strengths microgauss so that they are consistent. I agree with this comment because it is now easier to compare results.
2. Two-point structure function was not explained in the intro.
  - a. I have reworded this sentence to make this: “they applied a function to describe the dispersion of magnetic fields to the polarimetry data...” This sentence takes away the confusion of what a two-point structure function is and describes what

the function in question does. I also added this sentence: "See Chuss et al and Guerra et al for a discussion of details about this function and how it was employed." This lets the reader know that more details about this function are in other works, but they are not important for the purposes of this paper.

3. Does not explain how velocity dispersions are obtained from the spectral lines.
  - a. I do not think explaining this is necessary since it is not an important part of my science. I have added a sentence that explains how additional information about the processes of obtaining these components can be found in Chuss et al. (2019).
4. Observations section: everything needs to be explained more here
  - a. I definitely agree with this comment. Each element to the reduction process that I mentioned was not explained and I do think that I included way too much detail. To fix this, I am reducing the amount of explanation here and only including essential pieces. I am deleting the sentence about the raster scans and the part about the "bright" keyword being used. I am also deleting the information about the chop-nod-dither method, because adding explanations about that would increase the length of the paper and I do not believe that they are necessary in order to understand what is being done here. I also took out the equation about fractional bandwidth because it is a detail that is not needed. Finally, I took this sentence away: "In order to merge the measurements into combined maps, they used relative background subtraction and smoothing with a Gaussian kernel having Full-Width Half-Max (FWHM) equal to half that of the diffraction-limited beam for each HAWC+ band ; both of these are standard parts of the reduction pipeline." I do not think the fact that the measurements had to be merged into combined maps is not important to know. Generally, I think this section was way too detailed and even though the reduction information is important to know to an extent, I originally had way too much information about it.
5. Methodology section:
  - a. The boxcar filter sentence is long and jargon-heavy
    - i. I split this sentence into multiple sections so that it is easier to understand.
  - b. Beam and line of sight integration: Was this a method that Hwang did not use? If so, was it the point of discrepancy between results? Without the N values do the results align with Hwang?
    - i. I realized that there were flaws in this analysis, so I redid this piece. I think I explained it clearly in the paper, but there is a component to the field from Chuss et al that is a part of the DCF method which was not included in my calculation, so this had to be corrected in order to compare "apples to apples."
  - c. Order of tables should be rearranged, since table 6 is mentioned before 4 and 5.
    - i. I rearranged the order of the tables. I will describe it here. Table 1 is my angular polarization values, Table 2 are the N values from Chuss et al, Table 3 is the product of my angular polarization values and N, Table 4 is the calculation of B from my analysis, Table 5 is the turbulent-ordered

ratio and angular polarization values from Chuss et al, Table 6 is the B calculated by Chuss et al, and Table 7 is the percent difference between my and Chuss's angular polarization values. I thought this order made the most sense in discussing results.

6. Write "Equation" instead of "Eq."
  - a. This change has been made.
7. Instead of "two different authors," write "two different groups" or "papers."
  - a. This change has been made in order to clarify that there were not only 2 individuals involved, but two groups instead.
8. Abstract too in depth. Background should be saved for the introduction. The abstract should just present the goals and results.
  - a. I disagree with this comment. Because the abstract is the first thing someone sees when they are reading a paper, I think that it is important to have one or two sentences of background information so that the reader actually understands what the context of the paper is about.
9. More in depth explanation of the DCF method in the intro since it is so critical to science.
  - a. I first added this sentence: The DCF method relates the velocity dispersion along the line-of-sight to the polarization angle dispersion on the plane-of-sky and assumes an isotropically turbulent medium, whose turbulent and magnetic energy components are in equipartition. I also added a sentence about how Houde et al. and Hildebrand et al. equate the kinetic energy from the turbulence to the dispersion in magnetic field polarization vectors, as seen through the dust grain alignment, to estimate the magnetic field strength. This is definitely a necessary change to give some more background on this important method.
10. What is rho in the intro?
  - a. I corrected this to say that rho is the volume density of the gas in the cloud, rather than just saying it is the volume density.
11. Move the reasoning for why the values for Orion Bar are omitted to the beginning of the section.
  - a. I moved this sentence to near the first table description, so that the reader knows instantly why the values are not present in any of the following tables.
12. Make section 3 into 2 subsections to make it easier on the reader to follow and understand.
  - a. This is a good organizational point. I divided it up into 2 subsections, one about the calculations resulting from the unsharp masking technique and one about the calculation of B from Chuss et al.
13. Section 1 paragraph 1 last line hard to understand
  - a. I disagree with this, I think the lack of understanding comes from the unfamiliarity with the topic rather than the description itself. I am not changing this sentence or adding more description about this because if this paper is directed to people within the field, they would not need additional explanations.
14. Colors of words on figure 1 hard to read
  - a. This is a figure from another paper, so it is not something I can fix.
15. Section 4 not mentioned in summary at end of intro

- a. This has been fixed. I accidentally misnumbered the sections in that last paragraph but it is corrected now.
16. Section 3 can use more detail about what is being done with the filters
  - a. Similar to other comments in this section, I did add some more detail about the unsharp masking technique. However, I am not going to add detail about what happens within the convolutions themselves. I think that this is too much detail for the purposes of this study, and convolutions is a common technique that many people in the field are familiar with.
17. Explain more the role of N and how  $\sigma \times N$  results in the values in table 3
  - a. I did add some explanations of N. I
18. Table 5 and 6 located in section 3 and not mentioned until 4
  - a. I did try to do some reorganizing, but I don't think I can control the positions of the tables in latex, so this is not something I really focused on fixing.
19. Description of magnetic energy ratio is vague
  - a. I agree with this comment. I added a sentence about what each term means in the ratio.
20. Unsharp masking method is unclear, be more detailed
  - a. I definitely agree with this comment. But, I believe that I helped clarify the explanation. I added some more details in the methodology section about this so it is easier to follow.
21. Paper could use another proofread
  - a. This was completed upon finishing the paper.
22. Magnetic energy ratio calculations are carried out in discussion rather than in methodology section
  - a. I moved this calculation to the methodology section in order to keep all the calculations together.
23. Specify in the intro the results that are very different.
  - a. I did do this already in the introduction, so I do not think I can really make it clearer.
24. Paper not in AAS format
  - a. Since this is not an essential component of the paper for this class, I am not going to change it to AAS format. However, once I finish the project, then it will be in AAS format to be published,
25. State most prominent results in abstract
  - a. Because I do not have any numerical results, I am not going to put any values in the abstract. In the abstract, I described what occurred at the end of my analysis and I believe that that is sufficient.
26. In the introduction, in paragraph 2, "The distortion of magnetic field lines by turbulence is reflected into the dispersion of the polarization angles." Is this the polarization of dust grains, or of light?
  - a. I corrected this to describe the polarization angles is of the light reflected from the dust.
27. Better resolution on figure 1, it becomes pixelated when zoomed in

- a. Because this is just a screenshot from a paper, I am not sure about how to really correct for this, so it is not something I'm going to fix in this paper.
- 28. 2.1 section title can be deleted
  - a. I agree with this comment and it has been fixed.
- 29. "Chuss et al. (2019) combined these observations with photometry..." Was this photometry additional data from HAWC+?
  - a. Yes, I added that it was also obtained by HAWC in Section 2.
- 30. Is there a reason why the HAWC+/SOFIA data were used and not the SCUBA-2 data?
  - a. The reason for this is that only analysis was done with the HAWC+ data into the unsharp masking, and not with the SCUBA-2 data into the dispersion function. That is left for future work, which is a statement I have added to the paper in order to make it more clear.
- 31. Combine figures 1,2,3 into 1 figure with subplots
  - a. I tried to combine these into 1 figure, but the figures become too small to read and it is more of a personal choice to leave them separated, so I will not be changing that.
- 32. Methodology:
  - a. Why does each region in OMC-1 have a distinct B? I.e., why would they each have different angle dispersions?
    - i. This is a good point I should have explained. I added a sentence explaining that there are different angular dispersion values because each region has a different magnetic turbulence, which is what is being calculated in the end here.
    - ii. Earlier in the intro, I added this sentence too: There are two primary components to magnetic fields in the universe. The first is the large-scale, ordered, magnetic field, which is spatially coherent at the scale of the region being studied. The other is the small-scale magnetic field, which is caused by magnetic fluctuations, or turbulence, at different scales within the region. This clears things up and helps clarify what magnetic turbulence actually is.
  - b. "We must utilize the number of turbulent cells in a gas column" Is this gas column a general volume of gas ( $\rho$ )? It is unclear exactly what this is.
    - i. I am not going to explain what a column is because the audience of this paper, people familiar with the field, already knows that it is just the path that we observe through (the path from the source to the observer).
  - c. "The product of  $\sigma\phi$  and N, which are the values of  $\sigma\phi$ " the author should be clear that they are redefining  $\sigma\phi$ .
    - i. This is a valid comment. I did include a sentence saying that I am redefining  $\sigma\phi$ , and this clarifies things.
  - d. Is the measured column density in equation 4  $\rho$  or  $N(H_2)$ ?
    - i. I did indicate clearly that the column density is  $N(H_2)$ , so that is something I will not be changing.
- 33. Discussion



- a. Another table should be made to present the results from Hwang et al. (2021) as well.
  - i. I do not think it is necessary to present these results. If I were comparing the accuracy of the other components of the DCF method then yes, they would be presented. Or, if I used Hwang et al's data in the dispersion function. However, I am simply trying to see if the angular polarization played a role in the difference in field strengths with the 'unsharp masking' method.
- b. Does future analysis involve using data from Hwang with the methods from Guerra?
  - i. Yes, I added descriptions about the future analyses in the conclusions section.
- c. Can the author claim that there is a "significant difference" in the results quantitatively? If not, this should be reworded, that there is a substantial difference. The word "significance" implies statistical methods to confirm this.
  - i. I agree with this comment. I reworded "significant" to "substantial" to clarify that there indeed was a difference.

Critiques in the Evaluation points:

- 1. Length
  - a. Add more detailed descriptions of difficult terms and variables.
    - i. I have done this throughout the paper, specifically catering to the points mentioned above.
- 2. Title and abstract
  - a. Title should be changed to describe one component analyzing the deficiency.
    - i. I agree with this comment. I think that the title is misleading because it is too broad. I changed the title to "Determining the Magnetic Field Strength in OMC-1: Analyzing Angular Dispersion Calculation Methods." This title is definitely more appropriate for the actual analysis completed.
- 3. Level of english
  - a. Too much jargon and hard-to-read sentences.
    - i. I have done this throughout the paper, specifically catering to the points mentioned above.
- 4. Presentation of results
  - a. After the study is finished and the final results are obtained, it would be beneficial to add another table displaying the magnetic field strengths determined in this study and the other two studies for a direct comparison
    - i.
  - b. No uncertainties
    - i. Uncertainties will be added in subsequent studies.
  - c. Rearrange tables to present the data together
    - i. I rearranged the tables, as I described above.

5. Data management

- a. Author makes no mention of the release or intent to release data or software
  - i. I do not think this is necessary. The technique used is definitely reproducible based on how I described it in the paper, and the data is already available.
- b. All images should be shown
  - i. I was debating on making an image appendix, but I think it would have made the paper unnecessarily long and it is not significant enough for the outcome of this project.