1. Who are the partners: Brean and Laura
2. What are we proposing to model: Aurora Borealis
   1. Model a single particle
      1. Spiraling around magnetic field lines
   2. Model multiple particles
      1. What causes different colors
      2. Where in atmosphere happening
      3. Aggregate shapes made
   3. Summer versus winter, tilt of Earth, etc.
   4. Difference between lights on Earth and other planets (atmosphere, magnetic field)
3. What area of E and M: Charged particles in a magnetic field
4. Resources:

Potentially useful resources on how aurora borealis works:

Salat, T. (n.d.). Aurora Hunter. Retrieved March 13, 2018, from <https://www.aurorahunter.com/how-the-aurora-borealis-form.html>

This gives a brief overview of the main points of how the Aurora Borealis forms, including where in the atmosphere it forms and what types of collisions/ which gases cause different colors. This gives a good jumping-off point for expanding our models with more criteria for the Aurora Borealis.

Space.com (2017). Aurora Borealis: What Causes the Northern Lights & Where to See Them. Retrieved March 13, 2018 from

<https://www.space.com/15139-northern-lights-auroras-earth-facts-sdcmp.html>

This gives a more in-depth scientific look at how Aurora Borealis works and will be a good initial read for the criteria to include in our model. It starts by describing that solar flares travel to Earth and strike gases in the atmosphere that form colorful lights.

Potentially useful resources on modeling:

Jarmund, A. H. “A Simple Computational Simulation of Northern Lights.” *Norges Teknisk-Naturvitenskapelige Universitet, Trondheim, Norway.* March 30, 2017. <http://folk.ntnu.no/anderhja/aurora/aurora.pdf>.

This paper talks about simple computational models of the magnetic field and the trajectory of the particles that create the northern lights. We plan on using this paper as a guide for the types of theoretical models that can be used during our modeling. This also quite short so we could use this as a good example of the sort of paper we expect to write up about our project.

<https://github.com/millskyle/AuroraSim>

This is a github repository that includes a report about the simulation. While the report is useful in terms of showing us images of what our simulation could look like, the reference list also looks like it could be of use while we are researching our project further. It would also be useful to look at the other resources within this repository.

Baranoski, G. V., Wan, J., Rokne, J. G., & Bell, I. (2005). Simulating the dynamics of auroral phenomena. ACM Transactions on Graphics, 24(1), 37-59. doi:10.1145/1037957.1037960. Retrieved March 13, 2018 from

<http://cuca.cs.uwaterloo.ca/resources/docs/aurora-dynamics.pdf>

This paper gives a lengthy description of many equations and computer modelling examples off of which we can base our simulation.

Baranoski, Gladimir & Rokne, Jon & Shirley, Peter & Trondsen, Trond & Bastos, Rui. (2000). Simulating the aurora borealis. 2-432. 10.1109/PCCGA.2000.883852. <https://www.researchgate.net/publication/3875546_Simulating_the_aurora_borealis>

This paper is useful because it breaks down all of the different aspects of the northern lights that can be modelled (ie morphology, color, and shape). We also think that the photos included in this paper could be used to show us the the types of models that we can attempt when trying to model the northern lights. Many mathematical and physical models can also be found in this paper.

1. What has been done and how we are expanding it: Simulations of the Aurora Borealis have already been done to a great extent (they have been very successful). We plan on building on this by doing an in-depth simulation of a single electron during the whole process (coming from the sun and travelling through the earth’s atmosphere). We also plan on exploring this phenomenon during the different seasons and see why we are able to see the northern lights clearly during certain times of the year.