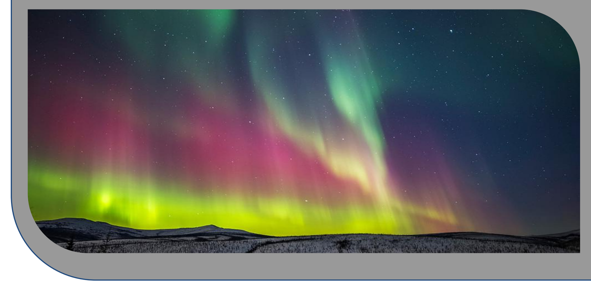
Aurora Borealis and STEVE

Brean Prefontaine and Laura Wood

Background

Aurora Borealis

- Usually green, yellow, and red
- Can also be green, violet, and blue
- Curtain shaped
- Can be at 60-90 MLAT (magnetic latitude)
- Formed by charged particles in solar wind that interact with the earth's magnetic field
- Last about 10 mins to all night
- Highest activity in the nothern latitude is during spring becuase of sun magnetostorms
- Activity happens in 22 year cycles
- About 10 degrees latitude high



STEVE

- Purple in color
- Sometimes seen with green aspects
- Typically a verticle arc
- Formed by subauroral ion drifts that occur during substorms
- Last about 20 mins to an hour
- Seasonal: not observed in winter (October - February)
- About 0.5 latitude wide

Comparison of key features of the aurora borealis and of STEVE (Strong Thermal Emission Velocity Enhancement)

- STEVE is a backronym given to a special kind of aurora that was recently discovered by scientists
- It is narrower and more vertical than typically studied auroras and usually green, while auroras can be many other colors
  - The colors of auroras are dependent on interactions of specific gases
- Forms due to subauroral (see Figure #...) ion drifts -
  - also called polarization jets, form during substorms, happens at subauroral latitude, which is about 60 degrees above the equator
  - ...

back·ro·nym
/ˈbakrəˌnim/

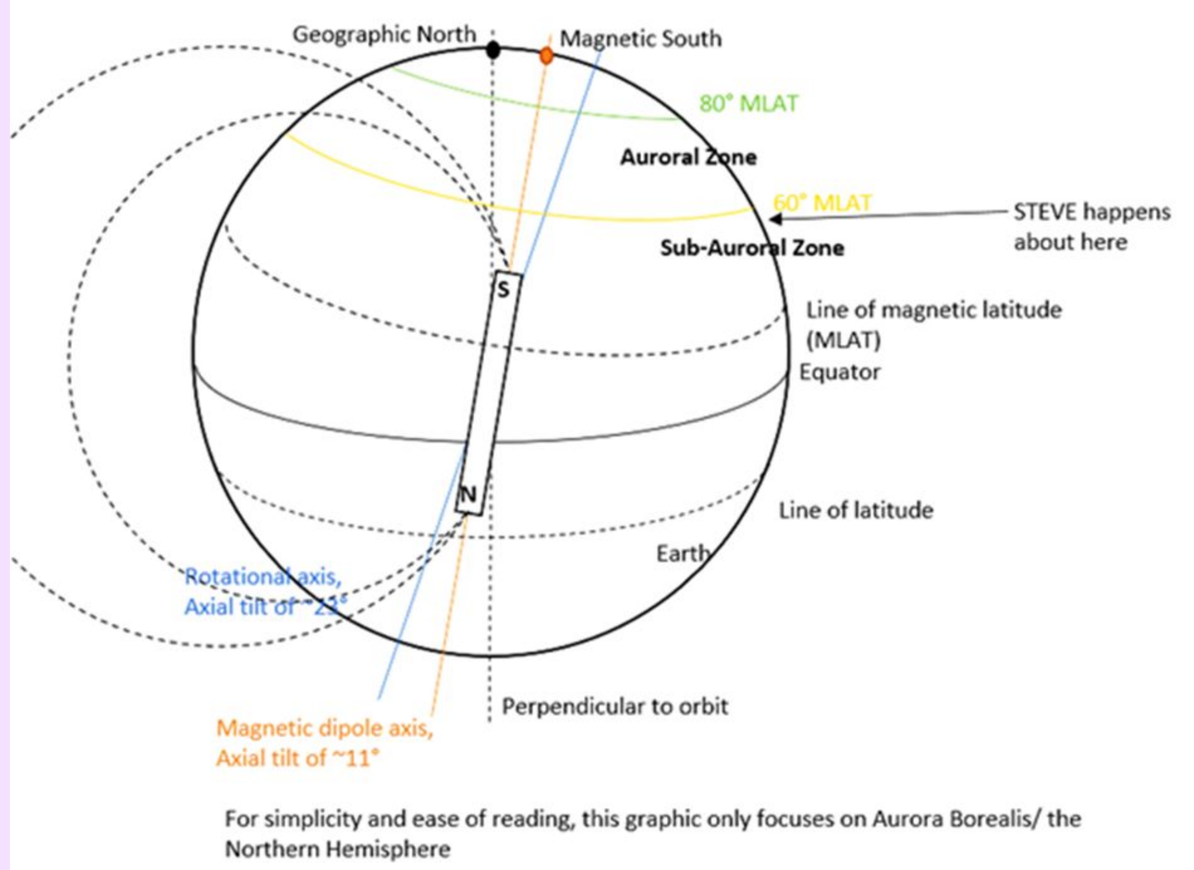
noun

an acronym deliberately formed from a phrase whose initial letters spell out a particular word or words, either to create a memorable name or as a fanciful explanation of a word's origin.
"Biodiversity Serving Our Nation, or BISON (a backronym if ever there was one)"

References

[1]

Physics of Aurora Borealis



Representation of Earth's magnetic field in the dipole approximation model

How do auroras form?

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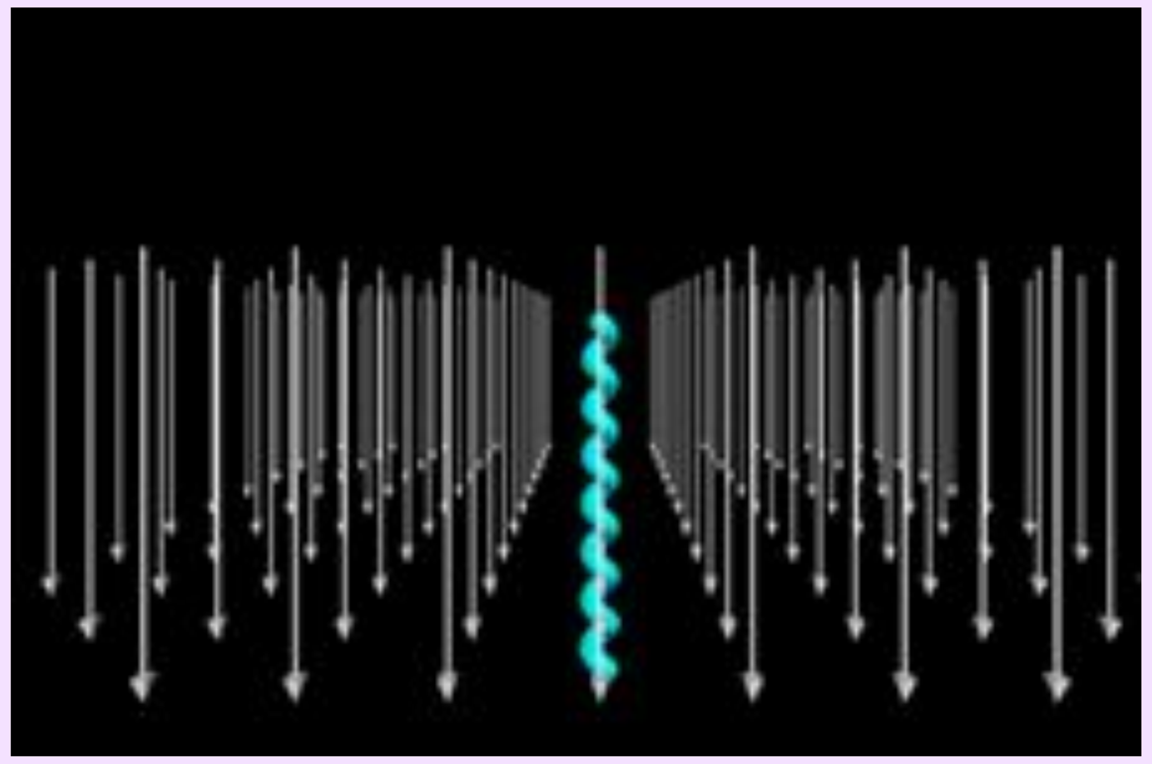
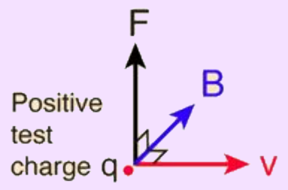


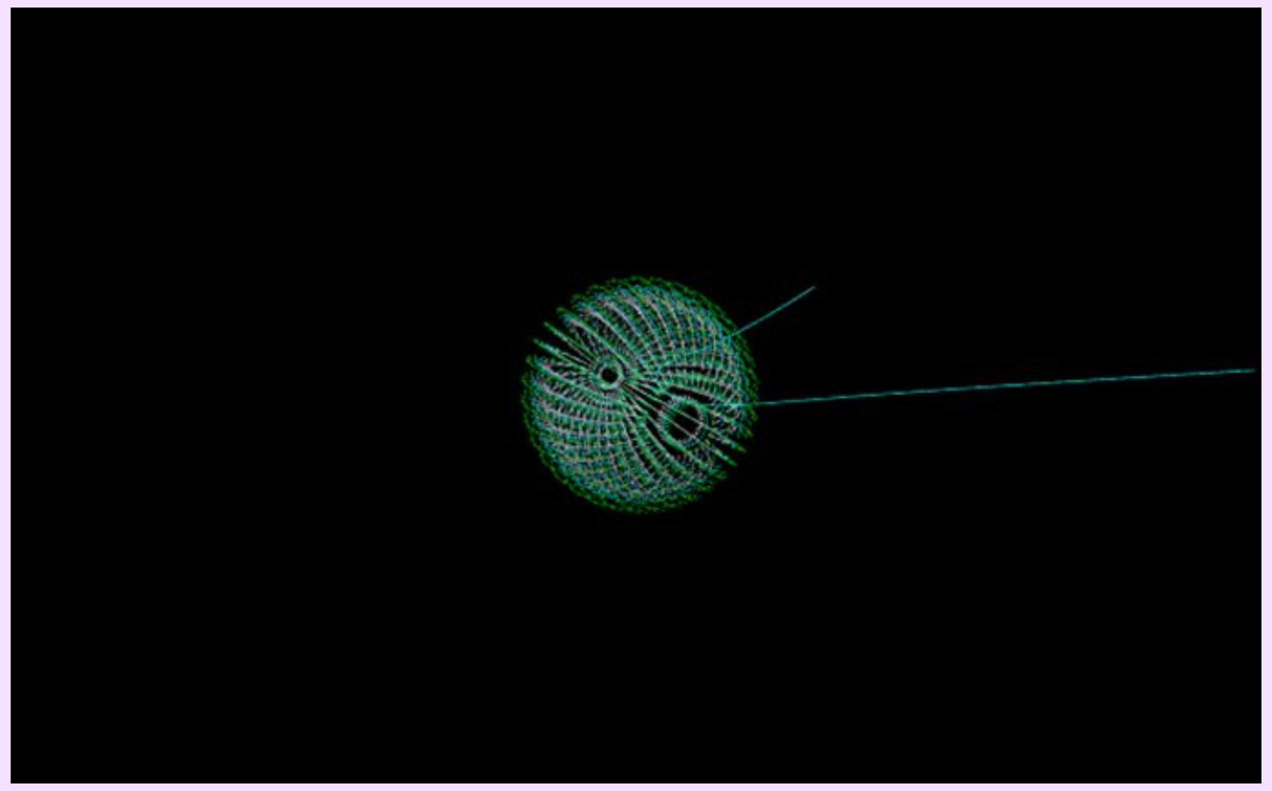
Particle moving through uniform magnetic field, under effects of Lorentz force

How does a charged particle interact with a magnetic field?

- The particle will feel a force, called the Lorentz force, which is the cross product between the velocity of the particle and the magnetic field
- This causes the particle to spiral around a static and constant magnetic field

$$\vec{F} = q\vec{v}\ x\ \vec{B}$$





Particle moving through Earth's dipole magnetic field

(We are still working on including the realistic values of earth's radius, particle's position, velocities, etc.)

Aurora Borealis versus STEVE

Here there will be a picture of particles moving in different parts of the Earth's magnetic field, as STEVE occurs at a different latitude than regular Auroras and a discussion of possible implications of our models for the differences between Auroras and STEVE

We will test particles moving at different positions and different velocities, once we get the visual to show up with realistic values used in the code

Potential Future Work

This model assumes that the only reason charged particles moving through Earth's atmosphere have any kind of interaction with Earth and experience forces and acceleration is due to the Lorentz force from Earth's magnetic field. In reality, Auroras form because of plasma being trapped in certain regions of Earth's atmosphere and differentially interact with various gases in Earth's atmosphere. Additionally, the particles would actually be radiating. These are possible additions to our model.

Even more advanced additions would include that the Earth's magnetic field actually experiences a compression effect from solar wind that forms a "magnetotail" in which particles also interact differently as the field cannot be perfectly approximated with a dipole model.