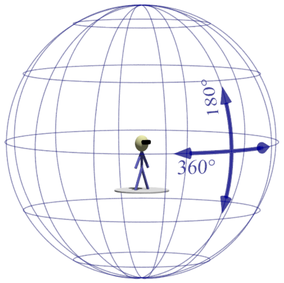
360 Images and Video Animations for Physics and Astronomy

Michael R. Gallis
Penn State Schuylkill
mrg3@psu.edu

360 Images place the viewer at the center of complete panorama and when used with smartphone VR glasses can provide a truly immersive experience. Emerging technology and software enables the creation of still images and animation that can aid in presenting topics in physics and astronomy involving 3D geometry. This poster presents examples from the Animations for Physics and Astronomy project at Penn State Schuylkill, and includes student projects. The software used to create these works will be discussed as well as strategies for displaying and sharing imagery and videos.



360 Imagery

- 360 videos, immersive videos, spherical videos
  - possibly Omnidirectional Stereo (ODS)
- 360° horizontal by 180° vertical

Why 360 Imagery?

- Immersive experience
- Helpful for some geometric concepts
- Entry level Virtual Reality
  - *The Art and Science of Virtual Worlds*, a new linked general education course
- The “Wow!” factor
- Opportunities for Creativity
  - Group projects with student creative and technical team

Technical Aspects of Dissemination

Playback

- PC, mobile devices: click and drag panning
- Smart mobile devices: windowing controlled through device internal gyroscope
- Smart Phones and viewers
  - Google Cardboard, View-Master VR, etc.

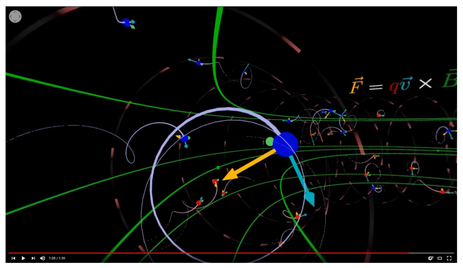
Google Cardboard, Image by Flickr user othree

View-Master Virtual Reality Starter Pack ad, Walmart

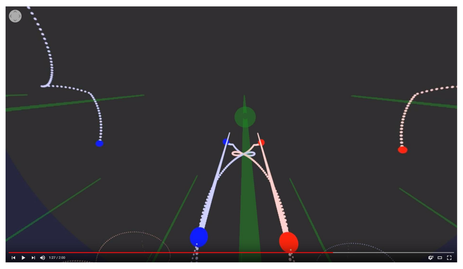
Playback software

- Web Browsers,
  - 360 Images in web pages: PhotoSphereViewer by Jérémy Heleine.
- Smart Devices
- “VR” apps with Google Cardboard mode
  - YouTube, Vimeo, Veer,
  - Mobile VRStation
  - VRPlayer

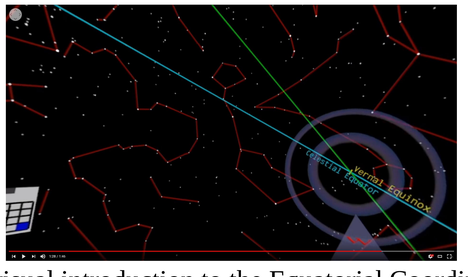
360 Animations



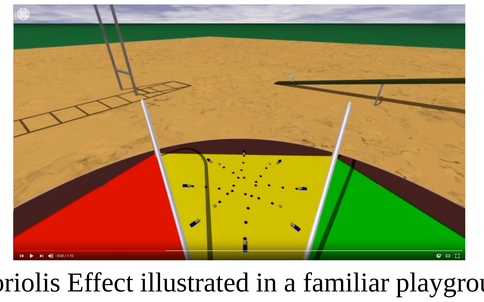
Electric Charges magnetically confined with a toroidal magnetic field, ala Tokamak.



Electric charges in a box, with varying strength uniform magnetic fields.

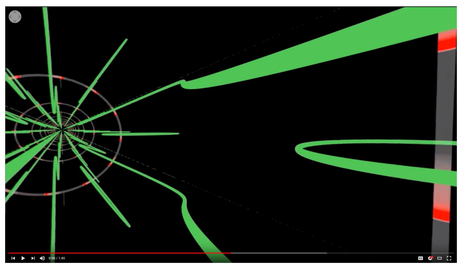


A visual introduction to the Equatorial Coordinate system and its zero points.

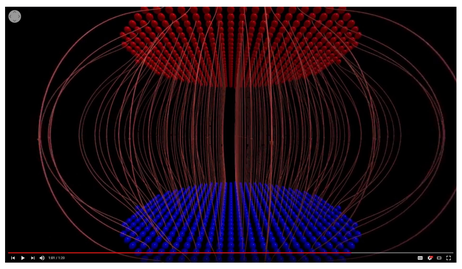


Coriolis Effect illustrated in a familiar playground setting.

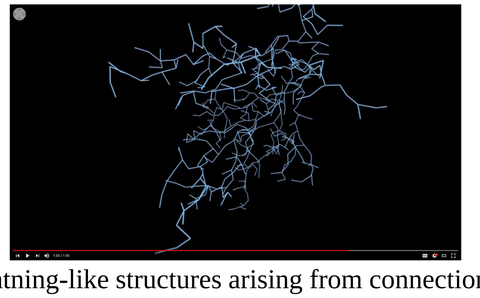
Collaborations with Student creative/technical team



Uniform magnetic field within a solenoid arising from closely stacked coils

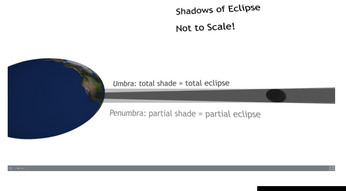


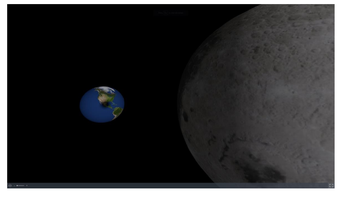
Oppositely charged disks yielding the uniform field of an ideal parallel plate capacitor with separation is small.



Lightning-like structures arising from connections in Diffusion Limited Aggregation.

360 Stills (Eclipse Themed)

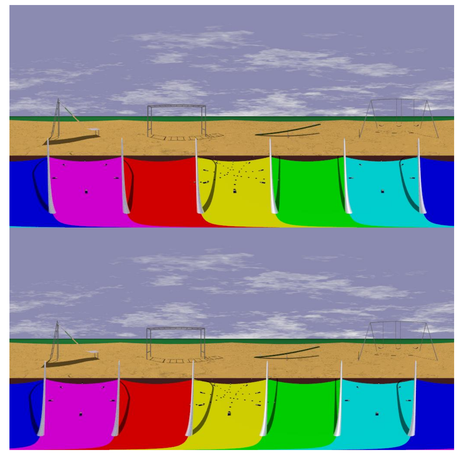




Animations available at https://www.youtube.com/mrg3,
Bring your VR viewers and smartphone!

Creating 360 Imagery with POV-Ray

- POV-Ray: free software or creating 3-D graphics[1]
  - user defined camera for ODS[2]
  - user defined camera requires beta versions of POV-Ray 3.7.1 or 3.8.0[2,3]
  - Camera definition from POV-Ray wiki based upon Google developers guide[4]
  - 4 to 10 hours render time for image stack for 2 minute, 30 fps video (double for stereoscopic)



Top-Bottom stereoscopic image. Images for frames of animation rendered at 4096x4096

- Audio recorded and edited with Audacity[5]
- Image and Audio stream compressed into .mp4 format with ffmpeg[6]
- Set video file internal information with Spatial Media Metadata Injector[7]
- Upload to favorite web based media repository (YouTube, Vimeo, Veer, etc)

1 http://www.povray.org/
2 http://wiki.povray.org/content/HowTo:ODS
3 https://github.com/POV-Ray/povray
4 https://developers.google.com/vr/jump/rendering-ods-content.pdf
5 http://www.audacityteam.org/
6 https://www.ffmpeg.org/
7 https://github.com/google/spatial-media

Acknowledgments:

Thanks to Student Team: Kelsey Shaffer, Baylee Colburn, Winnie Li, and Rohit Gangupantulu.

Thanks to Virtual Worlds colleagues Nicole Andel and Jeffrey Stone.