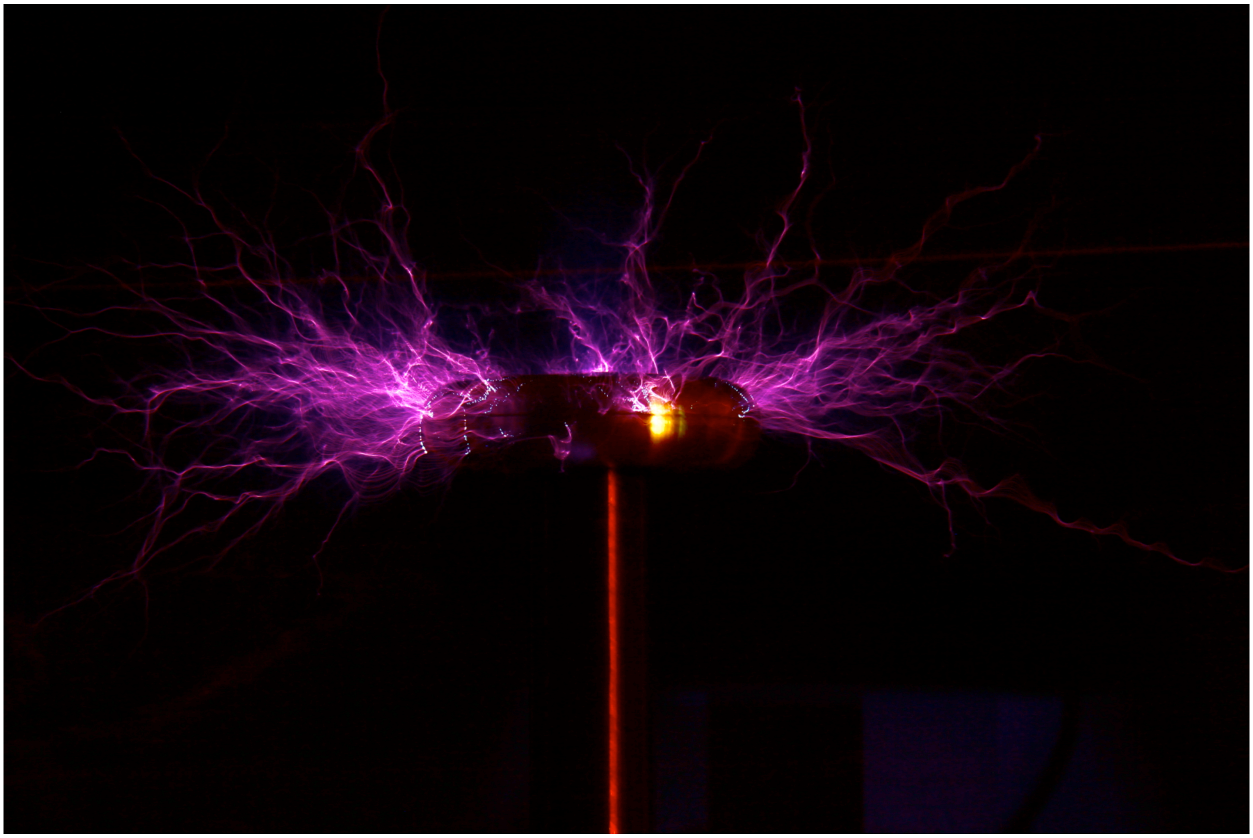


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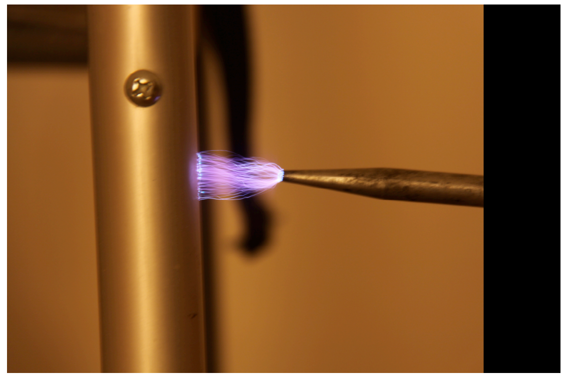
*Special Thanks to*
*Fred Gluck and Michael Thomason*

This was our first attempt at a group project. I was browsing through the webpage and I realized that there were not very many projects that visualized plasma. So, I set out on a mission of photographing plasma, and my father (Fred Gluck), being a science wiz offers a small object to me that appears at first glance to be a drill; however, after plugging it in, it is apparent that the tool is much more. This small spark maker can light up a line of fluorescent tubes, but we both desired more power, so we contacted Mr. Michael Thomason, the Director of Physics Learning Laboratories here at the University of Colorado Boulder Department of Physics. Originally, we asked for a Van der Graaf Generator and we were surprised to hear that in place of that, he had a large Tesla coil that would allow our group to access in his laboratory. After some group correspondence via electronic mail, we picked a day to meet after class and spent about an hour in the basement visualizing plasma.

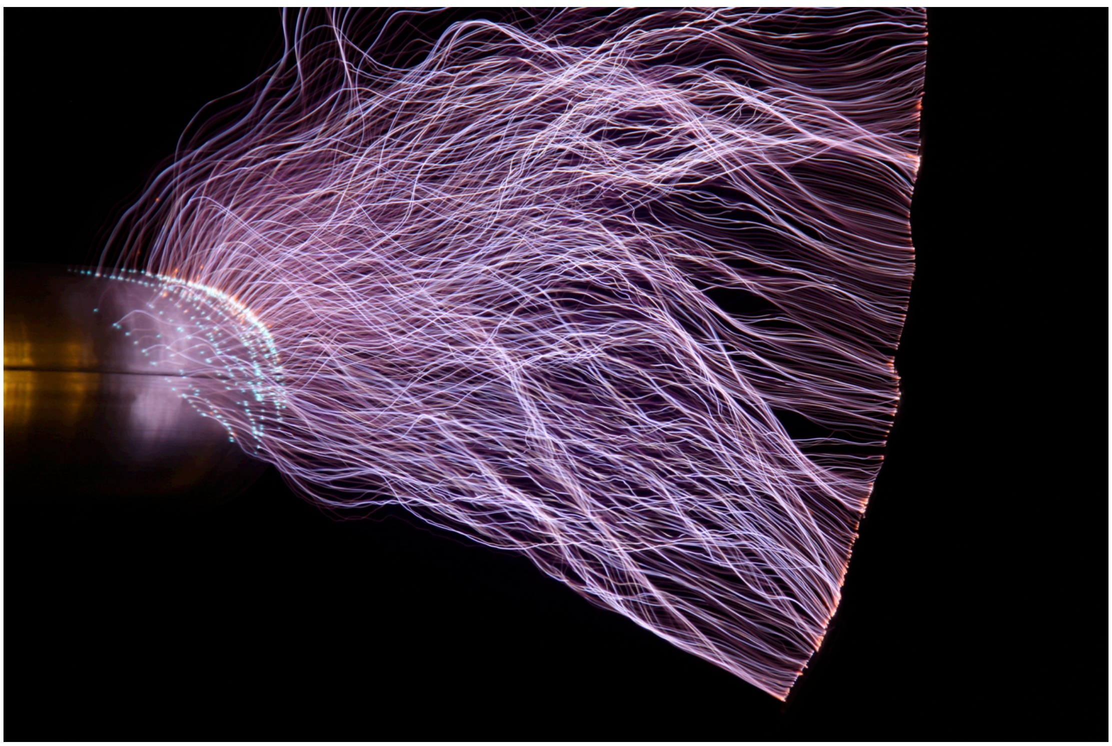


A Tesla coil is basically a high-frequency air-core transformer. First, a capacitor is charged to a voltage over 10,000 and when this exceeds the breakdown voltage of the spark gap, the gap begins conducting which in turn connects the capacitor and the primary inductor in a parallel circuit. This causes the discharge of the capacitor into the inductor creating a magnetic field around the inductor, and for a moment almost all of the energy is contained in this magnetic field until it collapses and discharges back into the capacitor. Now this process occurs hundreds of thousands of times every second and since there is a secondary inductor inside of the primary inductor's magnetic field, energy is transferred at each exchange. The primary and secondary circuits resonate at the same frequency creating a large voltage potential, which is what our group visualized because instead of a complete loop, the end electrodes in the secondary circuit of the Tesla coil project the charges into space.

In order to visualize the plasma created by the Tesla coil, it was necessary to find a dark laboratory room with power outlets. The Tesla coil was placed on a cart and attached to the side was a grounding rode, which could be used to direct all of the sparks to a particular point. A person can hold that wand in his or her hand and will not get shocked when the electricity flows to it because both the rode and the person are grounded. All we had to do to create sparks was to flip the switch that was connected to the outlet into which the Tesla coil was plugged. We did not want to use any flash photography because it would over-saturate the image. Nor did we want any stray natural or unnatural light to leak into our frame because the longer a lens is open, the more sensitive it is to light and any stray light can cause a flare or saturation in the final photo.

Each member of our group came prepared with either a video camera or digital camera except for Mark Reusser who I had told could share with me. I brought a Sony Handycam DCR-HC38, which has a 40x optical zoom, as well as a Canon DSLR ESO 50D with a 18-200 f/3.5 IS lens. We took still photographs and video, and I made a CD for Mark with his images on it. He also helped me film and we switched off taking still photos and using the video camera, and so I have included him as one of two director of photographers in my video project. When taking photos, we found the best technique to visualized the sparks was to use a timed-exposure, which opens the lens and keeps it open for the desired about of time. We tried between 1 second and 10 seconds and found that the longer the exposure the more prominent sparks would be because the sparks would continue to jump and the lens would continue to absorb this light creating a more dense looking spark capture in the frame. However, we could not leave the Tesla coil on longer than 10-15 seconds or it might destroy the coil. This limited the duration of our timed-exposures.

It was essential to maintain a distance of about six feet from the actual Tesla coil so as not to fry our electronics. Since we wanted to capture just the bolts of electricity, we turned off all the lights and therefore, needed to open our aperture up all the way (f5.6 for the 50D). The sparks that this particular Tesla coil created spanned a distance of about a foot and a half on any one side of the disk. For my video, I used both still and moving images as well as many special effects in the post-production process including cross dissolve and disintegration for transitions, N-square, slow motion, sound bridges, and zoom, for video effects, and electricity filters on the titles.



The images and video that we captured is breathtaking. The most visually pleasing image created was a timed-exposure of five seconds where my dad, holding the grounding rod, proceeded to drag his arm in a smooth upward motion as if holding a paint brush and making an upward stroke in the air, or drawing a magic wand. As a result of the timed-exposure, the image created shows a boundary line instead of a point where the sparks concentrate because at different moments in time, the rode was attracting the sparks to different locations in space. As my father and I observed the images, it occurred to us that perhaps there were particular instances when the spark never connected with the rod, rather it was sent out with other sparks searching for a destination and once the rod was found, they retracted to actually strike as one, similar to lightning. However, it is hard to prove this from a still image, and even the video camera does not have adequate frames per second to visualize this. In the future, I hope to find a high-speed camera and test this visualization process. Over all, the plethora of photos and motion pictures created an awe-inspiring splendor, which I hope my group enjoyed as much as I did.