Northern lights or the aurora borealis.

An aurora is one of nature's grandest, non-threatening spectacles whose story uses many familiar words. After many years of study, these words have been connected into a plausible scenario. It seems that an aurora is due to a chain of events that begins with the sun and ends up in the earth's atmosphere.

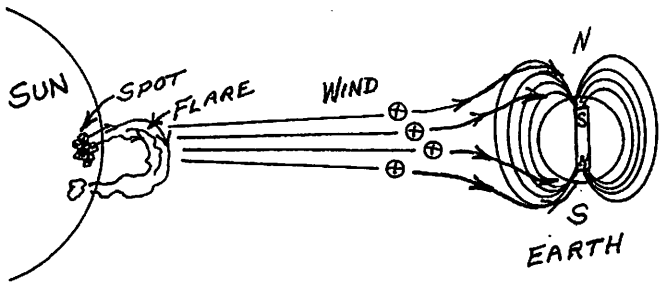
The sun is mostly hydrogen, which is the simplest element and atom, made of but one proton (+) and one electron (-), with no neutron. Due to huge forces involved in several steps, the hydrogen atoms are fused together to form neutrons and the second element, helium (2 protons, 2 neutrons, and 2 electrons). In the process, some of the nuclear mass is "lost" (mass defect) to become energy (partly heat) that keeps the process going. With all of this activity, the surface of the sun is "boiling", that is, huge bubbles of gas, mainly free protons (+), well up and burst becoming solar flares. With high energy, some of these protons escape and move out freely through space becoming a solar wind.

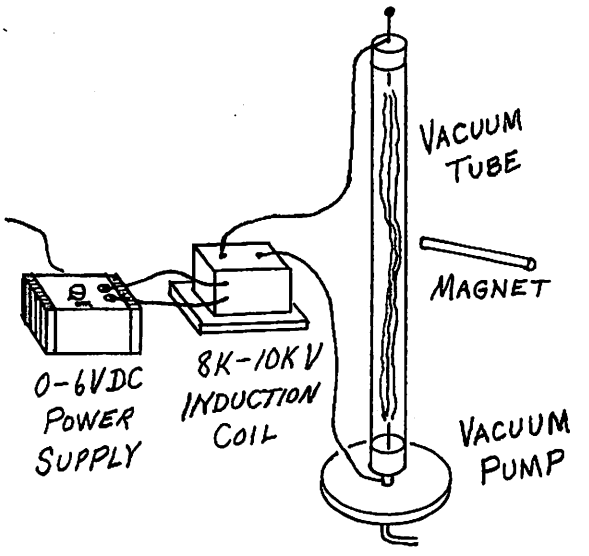
Meanwhile back on the sun, the location where the flare occurred becomes a sun spot, a cool,red (dark) area compared to the white hot surface surrounding it. With care, we can observe these sun spots daily and predict when their activity will affect us.

If the solar flare is pointed in our direction, the solar wind is coming toward us at a fairly high speed (93 million miles in 2 or 3 days). A proton (+) by itself is an ion or charged particle with an electric field around it. When the proton moves, its electric field simultaneously creates a magnetic field around it. Thus, when the solar wind nears the earth's magnetic field with its north and south poles, the moving proton's magnetic field interacts with it. The solar wind splits up, with some protons streaming toward the North Pole (borealis) and some toward the South Pole (australis). With their high energy, the wind's protons easily bombard the few molecules, mostly nitrogen and oxygen, of the earth's upper atmosphere. The high energy bombardment shakes up and causes quantum leaps in the nitrogen and oxygen atoms resulting in the emission of photons of light. Of course, millions (mega?) of bombardments occur per second to allow the aurora to be seen from many locations on the earth, especially in the polar regions. Once again the earth's atmosphere acts as a protective shield against this "invasion" from outer space.

So the next time you see an aurora, think of it as the sun giving away a little piece of itself to us and letting us know that it did so, a gift that lights up without batteries!

When I arrived at Nanuet H.S. in Sept. 1963, the pieces of apparatus needed to replicate an aurora in the classroom were present. At Union College in 1976, I learned how to connect them up. With a vacuum pump and a vacuum tube with electrodes, I could replicate the thin air of the upper atmosphere. With an induction coil of 8K-10K volts connected to the electrodes, I could use electrons (-) in place of protons (+) as my bombarding, charged particles. Just darken the room, turn on the induction coil, and start up the vacuum pump. In about 30 sec., a reddish glow appears inside the tube near one of the electrodes; it spreads until most of the remaining atoms inside the tube glow red. Bring a strong magnet near the tube and move it around. The red glow will swirl with the moving magnet. I had been able to replicate an aurora; with similar apparatus, you can, too!





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