Preliminary Design of

Solar Cathode Test

(for evaluation only)

Spatious Designs

743 Wilton Farm Drive
Baltimore MD 21228

DESIGNER
Charles L. Chandler

CLIENT
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FILENAME
SolarCathodeTest.vwx

Revisions

1. 2012-09-25 initiated
2. 2012-10-26 posted

Drawing List

PROJECT
Electric Sun Test

TITLE
Cover Page

SCALE	SHEET
none	01

The objective of this test is to establish one possible set of conditions necessary to create the distinctive features on the surface of the Sun.

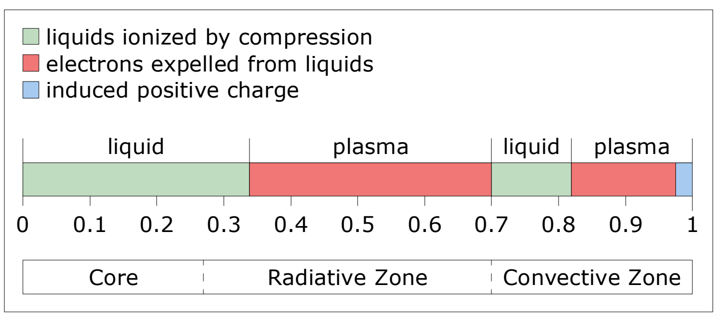
- granules, spicules, and sunspots on the surface
- helmet streamers in the atmosphere
- black-body radiation with absorption lines

The assumption is that the primary power source is ohmic heating from an electric current. Evidence suggests that the Sun is the cathode, and that the heliosphere is the anode. So there is a flow of electrons away from the Sun. Due to electron drag, some neutral and some positive atomic nuclei are also accelerated outward.

Yet arc discharges are famous for pinching down into discrete channels. This is problematic for solar models asserting a major electric current, as the solar energy release is well-distributed around the sphere.

The present contention is that this, and many other solar phenomena, are the result of a more complex electrostatic setup, in which there isn't just one E-field between the negative Sun and the positive heliosphere. Rather, there has to be at least two regions of positive charge, one above (i.e., the heliosphere), and one below, inside the Sun.

The following diagram below shows five proposed layers of charge inside the Sun. The present test is only concerned with the top three. The cathode that emits the electrons is the outermost red layer. The electrons pass through a positive double-layer on the outside, while another positive layer inside keeps the cathode organized, all within the convective zone.



In this configuration, the cathode sits on a current divider. Above it, electrons are attracted to the positively charged heliosphere. Below it, they are attracted to the underlying layer of positive charge that is ionized by the extreme pressures inside the Sun. At the current divider, electrons are stationary. The significance is that electrons moving away from a current divider move slowly at first, as the net field is weak. With more distance they accelerate, and later get pinched into discrete channels. This is the only way an electric current can emanate equally from all points on a sphere, with minimal consolidation (in "spicules") until well away from the sphere (at the tips of the helmet streamers).

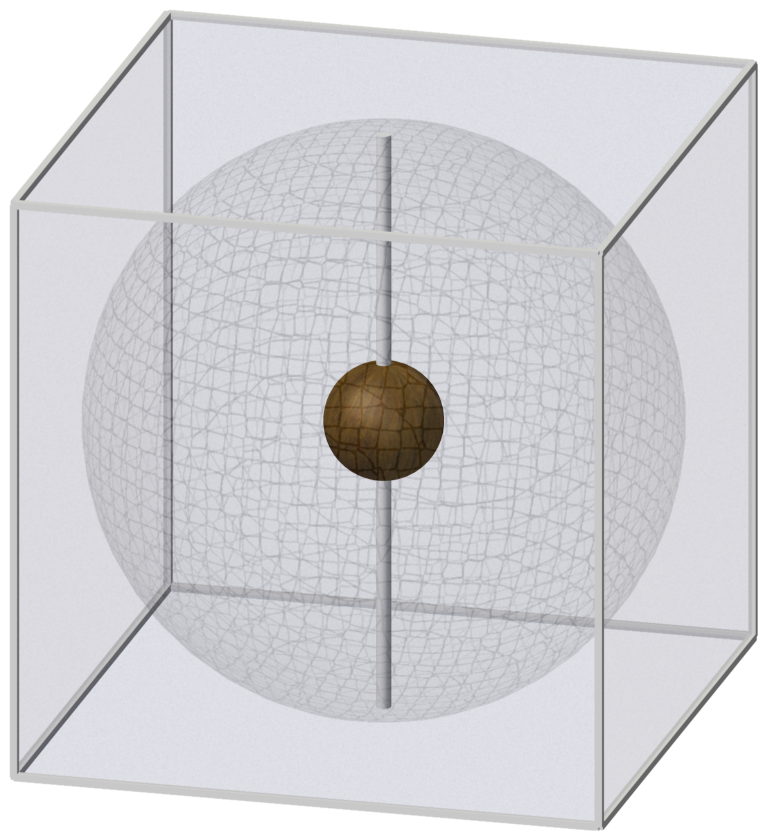
The present apparatus could be constructed to examine the behaviors of an electric current in this kind of environment.

Starting from the outside, the entire thing will be encased in a sealed enclosure, which will enable the development of an extreme low pressure that will more nearly approximate the solar atmosphere. The enclosure will also contain the extreme heat generated by the apparatus.

The interior will be filled with xenon, which is the heaviest element that is a gas at room temperature. It can be ionized easily, and in a powerful E-field it can become highly ionized, making it an ideal candidate for the positive double-layer around the cathode (i.e., the "cathode sheath").

Circumscribed inside the sealed enclosure will be a spherical wire mesh to which a positive charge will be applied, analogous to the heliosphere. The volts applied to this mesh will also be responsible for ionizing the xenon in the power-up sequence.

At the center of the apparatus will be a sphere representing the Sun. The outermost layer will be negatively charged, while inside the sphere, there will be a smaller sphere to which a positive charge will be applied, putting the cathode between two anodes, and setting up the current divider.



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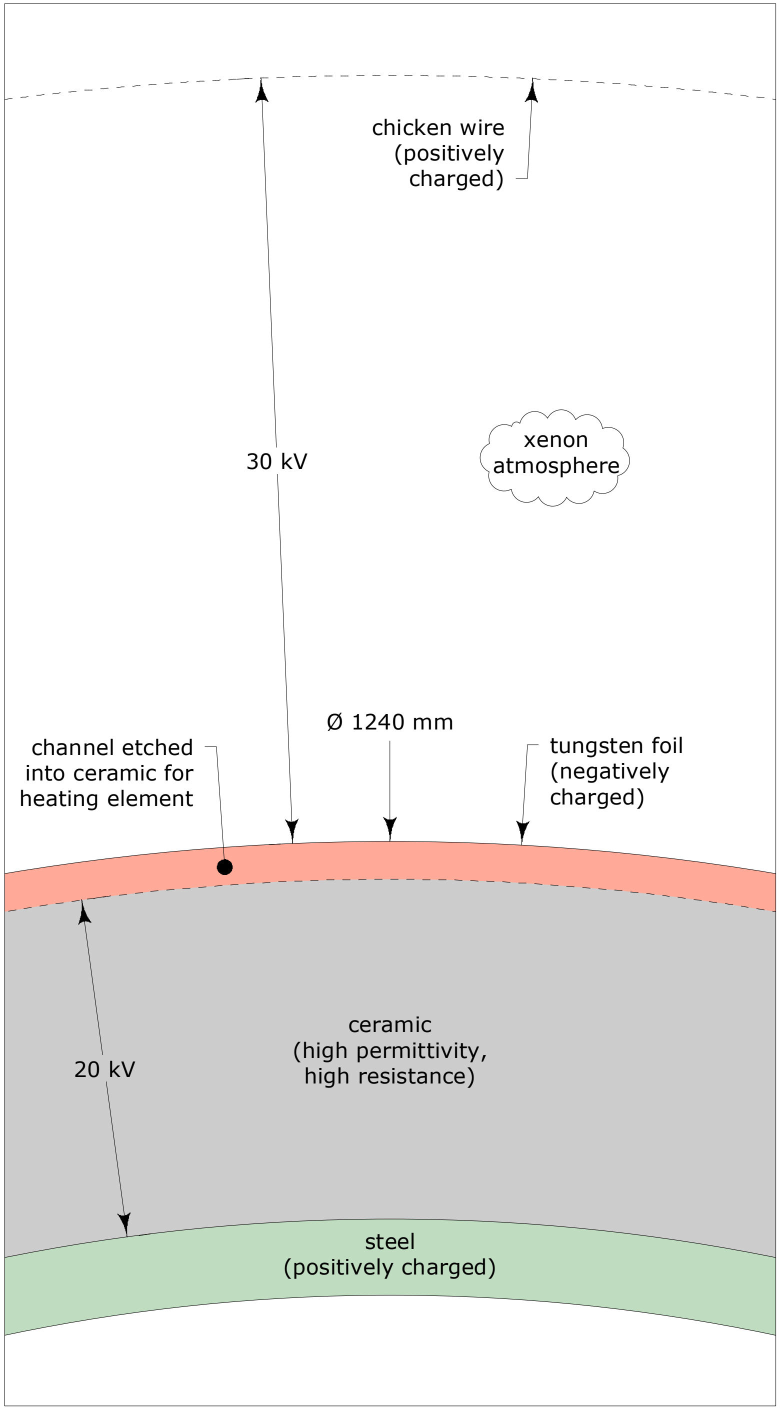
Notes

PROJECT
Electric Sun Test

TITLE
Overview

SCALE
1:25

SHEET
02



The electric field between the surface of the sphere (i.e., tungsten foil) and the chicken wire (analogous to the positively charged heliosphere) will produce an electron drift through the dense ion atmosphere. With a sufficient current density, the ions will be subjected to electron drag that will set up Rayleigh-Benard cells (i.e., cathode tufting). The dynamics of these cells will be compared to solar granules.

At high current densities, we might see some z-pinching as soon as the electrons leave the cathode. The properties of these consolidated discharges will be compared to spicules.

The z-pinching should continue will distance from the current divider, resulting in a relatively small number of charge streams arriving at the chicken wire. The behavior of these streams will be compared to helmet streamers. For this reason, the radius of the chicken wire has to be at least 3x the radius of the solar sphere.

Normally, it takes an extremely powerful E-field to strip electrons from the crystal lattice of a solid. When such potentials are achieved, we typically see "cathode spots," which are discrete locations at which a discharge occurs, or the generalized discharge becomes accentuated. (Image the filaments in a "plasma ball.") These are highly dynamic, and are responsible for a current density far out of proportion to their extremely small size. This does not appear to be analogous to the behaviors of the surface of the Sun, as the current appears to emanate from the entire sphere at once, and consolidated discharges such as spicules do not have the same dynamics. To prevent cathode spotting from dominating the discharge, the cathode will be pre-heated to the point of thermionic emission across its entire surface, without much hindrance from van der Waals forces. Using tungsten foil as the cathode will enable extremely high temperatures. The heat will be supplied by a resistive element running in a channel etched into the surface of the ceramic sphere, allowing it to be near, without touching, the tungsten foil on the outside.

This will have the added advantage of emitting black-body radiation (BBR), which is the primary component in the solar power output. The present test will leave the origins of the BBR unidentified, but it will provide the opportunity to see if the cathode tufts can introduce the absorption lines typical of the solar spectrum, and which can only come from elements above the source of the BBR. The standard model has the BBR coming from the topmost 300~700 km of the photosphere (which is an extremely thin layer to be producing so much power), and which leaves the absorption lines unaddressed. The present contention is that the BBR source is below, and the cathode tufts are cooler, and therefore are emitting spectral lines on electron uptake, and thereafter are absorbing the same frequencies out of the BBR.

The extreme heat from the tungsten foil is the reason for the reflective enclosure. The high temperatures will also be important in maintaining the ionization of the atmosphere.

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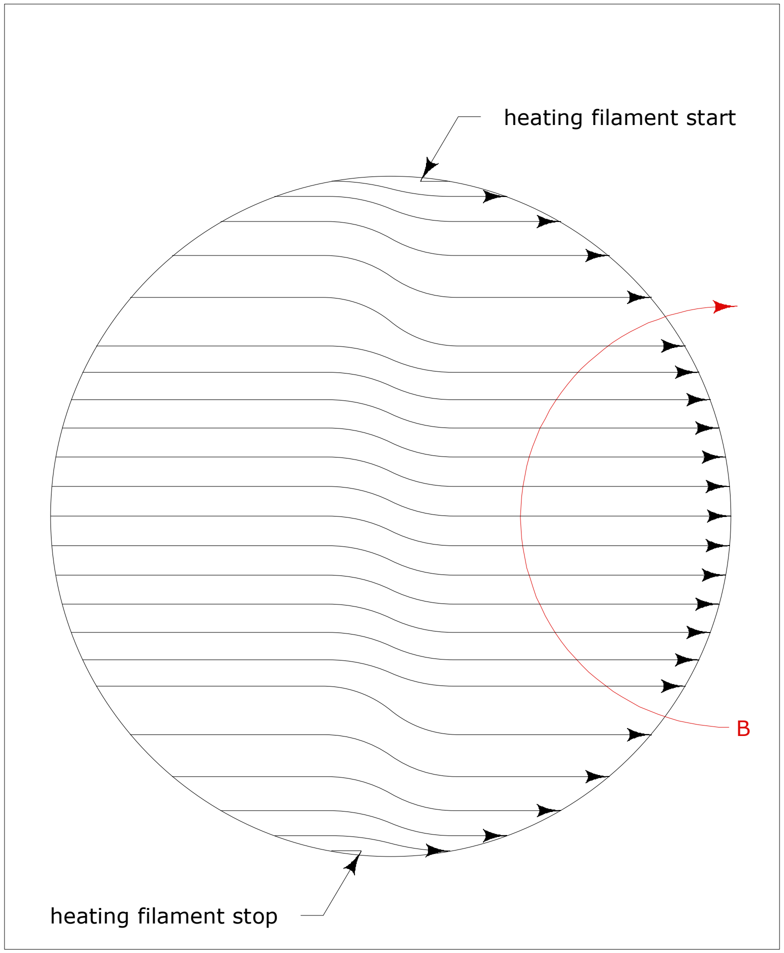
Notes

PROJECT
Electric Sun Test

TITLE
Criteria

SCALE
1:2

SHEET
03



Aside from solar granules, which this test will compare to cathode tufts, the next most distinctive feature on the surface of the Sun is sunspots. The present contention is that these are artifacts of the same solar~heliospheric current as granules. But with a higher current density, and with a little help from an external magnetic field, an organized electrodynamic form emerges.

Specifically, the Sun has a weak solenoidal field with poles that line up with the axis of rotation. But during the active period, differential rotation, with faster rotation at the equator, seems to generate a solenoidal field with lines of force that enter and leave the surface of the Sun closer to the equator, at the edges of the fast-moving equatorial band.

It's possible that magnetic lines of force normal to the surface help organize sunspots. Imagine an electron leaving the equator. Its journey to the heliosphere necessitates that it cross the solenoidal lines of force that are parallel to the surface at the equator. The Lorentz force will deflect the electron from its desired path. But where the lines of force are normal to the surface, the Lorentz force will put the electron into a spiral around the lines of force, and yet the electron will make more forward progress out into space in that spiral. So a sunspot "might" be an artifact of spiraling electrons in an external magnetic field entering or exiting the Sun at that point.

To attempt to reproduce this, we need a solenoidal field, and the lines of force need to be normal to the surface at 30° N/S latitude. This field can be generated by the current flowing through the heating filament, if it is deliberately set up to do so. The filament should start at one pole, and spiral around the sphere until it gets to the other pole. This will generate a solenoidal field. But if we make the turns closer between 30° N and 30° S, the field will be more powerful there, and we might get the surface perpendiculars we want above/below 30° N/S.

The concentration of wraps in the equatorial band will make it a bit hotter, but this is not necessarily unrealistic, as there is evidence that this band on the Sun is hotter than the poles.

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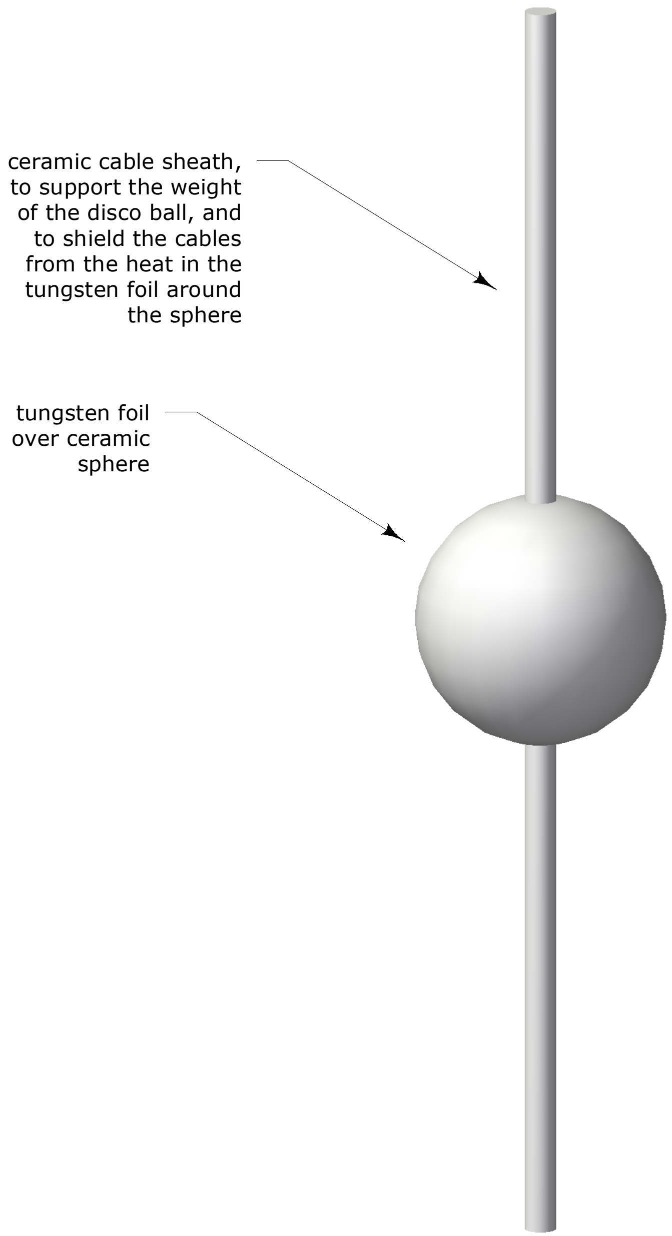
TITLE
Details 1
SCALE
none
SHEET
04

One of the main problems to be solved is how to feed an electric current into an apparatus operating at extreme temperatures (possibly > 2000 K) without melting the copper wires. The first solution is to use tungsten wires. The second solution is to pipe the wires through a ceramic conduit that will be air-cooled, with an inlet at the bottom, and open at the top, where convection will pull air through the conduit.



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PROJECT
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TITLE
Details 2

SCALE
1"=1'-0"

SHEET
05

The outside of the sphere will be covered with tungsten foil, which will emit electrons when heating and when exposed to a sufficient electric field. To get the proper acceleration of electrons as they move away from the outside of the sphere, there has to be an anode inside the sphere, creating a tri-polar field (positive inner sphere, negative outer sphere, and positive chicken wire around the whole thing, some distance away). Electrons emitted from the outer sphere will then be sitting on a current divider, and will move slowly at first toward the chicken wire, and accelerate as they go.

To get this effect, we need the positive inner sphere insulated from the negative outer sphere, so we don't get a short circuit between them, but we need a high permittivity between them, so the E-field shines through. This material seems to have the correct properties:

http://www.hindawi.com/journals/ijap/2012/905409/

"A high-permittivity ceramic-polymer composite substrate is fabricated and proposed for its potential use in UHF RFID tags. The substrate is developed using high-permittivity Barium Titanate ($BaTiO_3$) ceramic powder mixed with polydimethylsiloxane (PDMS) polymer. The resulting composite achieves a soft, hydrophobic, heat resistant, low loss, and flexible material with high dielectric constant."

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TITLE
Materials

SCALE
none

SHEET
06

The electron drift through the atmosphere will generate bremsstrahlung radiation, and electron uptake by ions near the sphere will generate spectral lines, while photo-ionization of atoms further from the sphere will create absorption lines.

Since the objective of this test is to reproduce conditions on the surface of the Sun, data collection can utilize technologies developed specifically for the Sun. For example, there are cameras, filters, and post-processing applications used by professionals and enthusiasts for solar photography.

More detailed data on the spectrum can be obtained using laboratory spectroscopy, but things like Rayleigh-Benard cells in the cathode tufts, and the dynamics of spicules and sunspots, would be best captured using standard solar videographic equipment.

The apparatus should be configured to handle a variety of potentials, and it should be tested in the opposite polarity to examine the properties of the inverse discharge.

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TITLE
Data Collection

SCALE
none