Has the Corona's High Temperature Had the 2nd Law of Thermodynamics Disabled?

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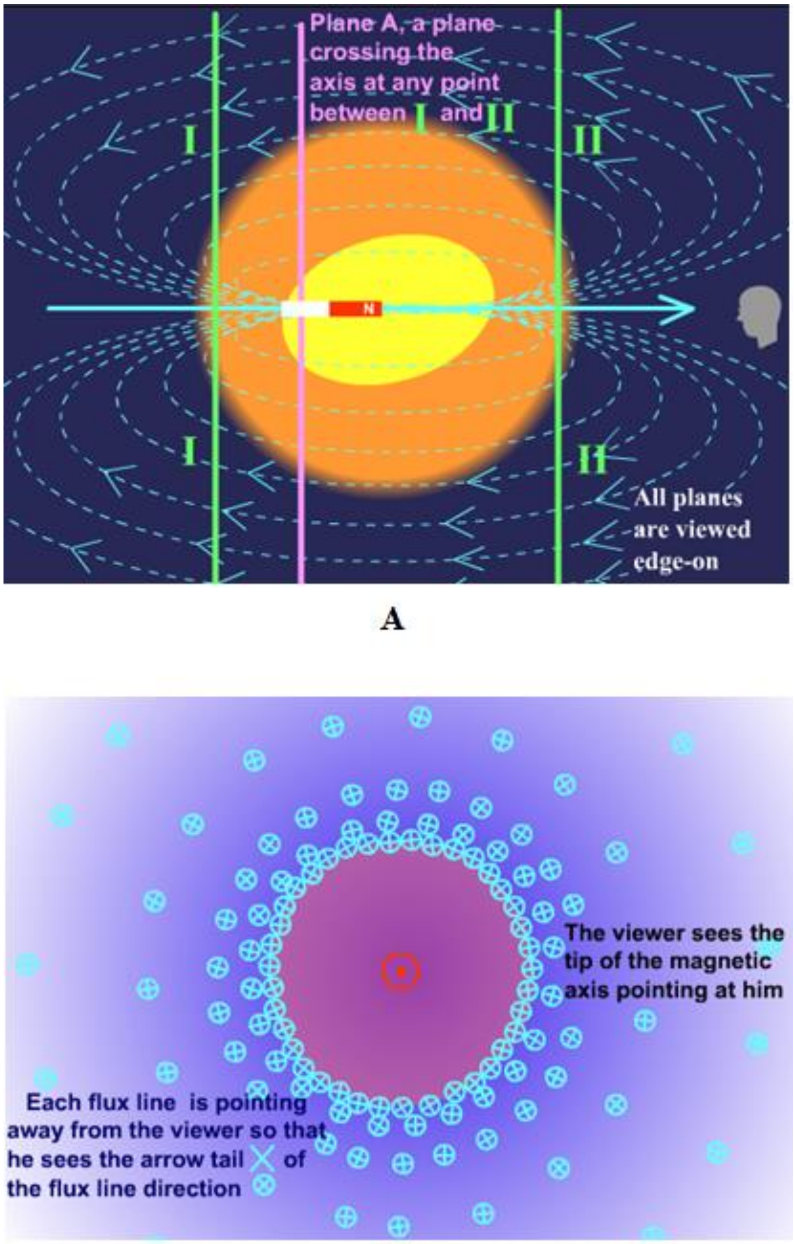
A plasma is a mass collection of subatomic particles; heat energy must throw each of them in a chaotically turbulent movement. With the statistically equal amount of energy each particle would receive, a particle of lighter mass must potentially move at higher speed than a heavier one. As such, electrons may always be "assigned" to stay as an "atmosphere" embracing the host body where mainly heavier particles but carrying positive charge are found. With the energy that the Sun so profusely releases, the above mass distribution should be even more typical for our Sun's plasma body. So, absolutely most of the freely moving electrons of the Suns should be found at a distance away from the photosphere. The huge quantity of them then naturally forms a thick but not massively dense structural layer having the entire Sun well wrapped.

It is a well-known fact that the Sun is also a hugely strong magnetic body. The analysis on the sunspot activity would encourage us to visualize the existence of a one piece magnetic "bar" that always has the same pole buried at the center of the Sun, while the other pole constantly migrates across the equatorial plane of the Sun under the combined gravitational influence of all the planets. It is this migration that causes the magnetic polarity reversal of the Sun's magnetic field. The magnetic field generated by the magnetic bar is so powerful that its magnetic flux of course extends far beyond the Sun's observable material body and thus forms an extensively large cage of magnetism enveloping the Sun.

Because of the magnetic cage, the supposedly random movement of the electrons can be random no more, but must follow what the flux guides and confines. The magnetic flux is produced by a magnetic bar that is continuously sweeping like a clock needle but in a counterclockwise direction if we look at it from the north of the ecliptic. Because the moving speed of the electrons and the sweeping speed of the magnetic field are so contrastingly different, we are going to explore the movement of the electrons in this magnetic field without regarding the sweeping rate of the magnetic field.

Now, let's look at the following typical scenario. The magnetic axis of the bar must penetrate the Sun's surface at two opposite points. At each of these points, let's have one plane perpendicular to this axis. We will call these two planes so found as I and II. Suppose a person looking at the north pole of the magnetic field (not the north side of the ecliptic!) while a plane, called A, parallel to I and II is cutting across the magnetic axis at any point of this axis. The viewer will fine the following flux alignment so distributed with respect to A: All magnetic flux lines are penetrating plane A but point away from him; the flux density is getting thinner and thinner at areas further and further away from the Sun's surface (Fig. 1, A & B).



A

B

Fig. 1 Magnetic Flux Distribution

Let's further suppose that an electron is entering the magnetic cage formed by all these flux lines at a direction perpendicular to the Sun's surface. There is no need to say that its entrance speed is formidable. As soon as this electron enters this cage, it must move along a helix loci in a clockwise manner with gradually but rapidly reduced curvature. As it so moves, it also gradually enters a space region where the ratio of the strength of two kind of forces F_1/F_2 begins to reverse, where F_1 is the electrical attracting force between the electron and the entire collection of particles of positive charge, which stay as the Sun's host body, and F_2 is the electromagnetic dynamic force produced by the interaction of the electron's movement in the magnetic cage. Eventually at some point quite far away from the Sun, the momentum of the electron initially invested with when entering the cage must be overcome by force F_1 and the electron must fall back toward the Sun.

When coming back, the electron's loci should be quite straightforwardly point at the center of the Sun (Fig. 2), However, this loci must getting more and more curving in approaching the Sun as it is entering a stronger and strong magnetic field. Each electron on the same plane must have countless neighbor. Suppose one of its neighbor also moves along a loci exactly like this electron, then two locus must cross and trespass each other. If we have a high number of electrons so move in a certain area (Fig. 3), friction and collision between them must only be absolute natural and inevitable. Friction and collision must end up with energy conversion, simply, from mechanical energy to thermal energy. With the number of electrons so moving in the "atmosphere" above the chemosphere, can we imagine how much energy would be unloaded here? Temperature in the order of million degrees should not be a surprise to us at all.

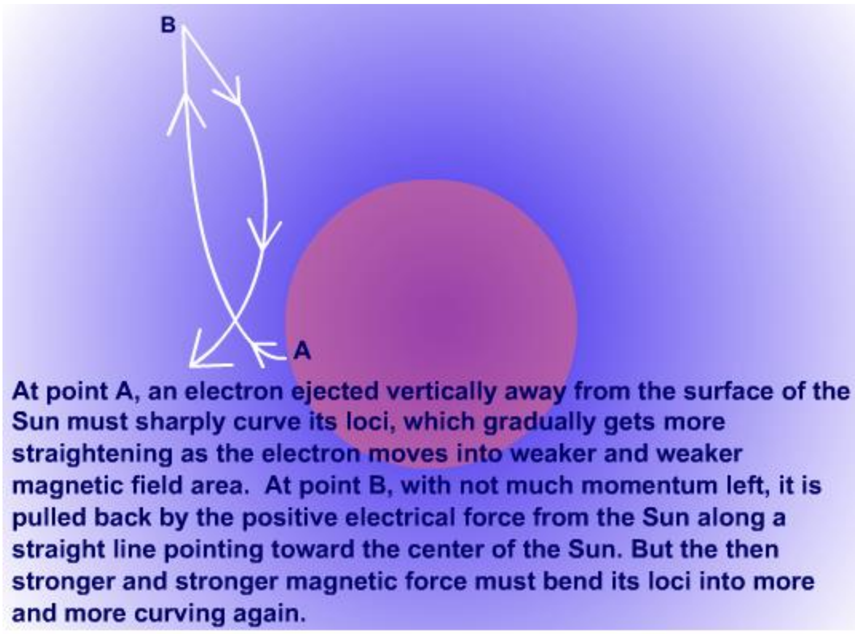


Fig. 2 Possible trajectory of one electron

Had these electrons moved strictly along some radial lines centered at the central point of the Sun as if there had never been a magnetic field, the friction and collision between them would be tremendously reduced, and energy would not be so dissipated by them and no high temperature corona would have been formed.

To those electrons whose energy are adequately dissipated during the friction and collision, they have no choice but are summoned back to the Sun's host body by the electrical force from the entire collection of particles of positive charges. When they are near the surface of the Sun, however, the violent explosive force of the Sun would mercilessly blow them away, and the electrons would have to enter the atmosphere with huge amount of energy once again and repeat their previous energy release process.

In the entire processing explained above, we can simply regard the electrons serving as some efficient peddlers conveying energy from the Sun to the outer space. Because the Sun's thermal energy is now transported to the outside world by a material collection of exceedingly high number of "workers", the second law of thermodynamics can no longer puzzle us why thermal energy can be "pumped" to a high temperature area from the area of lower temperature, i.e., the photosphere, where temperature is about only 5800^{o}C.

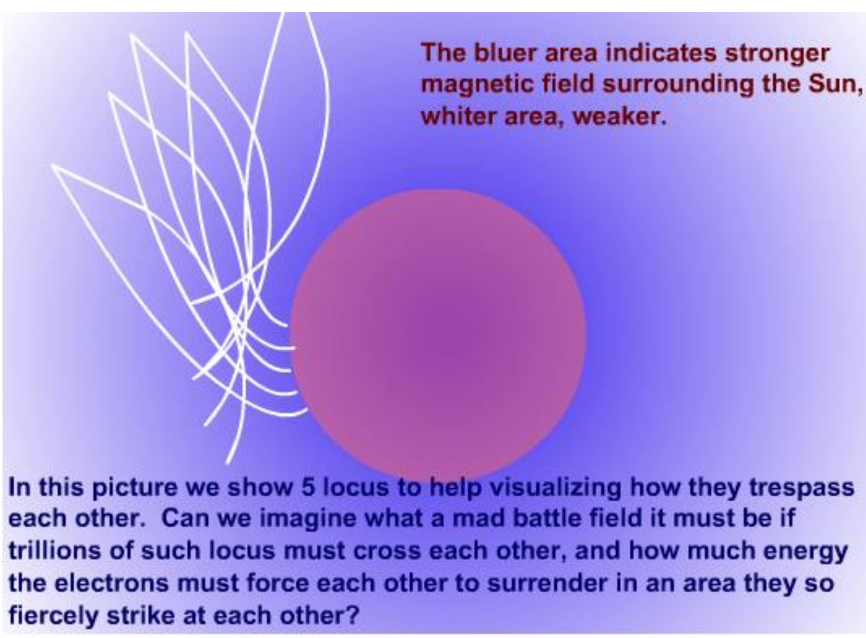


Fig. 3 Multiple Locus Interfering Each Other

In space not closed by plane I and II in Fig 1, the loci of the electrons' movement may be a little more complicated than what is previously described. However, the readers should have no difficulty to figure it out. The only thing needs to watch is that in any plane not between I and II, the flux lines have two groups pointing at two different directions: To the same viewer mentioned above, he would see lines pointing at himself at area near the axis, but pointing away from him at arear farther away from the axis.

As to those electrons that may tentatively move along the axis, we have no concern, because the constantly moving magnetic field of the Sun would shift them to be combed by the flux line at no time right at the moment any of them has set for moving along such axis.

With all that has been mentioned about the movement of the electrons, let's not omit that the repellent force between each of them would also further complicate their locus. However, statistically, they would all tirelessly do this arduous job: picking up energy near the photosphere, majorly at the transition region above the chromosphere, flying to the corona and unloading the energy there, with some of them coming back to the energy source to ask for more energy to pick up, and also some that really have carried excessive energy getting even further away above the corona.