# The Plasma Window – Looking Through to the Future

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Brookhaven National Laboratory (BNL) has won multiple R&D 100 Awards for products that have revolutionized the field of science, as well as the everyday lives of ordinary people. One of the most innovative award-winning inventions is the plasma window. This creation, invented by Ady Hershcovitch, utilizes the unique properties of plasma to separate vacuums from atmosphere.

Plasma is a "fully ionized gas of low density, containing approximately equal numbers of positive and negative ions." The plasma state is important in physics, and found commonly in the universe, therefore making it "a fourth state of matter." Magnetic fields influence it and the particles of the plasma move at high speeds. These exclusive features allow the plasma to be utilized in a variety of ways ("Plasma," 2001-05).

The creation of the plasma window takes the characteristics of this state of matter and applies them in a very functional method. Essentially, the plasma window is a porthole that "can separate vacuum and atmosphere, or regions of high and low vacuums" (Hershcovitch, n.d.). A gas is heated until it becomes a plasma, and then is released, but controlled by a magnetic field, to prevent other microscopic particle from passing. Since the plasma particles move at a very rapid speed, they push away any other, slower air molecule that comes near, so the air is blocked out. Nevertheless, radiation or charged particles are able to pass through the plasma window undisturbed. Plasma is a versatile phase of matter that is used well in Herschovitch's plasma window. ("Plasma porthole," 1997)

The plasma window currently is being applied to assist electron-beam welding. Electron-beam welding is used on a variety of products from computer chips to airplanes ("Acceleron," 2001). However, prior to this invention, the products to be welded had to be enclosed in a vacuum of limited size, since the electron-beam needs to be generated in one (Hershcovitch, n.d.). With the plasma window, the product itself no longer needs to be enclosed, just the electron gun, because the window allows the electron-beam to travel through the plasma unharmed and weld the product waiting on the other side. Also, the distortion of the electron-beam is not a problem, since it is mostly in a vacuum. ("Acceleron," 2001; Hershcovitch, n.d.)

This novel invention has extremely similar properties to the fictional "force fields" from the television series of Star Trek (Hershcovitch, n.d.), and perhaps can be used more like them in the future. In the series, the force fields are used to keep the air of the Starship Enterprise in and the vacuum of space out, much like the plasma window ("The Plasma Window," 1998). In fact, if the gas argon is used for the plasma, the window color would be blue, just like the force fields from the show (Hershcovitch, n.d.). Though this great innovation cannot fully achieve the strong effect of the force fields, perhaps in the near future, the current obstacles may be conquered, and the plasma window can be applied to a space shuttle.

The plasma window can be the basis for many other imminent inventions to come. Plasma has numerous uses that can be advantageous in the future. For example, presently, scientists are working on creating a "plasma bubble" that could shield astronauts on a trip to Mars (Shiga, 2006). This bubble consists of plasma that surrounds the shuttle with a wire mesh around it. The magnetic field created by the plasma would

be used to deflect cosmic rays, thus protecting the astronauts inside. This bubble is another way to apply plasma in the near future. (Shiga, 2006)

These are just a few examples of the many potential inventions that involve the plasma window. Possibly, in the future, the plasma window will act like the "force fields" and keep the air in a space shuttle enclosed (Hershcovitch, n.d.). Also, plasma may be able to protect astronauts from cosmic radiation (Shiga, 2006). These two possibilities can lead to future exploration into space, which, in turn, can lead to new discoveries in various fields of science. There are countless other possible applications for plasmas as well. Maybe, in a few years, the plasma window will be used for the military defense of a nation. Physical weapons would dissolve as they hit a plasma barrier, though weapons with radiation could still pass through. Perhaps a massive plasma window will even be used to colonize other planets, keeping oxygen inside of it and a harsher atmosphere outside. That idea would mean that humanity can spread across the solar system. All of these possibilities come from this incredible invention by Ady Herschovitch.

Plasma is a very interesting state of matter that has unique properties. These properties have great potential to be applied to many inventions in the future. The previously mentioned possibilities are only the beginning of a wide range of latent creations that can lead to worlds of discovery. The plasma window has, most definitely, revolutionized the field of science, and will continue to do so.

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