Concerning a technology that could help avoid another Columbia disaster

Paul A. LaViolette, Ph.D.
The Starburst Foundation
starcode@aol.com
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One technology that could prevent a Columbia-type hazard from happening in the future would be to apply a high voltage charge to the Space Shuttle hull during reentry, in particular to the leading edge of its wing. The ion sheath so formed would create a buffer zone around the craft, ionizing, repelling and deflecting oncoming air molecules and thereby preventing them from directly impacting and heating the hull. The technology is not new. It has been researched decades ago, as is described below. This electrification technology would provide a second line of defense to the heating problem, supplementing the refractory tile layer that is currently used.

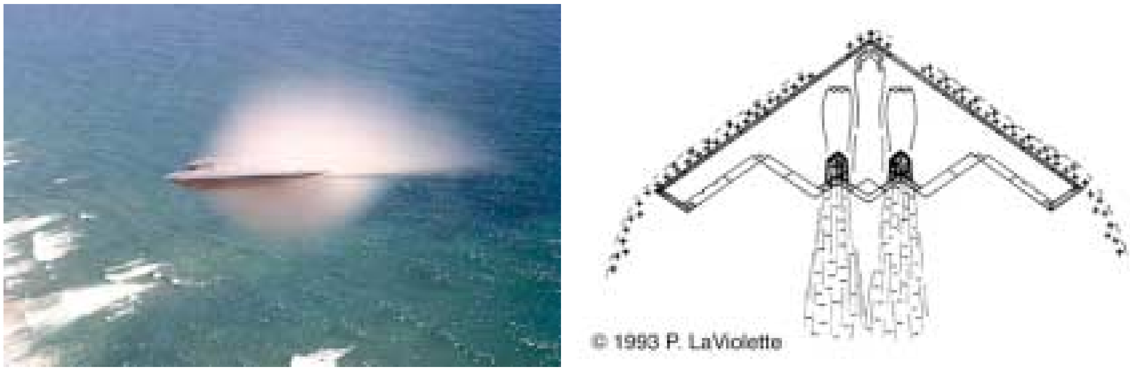
Prior history of development of the air frame electrification technology:

Airframe electrification was first suggested by Thomas Townsend Brown who did extensive research on it during the 1940's and 1950's. Referring to Brown's work of placing a high voltage charge on the leading edge of the air frame, Dr. Mason Rose wrote in 1952 that the positive field which is traveling in front of the craft "acts as a buffer wing which starts moving the air out of the way... acts as an entering wedge which softens the supersonic barrier, thus allowing the material leading edge of the craft to enter into a softened pressure area."

Brown's work was spotlighted in a 1956 air intelligence report entitled "Electrogravitics Systems" issued by Aviation Studies Intl. a UK based intelligence think tank. I obtained a copy of this report from Wright Patterson Air Force base Technical Library in 1985. The report along with excerpts about this technology that appeared in various past issues of the Aviation Studies newsletter, has been reprinted in a book by the same name entitled *Electrogravitics Systems*.[1] The report listed the names of many aerospace corporations that were actively researching this air frame electrification technology in the early 1950's.

Northrop corporation was one of these companies. At an aerospace sciences meeting held in New York in January of 1968, scientists from Northrop's Norair Division reported that they were beginning wind tunnel studies on the aerodynamic effects of applying high-voltage charges to the leading edges of high-speed aircraft bodies.[2,3] Echoing what Mason Rose had described over a decade earlier, they said they expected that the applied electrical potential would produce a corona glow that would propagate forward from the craft's leading edges to ionize and repel air molecules upwind of the aircraft. The resulting repulsive electrical forces would condition the air stream so as to lower drag, reduce heating, and soften or eliminate the supersonic boom. According to author William Moore, the results were significant in that when high voltage DC was applied to a wing-shaped structure subjected to a supersonic flow, seemingly new "electro-aerodynamic" qualities appeared which resulted in significant air drag reduction on the structure and the virtual elimination of friction-caused aerodynamic heating.

It is claimed that the B-2 bomber electrifies its wing-leading edge as a means of assisting its propulsion.[4] This appears to have been an extension of research that Northrop had carried out in the 60's, Northrop being the prime contractor for the design and construction of the B-2's airframe. I discussed the application of this technology to the B-2 in a conference paper I presented in 1993, and which was later reprinted in *Electrogravitics Systems*.



Airframe electrification used in the B-2 bomber to reduce air drag and hull friction. (Photo courtesy of Bobbi Garcia).

Power generation:

The electrostatic charge applied to the wing leading edge may be supplied either by a flame jet generator powered by the shuttle's own main engine or by flow through wind pods mounted on the wing surface. The latter alternative would have the advantage that it would require no fuel consumption. That is, the energy would be supplied by the reentry plasma wind striking the shuttle. The "wind jet" generator would operate much like a Van de Graff generator where the air stream is analogous to the charge carrying belt in the Van de Graff. The air stream would enter the pod on the upwind end and leave the pod on the downwind end. At the pod's entrance negative ions would be injected into the air stream and as this flowed toward the rear end of the pod, it would carry these ions to a progressively higher potential difference where a portion of the ions would be collected by a conductive grid, the remainder being allowed to flow away toward the rear of the craft. The grid would recycle this current turning an initial 50,000 volt starter current into a multi megavolt current. Since the negative ions are forcefully carried away from the craft by the reentry wind, the shuttle would acquire a very high voltage positive charge in excess of 10 million volts, reaching a maximum at the wing's leading edge which would be connected to the generator's positive terminal.

This plasma jet would operate much like the flame jet generator that Townsend Brown has described in his 1962 electrokinetic generator patent (No. 3,022,430), where the hot combustion gases are here replaced by the reentry airflow captured by the wind pods. In fact, in his patent Brown stated that any kind of flowing nonconductive gas would serve as a substitute for combustion gases.

Reentry effects:

One effect of hull electrification would be to accelerate the speed of the craft. That is, hull electrification would not only reduce hull heating but also air friction drag against the craft. Consequently, the craft would take longer to decelerate as it entered the atmosphere. This could be accommodated by arranging for the craft to have a longer air flight path, e.g., passing through the atmosphere at a slightly lower angle. Alternatively, if more braking is desired at any given time during reentry, the voltage electrifying the wing may be reduced or altogether shut off, thereby engaging once again air friction surface heating. By alternately turning the electrification on and off, hull surface temperatures may be kept minimal while frictional deceleration is employed. This ease of controlling reentry deceleration by the flick of a switch may be found to be superior to controlling the forward pitch of the craft, as is currently done.

Prior contact with NASA suggesting this technology:

In 1990 I had participated in NASA's Space Exploration Outreach Project and had submitted an idea entitled "Electrogravitics: An energy-efficient means of spacecraft propulsion" (submission category: Space transportation, launch vehicles, and propulsion). My paper informed NASA about T. T. Brown's work and about the 1956 Aviation Studies Intl. report mentioned above. I suggested that NASA aggressively pursue electrogravitics for propulsion. Although my submission was not summarized in the final report submitted to NASA. It had unfortunately been omitted by Rand Corp. contract employees who found it, in their opinion, irrelevant to NASA's objectives. One other participant had also submitted a suggestion that NASA look into applying Brown's electrogravitic technology. But that too was omitted from the main report. Attempts were made to obtain the computer records from this project giving the reasons why this technology was deemed unsuitable, but these tapes were reportedly "missing."

In 1992, and again in 1993, I contacted Mr. Charles Morris, Jr. who was at that time heading NASA's National Aero-Space Plane (NASP) program and had encouraged him to have NASA look into electrogravitics. I sent him a lot of material about Townsend Brown's research, including the Aviation Studies International report. In our telephone conversations we had discussed the issue of reentry heating of the hull, which was apparently a problem that NASP was grappling with. In a letter I had sent to him in September 27, 1993, I specifically had pointed out that "electrostatic charging of the plane's leading edge would have the added benefit of reducing air friction heating of the hull surface." But nothing came of this. Mr. Morris later informed me that he was unable to generate any interest at NASA to look further into this.

NASA had a 13 year advance warning. If their research programs had pursued this technology and had applied it to the Space Shuttle, the lives of an entire crew could have been saved along with the hundreds of millions of dollars that are now going into the wreckage recovery and the cost of putting the space program on hold.

Nevertheless, looking to the future, it is my hope that NASA will now undertake the challenge and seriously research the use of this technology. Jonathan Campbell of NASA Marshall Space Flight Center would be a good contact point for beginning such a project. He has spent many years researching the application of high voltage charge to aerospace propulsion. Although his requests for NASA internal funding of this line of research have in the past been turned down, hopefully NASA will now give a higher priority to this work in the wake of the Columbia disaster. As a start, wind tunnel experiments should be carried out similar to those Northrop conducted 35 years ago and efforts should be made at developing a high-voltage wind jet generator for application to the Space Shuttle. I would be glad to assist NASA in this effort.

References

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