Festo b-IONIC Airfish

Peter Lobner, Updated 3 April 2021

1. Introduction

The Festo b-IONIC Airfish airship was developed at the Technical University of Berlin with guidance from the firm Festo AG & Co. KG. In 2005, this small, non-rigid airship flew with a solid-state propulsion system, but it wasn't the first. In 1974 and 2003, LTAS flew two small electro-kinetically propelled airships designed by Michael Walden, the XEM-1 and EK-1, respectively. Like its LTAS counterparts, the neutrally buoyant Airfish only flew indoors, in a controlled environment, at a very slow speed, but it flew.

Airfish in flight. Source: Festo AG & Co. KG

2. Description of the Airfish

The basic technical characteristics of the Airfish are listed below:

- Length: 7.5 meters (24.6 ft)
- Span: 3.0 meters (9.8 ft)

- Shell diameter: 1.83 meters (6 ft)
- Helium volume: 9.0 m^3 (318 ft^3)
- Total weight: 9.04 kg (19.9 lb)
- Buoyancy: 9.0 – 9.3 kg (19.8 – 20.5 lb)
- Total thrust: 8 – 10 grams (0.018 – 0.022 pounds)
- Maximum velocity: 0.7 meters/sec (2.5 kph; 1.6 mph)

The b-IONIC Airfish employed two solid-state propulsion systems, an electrostatic ionic jet and a plasma ray, which Festo describes as follows:

- **Electrostatic ionic jet:** "At the tail end Airfish uses the classic principle of an electrostatic ionic jet propulsion engine. High-voltage DC-fields (20-30 kV) along thin copper wires tear electrons away from air molecules. The positive ions thus created are then accelerated towards the negatively charged counter electrodes (ring-shaped aluminum foils) at high speeds (300-400 m/s), pulling along additional neutral air molecules. This creates an effective ion stream with speeds of up to 10 m/s."

The Airfish electrostatic ionic jet on the tail cone.
Source: Festo AG & Co. KG

- **<u>Plasma-ray:</u>** "The side wings of Airfish are equipped with a new bionic plasma-ray propulsion system, which mimics the wing based stroke principle used by birds, such as penguins, without actually applying movable mechanical parts. As is the case with the natural role model, the plasma-ray system accelerates air in a wavelike pattern while it is moving across the wings."

The Airfish plasma ray on a side wing demonstrating the propulsive airflow deflecting the flame of a cigarette lighter
Source: Festo AG & Co. KG

The Festo b-IONIC Airfish demonstrated that a solid-state propulsion system was possible. The tests also demonstrated that the solid-state propulsion systems also reduced drag, raising the intriguing possibility that it may be possible to significantly reduce drag if an entire vessel could be enclosed in a ionized plasma bubble.

Airfish overhead. Note the plasma ray panels inset on the side wings. The electrostatic ionic jet is on the tail cone. Source: Festo AG & Co. KG

You'll find more information on the Festo b-IONIC Airfish, its solid-state propulsion system and implications for drag reduction in the Festo brochure here:
https://www.festo.com/net/SupportPortal/Files/344798/b_IONIC_Airfish_en.pdf

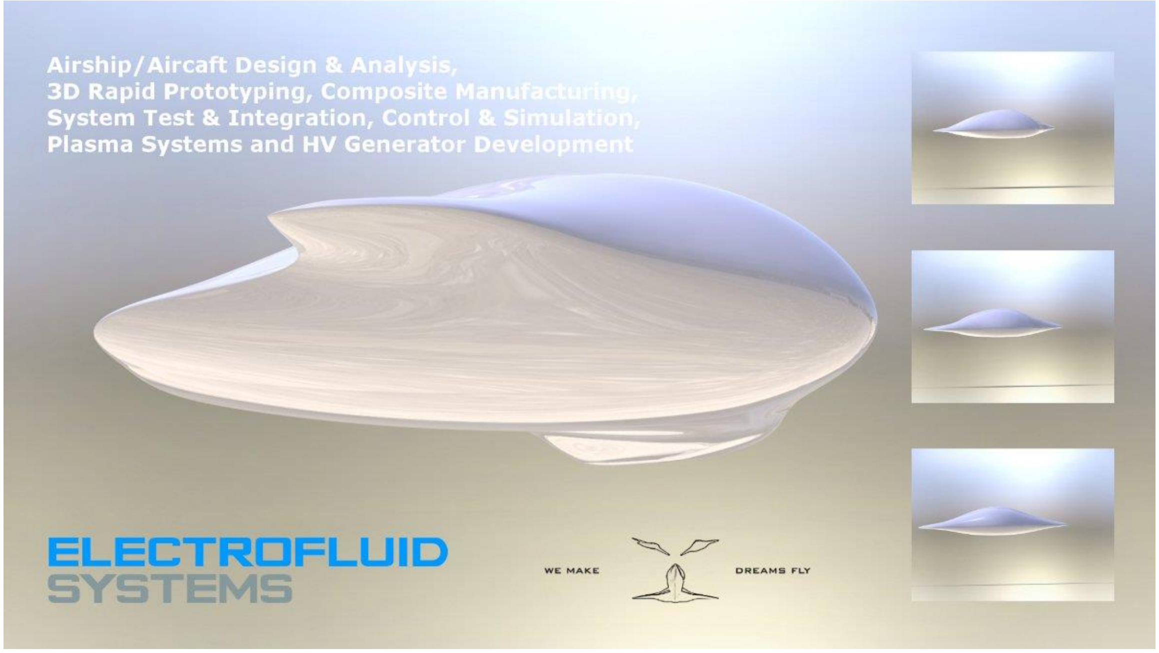
You can watch a 2005 short video on the Festo b-IONIC Airfish flight here:
https://www.youtube.com/watch?v=P7FENAXuHIY

Bow quarter view of Airfish. Source: Festo AG & Co. KG

Source: Festo AG & Co. KG

3. Beyond the Airfish

In 2006, the Technical University of Berlin’s Airfish project manager, Berkant Göksel, founded the firm Electrofluidsystems Ltd., which in 2012 was rebranded as IB Göksel Electrofluidsystems. This firm presently is developing a new third generation of plasma-driven airships with highly reduced ozone and nitrogen oxide (NOx) emissions, magneto-plasma actuators for plasma flow control, and the company's own blended wing type flying wing products. You’ll find their website here:
https://www.electrofluidsystems.com



Source: Electrofluidsystems TU Berlin