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SPACE EXPERIMENTS WITH PARTICLE ACCELERATORS (SEPAC) (N002)

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The purpose of Space Experiments with Particle Accelerators (SEPAC) is to carry out active and interactive experiments on and in the Earth's ionosphere, atmosphere, and magnetosphere. The instruments (Fig. III-3) to be used are an electron beam accelerator (EBA), plasma contactor, and associated instruments the purpose of which is to perform diagnostic, monitoring, and general data taking functions. All are mounted on the pallet. Command and display systems are located in the aft flight deck.

Four major classes of investigations are to be performed by SEPAC. They are: beam plasma physics, beam-atmosphere interactions, the use of modulated electron beams as transmitting antennas, and the use of electron beams for remote sensing of electric and magnetic fields. The first class consists mainly of onboard plasma physics experiments to measure the effects of phenomena in the vicinity of the shuttle. The last three are concerned with remote effects and are supported by other ATLAS 1 investigations as well as by ground-based observations (Figs. III-4 and III-5).

A systematic examination of various plasma coupling processes will be performed with the beam plasma physics investigations. The injection of an electron beam into a plasma often results in interactions that modify the structure of the beam and its velocity distribution while generating a wide variety of plasma wave phenomena. The instabilities responsible for these effects are of interest because they are manifestations of basic physical processes that occur in beam plasma interactions. Waves generated in the beam-plasma interaction will be detected at ground observation facilities to investigate a possible use of an electron beam as a virtual antenna.

The purpose of the beam-atmosphere interaction investigations is to study mechanisms for the formation of auroras and the excitation of airglow. The physical and chemical processes involved in the formation of natural auroras are complex. The dynamic nature of the aurora and associated rapid changes in the input particle distributions have severely limited the ability to understand the aurora through passive experiments alone. An auroral input-output experiment, wherein a stable beam of electrons with a narrow spread in energy and pitch angle will be injected into the atmosphere by SEPAC, should significantly advance the understanding of auroral phenomena. Artificial auroras that are produced by firing the electron beam accelerator upward into the magnetosphere will be used to search for electric fields parallel to the magnetic field in the auroral zone. These fields may reflect the beam causing it to impact the atmosphere below the Orbiter.

The SEPAC instrumentation is divided into three groups: the active elements; the monitor and diagnostic instruments; and the control, display, and data management equipment.

The active elements are the electron beam accelerator, plasma contactor, and neutral gas ejector. The electron beam accelerator is capable of operating at voltages from 500 V to 7.5 kV at a maximum of 1.6 amps.

The plasma contactor produces a xenon plasma which will clamp the electrical potential of the Orbiter to the plasma potential, allowing the full 1.6 amps of electron current to be ejected from the EBA. The third active element is a neutral gas ejector which ejects xenon into the ionosphere.

Monitor and diagnostic instruments to be used are a beam monitor television, a photometer, an energetic particle analyzer, plasma probes, and plasma wave detectors.

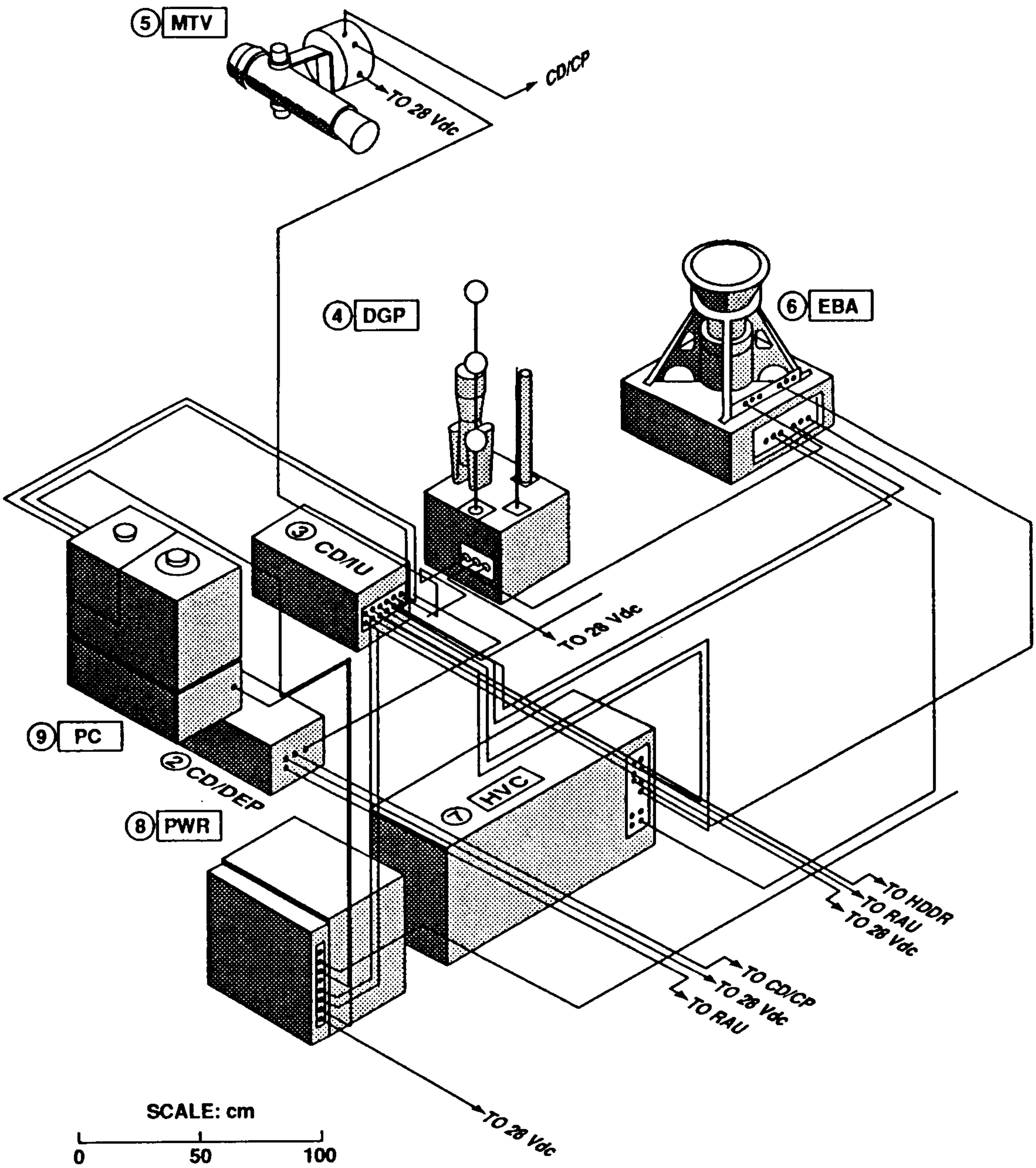

Figure III-3. Layout of SEPAC equipment.

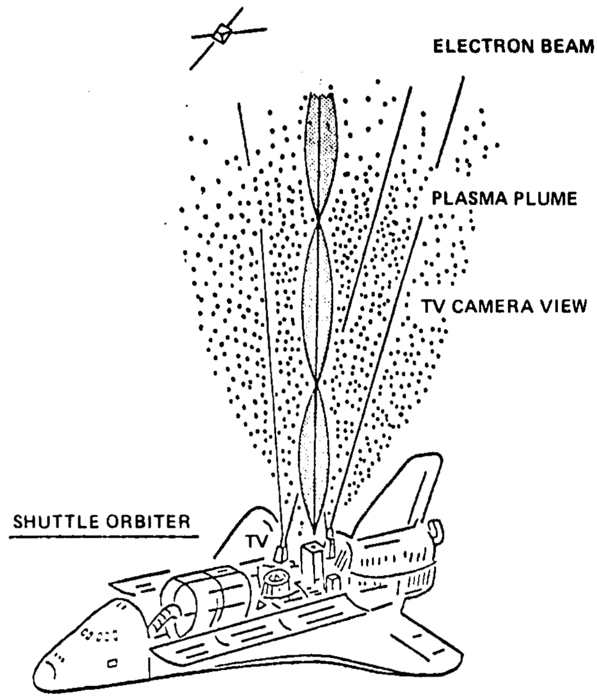

Figure III-4. SEPAC experiments in the vicinity of the Orbiter: beam plasma physics.

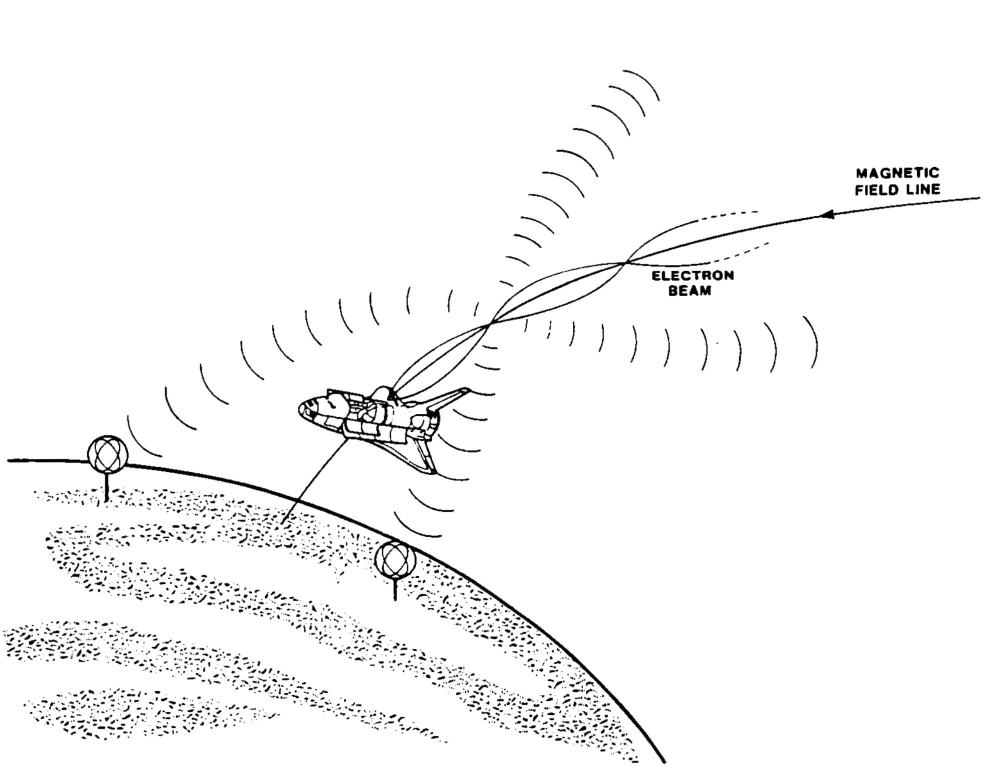

Figure III-5. SEPAC virtual antenna experiments.