The PERCS satellite will be launched in a stowed configuration that has less than one meter in diameter. After launch, the PERCS will expand to a diameter of over 10 meters. Hoberman Sphere technology will be used to produce a stable wire-frame to act as a radar scatter target. After examining a number of polyhedron structures for the wire frame, the chosen design is a 180-vertex sphere is based on a truncated Rhombic Triacontahedron. The 180 vertices are intersection points to 270 edges. Each edge is composed of hinged scissors so that the PERCS can be folded into a compact package for launch. The total sphere has 360 hubs and 1620 links to form the transformable structure. The mass of the sphere is estimated to be 160 km with 6 mm diameter links. Each of the 80 hexagon faces and 12 pentagon faces are uncovered so that the orbiting sphere has low atmospheric drag. At an altitude of 500 km, the PERCS sphere will be in orbit more than 800 days.

Analysis of the V180 wire frame with a 10.2 meter diameter shows that the radar cross section (RCS) is independent of viewing angle up to 36 MHz. In addition, there is a VHF window at 50 MHz where the backscatter cross section is independent of orientation. This makes it ideal for calibration of SuperDARN radars in the 8 to 20 MHz range as well as the meteor and E- and F-region radars near 30 and 50 MHz. The PERCS target is also invaluable for checking the antenna patterns for ionospheric heating facilities such as HAARP, EISCAT Heating and the new Arecibo HF Facility. Radar performance will be measured or validated using the radar echo data and the precise knowledge of the target RCS, position, and velocity. The wire frame structure has several advantages over a metalized spheroid “balloon” with (1) much less drag, (2) large radar cross section, and (3) low fabrication cost. After PERCS is launched, the international HF radar community for HF studies will greatly benefit by having a target the can yield radar return signal strength measurements in absolute, not relative, units.

A new nitric oxide detector with absorption cells driven by a fast cam system

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A nitric oxide (NO) detector, making use of a newly designed fast cam-driven absorption cell system is being developed for launch on board sounding rockets, to measure the height profile of the NO gamma band day glow emission intensity and thereby to estimate the height profile of the number density of atmospheric NO in the equatorial region. Two absorption cells, one of them containing the gas NO and the other nitrogen are brought in front of the photocathode of a photomultiplier (PM) tube alternately using a cam system. Each cell remains in front of the PM tube for an interval of time fixed by the cam shape. In conventional NO detectors the absorption cells are mounted either on a rotating wheel or are moved by a cam system controlled by a step motor. In the new mechanical system presented here the movement of the cam is controlled by curve segments on a circular disc, that are cycloids of the form $y = r\varphi - d.\sin\varphi$ designed to optimize the time needed for positioning the cells one after the other and also to make smooth the operation of the step motor responsible for the movement of the absorption cells. The cycloidal form was chosen for the cam profile after analyzing the mechanical performance characteristics of various other types of curves. The major advantage of the cycloid is the smooth variation of the gradient along it from one point to another. The gradient is what decides the motor torque needed for the movement of the shaft along the cam profile. Thus a smooth variation in the gradient guarantees smooth variation in the motor torque. The advantages of this new system over the conventional wheel mounting are also presented.