Measured Bandwidth of Resonant Patch Antennas Supported by a Conducting Sphere with Comparisons to Chu's Limit

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In this work, we discuss the measurement process and construction of a unique antenna having a spherical shape. Measured data are then presented from which the antenna's bandwidth can be determined. The antenna(s) are patch antennas with canonical spherical shapes supported by and underlying conducting sphere, Figure 1a. The unique nature of the feed precludes stored energy from existing inside the sphere and allows the antenna to approach, but not exceed, Chu's limit, Figure 1b. Chu's limit estimates the Q of electrically small antennas using the stored energy external to a sphere that encompasses the antenna. However, the stored energy inside the encompassing sphere is neglected, (e.g., a sphere encompassing a dipole.) The addition of this energy would raise the value of Q reducing the theoretical lowest possible bandwidth. Accordingly any calculation of Q is lower that can be achieved in practice.

In Figure 1a, a spherical cap is shown located over a conducting sphere. In Figure 1b, we show the patch antenna fed by a probe as connected to a copper SMA cable. The SMA cable enters the conducting sphere through a small hole and then solder is placed around the perimeter of the hole ensuring electrical contact with the outside of the SMA cable. At the location where the probe connected to the SMA cable meets the conducting sphere underneath the patch, a similar solder procedure is used. Accordingly, the inside of the sphere is not exposed to time varying currents. Therefore, fields internal to the conduction sphere are zero. Measured data for this antenna construction will be presented.

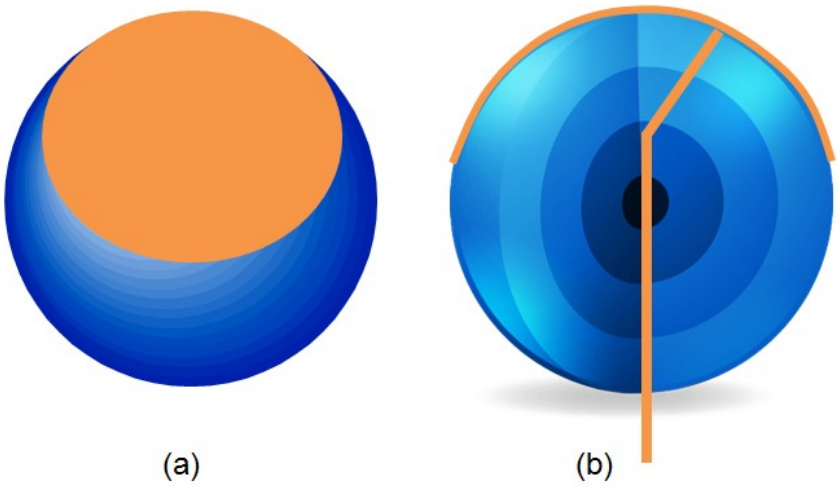

Figure 1 – Spherical patch antennas residing on a conducting spherical support.