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Cavities for electron spin resonance: predicting the resonant frequency JOHN COLTON, KYLE MILLER, MICHAEL MEEHAN, ROSS SPENCER, Brigham Young University — Microwave cavities are used in electron spin resonance to enhance magnetic fields. Dielectric resonators (DRs), pieces of high dielectric material, can be used to tailor the resonant frequency of a cavity. However, designing cavities with DRs to obtain desired frequencies is challenging and in general can only be done numerically with expensive software packages. We present a new method for calculating the resonant frequencies and corresponding field modes for cylindrically symmetric cavities and apply it to a cavity with vertically stacked DRs. The modes of an arbitrary cavity are expressed as an expansion of empty cavity modes. The wave equation for D gives rise to an eigenvalue equation whose eigenvalues are the resonant frequencies and whose eigenvectors yield the electric and magnetic fields of the mode. A test against theory for an infinitely long dielectric cylinder inside an infinite cavity yields an accuracy better than 0.4% for nearly all modes. Calculated resonant frequencies are also compared against experiment for quasi-TE011 modes in resonant cavities with ten different configurations of DRs; experimental results agree with predicted values with an accuracy better than 1.0%. MATLAB code is provided at http://www.physics.byu.edu/research/coltonlab/cavityresonance.

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