there is a sufficient number of gas molecules in the chamber, an electron can collide with these molecules. If it looses energy in these collisions the return to the cathode is impossible and the electron will describe a significantly longer path before eventually impinging onto the anode.....'[10]

Even though this discussion contains the most important ingredient of the Penning trap, the long path of a charged particle in a magnetic field perpendicular to the particles momentum (and H. G. Dehmelt therefore justifiably chose the name Penning trap for this device [2]), a complete description of the confinement mechanism can be credited to J. R. Pierce [11]. In his study of the magnetron he concerned himself with the leakage of electrons from the magnetic field region. He discussed inhibiting this leakage by confining emission to a central region and adding "end hats" in axial direction. He mentions "one particular field which perhaps merits individual attention; a charge free region in which the electric potential is given by

$$V = \frac{\omega_o^2}{2\eta}\left(\frac{r^2}{2} - z^2\right) + V_o .$$

This field can be produced by hyperbolic electrodes indicated....." Figure 2 shows a copy of the relevant page in his book, and to the uninitiated reader this could be as well a page from a modern text book on confinement of charged particles. Not only does he describe the potential and the axial harmonic motion, but he also solves for the stability criterion, which essentially states that the radial confinement by the magnetic field, represented by the cyclotron frequency, must overcome the repulsion due to the radial component of the electrical quadrupole field, which is represented by the axial frequency.

4. Precision Measurements

With the confinement techniques mentioned above at hand, the field of precision measurements on elementary particles was off to a good start. Observation times could now be made so long, that this time scale was not limiting anymore the accuracy with which one could obtain a measurement for a frequency, and our new "artificial atom" displays a very simple level scheme (Figure 3) from which two very important and fundamental quantities can be derived. The difference between two cyclotron levels is a measure for the inertial mass of the particle(s) in the trap, and the difference between this energy splitting and the spin precession frequency gives the deviation of the electron g-factor from the value of 2. But before one can set out to probe our fundamental knowledge of physics by measuring these two quantities with