The predicted magnetization curve is linear until $\eta_1 H_e = 1$. (See Figure 3.5.) In this region it has the same form as obtained in the interacting grain theory,

$$\frac{M}{M_s} = -\frac{M_s}{2Be} H_e,$$

except B is given by the arithmetic mean,

$$\frac{1}{B} = \frac{1}{2}\left(\frac{1}{b_1} + \frac{1}{b_2}\right).$$

The subsequent magnetization curve joins continuously to first and second order but approaches saturation more slowly than the interacting grain magnetization curve.

In the case of magnetoelastic isotropy $(b_1 = b_2)$, the independent grain theory degenerates to the predicted curve for the interacting grain theory. The predicted magnetization curves for the two assumptions along with those for the <100> and <111> problems are shown in Figure 3.5 for YIG.

3.3. Micromagnetic Theory

The intention in this section is to review briefly the concepts of micromagnetic theory and its progress concerning the shock induced anisotropy effect. The theory proceeds by invoking the thermodynamic equilibrium postulate on the total integral energy expression, Equation (2.15).[31,47] The resulting variation, accomplished by calculus of variation techniques, yields Brown's equations which, along with the corresponding magnetostatic boundary value problem, constitute a system of nonlinear differential equations for the magnetization field throughout the material parameterized on the external applied field H_e.

Since this system of equations is nonlinear, for a given H_e many solutions are allowed. Some of these solutions will be stable while others will be unstable. Each stable solution represents a possible physical state of the thermodynamic system. Which state is occupied depends on the history as well as existing conditions. Hence, this theory is capable of predicting magnetic hysteresis. With variation of the applied field H_e, the present state of the system may change continuously or by finite jumps if the state becomes unstable. These jumps are known as Barkhausen jumps and have been observed experimentally.

Progress by this very elegant approach has been limited due to the extreme complexity of the system of nonlinear equations. Some success has been made in select regions of the magnetization curve for very special geometries of magnetic material.[31,47]

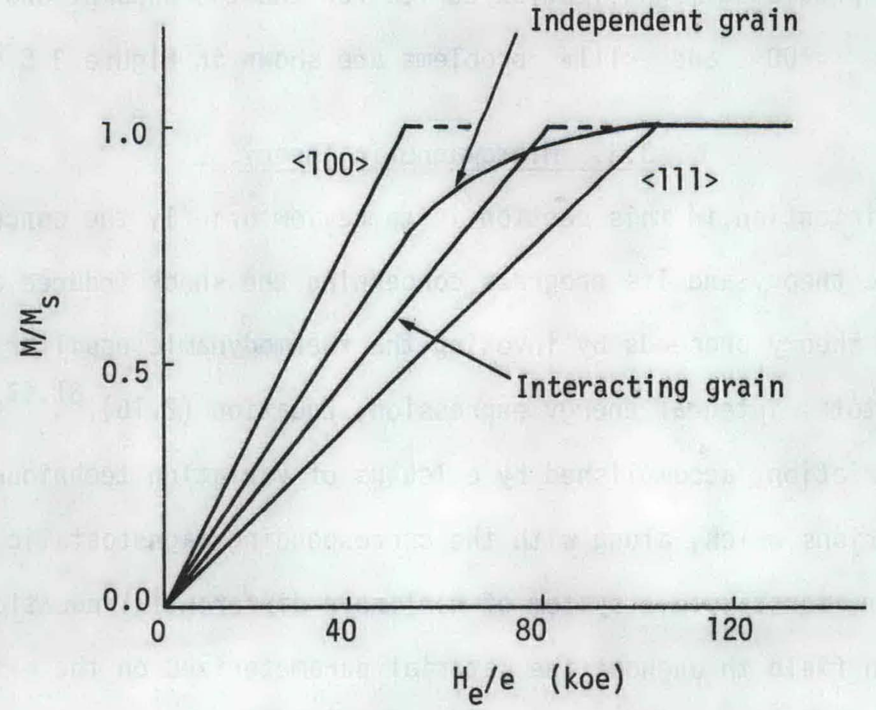

Fig. 3.5.--Magnetization curves for various theories.