ABSTRACT

Data was collected from a non-clinical young adult population for a near viewing distance. Fixation disparity curves were then generated utilizing both prism (fusional vergence) and lenses (accommodative vergence) for each subject. Data was evaluated to determine if curve typing produced with lens stimuli was consistent with Ogle prism typing.

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Senior Project
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BACKGROUND: Ogle, et al[1,2] investigated the relationship of fixation disparity curves generated utilizing prisms and those generated utilizing lenses in order to study the AC/A ratio. Fixation disparity curves generated with prisms were found to be of four general shapes and designated Types I - IV. Several conclusions concerning lens-derived fixation disparity curves were proposed, but no discription of curve typing with lenses was undertaken. The intent of this study is to determine if curve typing can be accomplished utilizing lenses and further, if possible, do specific lens curve types correspond to particular prism types.

METHOD: Twenty subjects with normal binocular function were tested. Ages ranged from 22 to 29. All measurements were made with best refractive correction being worn. Fixation disparity measurements were made with the subject binocularly viewing a target at 40cm. A central fusible circle of 1.5 degree diameter was used. Within the circle were two perpendicularly polarized vertical lines, and analyzers in the refractor made one line visible to each eye. Disparity of the two lines could be varied by the examiner turning a dial which resulted in lines of varying horizontal displacement being displayed. Accommodation was controlled with targets either side of the central circle. Pairs of lines were displayed until alignment was reported by the subject. Bracketing was used to best estimate the fixation disparity. For each stimulus three measurements were made. Prism stimulus values were made in 3 diopter intervals BI and BO up to 15 diopters. Measurements were then made at greater than 15 diopters for subjects capable of fusion at higher levels. This was done in order to properly

determine prism curve typing. Temporal effects on prism measurements reported by Schor[3] were minimized by keeping viewing time at a minimum. BI and BO measurements were alternated even though alternation of BI and BO was shown not to be necessary by Hebbard[4]. Lens powers generally ranged from -2.50 diopters to +2.50 diopters in .50 diopter increments. Most subjects were incapable of maintaining the accommodative target clear beyond this range. Limiting the lens powers to this range and the use of the accommodative target assured that the effect of blur reported by Hebbard[5] on fixation disparity measurements was minimized. Data for prism and lens data was graphed for each subject. Since minus lenses produce a shift toward eso-disparity the same as BI, minus lens and BI were plotted in increasing values to the left of origin with eso-disparity above the origin. BO and plus lens values were plotted in increasing values to the right of origin and exo-disparity below the origin. The plotting of the lens data was opposite to the convention used by Ogle[1] in order to more easily compare the curve types. AC/A ratios were calculated from the data for each subject and the x-axis lens values were plotted in intervals superimposed over the prism values corresponding to each individual's AC/A ratio. Graphed data for all subjects is attached.

DISCUSSION: Table 1 shows the comparison of lens-produced disparity curves for each type of prism curve. Of the twenty subjects 71.4% of Type I prism curves had lens curves in agreement,66.7% of the Type II curves were in agreement, 50.0% of the Type III and 80.0% of the Type IV curves were in agreement. In total, 70.0% of the lens generated curves agreed with the prism generated curve. It appears that in the majority

Table 1.

Prism Type	#	Lens Type	#
I	7	I	5
		II	1
		III	-
		IV	1
II	6	I	1
		II	4
		III	-
		IV	1
III	2	I	1
		II	-
		III	1
		IV	-
IV	5	I	-
		II	1
		III	-
		IV	4

of cases lens typing is consistent with prism typing and could be used for the typing of prism disparities. Other observations of interest from the data collected include the relative prevalence of curve types, the eso-shift of the lens-generated data, the increased effect of lenses as compared to prism, and the reduction of fixation disparity to zero utilizing lenses.

The current study produced a prism typing prevalence of 35.0% Type I, 30.0% Type II, 10.0% Type III, and 25.0% Type IV. This is in comparison to the work of Ogle[1] which reported a prevalence of 46.3% TypeI, 17.2% Type II, 6.8% Type III, 2.3% Type IV, and 27.3% mixed type (different at distance and near). Ignoring mixed type curves the relative ratio of the Ogle data would be 63.7% Type I, 23.6% Type II, 9.4% Type III, and 3.2% Type IV. In comparison of the relative frequency of curve types found in this current study is compared to that expected from Ogle's data a significant difference is found. The significance of this finding

is not apparent to this author. However, it is not considered to negatively impact on the purpose or result of this study showing that curve typing with lenses is consistent with prism typing.

In examination of the data 55.0% of the subjects showed a uniform shift towards eso or less exo with the lens generated data. In data collection the lens data was collected immediately after the prism data. Since BI and BO were alternated and neither were worn over a prolonged period, prism adaption would not account for this shift. One explanation may lie in the effect or difference in the mechanisms of the AC/A and CA/C systems. A limitation of the study was that the accommodative system did not operate under completely open loop conditions during prism measurements and in addition accommodative response was considered to equal the stimulus level. In order to more precisely determine the nature of this eso-shift a study should be designed to use accommodative response and the possible use of a pinhole during prism measurements to open the accommodative loop. It is my impression that using response versus stimulus values would only result in a compression of the data towards the y-axis and would not result in a vertical movement. Therefore, it is reasonable to expect that the eso-shift is a result in difference of functioning of the AC/A and CA/C systems.

It is also the difference in the effects of the AC/A and CA/C ratios that this author believes to account for the increased rate of change found with lenses than with prism. In the age range of the subjects tested one would expect to find that the AC/A and CA/C ratios to be nearly reciprocally related. This even more supports the opinion that the AC/A and CA/C are two seperate and different acting mechanisms. The increased rate of change

would be even more dramatically different if the accommodative response was used. This is because one would expect in general for the response to be some value less than the stimulus.

A final consideration of the data collected is the implication that in 3 cases the fixation disparity could be reduced to zero with lens power, but was not reduced to zero with a comensurate amount of prism power.

CONCLUSIONS:

1. Lens typing is consistent with prism typing in 70.0% of the twenty subjects tested.
2. Future investigations should monitor accommodative response in lieu of using accommodative stimulus in order to use an accommodative function that is more directly comparable to the CA/C function.
3. Future investigations should remove the influences of accommodation during prism measurements. The current study implies that the AC/A and CA/C mechanisms are not a single mechanism inverse but are two discrete, individually acting systems.
4. Reduction of the fixation disparity using lenses in cases where prism becomes impractical has been suggested in relief of patients with near point asthenopia.
5. It may be possible to determine an add power that would reduce or eliminate near point asthenopia in some patients who would not respond to prism.

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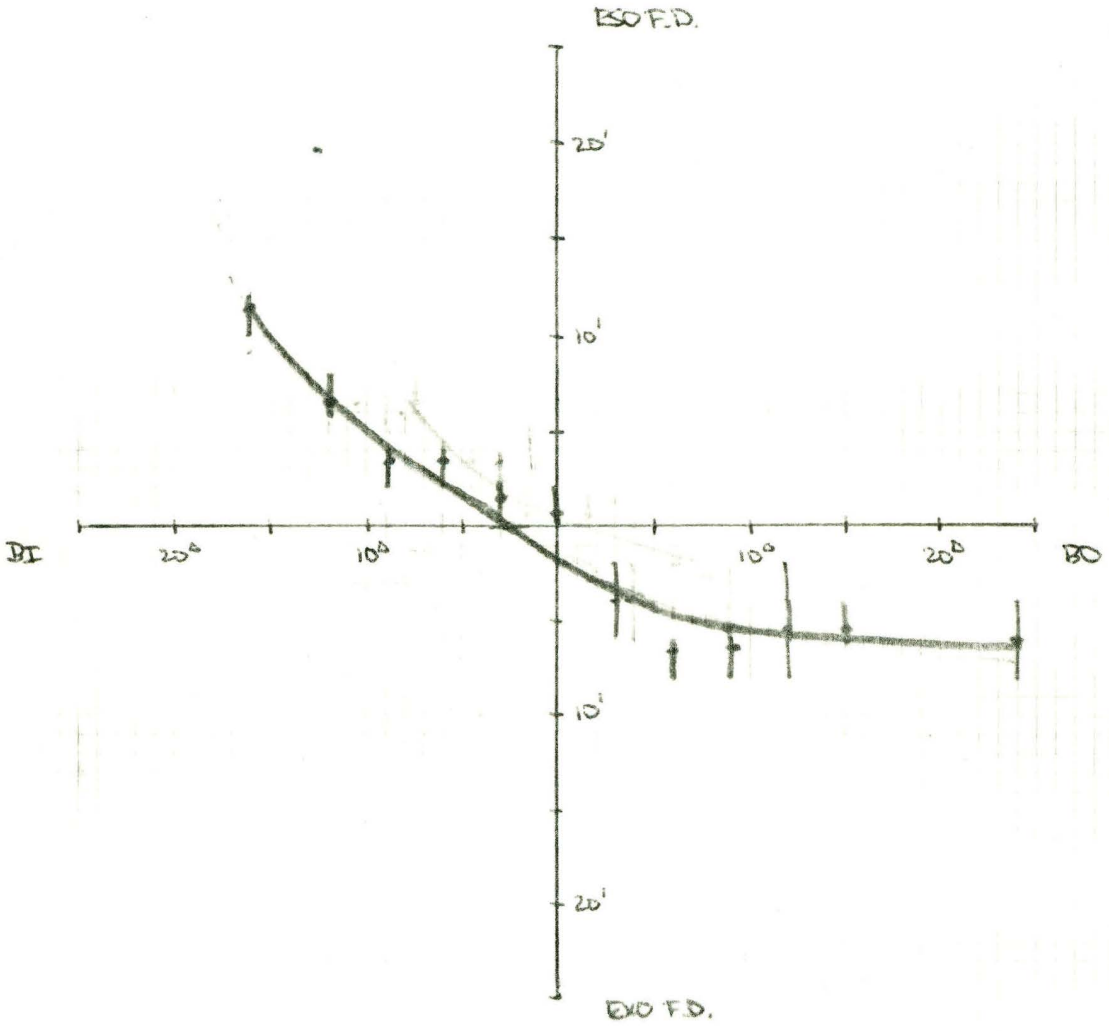
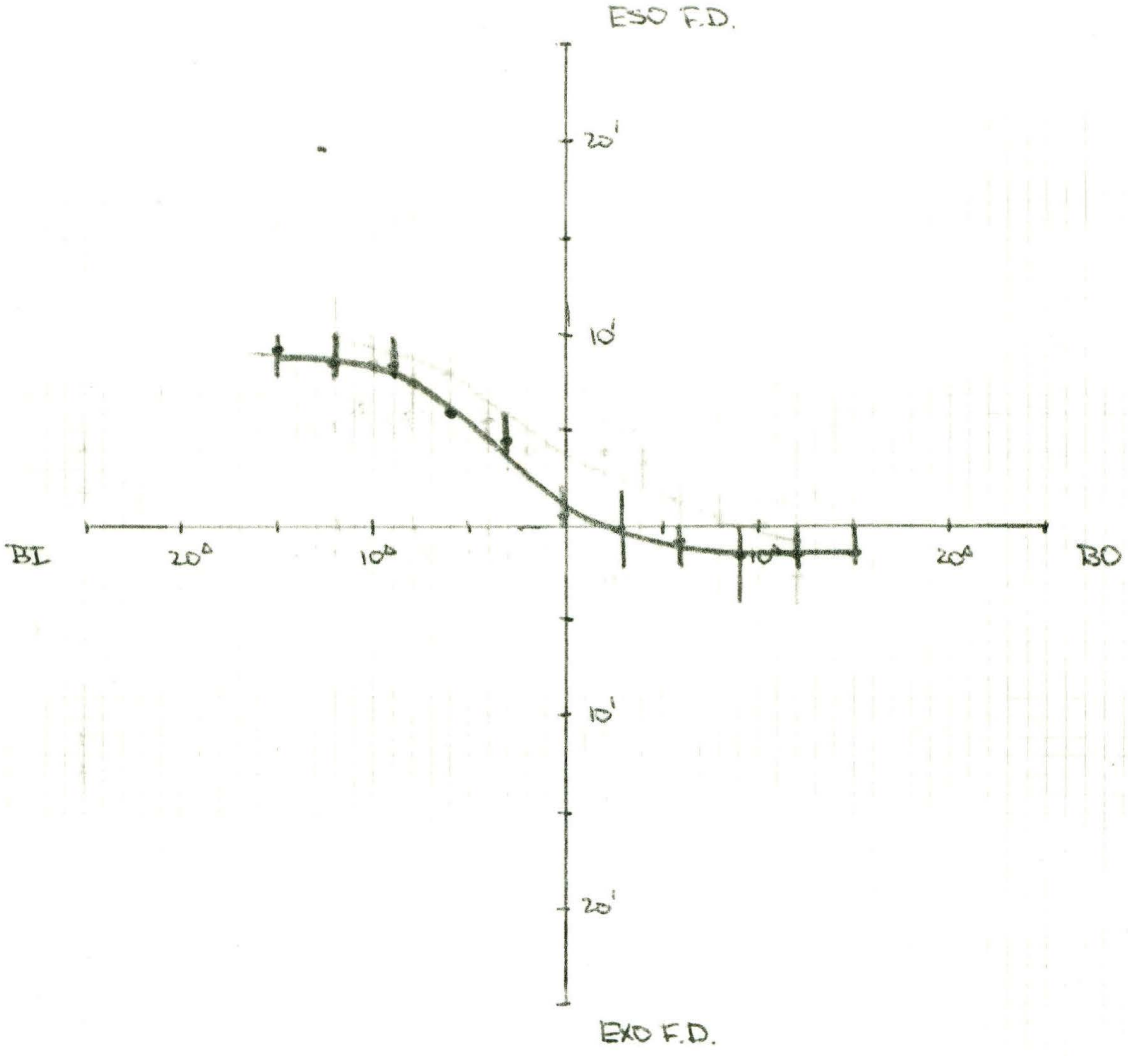


P.M. AC/A = 3/1



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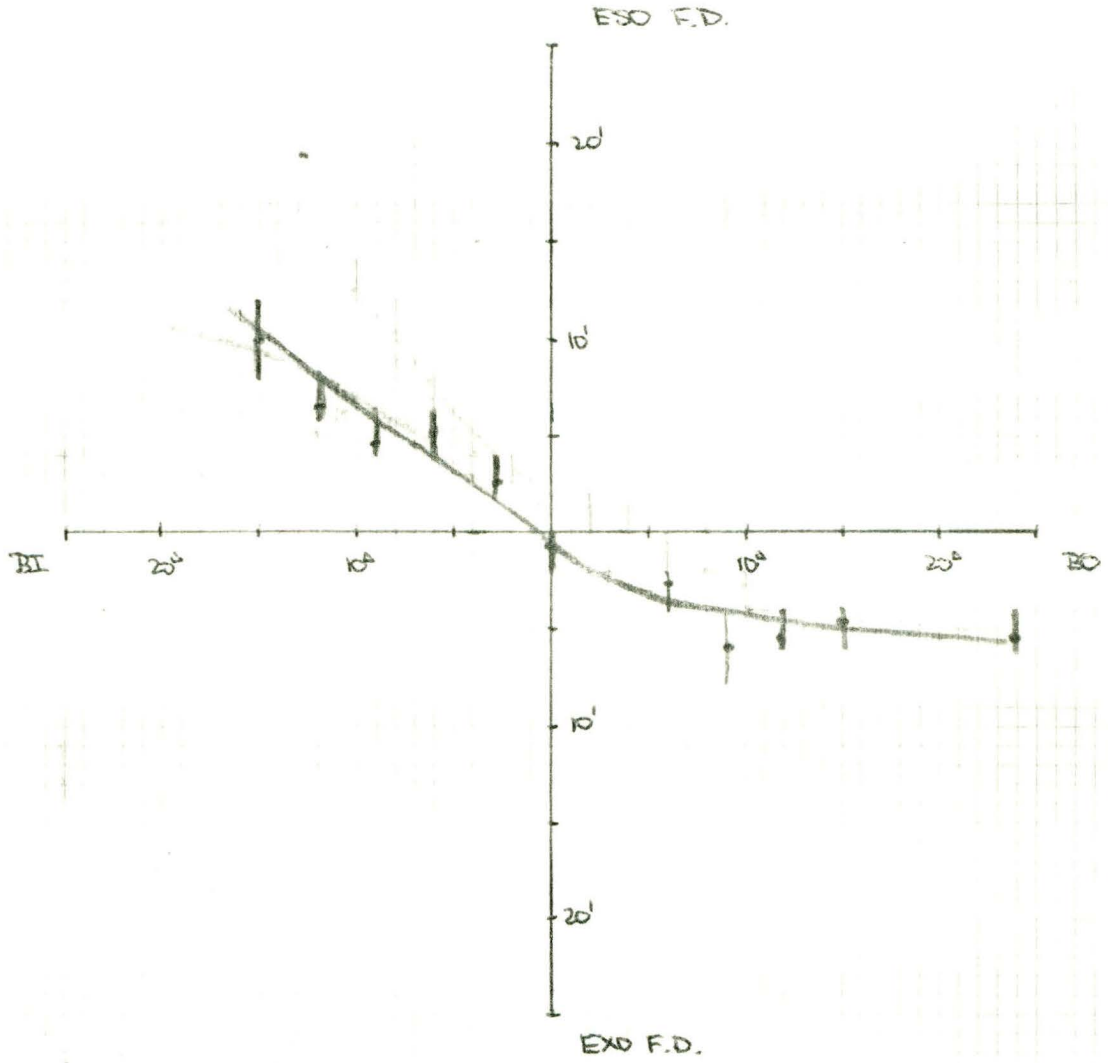

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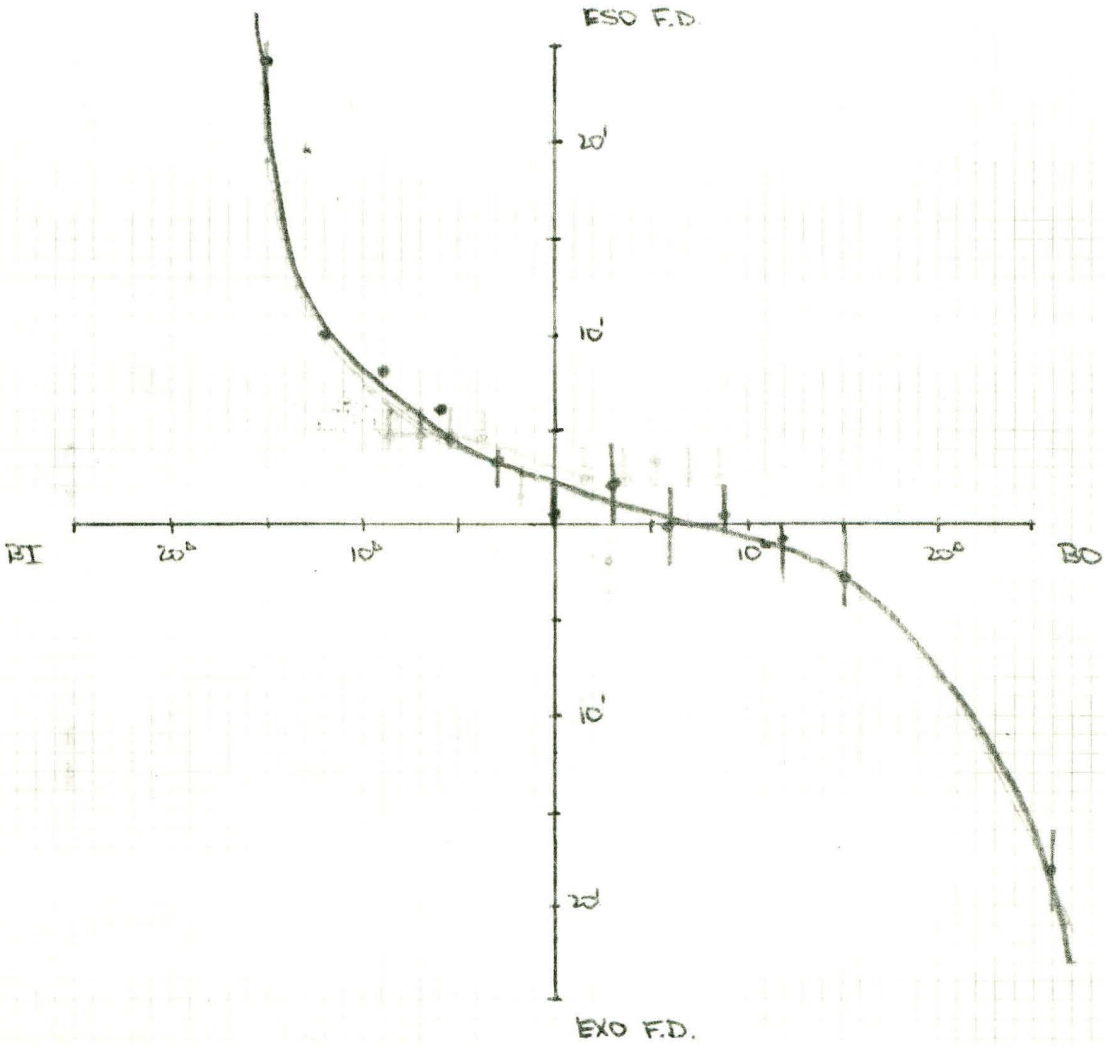

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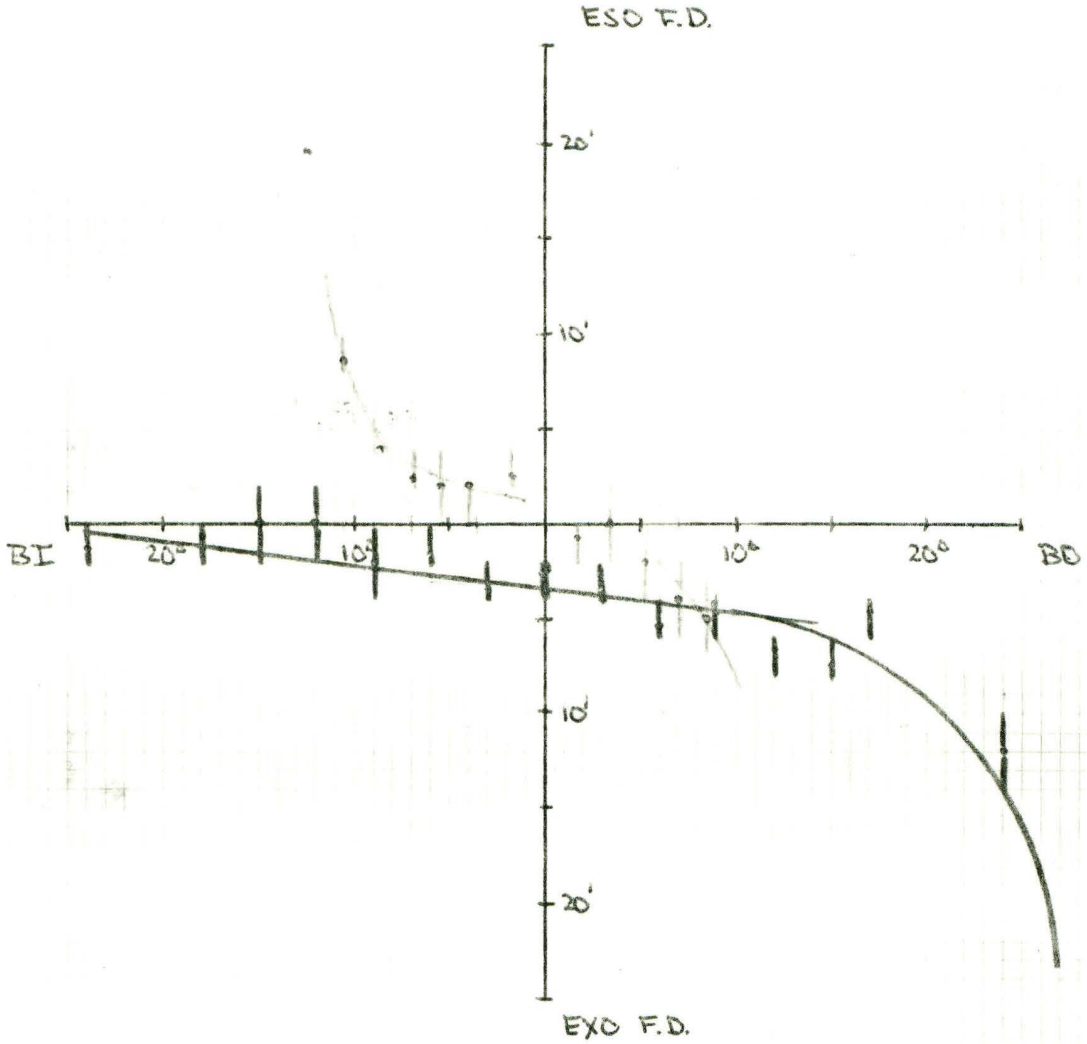

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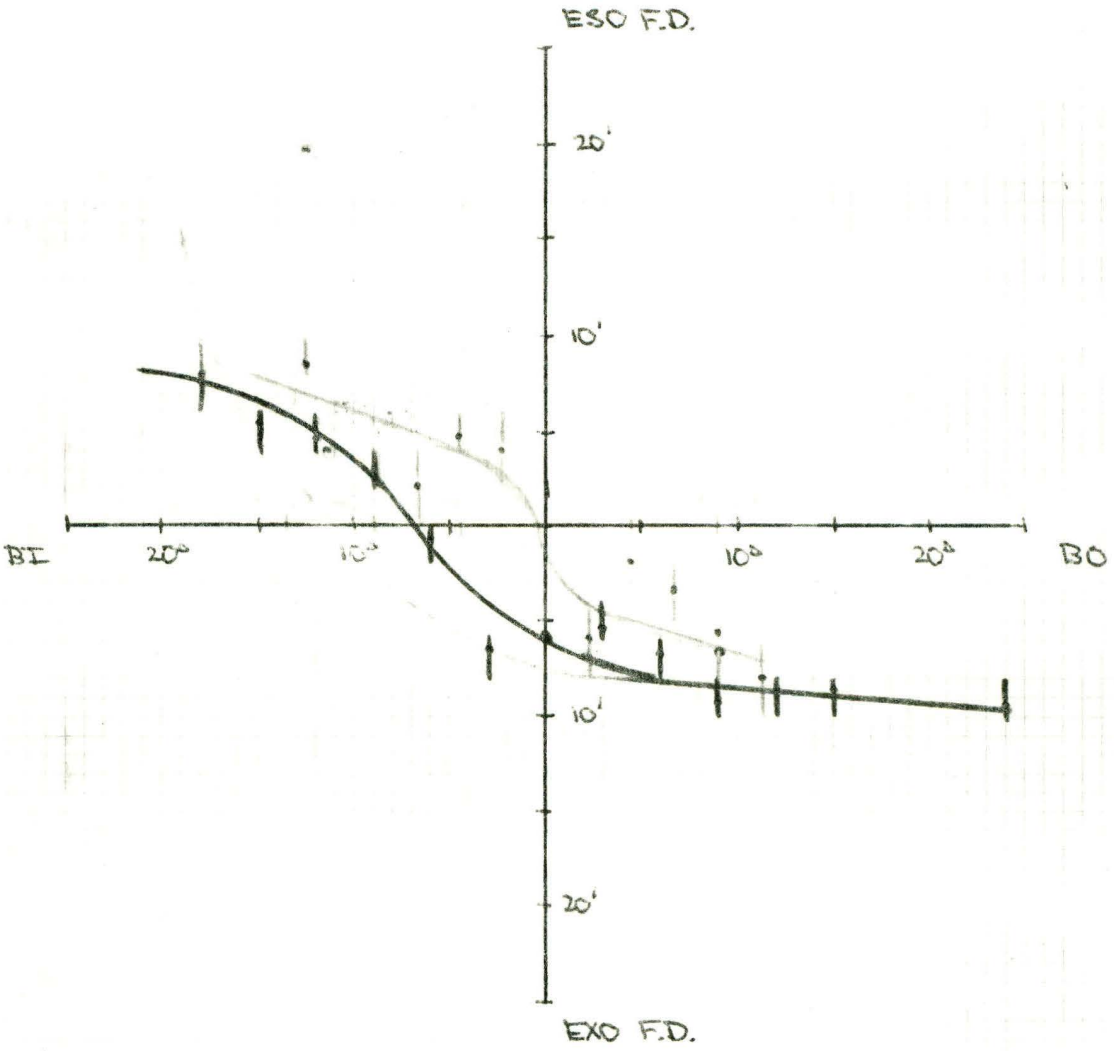

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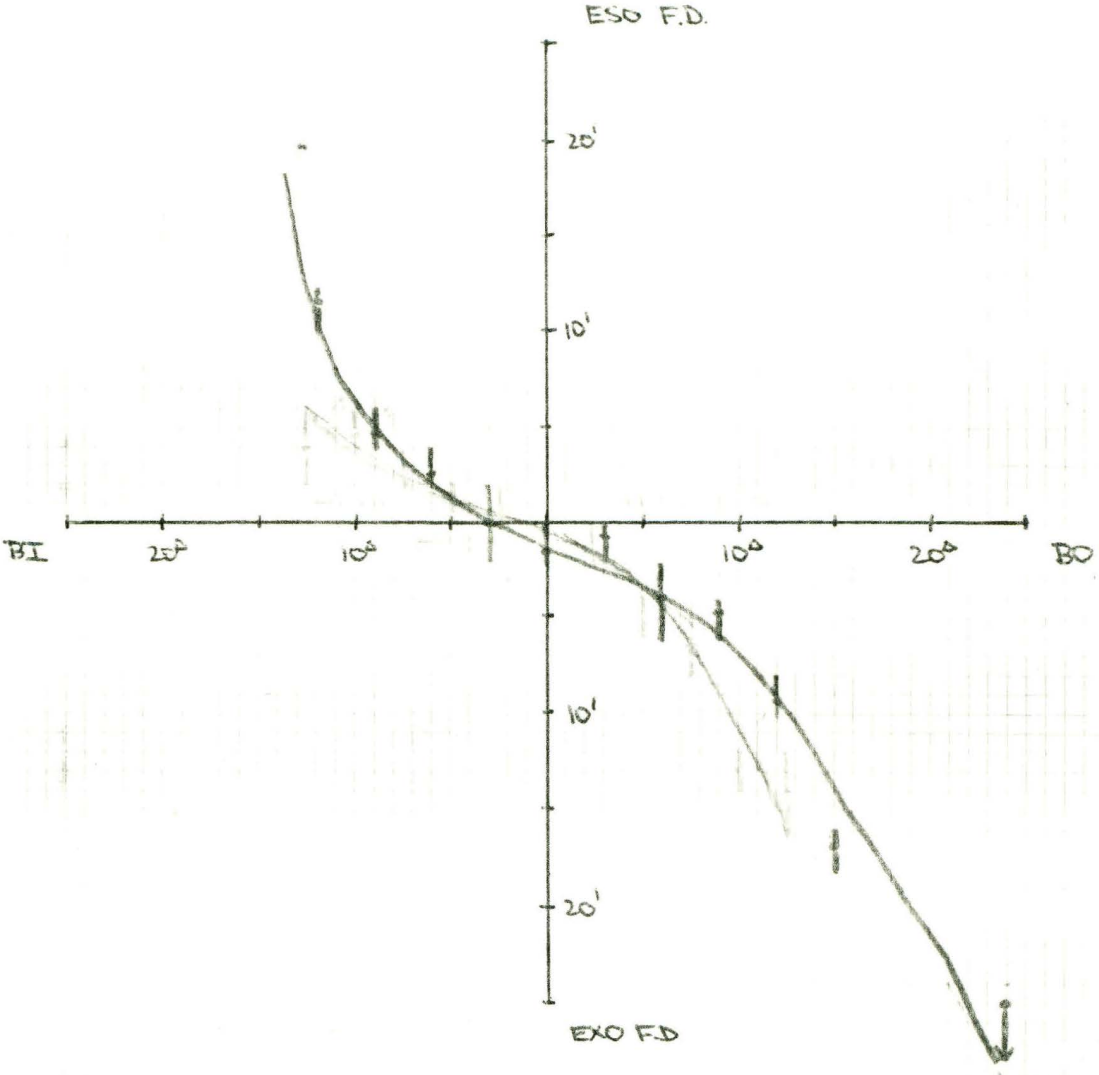

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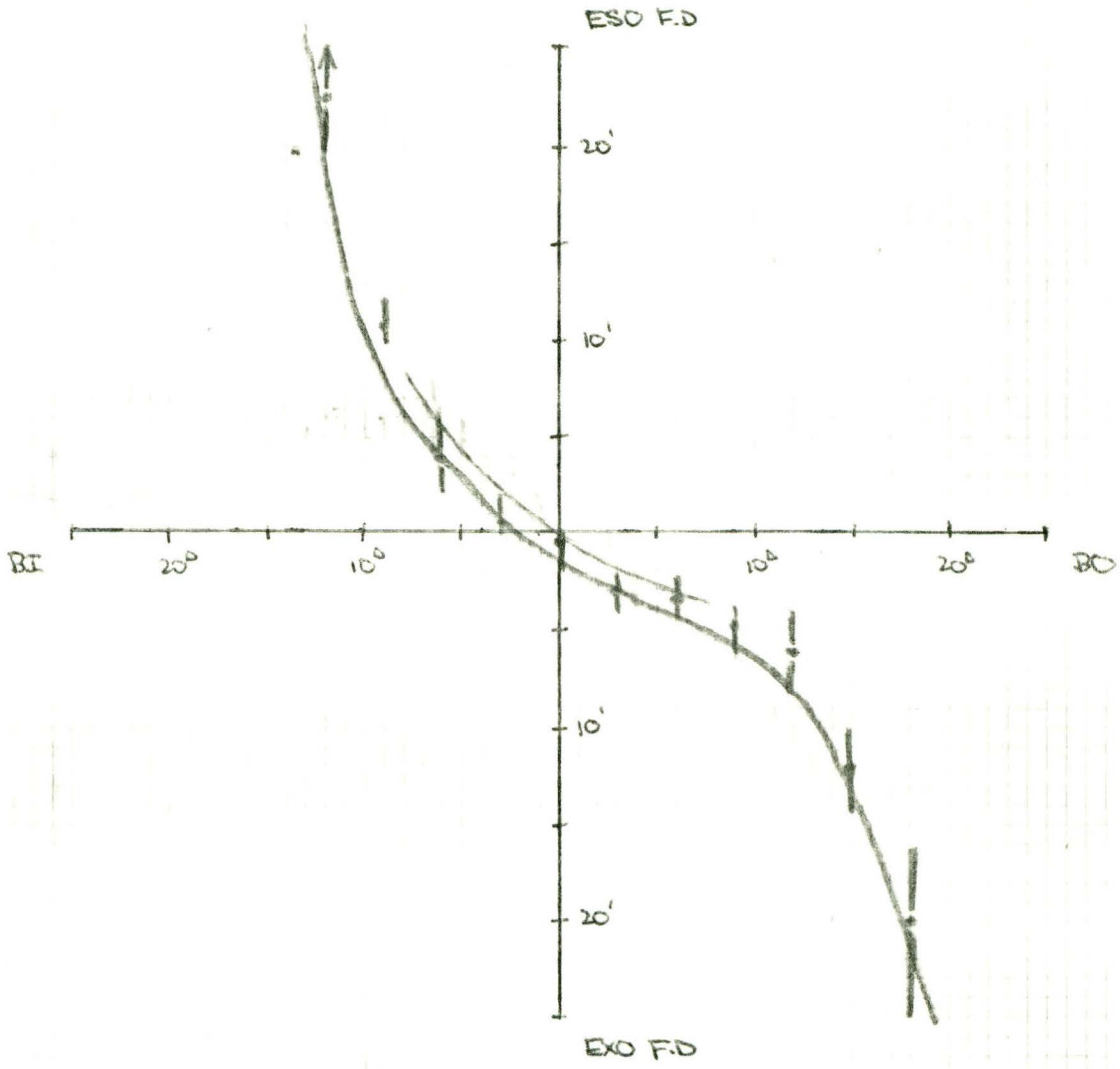

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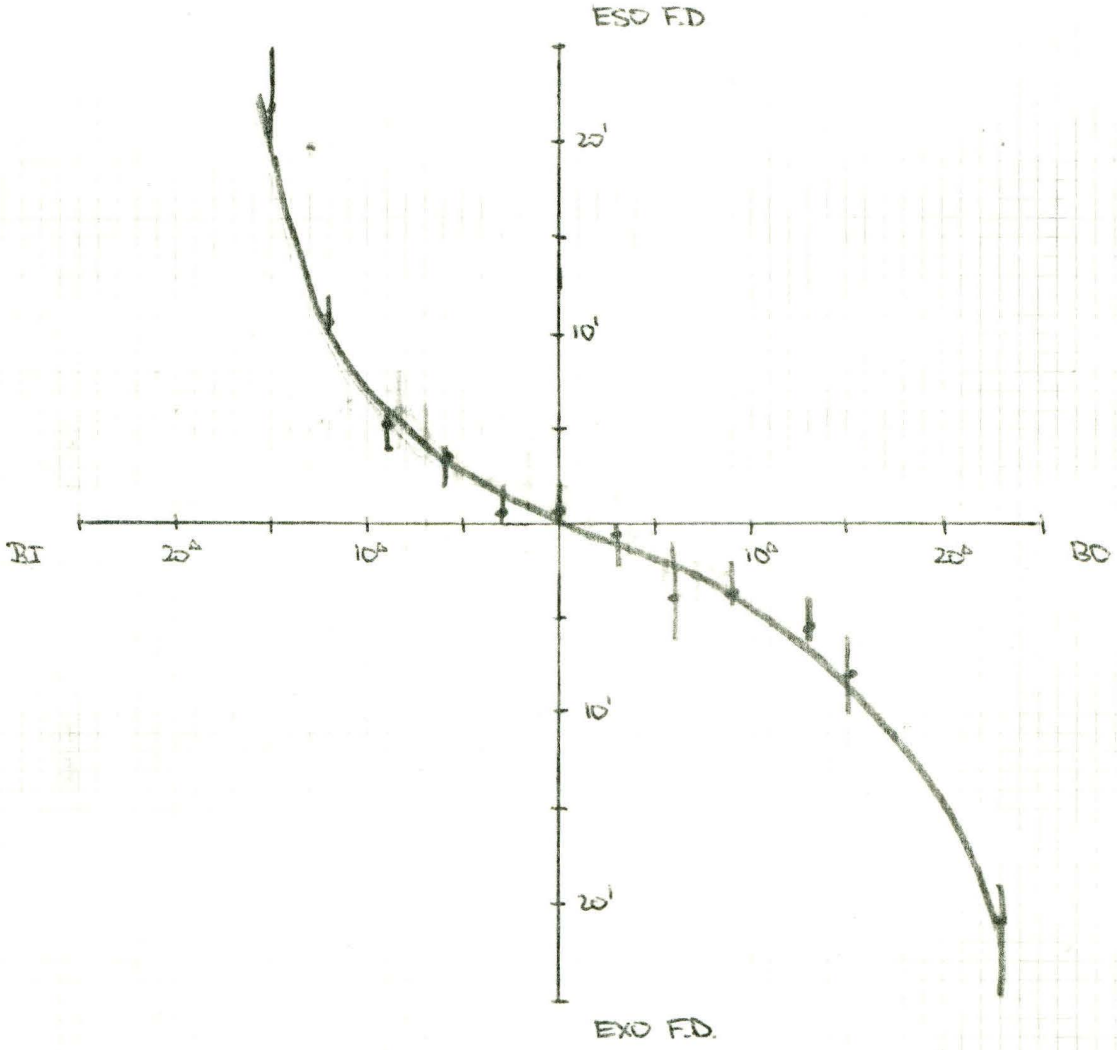

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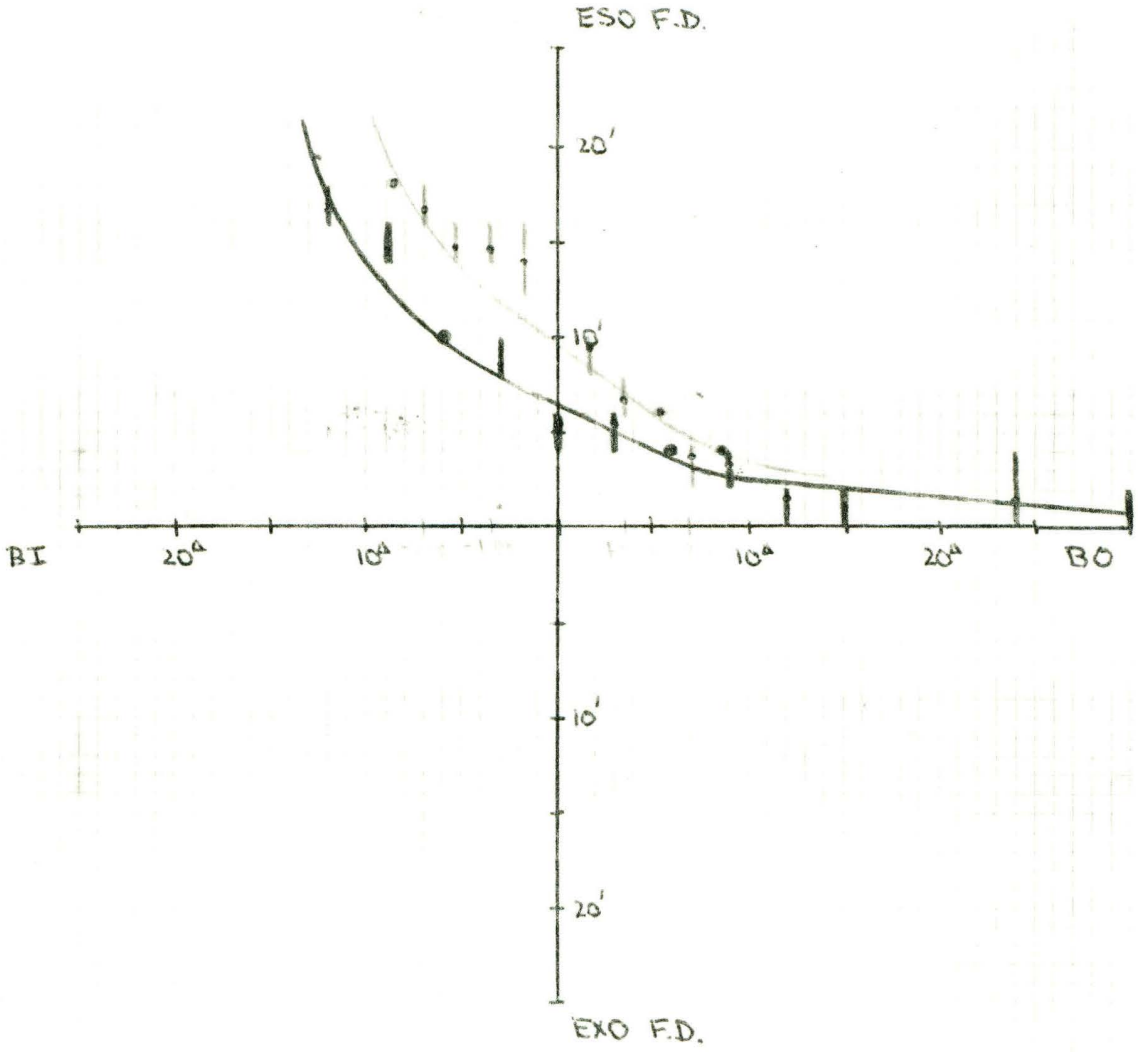

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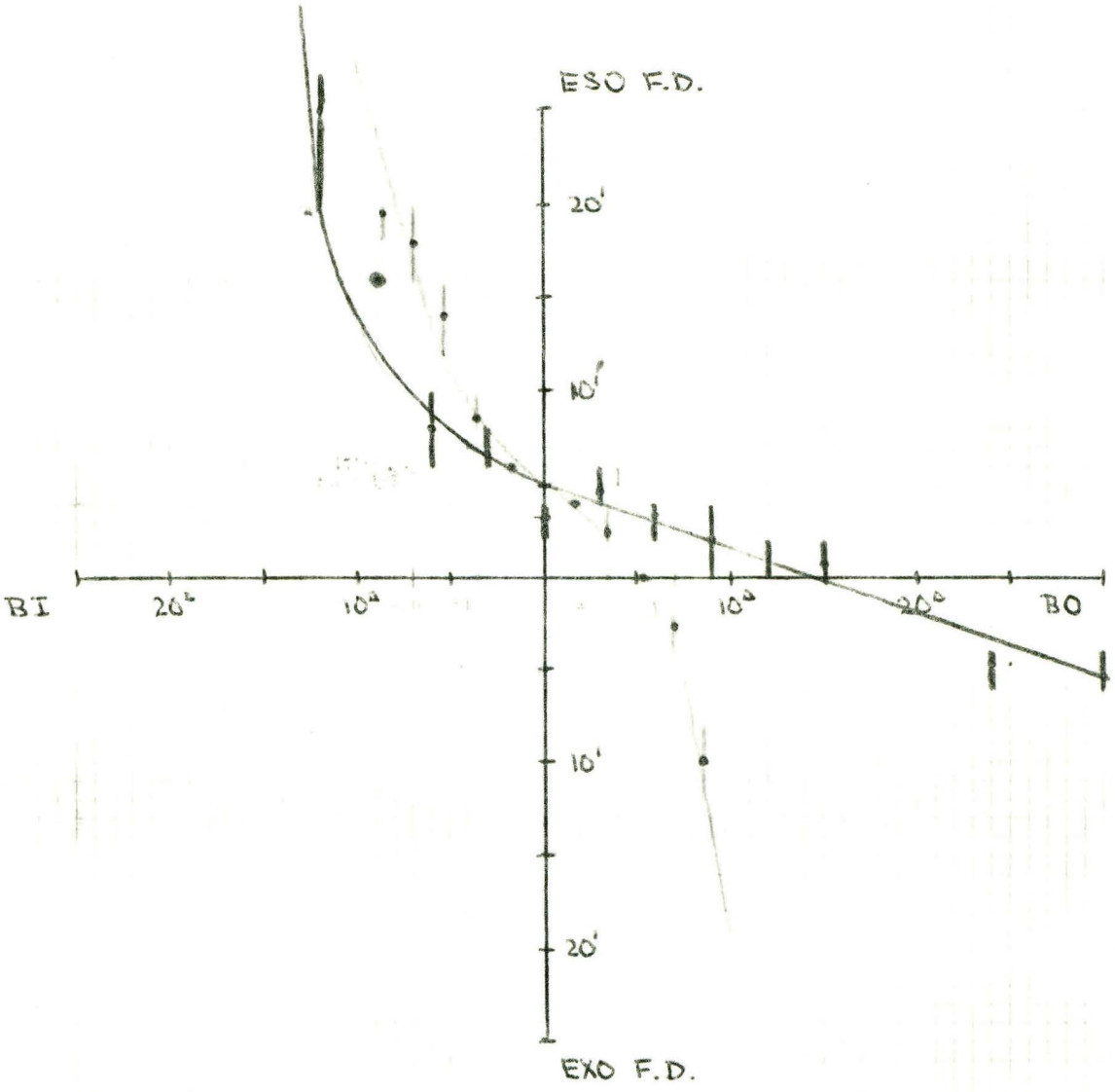

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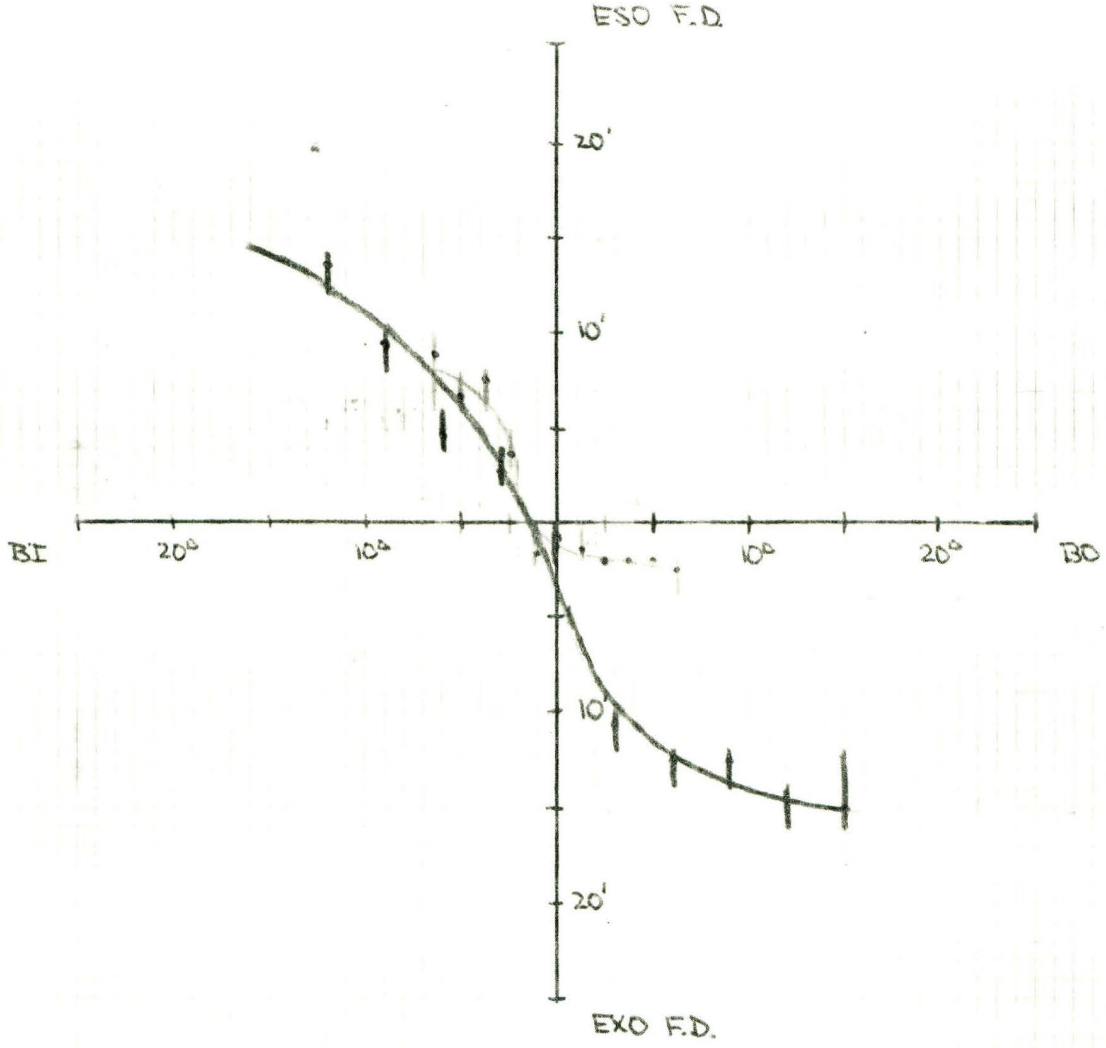

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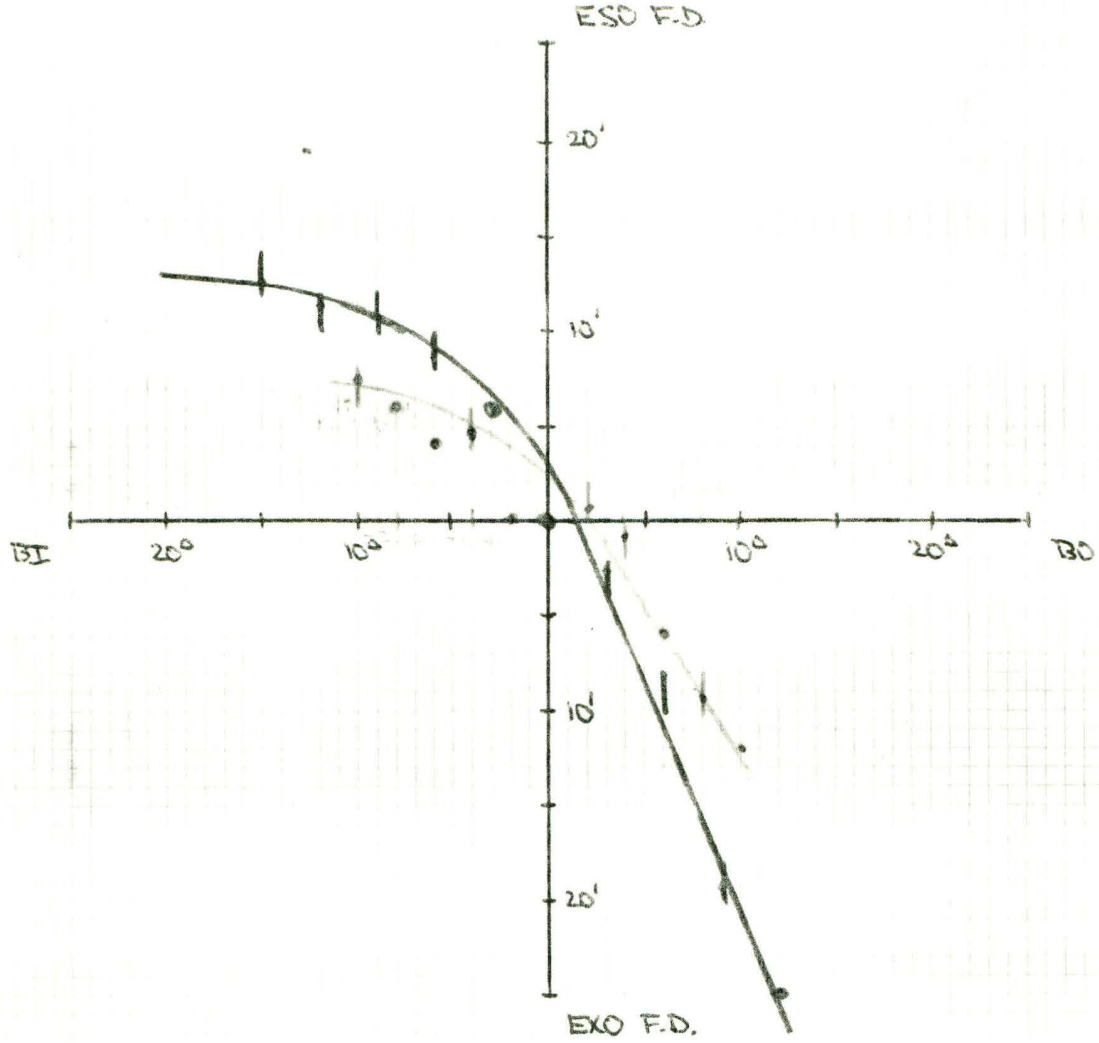

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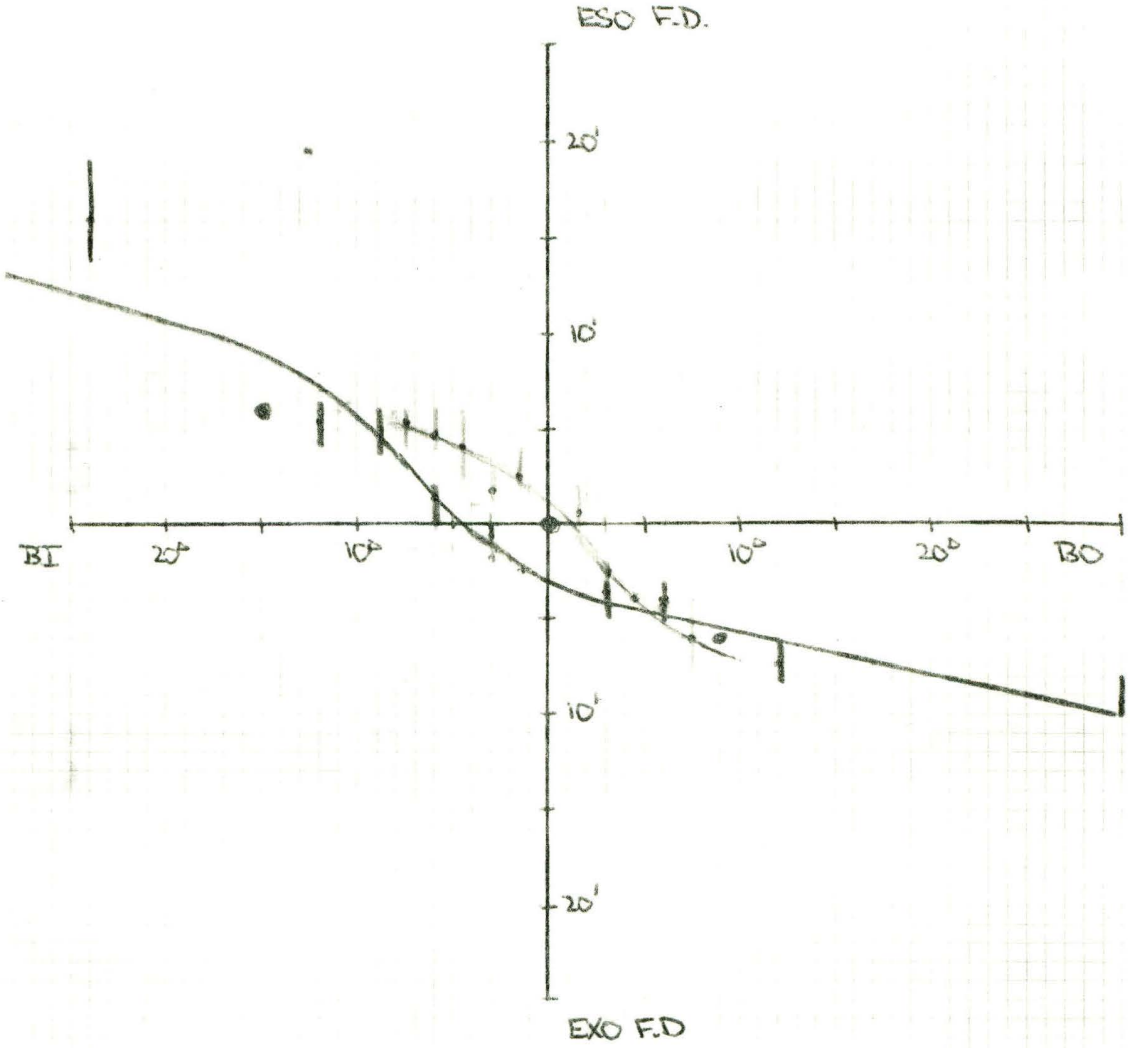

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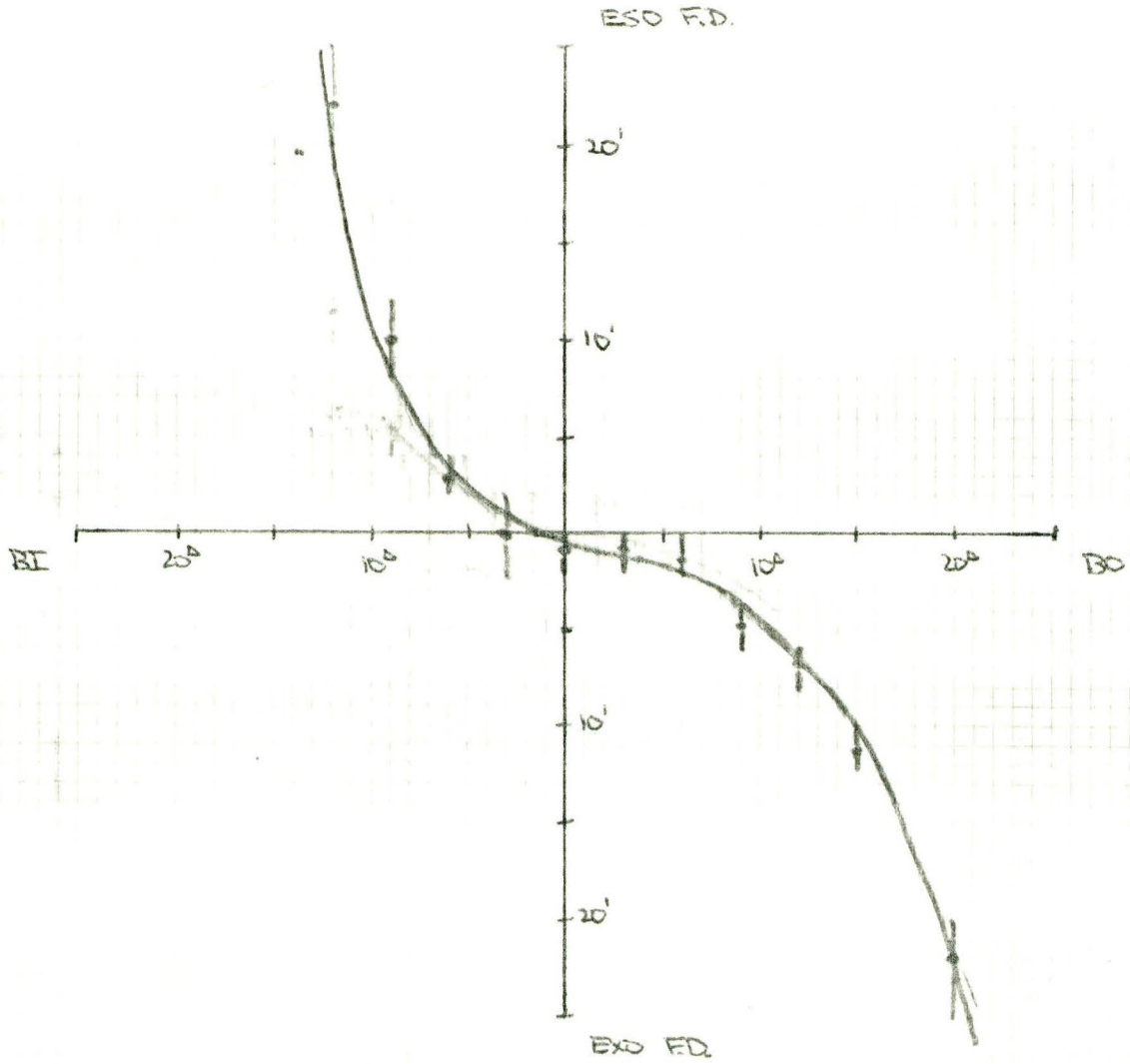

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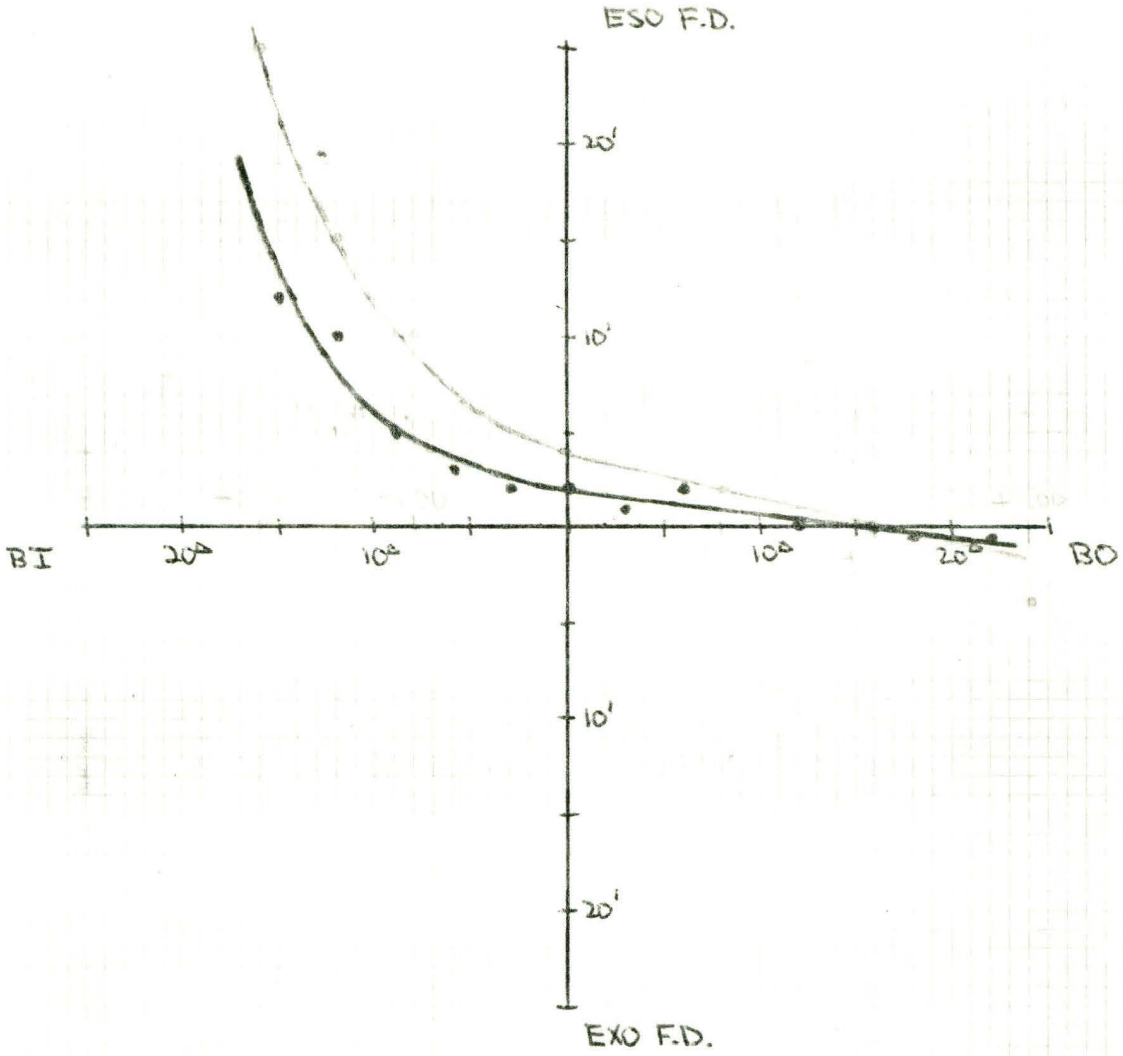

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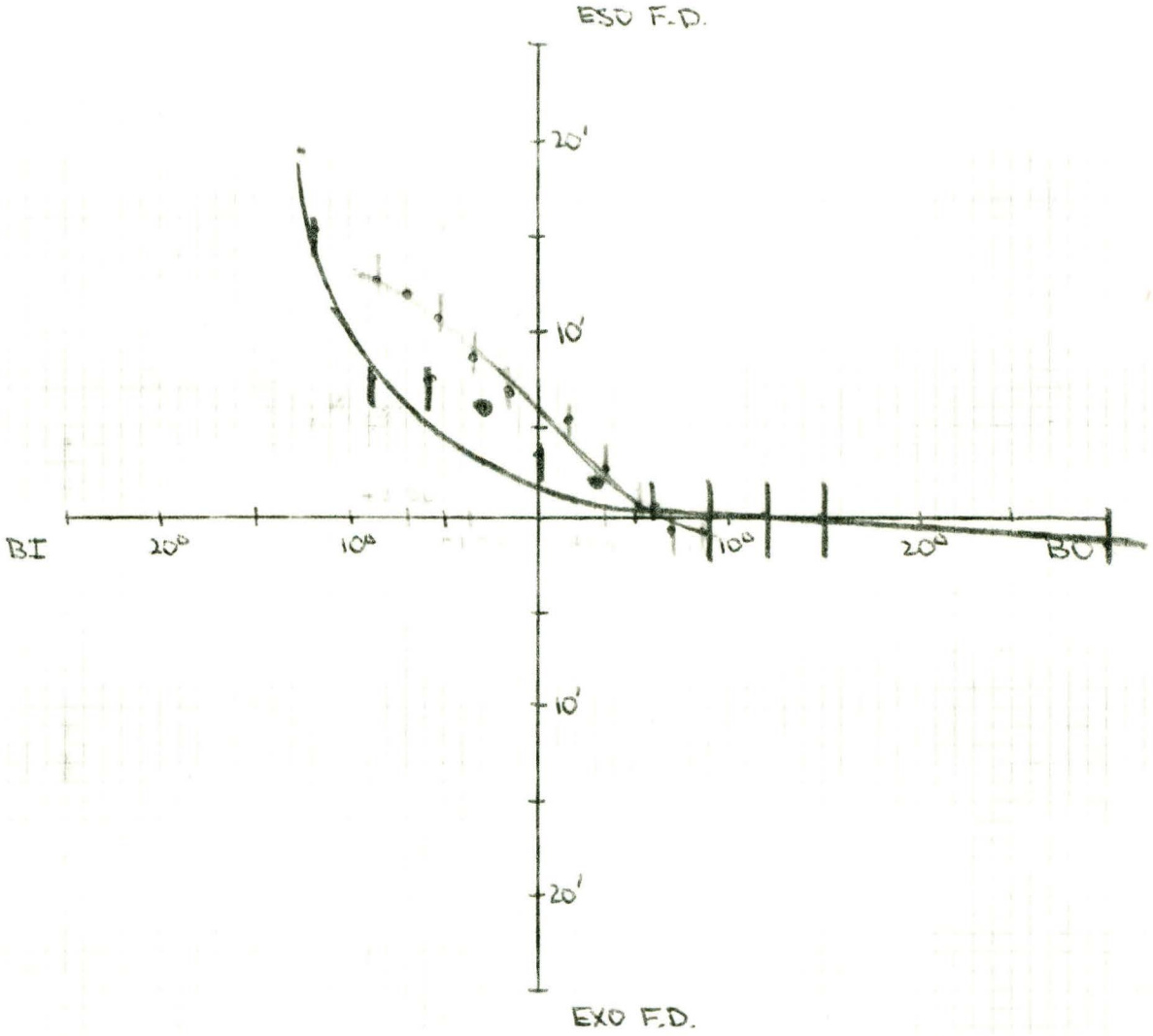

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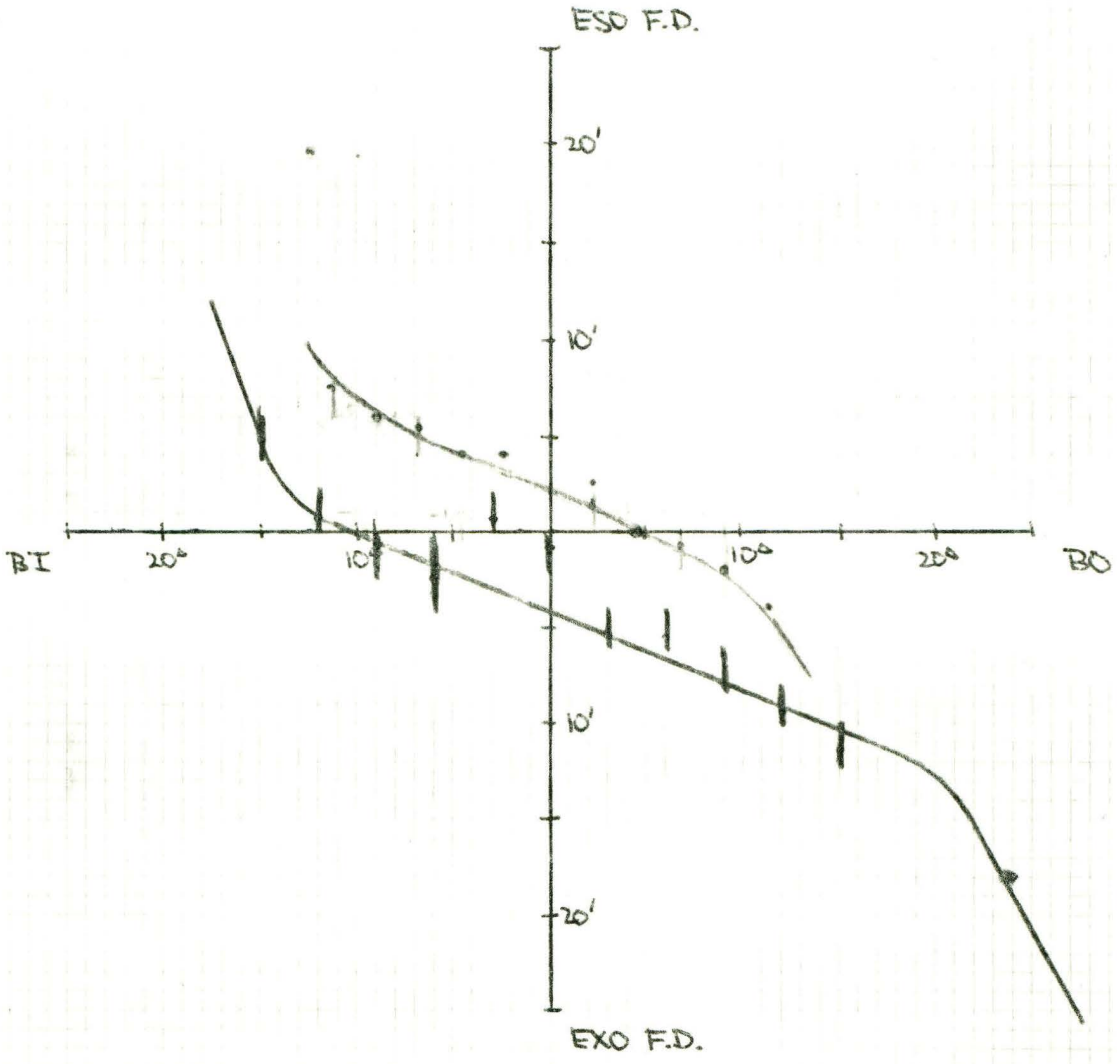

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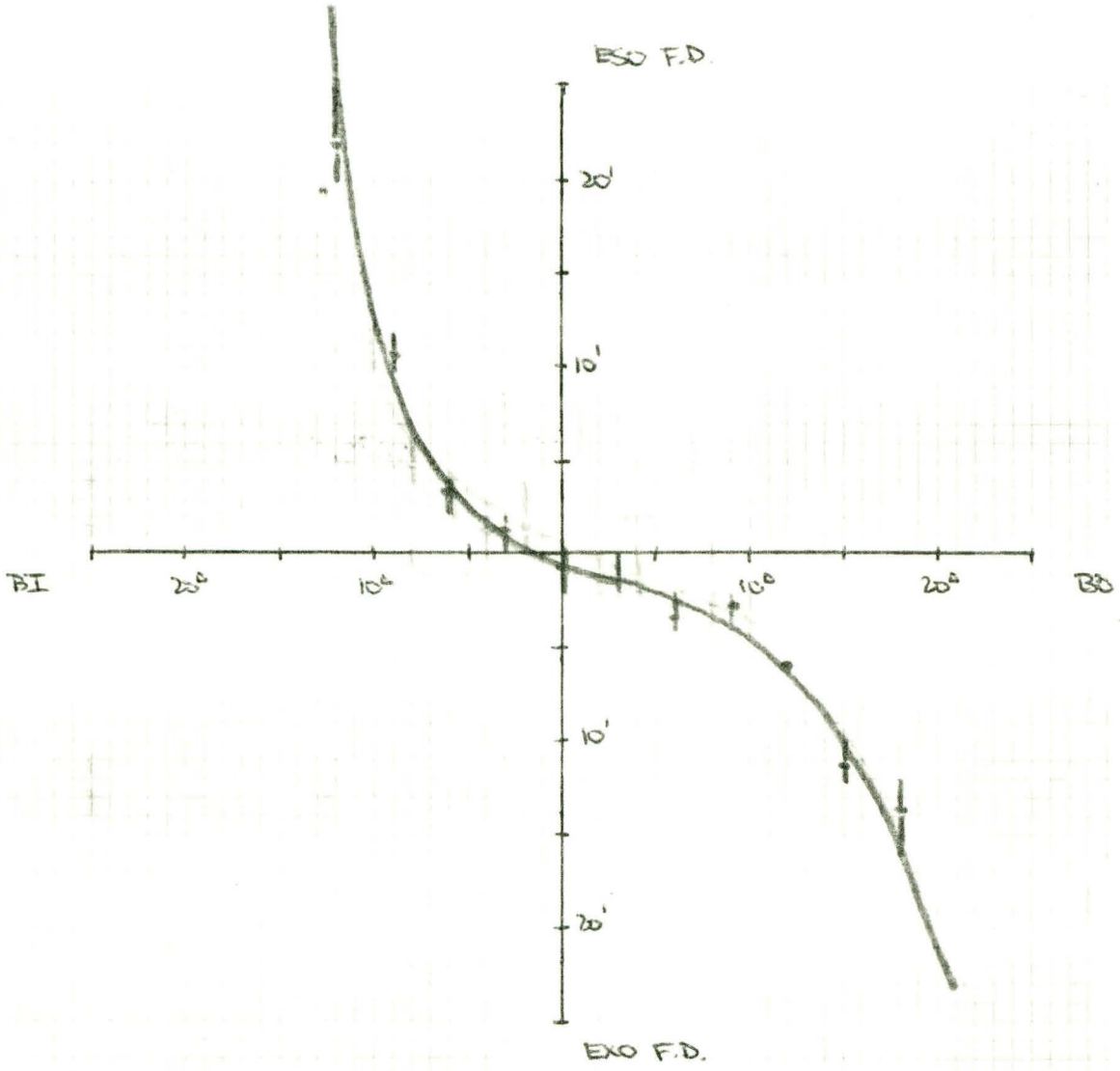

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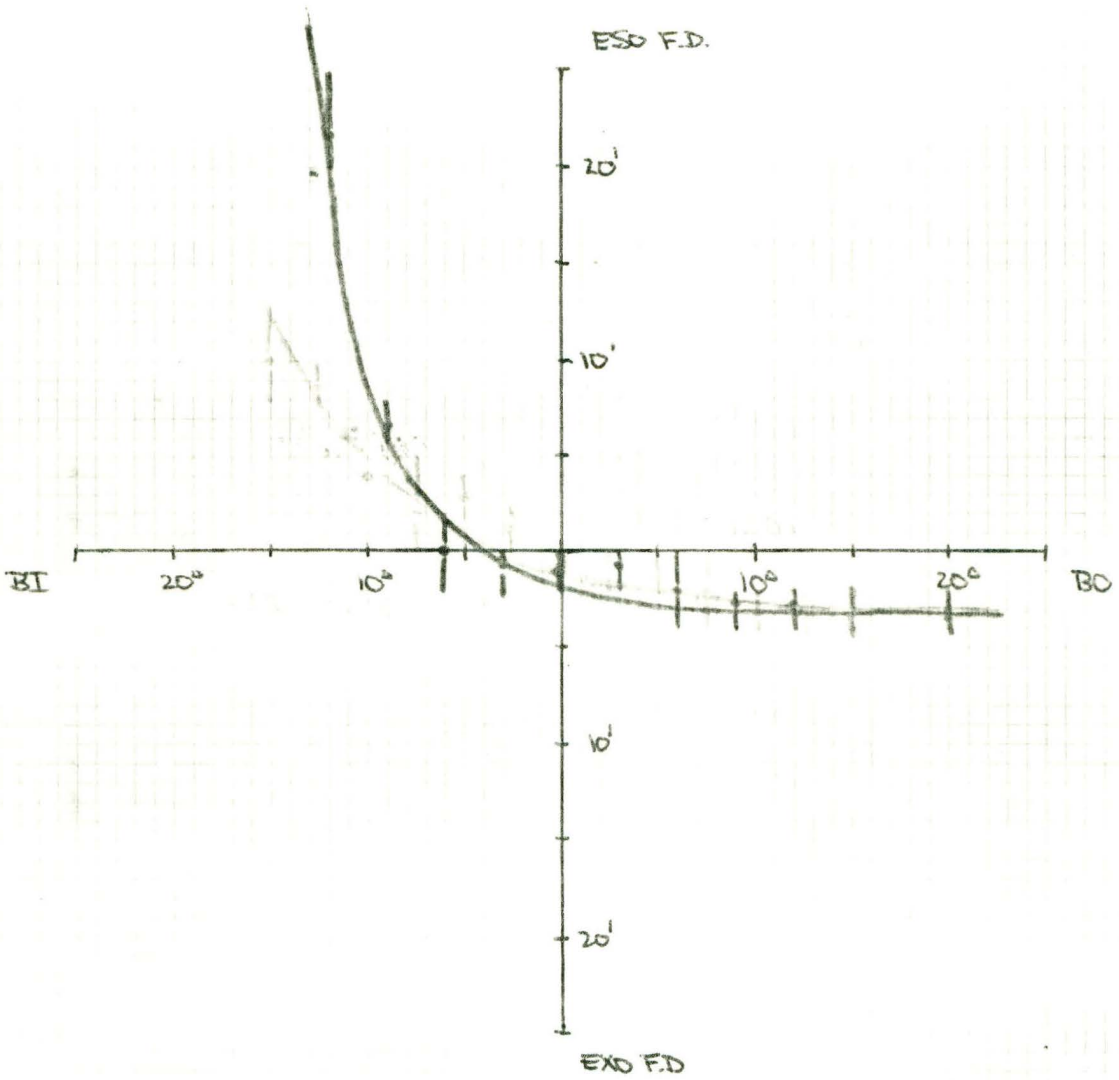

M. K. AC/A = 5/1