STANFORD UNIVERSITY

DEPARTMENT OF PHYSICS

STANFORD UNIVERSITY, CALIFORNIA

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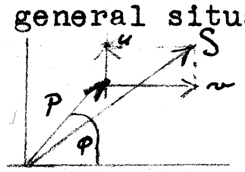
Dr. L. Giulotto
Institute of Physics
University of Pavia
Italy

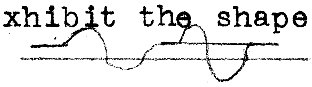
Dear Dr. Giulotto:

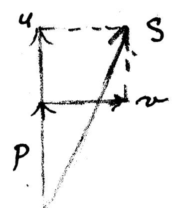
Thank you for your reprints from the Nuovo Cimento. It was a great pleasure for me to see that nuclear induction experiments are carried out in Pavia and that, judging from the pictures, your apparatus seems to be working well.

Concerning the varying shapes of your signals, I believe that the explanation is essentially found in section 4 of my paper. With the rather high concentration of $Fe(NO_3)_3$ in your solution your relaxation time must be considerably shorter than the sweep period and you are essentially dealing with the case of "slow passage." Now the signal which you observe will essentially depend upon the phase of the strong "pickup" voltage of radio frequency which reaches your rectifier and upon which the small nuclear signal is superimposed. The latter has two phase components, denoted by the symbols "u" and "v" in my paper and the observed rectified signal S depends upon the relative phase of the "pickup" P with respect to these. Representing the various amplitudes as vectors in the complex plane, the general situation is as follows:

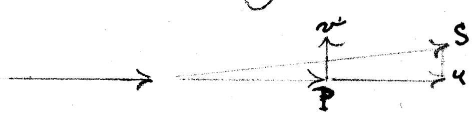


For $\varphi = \frac{\pi}{2}$ you have the special case where the signal increase at resonance is (except for small quadratic terms in u and v) proportional to u and it will, in the ideal case, exhibit the shape of a dispersion curve:



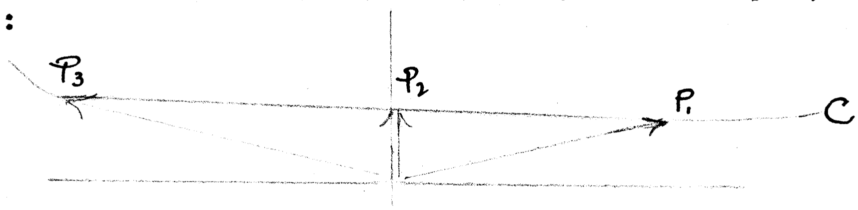


For $\varphi = 0$ you have



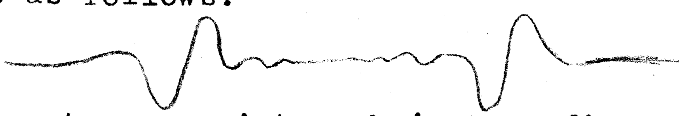
and the signal will be proportional to v with the shape of an absorption curve

I believe that turning your receiver coil has essentially the effect that the end point of the vector P moves on some curve C in the complex plane, for example, as follows:



Then you would have for P_1 a "u" signal, for P_2 a "v" signal, for P_3 again a "u" signal but with the sign inverted from the case P_1. It is of course possible that the curve C passes through the origin so that case P_2 may result in a zero signal (as in picture b of your second publication). We have studied all these various aspects with the main difference that we turn the "paddle" instead of the receiver coil, as you are doing.

By looking at your signals, it seems to me that you have also indications of the oscillations, treated in a recent paper of Jacobsohn and Wangsness (Phys. Rev. 73, 942, 1948). As a result, the "u" curve will not have the simple dispersion type but will appear about as follows:



similar to your picture b in your first publication. I am sure that all your effects can be explained along these lines, particularly those of your second paper where the phase-shifting circuit, which you have added, can modify the pickup in almost any fashion.

I realize that this letter is rather short and that there are many more questions which could be answered. I hope, however, that it indicates at least the things which one has to look out for in this game and that it will be of some help to you.

Wishing you the best of luck for your further experiments, I am

Very sincerely yours,

F. Bloch

F. Bloch
Professor of Physics

FB:bd