Chapter III

EXPERIMENTAL RESULTS

III.1 The Spin Lattice Relaxation Time of PCBAV

The smectic liquid crystal, PCBAV, used in this experiment was obtained from Eastman Kodak and was investigated without purification. The induction tail following the 90° pulse is shown in Fig. 3.1 . The observed induction tail does not decay smoothly and also the signal obtained by applying 180° pulse is not a straight line. So it is difficult to select the apporpriate one, to give an exact null on the oscilloscope. Thus we will account this as an experimental error. The estimated value of the experimental error for T_1 in the isotropic phase is ± 5 % and for the smectic phase is about ± 10 % .

The experimental data of T_1 of PCBAV

(a) at 7.85 MHz. are listed in Appendix 1 ,

(b) at 10.25 MHz. are listed in Appendix 2 ,

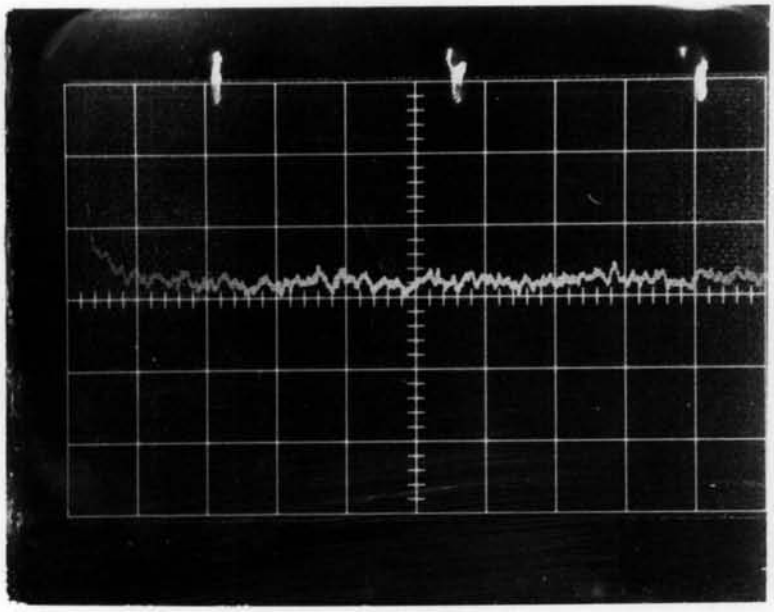
and (c) at 11.65 MHz are listed in Appendix 3 .

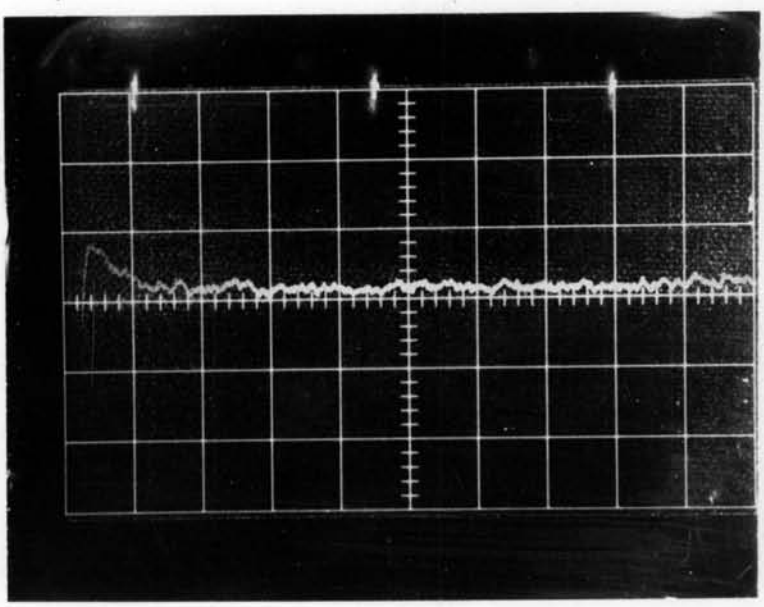
The temperature dependence of the spin - lattice relaxation time T_1

(a) at 7.85 MHz. is shown in Fig. 3.3 (The experimental data are illustrated in table 3.1),

(b) at 10.25 MHz. is shown in Fig. 3.4 (The experimental data are illustrated in table 3.3),

(c) at 11.65 MHz. is shown in Fig. 3.3 (The experimental data are listed in table 3.2).





III.2 The Spin Spin Relaxation Time of PCBAV

The experimental value T_2 of PCBAV at 10.25 MHz in the smectic phase was obtained from the method of line width because it was found to be very short. T_2 obtained by this method is caused by two effects , the dipolar coupling and the inhomogeneity of the static field.

Since it has been known that T_2 of pure water is long, T_2 of water obtained by the line width method arises principally from the inhomogeneity of the static field. Comparing the induction tail of PCBAV and water , it is clear that T_2 is not caused by the inhomogeneity. At high temperature, far from the smectic-isotropic transition temperature, the spin echo method could be employed but only a few echoes have been obtained. The static field was not quite stable and the induction tail did not decay smoothly. T_2 can not therefore be measured accurately. The estimated experimental error is about ± 20 % in the isotropic liquid, ± 25% in the smectic phase. The experimental data are illustrated in table 3.4 . The time dependence of T_2 is shown in Fig. 3.5 .

Table 3.1 The spin lattice relaxation time of PCBAV, at 7.85 MHz.

Temperature (Kelvin)	τ null (m sec)	T_1 (m sec)	Estimated error (%)
383	192	295	± 10
382	205	314	± 10
379	210	322	± 10
377	220	338	± 10
374.5	230	353	± 10
373	235	361	± 10
372	245	376	± 10
37 .5	240	368	± 10
369.5	215	330	± 10
366	200	307	± 10
362	185	284	± 10
358	150	230	± 10
356	135	207	± 10
354.5	125	192	± 10
353	115	176	± 10
351.25	150	230	± 15
350	170	261	± 15

Table 3.2 The spin lattice relaxation time of PCBAV, at 11.65 MHz.

Temperature (Kelvin)	τ null (m sec)	T_1 (m sec)	Estimated error (%)
383	225	345	± 10
381	230	353	± 10
378	240	368	± 10
376	250	384	± 10
374.5	258	396	± 10
373.25	275	421	± 10
372	282	433	± 10
371.25	270	414	± 10
370	250	384	± 10
366	230	352	± 10
362.75	200	307	± 10
360	185	284	± 10
359	175	268	± 10
356.5	155	238	± 10
354.5	145	222	± 10
353	130	199	± 10
352	150	230	± 15
350	158	242	± 15
349	165	253	± 15
348	170	261	± 15

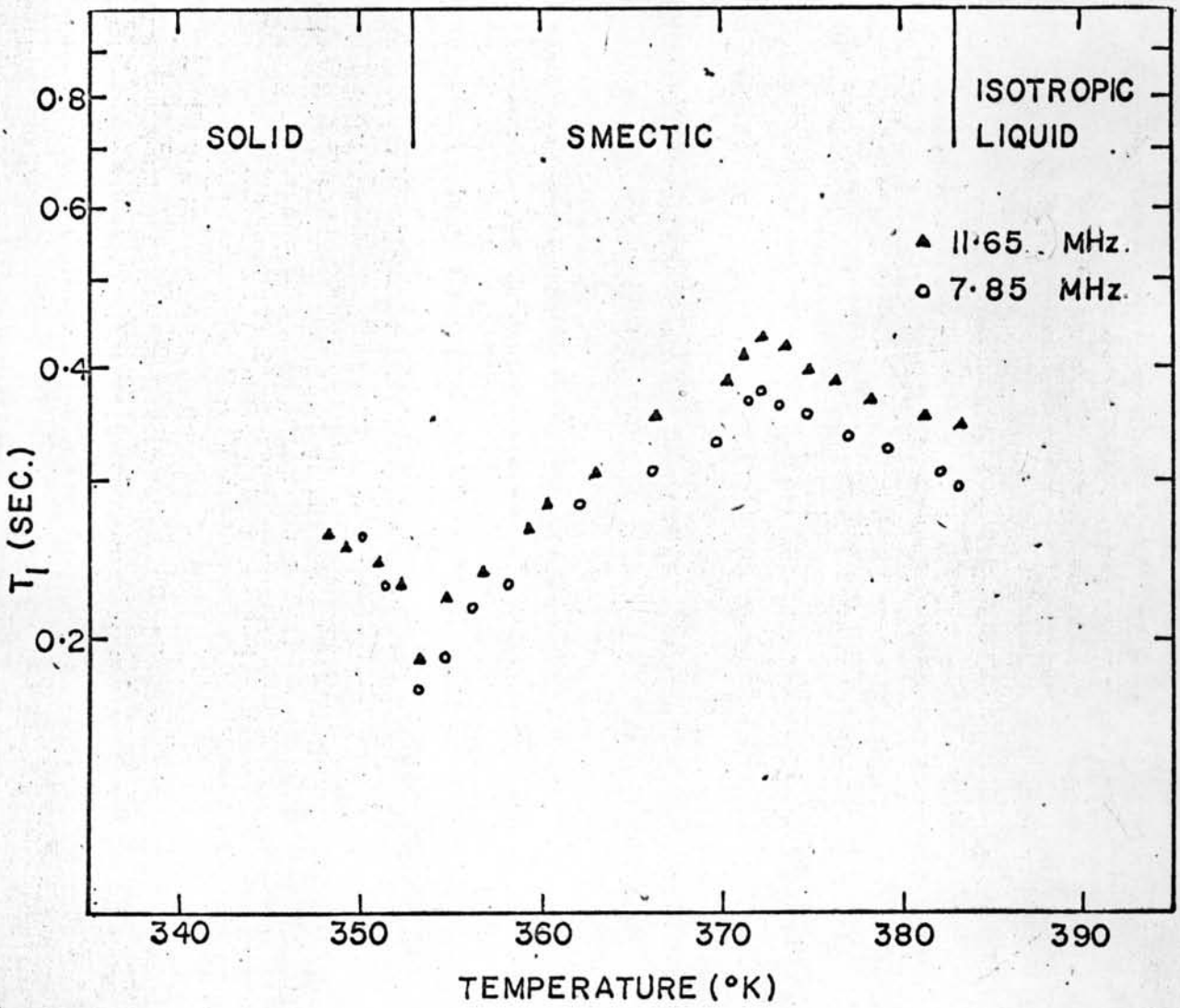


Fig. 3.3 Proton spin lattice relaxation time T_1 in PCBAV versus temperature, at the frequency 7.85, 11.65 MHz.

Table 3.3 The spin lattice relaxation time of PCBAV, at 10.25 MHz,

Temperature (Kelvin)	τ null (m sec)	T_1 (m sec)	Estimated error (%)
393	320	490	± 5
392	295	452	± 5
391	285	437	± 5
390	275	422	± 5
389	265	406	± 5
387	250	384	± 5
386.75	235	361	± 5
385.25	225	345	± 5
384	218	334	± 5
383	210	321	± 5
380	215	330	± 10
377	220	338	± 10
374	240	369	± 10
372	250	384	± 10
370.5	230	353	± 10
369.5	210	321	± 10
367.5	200	307	± 10
366	190	292	± 10
363	180	276	± 10
361.5	170	261	± 10
360	160	246	± 10
355	140	215	± 10
353	130	199	± 10
351	160	256	± 15
349.5	200	307	± 15

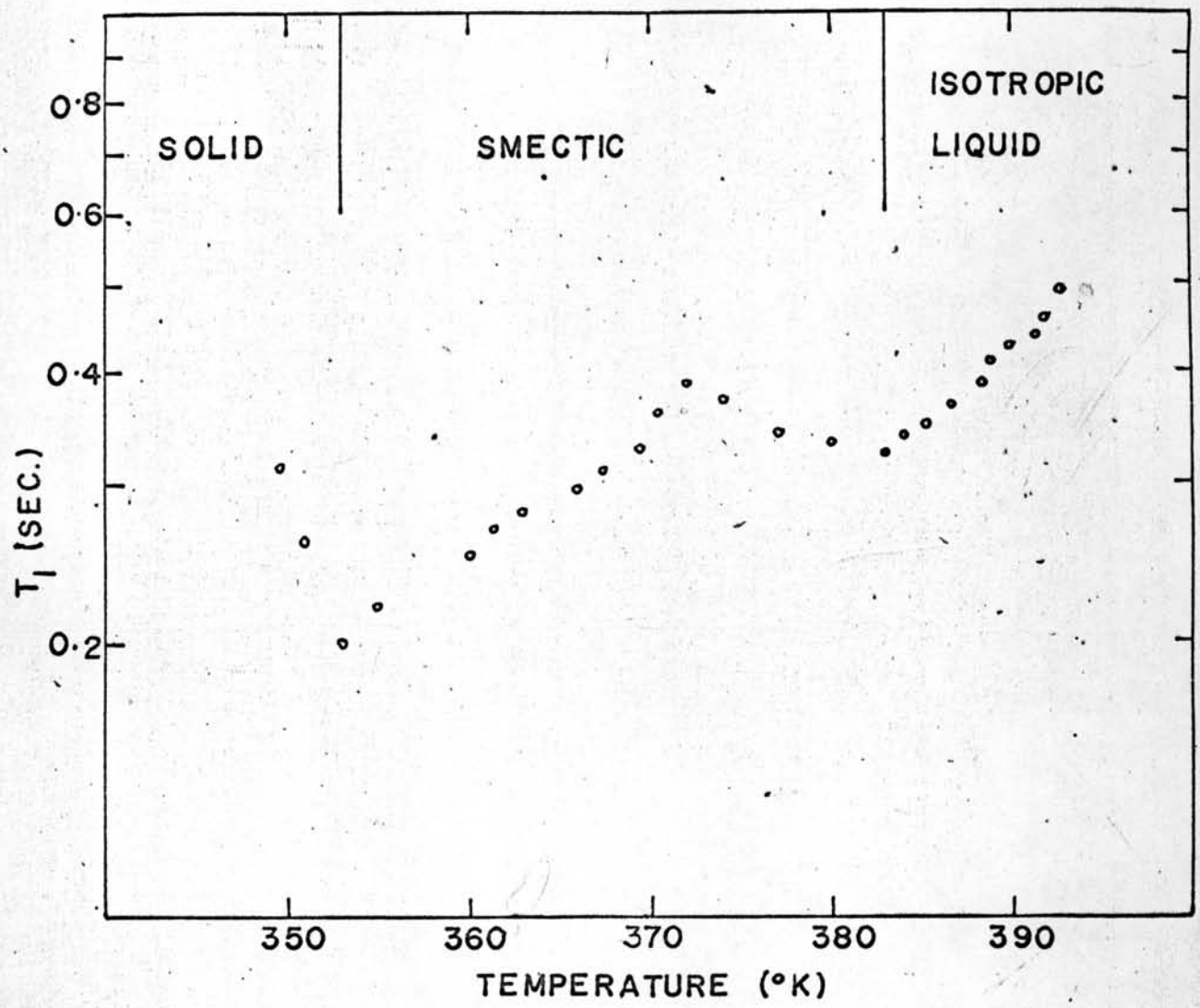


Fig. 3.4 Proton spin lattice relaxation time T_1 in PCBAV versus temperature, at the frequency 10·25 MHz.

Table 3.4 The spin spin relaxation time of **PCBAV** , at 10.25 MHz.

Temperature (Kelvin)	T_2 (m sec)	Estimated error (%)
386	37	± 20
383.5	28.3	± 20
381	60×10^{-3}	± 25
376	52.2×10^{-3}	± 25
367	54×10^{-3}	± 25
359.5	55×10^{-3}	± 25
353	36×10^{-3}	± 25

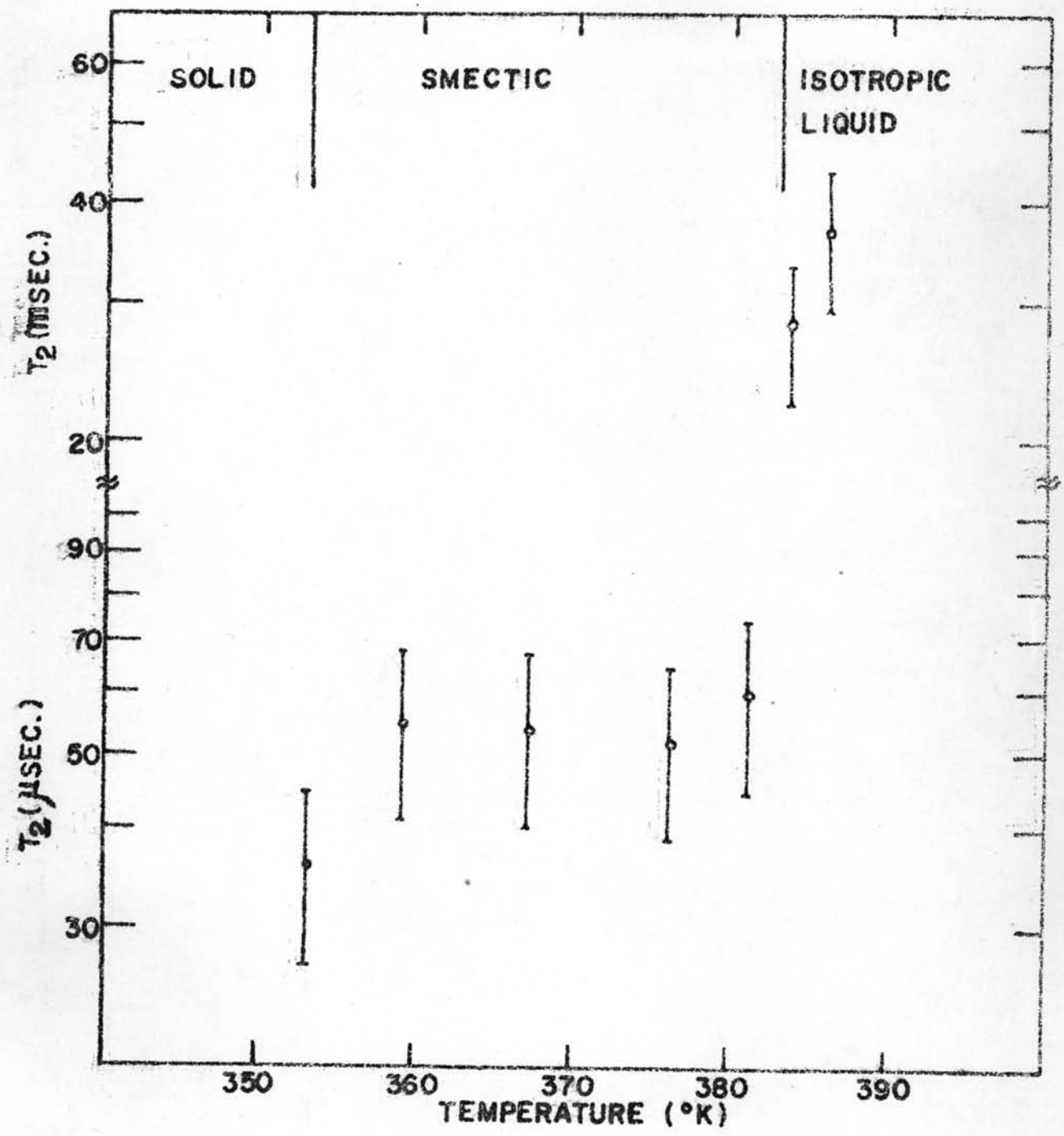


Fig. 3.5 Proton spin spin relaxation time T_2 in PCBAV versus temperature, at the frequency 10·25 MHz.

III.3 The Spin Lattice Relaxation Time of DADB

The smectic liquid crystal , DADB, was also obtained from Eastman Kodak and was investigated without purification. The induction tail following the 90° pulse is shown in Fig. 3.2.

The experimental data of T_1 of DADB

(a) at 10.25 MHz. are listed in Appendix 4,

(b) at 11.65 MHz. are listed in Appendix 5 .

The time dependence of the spin lattice relaxation time T_1

(a) at 10.25 MHz. is shown in Fig. 3.6 (The experimental data are are illustrated in table 3.5) , and

(b) at 11.65 MHz. , the experimental data are illustrated in table 3.6.

III.4 The Spin Spin Relaxation Time of DADB

The experimental value for T_2 of DADB was obtained by the method of line width.

The experimental data are illustrated in table 3.7. The time dependence of T_2 is shown in Fig. 3.7 .

Table 3.5 The spin lattice relaxation time of DADB, at 10.25 MHz

Temperature (Kelvin)	τ null (m sec)	T_1 (m sec)	Estimated error (%)
404	350	537	± 5
403	335	515	± 5
402	310	475	± 5
401	280	430	± 5
400	250	384	± 5
399.5	240	368	± 5
398	230	353	± 5
396.5	170	261	± 5
396	150	230	± 10
394	180	276	± 10
393	195	299	± 10
392	200	307	± 10
389.5	180	276	± 10
388.5	165	253	± 10
387	145	222	± 10
385.25	200	307	± 15

Table 3.6 The spin lattice relaxation time of DADB, at 11.65 MHz

Temperature (Kelvin)	τ null (m sec)	T_1 (m sec)	Estimated error (%)
393	210	322	± 10
392	220	328	± 10
391	200	307	± 10
390.5	188	288	± 10
388.25	165	253	± 10

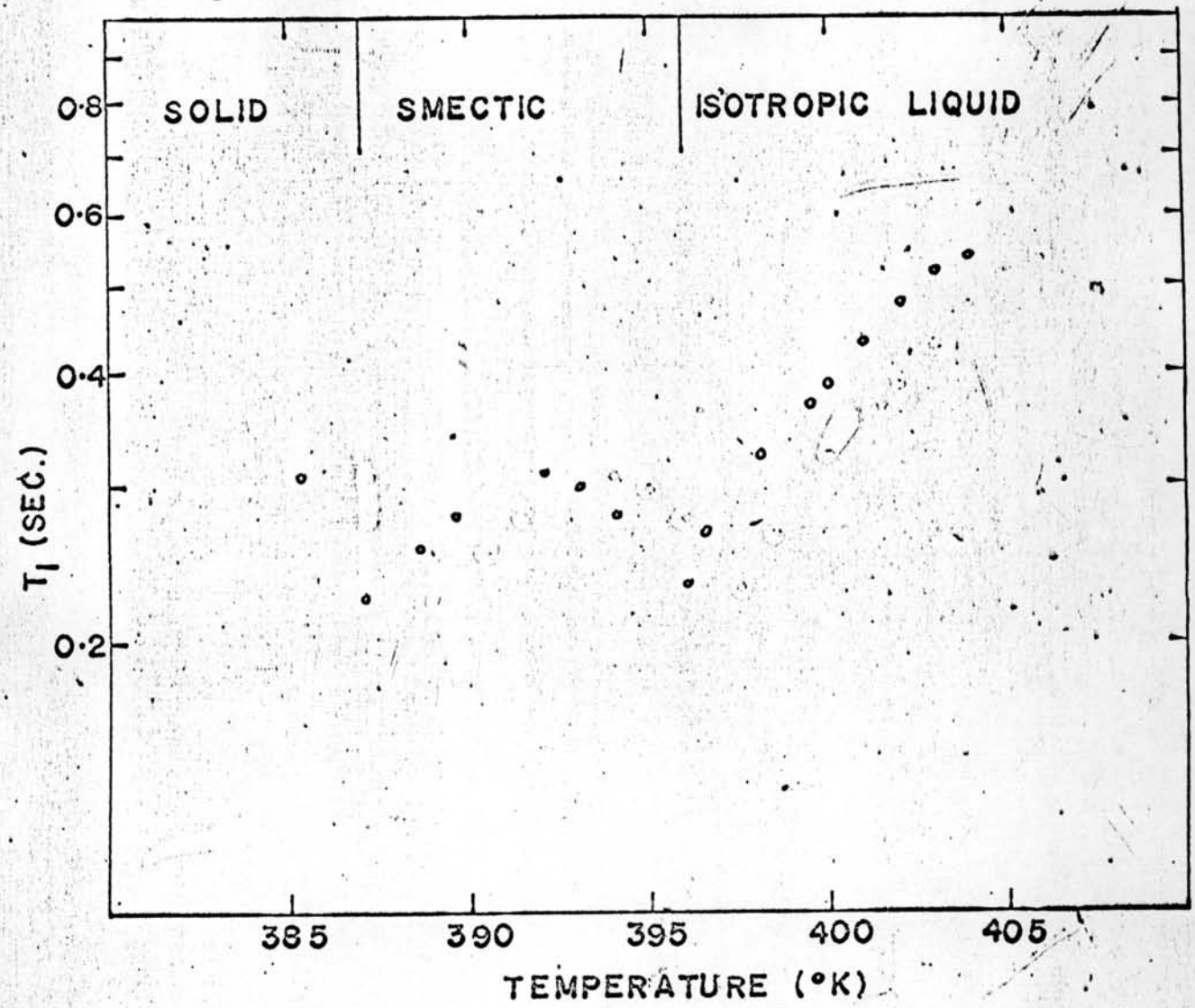


Fig. 3.6 Proton spin lattice relaxation time T_1 in DADB versus temperature, at the frequency 10·25 MHz.

Table 3.7 The spin spin relaxation time of DADB, at 10.25 MHz.

Temperature (Kelvin)	T_2 (m sec)	Estimated error (%)
396	..045	± 25
394	.048	± 25
393	.046	± 25
392	.051	± 25
390.5	..049	± 25
389.5	.048	± 25
388	.041	± 25
387	.038	± 25

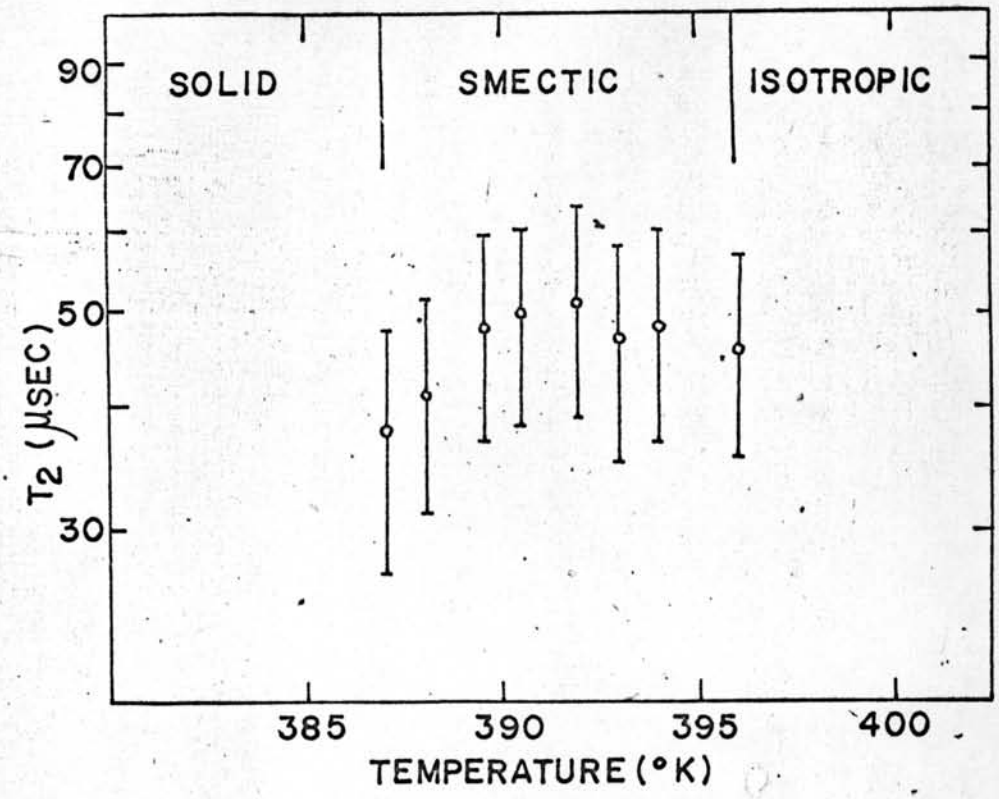


Fig. 3·7 Proton spin spin relaxation T_2 in smectic DADB versus temperature at 10·25 MHz.

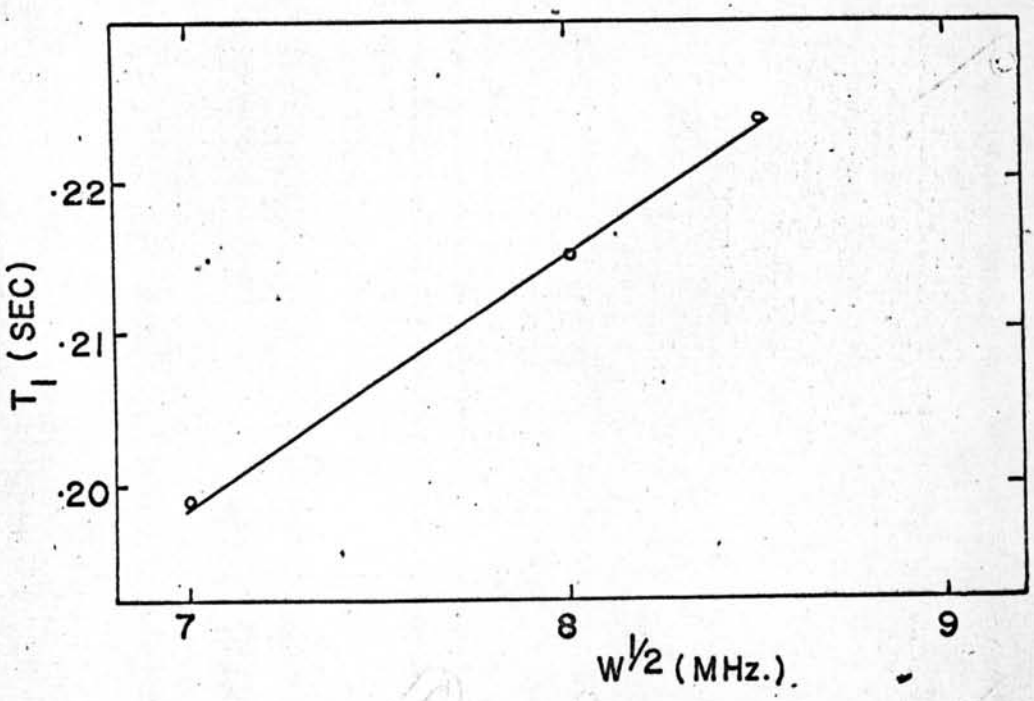


Fig. 3·8 T_1 versus the square root frequency