The presence of the magnetic field acts as a cosmological retardation stopping the expansion of the model which ultimately collapses to the second singularity. In the absence of magnetic field the line element (2) reduces to a model given in an earlier paper[1].

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PERFORMANCE CHARACTERISTICS OF PURIFIED TETRABUTYL-TIN IN LIQUID SCINTILLATION COUNTING FOR RADIOIMMUNOASSAY AND OPTIMISATION OF COUNTING VIAL DESIGN

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IODINE-125 is one of the most commonly used radiotracers for radioimmunoassay. Its decay scheme ($T_{\frac{1}{2}} = 60\,d$) includes electron capture followed by the emission of a single gamma ray. However, most of the gamma radiations are internally converted and subsequent rearrangements in the atom give rise to the emission of weak x-rays and gamma rays (about 75% of the disintegrations result in photons within the energy range of 27.4 to 35.3 keV) and gamma detection of iodine-125 using heavy element having higher atomic number loaded liquid scintillator becomes more efficient due to increase in the effective atomic number of the 'cocktail' which enhances the gamma ray absorption coefficient.

Design of a gamma vial, in which the sample and scintillator are kept in two different concentric compartments, has facilitated the following: (i) Overcoming incompatibility between the sample and the solvent used for the scintillator (ii) avoidance of phase separation between the sample and the solvent and overcoming quenching corrections. Further the liquid scintillator can be reused for many determinations. Tetrabutyltin when loaded as an additional component of the scintillator, serves as the source of heavy atoms for iodine-125 detection[1]. Since it is a colourless stable liquid and miscible in all proportions with the scintillation solvents used, it is a convenient compound for the incorporation in the scintillation cocktail.

Optimisation of sample holder

The optimisation of the counting procedure was based on the following steps: (i) Synthesis and purification of tetrabutylin-loaded liquid scintillator (ii) Optimising sample holder dimensions (iii) Optimising tetrabutyltin-loading in the scintillator.

Spectroscopically pure tetrabutyltin was prepared by first making the Grignard reagent of *n*-butylbromide and then reacting with anhydrous stannic chloride. The purification steps involved the removal of the chlorides formed due to incomplete reaction and then vacuum distillation. Its structure was confirmed by NMR, IR and elemental analysis[2–4].

The common scintillation vial was so modified (figure 1) that the sample remained away from the scintillator. A set of vials containing different percentages of purified tetra-*n*-butyltin loaded scintillator cocktails were prepared in the range of 0 to 50% (W/V) of tin-loading. The relative performance of these concentrations was studied using LS spectrometer of Packard Instrument (Model 3255) for iodine channel. Keeping the total volume of the scintillator constant, the relative efficiencies for different percentages of tin loading were experimentally found to increase with tetra-*n*-butyltin loading concentration upto 40%. As the concentration of tin-loading in the scintillator is further increased the relative efficiency dropped down. Thus 40% tin-loading was found to be the optimum value, beyond which the concentration quenching effect is observed.

For inner sample holder tube, two different thicknesses (0.95 mm and 0.5 mm) were tried. The thicker one gave an efficiency of 26.7% while the thinner one showed better detection efficiency of 35.5%. Aqueous NaI^{125} having a concentration of 2.73×10^4 disintegrations per minute/ml was used. The height of the sample holders was varied, keeping the standard

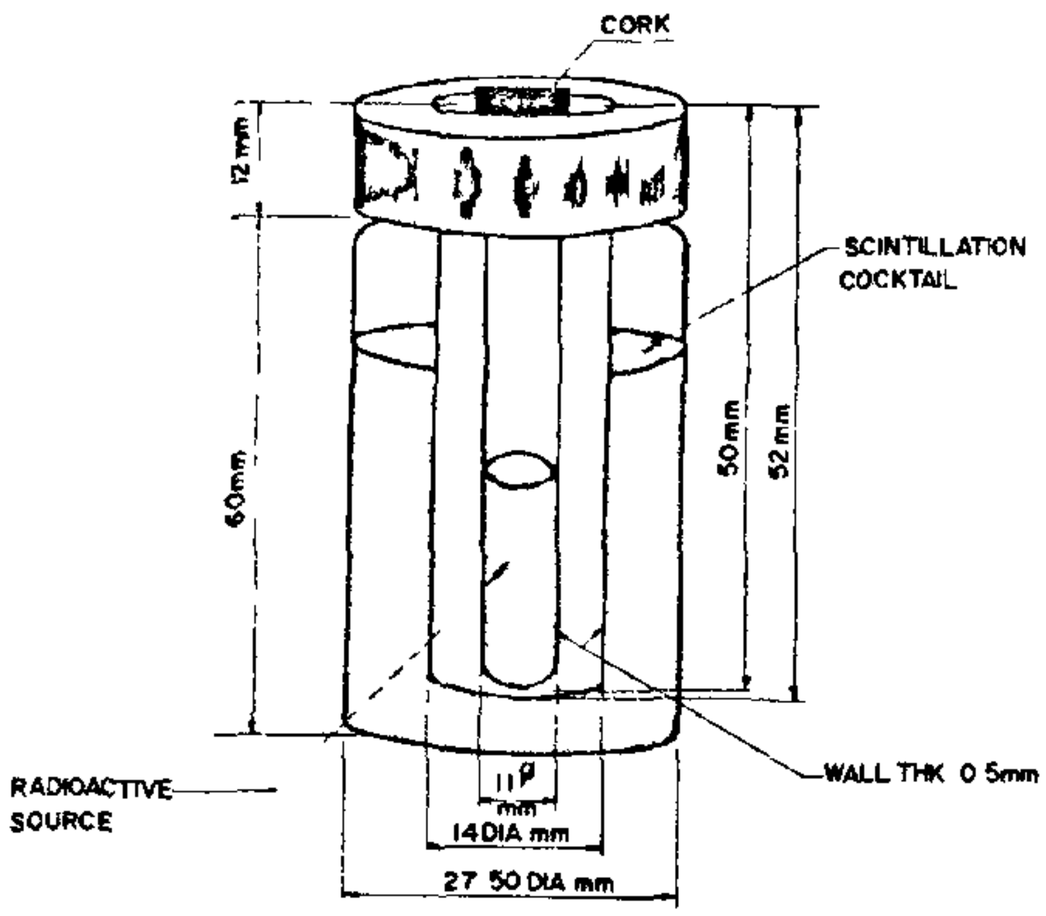

Figure 1. Liquid Scintillation Vial

scintillator vial constant. The inner concentric sample holder served as the recepticle for the ampule containing radioimmunoassay sample with I^{125} as tracer. The optimum dimensions for the sample holder (figure 1) were 52 mm external length and 50 mm internal length to give a maximum relative performance efficiency (table 1). Varying the volumes of radioactive samples resulted in the increase in the total count rate but did not necessarily increase the efficiency per unit volume. The relative efficiency was maximum for 0.1 ml of the sample kept inside the optimised sample holder, due to minimum quenching by the sample.

Table 1 *Relative performance efficiencies of different sample holders*
(Scintillator Vol. = 14 ml and Vial capacity = 20 ml)

Sample holder length Outer (mm)	Inner (mm)	Relative* efficiency
60	58	73.26
58	56	91.87
56	54	92.86
54	52	92.38
52	50	100.00
50	48	98.61
48	46	97.27

* Relative to vial No. 5 as 100.00

Scintillator used—Optimised Volume: 6 ml of scintillator [7 g of PPO + 0.3 g of POPOP in 1 l of toluene] and 8 ml of tetrabutyltin scintillator [70 g of tetrabutyl-tin + 0.7 g of PPO + 0.03 g of POPOP in 100 ml].

Table 2 *Relative figure of merit and detection efficiency of tetra-n-butyltin loaded liquid scintillator system*

Detector matrix	Efficiency percent (E)	Background cpm (B)	Relative figure of merit (E^2/B)
14 ml liquid scintillator without tin loading	3.5	15	0.8
14 ml liquid scitillator with 40% (W/V) of tetra-n-butyltin with sample volume 0.1 ml	35.5	20	62.9

Thus the percent efficiency of the present tin loaded scintillator cocktail is about ten times that of the unloaded one and is comparable to those reported earlier[1] with conventional NaI^{125} well crystal assembly (table 2) and is convenient for routine measurements.

With the present system, having detection efficiency of 35.5% and background 20 counts per minute, a lower detection sensitivity of 25 pCi/ml for every radioactive tracer count per minute above background, with 0.1 ml sample is achievable by counting for long periods *viz* $\geqslant$ 100 min for better statistical accuracy.

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