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# COMPARISON OF SINGLE BUBBLE SONOLUMINESCENCE (SBSL) AND MULTI BUBBLE SONOLUMINESCENCE (MBSL)

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***Abstract –*** The difference between SBSL and MBSL have been explained on the basis of normalized intensity to the peak value SBSL and MBSL as a function of frequency in units of c $(nm)^{-1}$ (where c is the speed of light). Also, this difference could be appreciated by plot of $I_{SBSL}$ - $I_{MBSL}/I_{SBSL}$ versus frequency.

***Index Terms –*** Acoustic cavitation, Sonoluminescence.

## I. INTRODUCTION

The sonoluminescence arising due to ultrasonic field under appropriate cavitation conditions has been reviewed by Walton and Reynolds [1] and by Barber et al. [2] In a standing wave sound field the sonoluminescence originates from bubbles attracted to the pressure antinodes and has its maximum intensity when the bubble volume is minimum. Sonoluminescence is an amazingly efficient mechanism for conversion of sound into light. The mechanism of sonoluminescence has been discussed experimentally but it is not yet understood. An identified mechanism is thermal bremsstrahlung.

Multi bubble sonoluminescence (MBSL) is the light emission phenomenon from cavitation bubble in liquid irradiated by strong ultrasound. In cavitation a bubble collapses very violently after bubble expansion under some conditions. Acoustic cavitation effect has been studied for a long time using continuous and pulsed ultrasound fields [3-6].

Significant development in sonoluminescence research has been brought about after the discovery of single bubble sonoluminescence (SBSL) in 1990 by Gaitan and Crum [7]. SBSL is the sonoluminescence from a stably pulsating bubble trapped at pressure antinode of a standing ultrasonic wave. In 1991 Barber and Puttermann [8] reported in Nature that SBSL pulse width in less than 100 ps which attracted many researchers' attention.

Our objective on this paper is to compare the relative change in normalized intensity of single bubble sono luminescence (SBSL) to multi bubble sono luminescence (MBSL) as a function of circular frequency $\omega$ in units of c $(nm)^{-1}$ where c is the speed of light. We have chosen some parameters from the existing literature for the purpose to see the parametric variation and their effect on sonoluminescence.

## II. RESULTS AND DISCUSSIONS

In spite of the complexity of cavitating bubble fields many studies have been made of multi bubble sonoluminescence (MBSL) and the influence of fluid and gas properties. The optical spectra of MBSL typically contains distinct, pressure broadened molecular or atomic emission bands. Many workers have investigated MBSL theoretically and experimentally. The work done on MBSL is included in the report of several workers [3-6,9].

Matula et al. [10] have given experimentally a comparison of the spectral characterization sonoluminescence from cavitation in bubble fields (MBSL) versus cavitation of single bubble (SBSL) for aqueous solution under similar experimental conditions.

We have arbitrarily chosen the range of parameters relevant to SBSL and MBSL. These parameters have been used for the analysis of the data. The difference between SBSL and MBSL have been explained on the basis of the ratio of normalized intensity to the peak value of SBSL and MBSL as a function of frequency in units of c $(nm)^{-1}$ (where c is the speed of light). given in Fig.1 Also difference could be appreciated by another plot of $I_{SBSL}$-$I_{MBSL}/I_{SBSL}$ versus frequency as illustrated in Fig.2.

## III. CONCLUSION

In Fig.1 we compare the relative change in normalized intensity of single bubble sonoluminescence (SBSL) to multi bubble sonoluminescence (MBSL) as a function of circular frequency ω in units of c $(nm)^{-1}$ where c is the speed of light. We have plotted for certain ranges, intensity of SBSL normalized to its peak value and that for MBSL normalized to its peak value against frequency as shown in Fig.1. This figure illustrates that below ω =0.03c $(nm)^{-1}$, intensity of SBSL goes on increasing with nonlinear behaviour giving peeks at ω=0.0027, 0.0040, 0.0065 and 0.0133 c $(nm)^{-1}$. The values of peaks are 4.5, 2.5, 1.5 and 1.4. These peaks give us around 1.5 times, 2.5 times and 4.5 times more intensity in case of SBSL in comparison to MBSL. But at larger frequencies more than ω=0.03c $(nm)^{-1}$ both SBSL and MBSL seen to be equal in magnitude and independent of frequency. This is an important observation in the present work. Fig.2 also shows the relative change of SBSL: and MBSL by the ratio $I_{SBSL}$-$I_{MBSL}$/$I_{SBSL}$ as a function of frequency. From this figure relatively significant changes are exhibited with peaks similar to Fig.1

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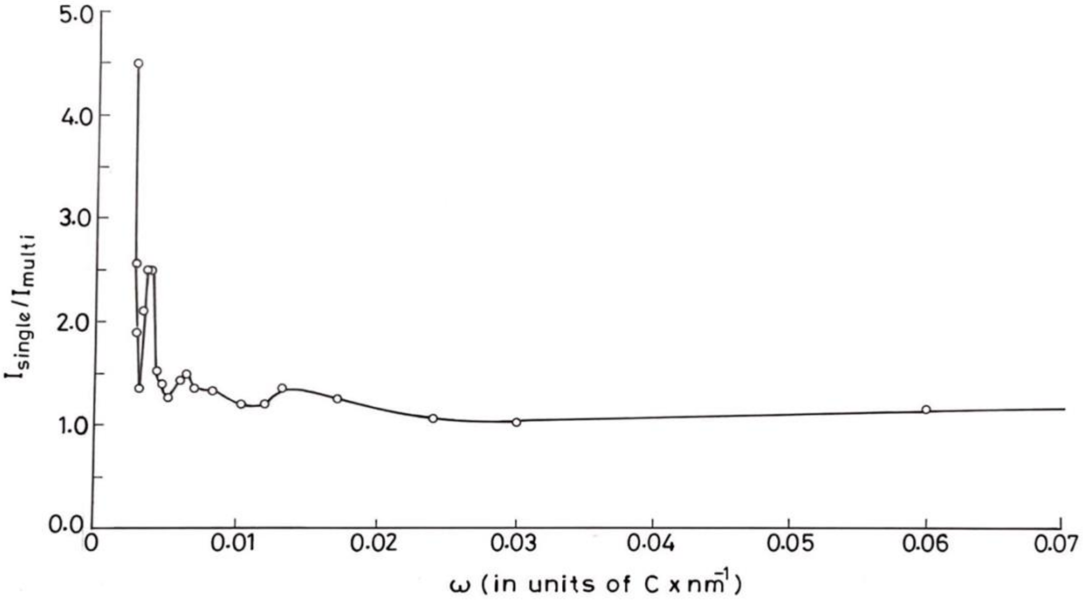


Fig.1 Variation of relative change in normalized intensity of single bubble sonoluminescence (SBSL) to multi bubble sonolminescence (MBSL) as a function of circular frequency ω (in units of C x nm$^{-1}$) where C is the speed of light

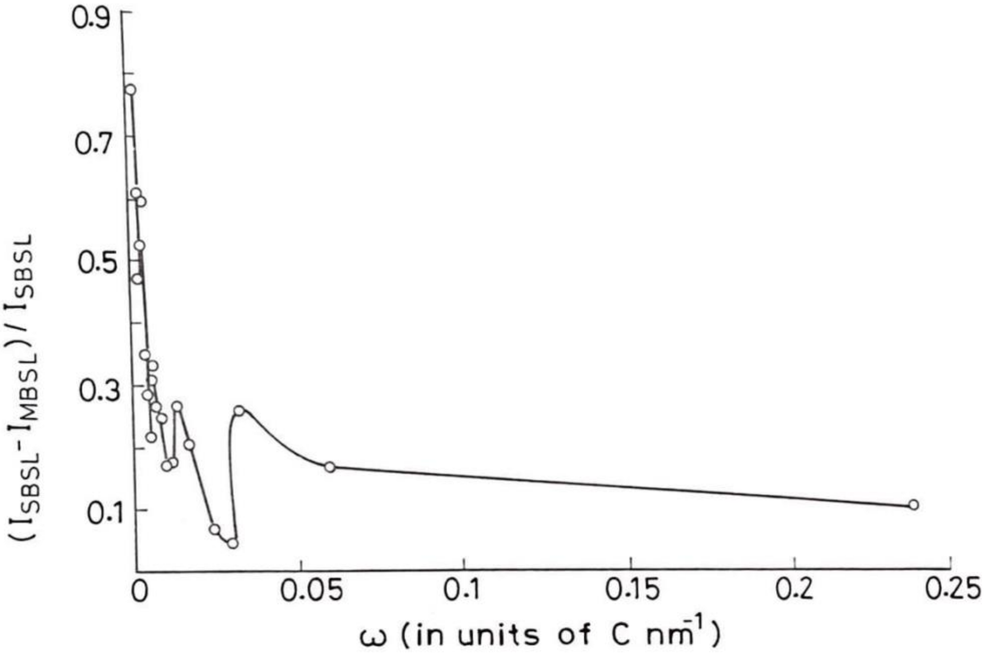


Fig. 2 Variation of $I_{SBSL}-I_{MBSL}/I_{SBSL}$ as a function of circular frequency ω (in units of C x nm$^{-1}$) where C is the speed of light