1. Introduction

Laser induced bubbles make it possible to investigate cavitation bubble dynamics in detail [1], in particular during the final stages of collapse [2]. In this paper we extend our previous work by studying not only the bubble shape but also the light emission [3] during the collapse. We will address the question whether an aspherical bubble collapse boosts or lessens the light emission.

Figure 1. Experimental arrangement for studying the dynamics and the light emission of laser induced cavitation bubbles.

In contrast to experimental sonoluminescence studies (see, e.g. [4]), where a sound field drives the bubble to a large expansion, in single cavitation bubble luminescence (SCBL) a bubble expands through vaporization of liquid at the laser focus. The experimental arrangement is depicted in
Fig. 1. Single bubbles are produced inside a water filled cuvette at the focus of a Nd:YAG laser beam. The laser delivers pulses of 8 ns FWHM with a pulse energy of up to 20 mJ at the fundamental wavelength of 1064 nm. A two lens system is used to produce a nearly pointlike bubble nucleation site. Successive images of the bubble dynamics are taken with an image converter camera at 227,000 frames/s illuminated with a long duration photo flash. A different photographic system is used to observe the luminescence event, an intensified CCD camera (ICCD) and a long distance microscope. The ICCD with a high contrast ratio between shuttered and opened state suppresses the intense continuum light emission from the dielectric breakdown process. An optical resolution of the luminescence image better than 3 μm is achieved.

The acoustic transients at bubble generation and at bubble collapse are recorded with a hydrophone on a digital storage oscilloscope. The aspherical bubble collapse is investigated using a rigid perspex boundary of adjustable height placed below the laser focus.

2. Spherical Bubble Collapse

The technique for generation of cavitation through a laser induced dielectric breakdown allows for the creation of a bubble in a highly reproducible way [1,2]. In absence of a boundary, the bubble collapses spherically and emits a single shock wave [2]. Its dynamics can be described by Gilmore’s model [5] until the final stages of collapse.

![Image](image_url)

*Figure 2. ICCD image with shutter open for 5 μs with an additional weak illumination from the front. The bubble appears dark on a bright background with the luminescence spot in the middle. During the gating time, the bubble wall collapses from the position marked with the dashed outline to a smaller bubble size. The rapid motion blurs the bubble outline. The size of the frame is 0.784 mm x 0.784 mm.*