Ultrasound has the ability to excite volatile and non-volatile species in aqueous solution. This arises largely through acoustic cavitation bubbles, the formation, growth and violent collapse of gas bubbles. The collapse generates high temperatures and pressures going along with the production of reactive chemical species, as well as short light pulses, termed sonoluminescence (SL). This light emission can either come from a single bubble (SBSL) or a bubble cloud (multi-bubble sonoluminescence, MBSL).

SB/MBSL spectra of water consist of a continuum spanning from UV to near IR attributed to bremsstrahlung, recombination of H$^*$ and OH$^*$ radicals, and the deexcitation of water molecules. Under certain experimental conditions the continuum is punctuated by molecular or atomic emission bands of electronically excited hydroxyl radical or sodium [1], [2]. Their excitation is attributed either to droplet injection into the hot core of the cavitation bubble during its compression phase or to collisions with ‘hot’ particles at the bubble interface. Photons generated by SL can excite fluorescent solutes surrounding the bubble such as fluorescein, eosin, and pyranine this process is referred to sonophotoluminescence (SPL) [3].

Recently, studies on the SL of lanthanides in MBSL [4] and SBSL [5] were performed. These ions possess the particularity of being excited by photons and/or by collisions. In the present study the SB and MBSL spectra of a 0.1 M terbium chloride show characteristic absorption and emission bands of Tb$^{3+}$ as shown in Fig. 1. Furthermore, we observed the emission of Ce$^{3+}$ in MB and SBSL, emission of Eu$^{3+}$ is only observed in MBSL, and Gd$^{3+}$ is not observed at all. In this presentation, we will also demonstrate the influence of the nature of the medium (complexation of the ions), and make a detailed comparison between SBSL and MBSL spectra.

Fig.1: left: SBSL spectra of a 0.1 M TbCl$_3$ solution, 27 kHz, 70 mbar argon; right: MBSL of a 0.1 M TbCl$_3$ solution saturated with argon, 20 kHz