Simulation assisted particle size distribution measurements in the Keldysh Research Centre experimental setup at ONERA.

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In order to increase performances, several launchers now flying use aluminium-doped propellant grains in their Solid Rocket Motors (SRM). This results in the creation of liquid aluminium oxide droplets amongst the combustion products, yielding an internal two-phase flow field. Studies of the P230 SRM as used on the Ariane 5 revealed a possible, amplifying influence of these particles on pressure and thrust oscillations. Besides the amplification of pressure oscillations, part of these particles get trapped and agglomerate in the aft-end cavity, resulting in 2 to 3 tons of slag. The slag formation leads to performance losses and can contribute to thrust oscillations when parts of it transit through the nozzle.

To determine the influence of the aluminium oxide particles on the overall flow and to try to understand and solve at least part of the above-cited problems, we need to determine the size distribution of the particles throughout their life inside the motor. In order to do so, several experimental set-ups as well as numerical studies have been developed all over the world. They all burn aluminized solid propellants and try to measure particle distributions but, besides the installation developed at the Keldysh Research Centre (KeRC), none that we know of gives satisfactory results. In 2005, ONERA obtained an installation equivalent to the KeRC experimental set-up and has been conducting experiments since.

As presented previously the KeRC installation suffers from a bias favouring large over small particles. One way to circumvent this inherent error is to combine the experiments with numerical simulations. This paper describes the evolution of this complex installation and it's coupling with numerical simulations taking into account complex phenomena such as coalescence , break-up and rebound. It refelcts our failures, experiences and successes as well as our plans for the future.