The fuel distribution and degree of atomization in the combustion chamber is a primary factor in the formation of emissions in diesel engines. A number of diagnostics to study sprays have been developed over the last twenty years; these are primarily based on visible light measurement techniques. However, visible light scatters strongly from fuel droplets surrounding the spray, which prevents penetration of the light. This has made quantitative measurements of the spray core very difficult, particularly in the relatively dense near-nozzle region [1-3]. For this reason we developed the x-ray technique to study the properties of fuel sprays in a quantitative way [4]. The x-ray technique is not limited by scattering, which allows it to be used to make quantitative measurements of the fuel distribution. These measurements are particularly effective in the region near the nozzle where other techniques fail. This technique has led to a number of new insights into the structure of fuel sprays, including the discovery and quantitative measurement of shock waves generated under some conditions by high-pressure diesel sprays [5]. We also performed the first-ever quantitative measurements of the time-resolved mass distribution in the near-nozzle region, which demonstrated that the spray is atomized only a few nozzle diameters from the orifice [6].

Our recent work has focused on efforts to make measurements under pressurized ambient conditions. We have recently completed a series of measurements at pressures up to 5 bar and are looking at the effect of ambient pressure on the structure of the spray. The enclosed figure shows the mass distributions measured for 1, 2, and 5 bar ambient pressures. As expected, the penetration decreases as the pressure increases. This leads to changes in the measured mass distribution, including an increase in the density at the leading edge of the spray. We have also observed a narrowing in the cone angle of the spray core as the pressure increases. This is counter to visible light spray measurements, and current work is underway in an effort to understand this effect.