An ultra cold gas of metastable helium atoms: 
Bose Einstein Condensation and cold collision studies

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A BEC of $^4$He atoms in the $^2S_1$ metastable state was first observed in 2001 [1], [2]. We shall 
recall the experimental steps that led to the BEC transition at 5µK at ENS, as well as the 
onlytical detection of the cold cloud. We shall discuss the optimization of the evaporative 
cooling ramp which allows to bring the atomic temperature from 1 mK to 1 µK in 8s with a 
gain of $10^6$ in phase space density. Quantitative measurements of the rates of elastic and 
inelastic collisions both above and below the transition will be given. Evidence for the strong 
inhibition of the Penning ionizing collisions will be presented. A value of the scattering length 
between two metastable atoms will be derived.

We shall also present recent studies of the elastic collisions in the gas above the transition. We 
magnetically excite a quadrupolar mode and measure both the damping and the frequency 
shift of the mode at different temperatures and different collision rates along the evaporative 
cooling ramp. Preliminary results indicate that one approaches the hydrodynamical regime 
(more details will be given in the poster of J.Léonard).

A more prospective discussion will follow, prepared with Allard Mosk and related to the 
photoassociation of metastable helium atoms [3] from a magnetic trap, the possibility of 
changing the scattering length with light [4] and to perform Raman photoassociation [5].