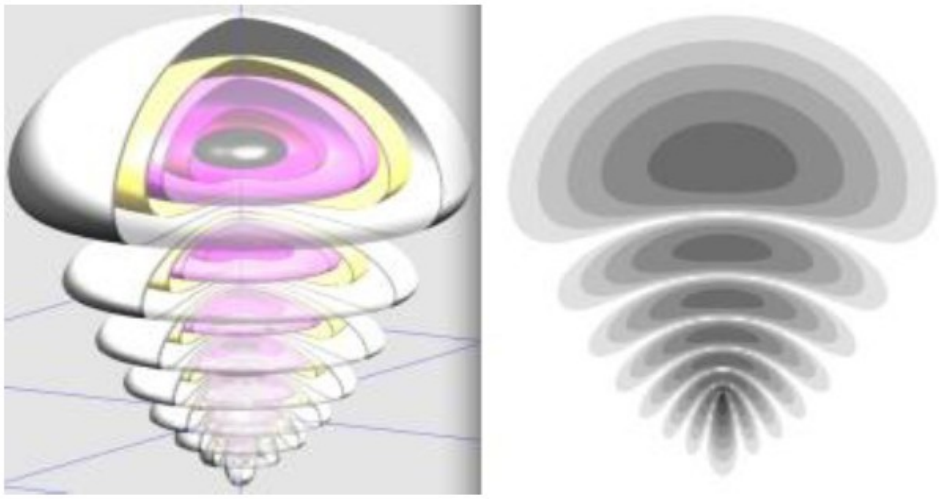
1. FINAL PUBLISHABLE REPORT

The DWQBS project involves theoretical and experimental studies of inelastic atomic breakup processes and structure and dynamics of weakly and tight bound quantum systems. The project involved the exploration of interacting diatomic Rydberg systems with regard to state description and with regard to wave packet dynamics and studies of breakup processes of molecules by photons and particle impact. The partnership covered three European institutions in Norway (coordinator), Sweden and France as well as to institutions in India and Argentina with all together 18 experienced and early stage researchers participating.

A range of new results has surfaced. On the theoretical side the nature of a particular class of long-range diatomic states and the formation of state-selective radial Rydberg wave packets has been discovered. Another aspect of the project has been the study of the response of ground state molecules to fast strong electromagnetic time dependent fields. Here researchers has published papers on details of the breakup mechanisms and the sensitivity to molecular orientation or electronic correlation. In the final part of the project two processes has been in focus: The role of extended systems during generation of high harmonics and the possible occurrence of multi-scattering processes during one-electron ionization of diatomic molecules. One work package has also been devoted to the study of the possibility of atom formation around unstable superheavy nuclei. Here the researchers have delivered a review of this field which concludes that this possibility is rather small at present as long as the superheavy elements so far detected is very unstable.



A new perspective of Rydberg Stark States, from http://iopscience.iop.org/0953-4075/labtalk-article/47053

The experimental work has been devoted to Rydberg wave packet dynamics in Norway and to particle induced fast collisions in Argentina. In Norway both angular (intra n-shell) and radial (intra l-"shell") wave packets were explored and their dynamics were recorded and analysed. In the first case the role of the core displayed special features on the suppression of certain resonances. In the latter case a pump-probe measurment demonstrated interference effects in the radial wavepacket and the role of the chirp of the laser pulse were documented. In the experiments performed in Argentina several novel multi-electronic processes were studied in intermediate velocity ion impact on neutral target.

The goal of all work-packages of the project were achieved through the delivery of 16 publications and reports, based on in total 30 secondments. This project lead to a strong new connection between research groups in Argentina on one side and Norway and Sweden on the other side. At the same time the project was beneficial also for scientific collaboration between the European nodes, partly stimulated by the involvement of the two non-European sites. The transfer of skills has widended the theoretical expertise of all nodes in general and experiments have been developed and performed which only would have been possible by the staff exchange scheme. The new collaborations clustered into a few new experimental and theoretical groups which also involved researchers taking part from outside the projects such as from the Czech Republic and from Brasil. These collaborations will likely survive into the future and gain additional momentum.