# Basic physics and materials science in actinides – status and future needs

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***Abstract -*** *This talk will cover some of the activities at ITU that involve physics and materials science of the actinides. Basic research aims to be intellectually challenging and involves many collaborators. Applied materials science aims to address some issues of importance for the future of nuclear energy, in particular with our capability to examine irradiated materials and perform leaching experiments on strongly radioactive materials.*

*In condensed-matter physics of the actinides the central question is the state of localisation of the 5f electrons and their interaction (hybridisation) with other electron states. The most recent discovery of superconductivity in $PuCoGa_5$ at a surprisingly high tempereature of 18 K is simply one highlight of the extraordinary complexity of the physics of 5f systems. Some other examples will be given, as well as a brief description of our Actinide User Laboratory, which allows outside teams of researchers to profit from our infrastructure.*

*In materials science we have a major effort on irradiated fuel. The crucial aspect for the mechanical properties is the change of the form of the material, especially due to the release of helium. The self-damage is particularly severe over a long time, and can lead finally to a non-crystalline fine-grain amorphous material. Changes of thermal properties are studied as a function of burn up in irradiated fuel. Laser melting of surfaces has established the phase diagrams as a function of oxygen stoichiometry. New laser capabilities are planned. Leaching experiments on $UO_2$, as well as alpha-doped material, show the importance of oxygen concentrations in the environment and especially of radiolysis.*