One of the intrinsic properties of quantum theory is uncertainty: typically, a measurement of an observable can yield different results for two identically prepared states. This indeterminacy can be studied by considering the probability distribution of measurement outcomes, and quantized by a number that characterizes the randomness of this distribution. The Shannon entropy is the most natural tool for this purpose. Obviously, the value of this quantity is determined by the choice of the initial state of the system before the measurement. Thus in the general case the following questions arise: what are the extremal values of the entropy of measurement and which (pure) input states minimize or maximize the uncertainty of the measurement outcomes? In other words, which states can be considered as 'most classical' or 'most quantum' with respect to a given measurement.

In this project we would like to focus on the following issues:

I. The relationship between the states defining the measurement and sets of minimizers and maximizers, which we shall call extremal configurations.

II. The relationship between the extremal configurations for the measurement and for its noisy versions.

While the first problem is more theoretical, the second one has a practical counterpart since in fact every measurement performed in reality is noisy. The results obtained so far show that the minimal configurations can remain the same for any amount of white noise. Thus one of our aims is to establish the conditions under which extremal configurations for depolarized measurements remain the same.

The measurements we are in particular interested in, i.e. SIC-POVMs and MUBs, provide a variety of open problems, including their existence in arbitrary dimension, that get the attention of mathematicians as well as quantum physicists. They are interesting not only from the theoretical point of view but also due to the wide applications in quantum information, e.g. quantum state tomography. In particular, we hope to obtain as an indirect result of this project the better understanding of SIC-POVMs and MUBs, as well as the connections between these objects.