Among magnetic materials two important groups can be selected, ferromagnets (FM) and antiferromagnets (AFM). In the simplest picture, magnetic moments (tiny magnets) of individual atoms or molecules tend to align parallel to each other in case of ferromagnets and antiparallel in antiferromagnets. So aligned (oriented) magnetic moments still have to make a choice of their common direction, along which they will be all aligned. This choice is in principle the so called magnetic anisotropy of the material. For example, iron and cobalt atoms choose different directions for the alignment of their magnetic moments and so we say they have different magnetic anisotropies. Magnetic anisotropy properties of bulk ferromagnets, like those that we pin to our refrigerators, are for many years relatively well known and are already described in text books. If we exchange our refrigerator magnet with the two or even ten times thinner magnet it will not change its magnetic properties significantly. However, if we imagine that we can decrease the thickness of a magnet by a factor of million or tens of millions then such ultrathin, with the thickness equal for example to the size of a single atom, layer will exhibit drastically different magnetic properties. For example, bulk ferromagnet can totally loose its magnetic properties as a thin film and even hypothetical attempts to attach it to the refrigerator will be hopeless. Also magnetic anisotropy is completely different in case of refrigerator magnet and ultrathin atomic layer of a ferromagnet. Properties of antiferromagnets are even more fascinating in case of antiferromagnets when compared to ferromagnets. Approaching a permanent magnet to our refrigerator magnet can easily result in either rotation or attraction of the latter. We say that ferromagnets easily interact with external magnetic field. In case of antiferromagnets this is no longer true; they are materials with strong magnetic properties but their reaction with external magnetic field is practically negligible. For this reason it is much more difficult to study antiferromagnets and consequently their application in magnetic techniques of data storage is postponed by tens of years. Nowadays, commonly used in magnetic memories and hard drives are ferromagnets. These devices present a great functionality however they have one huge disadvantage, data can be easily lost as a result of strong external magnetic field, for example in hospitals or laboratories. Magnetic memory basing on antiferromagnets would be practically totally independent on destructive interactions with external magnetic fields. Similarly to ferromagnets, the properties of antiferromagnets become even more interesting when we study thin films or nanostructures. Moreover we can make one step further and prepare multi-layered “sandwich” with various AFM “ingredients” which greatly extends range of interesting magnetic phenomena and potential applications.

And here we come with the aim of our project. We will build various kinds of “sandwiches” and we will combine various AFM components in order to tune the magnetic anisotropy of both whole “sandwich” and its each particular building element. In this way, we should be able to design a magnetic memory, completely insensitive to the destructive effects of external magnetic fields, the operation of which also does not require the use of a magnetic field and is energy-efficient.