

MAGNETISM IN CARBON: PAST, PRESENT AND FUTURE RESEARCH

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Not a long time ago and from the magnetic point of view carbon allotropes like graphite, diamond, carbon nanotubes and fullerenes were accepted to be basically diamagnetic. It was a common belief that any ferromagnetic-like signal measured at room temperature in a carbon structure was due to magnetic impurities. In the first part of my talk I will review some evidence published in the past, which suggests that this belief was not based on facts but on scientific scepticism. At present, there are a few works that provide evidence that in some carbon structures and under special conditions a magnetic order exists even above room temperature. For a material with only s- and p-electrons this (rediscovered) room-temperature magnetic order has profound consequences in solid state magnetism. Taking into account the main topic of the school, I will present and discuss recent experiments we have done using a proton micro beam to induce magnetic order in graphite, fullerenes and other carbon structures, and simultaneously to check the concentration of magnetic impurities. These studies provide clear evidence against the “impurity belief” and indicate that lattice defects and, very probably, the influence of hydrogen trigger ferromagnetism in carbon structures. I will show that it is possible to “write” magnetically on a pure graphite surface using a proton beam, as shown by the image ($10 \times 10 \mu\text{m}^2$) of a “magnetic cross” below. At the end of my talk I will discuss the main theoretical ideas, the main open questions as well as preliminary results which indicate that room temperature ferromagnetism in carbon-based organic structures is a general phenomenon with implications in basic and applied research.



D. Spemann, M. Diaconu, H. Schmidt and T. Butz (to be published)