From Do-it-yourself Quantum Mechanics to Nanotechnology? The History of Experimental Semiconductor Physics in Germany, 1970-2000.

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Abstract:

This paper focuses on developments in semiconductor physics in the 70s and early 80s. At that time new materials technologies such as molecular beam epitaxy made experiments with quantum states possible and gave semiconductor physics a new push. Electrons were confinded in precisely tailored, ultrathin layers of semiconducting materials, so that new quantum effects in the surface and boundary layers of semiconductors could be described and analyzed – in ultra high vacuum conditions as well as in real room temperatures. While this rather basic and far reaching research lead for example to the discovery of the Quantum Hall Effect by Klaus von Klitzing, it is characteristic of that dynamic field that there are close ties to the semiconductor industry. The chips for von Klitzing's Hall measurements at Grenoble for example were produced at Siemens in Munich. However, the Siemens researcher Gerhard Dorda did not only provide these materials for von Klitzing. He was also one of the first scientists that could measure and prove quantum states at real room temperatures in the early 70s. He was part of a growing international, but also local network of scientists, from leading international industrial research laboratories as well as universities that shaped this field and influenced a new generation of scientist, like Gerhard Abstreiter, who founded the Walter Schottky Institute at Munich or Jörg Kotthaus, who's move back to Munich in the 80s was a media event and political concern. In these years quantum state experiments with III-V semiconductors blossemed and gave also rise to technological considerations such the HEMT transistor for high-frequency applications, which was patented in Japan but also developed in Germany by Gerhard Abstreiter and Klaus Ploog. This new branch of semiconductor physics dealing with the confined flow of electrons and their quantum behavior was and still is a very fruitful field of research. However, in the 90s the globalization of semiconductor industries and the severe cut of industrial research funds forced the more basic research efforts to search for new allies and political strategies. That's why the experimental quantum physics generation of Kotthaus and Abstreiter turned to "nanotechnology" and actively took part in the politically motivated effort to push this "New Technology". The history of the Walter Schottky Institute is closely related to that story. It was founded with the financial support of Siemens in the 80s to strengthen the local and regional research landscape in the highly competitive field of semiconductor technology. Nowadays, it is reorienting its research agenda towards biophysics

and nanotechnology, supported by the Munich Nanotechnology Excellence Network NIM (Nanosystems Initiative Munich).

I will argue that the recent developments of nanotechnology go back to the experimental practices and research interests of experimental quantum physics in the early seventies and that nanoelectronics and nanotechnology are mainly a relabeling of a well established and dynamic research field. However, semiconductor physics lost ground in the 90s and made new orientations and strategies necessary, because the general consensus for basic research as it was practiced in the Cold War – especially in military related fields – vanished and the rise of the life sciences forced semiconductor physics to reorient their research strategies.

This paper presents the results of a three years interdisciplinary case study on the practice and knowledge production of nanotechnology in Munich. It is based on 30 expert interviews and carried out in close cooperation with a sociologist at the Deutsches Museum.