

UMSAEP UM/UWC Linkage Program: Final Report

“Curriculum Development in Materials Science at UWC”

Carsten A. Ullrich

Department of Physics and Astronomy, University of Missouri, Columbia, MO 65211

This final report summarizes the activities and outcomes of my visit to South Africa, sponsored by a \$1,500 UMSAEP grant. The visit took place from April 1 to May 4, 2017, together with Prof. Suchi Guha from MU Physics. Our hosts were Profs. Chris Arendse, Theophilus Muller, and Dirk Knoesen from the UWC Physics department.

I. Teaching activities

During the first two weeks of this visit (April 3-14, before the Easter break), I taught two short courses at the BSc and MS level, respectively.

I.1 Electronic structure and excitations in nanomaterials (MSc nanophysics)

The Master of Science (MSc) two-year degree in Nanoscience, a unique program in South Africa, is a collaborative initiative between UWC, University of Johannesburg (UJ), University of the Free State (UFS), the Nelson Mandela Metropolitan University (NMMU) and the Department of Science and Technology. It is spearheaded by UWC (and coordinated by Prof. Dirk Knoesen). The partnership between these institutions allows students from other campuses across South Africa to take courses at UWC. This year has been one of the largest enrollments in their MSc Nanoscience program: the course was taken by 11 students, about half of these were from UWC.

Prof. Suchi Guha and I team taught the course on “Electronic Structure and Excitations in Nanomaterials” over two weeks. The course was offered every day for two hours in the afternoon (on two days there was no class, due to a holiday and due to graduation)

The aim of this survey-style course was to provide students with an appreciation and understanding of the

Day 1:

- x Review of quantum mechanics;
- x Atomic structure
- x Interatomic binding I and II
- x Crystal structure I

Day 2:

- x Crystal structure II
- x Reciprocal lattice
- x Quantized electron gas

Day 3:

- x

II. Other activities

During our stay at UWC, Prof. Guha and I had the opportunity to visit other research facilities: The iThemba LABS in Cape Town and NMMU in Port Elizabeth. Research activities at the IThemba LABS are based on subatomic particle accelerators. It also has a strong focus on materials science related research. We got an in-depth tour of their research facilities.

The visit to NMMU in Port Elizabeth was organized by Prof. Arendse and the Nanoscience program. The electron microscopy facility at NMMU is a world-class research facility and is equipped with state-of-the-art electron microscopes. We are grateful to Prof. Jan Neethling (Director of the high resolution microscopy center) and other faculty members of the physics department at NMMU for discussing their research activities and giving us a tour of their world-class research capabilities.

My own research is in theoretical and computational condensed matter physics. Therefore, learning about ongoing experimental research at UWC, IThemba and NMMU was very interesting for me, even though it did not lead to any concrete scientific project collaborations, at least not at this time.

I made the observation that there is a notable absence of theoretical condensed matter physics at UWC or, for that matter, in most of South Africa. The UWC physics department is very strong in nuclear physics and astrophysics, including theory, but there are no theorists to lend support to the materials science program, or to train their students. I believe that this would offer opportunities for future visits to UWC, either to teach or to collaborate. I wo