C. THE NUSEL-HOMESTAKE SCIENCE BOOK

The **NUSEL Science Book** describes the physics, earth science, applications, and education/outreach opportunities that can be realized at Homestake. The corresponding four sections are developed around project areas, such as double beta decay or geomicrobiology. For each project area we describe the **importance of the science**, the **readiness** of the project, and the project's **facility requirements** (e.g., the space and supporting infrastructure needed underground). The results of this chapter are then summarized in Section D, the **Science Timeline**, on which our Homestake Facilities Development Plan of Section E is then based.

The Science Book discussion of NUSEL science is not complete. Rather, it reflects the major science themes that were developed by the science community during the Lead Physics, Outreach, and Geomicrobiology workshops, during the Aspen Underground Science program, and during NESS02 (including collaboration responses to the NRC Neutrino Facilities Committee). We are aware of several research directions that have not yet been explored adequately in these workshops. For example, there have been recent suggestions of gravitational drop tests (using the 5000-ft shafts of Homestake in place of drop towers, which are typically limited to 3000 ft or less and are influenced by wind) and of underground gravitational wave antennas. (In Japan's Oto Underground Laboratory a 300m laser interferometer TAMA operates for gravitational wave detection: the underground location provides a "quiet" location.) Underground experiments have been mounted for magnetic monopoles and other exotic objects produced in the early universe. While some materials science is included in the Applications sections of the Science Book (section III), this discussion so far has been limited to radiopurity issues in microelectronics. However, techniques for isolating a few atoms within a macroscopic sample, creating materials of extreme purity through underground manufacturing, and single-atom counting have much broader applications in materials science.

While most of the Science Book is based on materials produced by our collaboration, we have also had important help from others in the science community. In particular, following the collaboration's Lead meeting and other early work on earth science, an independent earth science group was organized by the NSF to develop the case for EarthLab. We are very grateful to them for making the results of their study available to us (section II). We intend to maintain the Science Book as a living document, updating it as the science moves forward. We invite any community member to contribute to its development.