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Challenging theoretical physics problems in the energy industry

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Critical reliance on technology is ubiquitous in the energy industry, where considerable resources are dedicated to fundamental research aimed at solving our most challenging problems. For example, technological challenges are found in all aspects of the oil and gas industry ranging from exploration, development, and production of oil fields, to transportation and refining of the raw materials, and all the way to the production of specialty products such as polymers and lubricants. From a scientific perspective, these activities cover a broad range of physical science disciplines. As examples, during the exploration and development of oil and gas fields, sound and electromagnetic waves are used to image the earth's interior, and drilling involves an array of sophisticated tools and detectors at the bore hole, both activities being possible thanks to geophysicists, applied mathematicians, and rock physics specialists. Similarly, the transformation of crude oil to refined products requires a fundamental understanding of physical chemistry, phase transition, and transport processes, while the design of products involves polymer physics, and special disciplines such as tribology. The goal of this talk is to present examples of problems posed by the energy industry in view of encouraging physicists to contribute to finding solution to these problems, either through their academic research, or by pursuing a challenging career as industrial physicists. Many of those problems can benefit from the unique approach provided by a rigorous physics training.