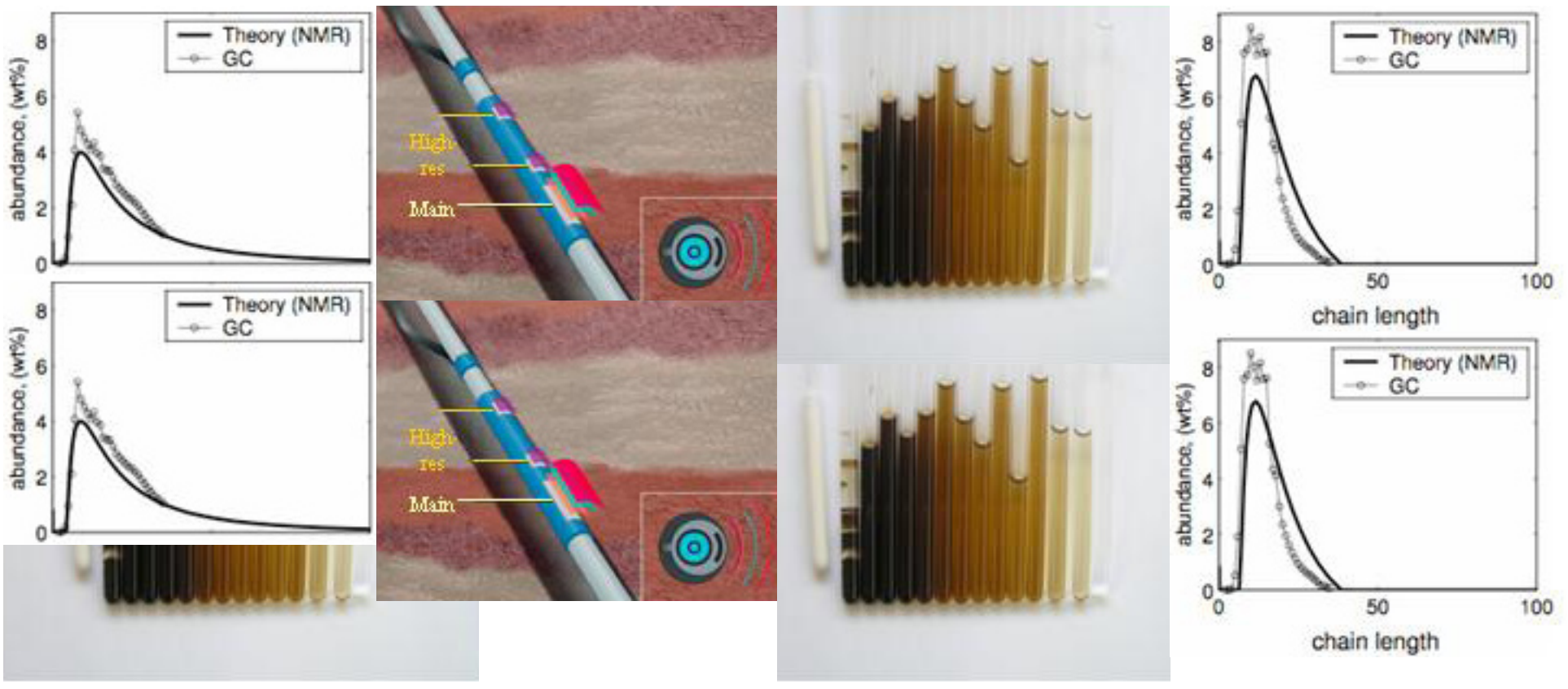
Boston University Physics Colloquium



The Physics of Crude Oils: What down-hole nuclear magnetic resonance can tell

Crude oils are complex fluids that can contain tens of thousands of different molecules. These molecules can interact to form aggregates and the fluids can also undergo several types of phase changes. The constituents of the fluid determine many of its important properties, such as its viscosity and phase diagram. These properties have an enormous effect on how easily the oil can be produced from the well. Thus, an understanding of the oil's properties, especially in its natural state, underground, inside the rocks, is desirable.

Nuclear magnetic resonance measurements of relaxation and diffusion are currently used in oil wells to determine the pore sizes in the rocks and the amount of oil, gas and water inside the pores. Of all the downhole tools, it is the only one that can give detailed information about the fluid inside the rock. In this talk, I will explain how NMR relaxation and diffusion can be used to measure properties of the oil. Both the diffusion and relaxation are sensitive to the size of the molecules in the oil. Thus, using ideas borrowed from polymer physics, we can determine the size distributions of the molecules in oils that are high in saturates. By comparing the diffusion and relaxation distributions of an oil, we can also determine something about the chemical composition of the oil. In particular, we can distinguish oils that are high in saturates, oils that are heavily biodegrated and oils that contain asphaltenes. Asphaltenes are highly aromatic, polar molecules often found in oils. They self-associate and can eventually clog the rock pores and pipelines. They are extremely heterogeneous and many of their properties are still not well understood. In this talk, I will present results on asphaltene nano-aggregation in extremely dilute solutions, which sheds some light on the size of asphaltene particles and the energy and dynamics of aggregation. I will also discuss the effects of asphaltenes on NMR relaxation in crude oils and show how they can be used to determine the size of aggregates within the crude oils.

Denise Freed

Schlumberger

October 21, 2008 (Tuesday) at 3:30pm (Refreshments at 3:15pm)

SCI 107, Metcalf Science Center, Boston University

Call: Winna Somers (wsomers@bu.edu) (617) 353-9320

Host: Claudio Chamon