

Close squint at protein molecules



N-G photo by Robert K. O'Daniell
University of Illinois chemistry Professor Chad Rienstra talks about nuclear magnetic resonance in the Chemical and Life Sciences Building on the UI campus in Urbana.

When Chad Rienstra talks about combining 3-D magic-angle spinning nuclear magnetic resonance and the liberal arts, he's not talking about pulling a rabbit out of a hat and writing poetry about it.

Rienstra, a University of Illinois chemistry professor, uses nuclear magnetic resonance – a tool pioneered by physicists that is akin to MRI – to look at the workings of proteins vital to the body's functioning.

As scientists map and understand more about gene systems, protein molecules are the next frontier in biotechnology and a focus of efforts to create new treatments for diseases such as Parkinson's disease.

Proteins work by moving and taking shapes. One of the molecules, synuclein, is associated with Parkinson's when it doesn't take the right shape. The disease affects nerve cells in the brain and impairs the ability of suffers to move.

By understanding the structure and dynamics of the protein, scientists may gain insight that could lead to techniques for preventing or reversing its malfunction.

Of course, getting a look at the shape and movements of tiny molecules is another matter.

That's where nuclear magnetic resonance, or NMR, comes in.

Like MRI, nuclear magnetic resonance involves placing a subject inside a magnetic field and exposing it to a second, oscillating magnetic field. That causes atoms in the

subject to "resonate," or give off radio frequency signals, which can be captured and used to compute images.

But where the image might be the inside of your knee or your brain in an MRI scan, protein molecules are the subject in Rienstra's experiments, particularly proteins associated with cell membranes, which aren't well understood at this point.

"It's the same basic physics (as MRI) but it's applied at a different scale," Rienstra said recently.

Rienstra and colleagues – his collaborators range from physicists to physiologists – spin samples around their axes in the magnet, at 20,000 revolutions a second, to achieve the so-called "magic angle" that produces the sharpest images.

They have helped improve both the technique used to prompt the signals from which the images are created and the hardware employed.

"Illinois is one of the few places in the world ... that can support young faculty with those sorts of resources," said Rienstra, who came to the UI in 2002 after a postdoctoral fellowship at Columbia University. He did his doctoral work at MIT.

The UI has one of the most powerful NMR magnets in the country for such experiments, and the infrastructure to support them, as well as a long history in the field.

UI Professor Herbert Gutowsky, who died in 2000, broke ground in using NMR for chemistry and medicine and the university is the longtime academic home of Paul Lauterbur, the chemist and Nobel Prize winner who developed MRI.

Originally from Michigan, **Rienstra did his undergraduate work in chemistry at Macalester College, a small liberal arts school in St. Paul, Minn.**

He was aiming for medical school when Macalester got money to buy an NMR unit and he became involved in setting it up. In working with the machine, his career plans changed.

"I decided that's the research I wanted to do in graduate school," he said.

His own experience has Rienstra involving undergraduate students at the UI in his research – four are working in his lab this summer – and emphasizing more than science.

He did a lot of writing and took economics and political science courses at Macalester and finds the experience valuable in things like preparing grant proposals, weighing the value of investing time and resources in an experiment, and navigating the byways of university politics. Now, he encourages his students to think and learn broadly as well.

The emphasis on undergraduate and cross-disciplinary education and research is one thing that recently won him a \$100,000 Cottrell Scholar Award from the Research Corporation, the oldest U.S. foundation (established in 1912) that promotes scientific research. The award recognizes cutting-edge science that also incorporates innovative teaching methods.