



Interuniversity National Consortium  
"Chemistry for Environment"

## INCA LABORATORY OF NAPLES

The Naples NMR laboratory is a competence centre by INCA Consortium and it is devoted to all different applications in environmental chemistry.

Nuclear magnetic resonance is a technique based on magnetic properties of some atomic nuclei such as  $^1\text{H}$ ,  $^{13}\text{C}$ ,  $^{15}\text{N}$ ,  $^{17}\text{O}$ ,  $^{19}\text{F}$ ,  $^{23}\text{Na}$ ,  $^{27}\text{Al}$ ,  $^{29}\text{Si}$ ,  $^{31}\text{P}$ ,  $^{39}\text{K}$ .

The ratio protons/neutrons of such nuclei causes magnetic properties (spin) and the spin movement generates a weak magnetic field. Thus, these nuclei can interact with a stationary magnetic field and will also show reciprocal magnetic interactions. These interactions, ruled by quantum mechanics laws, lead to different spin energetic levels. Applying electromagnetic radiations of frequency corresponding to energy differences, it is possible to examine these energetic levels.

Nuclear magnetic resonance spectroscopy has gained a leadership in the instrumental methods employed in the analysis and characterization of synthetic and natural chemical substances. It is employed in the determination of lipids, peptides and carbohydrates in complex alimentary matrixes such as oils, wines, honey, fruit juices; it is used in clinic field in nuclear spin tomography and it is widely used for solid samples, organic and inorganic, such as aliments, biological tissues, gels, soils.

NMR has been utilized as an advanced technique for the elucidation of molecular structures since late 60's, and the first environmental application is in 1975 when Petroff used a NMR spectrometer to monitor an effluent from an active sludge unit. Then, NMR has been employed in the analysis of wastes from paper factories, urban solid residues, pesticides and PCB. Recently this technique has been utilized in the investigation of environmental degradation of xenobiotics in soils and in the assessment of biotic and abiotic transformations of polluting organic compounds such as volatile fatty acids, cholesterol, alkyl sulfonates and detergents. A very important application of this technique is in the study of pollutants toxicity. Using substrates marked (e.g.  $^{19}\text{F}$  or  $^{13}\text{C}$ ) allow to follow the cellular metabolism of pollutants and understand the action mechanism.

The Naples Laboratory has a spectrometer NMR Varian 500 MHz purchased in the framework of P0 Project, Legge 488/92. This laboratory is located in the Centro Interdipartimentale di Metodologie Chimico-fisiche of the University of Naples Federico II, where technical assistance is guaranteed. This Centre has many NMR spectrometers as well as mass spectrometers, X-ray diffractometers, UV spectrophotometers and computers for molecular dynamics studies.

This NMR apparatus has allowed us the development of researches included in the P0 Project:

- Synthetic strategy for stereoselective preparation of nucleosides analogs (purinic and pirimidinic).
- Synthesis of new environmental-friendly algicides, mimicking natural products,
- Isolation and characterization of metabolites by aquatic plants, inhibiting algal growth
- Chemical and toxicological investigation of phenolic compounds by olive oil mill wastewaters, in order to develop an eco-compatible disposal.
- Structure elucidation of polysaccharides by extremophile bacteria and phytopathogen fungi.

In this moment studies on environmental transformation of pharmaceuticals and pesticides are in progress. We hope that in future new research activities will be supported by NMR studies, especially studies on environmental transformation mechanisms and green technologies.

In 2003 the Naples laboratory arranged a NMR course for young researchers from INCA to get deeper insight into the potential of NMR in environmental studies. This activity will continue because it is an essential condition for the research delopment.