



ABSTRACT

The Nuclear Magnetic Resonance (NMR) Core Facility of the WCM Core Laboratories Center provides state-of-the-art biological and chemical nuclear magnetic resonance resources and services, and expertise in their analytical, structural and biochemical applications, to the Weill Cornell Medicine (WCM) community and to outside investigators. Services include sample preparation, NMR data collection and data analysis. The core facility provides consultation on project design and data analysis, and offers seminars, training and educational workshops.

OVERVIEW

Background: NMR is an essential component of structural biology since it is uniquely suited to examine changes in the conformation, structure and mobility of biomolecules using solution conditions closely approximating the biological environment. NMR is critical for chemical analysis and synthetic chemistry, providing atomic "eyesight" for confirming chemical compounds. NMR data is often required for patents and publications. NMR is also a necessary component in drug discovery efforts. Basic NMR applications can be employed for assessing sample purity, chemical changes, binding events and the effects of mutations. More involved multidimensional NMR applications can be implemented for protein structure determination and dynamics investigations.

History: The NMR Core Facility was founded in 1999. The core became part of the WCM Core Laboratories Center (CLC) in 2015.

Location: The NMR Core Facility's instruments are located in the "S" building annex at 516 East 72nd Street, New York, NY, and in the basement of the Belfer Research Building at 413 East 69th Street, New York, NY.

WCM Core Laboratories Center (CLC): The WCM CLC was established in 2015. In addition to the NMR Core Facility, the CLC includes core facilities that offer resources and services in genomics and epigenomics, proteomics and metabolomics, synthetic and analytical chemistry, flow cytometry, imaging (including optical and electron microscopy and high content screening) CBIC (MR/MS, PET/CT, and ultrasound), biorepository, bioinformatics, and advanced technology assessment.

Instruments: The core's resources include four NMR spectrometers (Bruker Avance III HD 600 MHz, Bruker Avance III HD 500 MHz, Bruker Avance III 500 MHz, Varian Inova 600 MHz). All of the facility's instruments are used directly by investigators, with training and support from the facility staff.

Sample preparation: The core offers advice and basic equipment for NMR sample preparation, including solvents, NMR tubes, and instrumentation for preparing protein and small molecule samples.

NMR data collection and data analysis: The core provides state-of-the-art methods for collection and analysis for NMR studies of protein and peptides for analyzing structure, stability and dynamics. Projects can range from rapid 1D analysis of protein structure, or molecular characterization, to measurement of molecular size and protein dynamics, and heteronuclear NMR assignments for investigation of structural change and molecular binding interactions. The core also provides NMR chemical analysis for conformation of chemical composition, characterization of reaction products, investigation of chemical impurities and chemical quantification. We have the capability to rapidly examine arrays of conditions for chemical reactions and protein stability/solubility. The core also offers the capability to test large arrays of chemical reaction products, to confirm the integrity of chemical libraries, and to examine an array of conditions for protein and biological molecule stability studies or for fragment-based drug binding discovery studies.

Consultation and training: The core offers consultation on NMR applications, including project design, sample preparation, data collection methods and data analysis. The core also offers training for unassisted use of the core's instruments.

Administration: The NMR Core Facility is administered by the Weill Cornell Medicine (WCM) Core Laboratories Center (CLC).

Open to all: The resources and services of the NMR Core Facility are open to all investigators at Weill Cornell Medicine, Cornell University and Cornell-affiliated institutions. The facility also provides services to external investigators at both academic institutions and commercial enterprises.

RESOURCES

Four NMR spectrometers (Bruker Avance III HD 600 MHz, Bruker Avance III HD 500 MHz, Bruker Avance III 500 MHz, Agilent Varian Inova 600 MHz), facilities for sample preparation and offline data analysis.

NMR Applications

- ◆ Protein Structure Characterization
- ◆ Chemical Analysis
- ◆ Measurement of molecular size
- ◆ Protein dynamics
- ◆ Investigation of structural change
- ◆ Molecular binding interactions.
- ◆ Conformation of chemical composition
- ◆ Characterization of reaction products
- ◆ Investigation of chemical impurities
- ◆ Chemical quantification
- ◆ Biological assays
- ◆ Rapidly examine arrays of conditions for chemical reactions and protein stability/solubility
- ◆ Test large arrays of chemical reaction products
- ◆ Confirm the integrity of chemical libraries
- ◆ Examine an array of conditions for protein and biological molecule stability studies
- ◆ Fragment-based drug binding discovery studies

NMR Instrumentation



Bruker Avance III HD 500 MHz

- automated NMR runs
- daytime walk up use
- small molecular analysis
- fragment based drug discovery
- protein and peptide studies
- cryogenic probe for ¹H/¹⁵N detection
- located in the Belfer Research Building



Bruker Avance III HD 600 MHz

- protein NMR applications
- cryogenic probe 700K1 H₂S/N
- funded by S10 OD016320
- located in the "S" building



Varian Inova 600 MHz

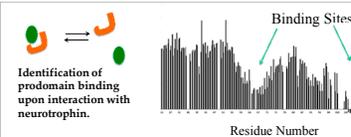
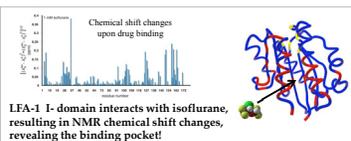
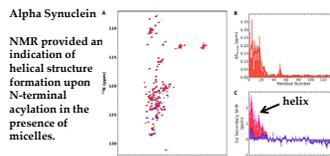
- biomolecular NMR applications
- cryogenic probe 400K1 H₂S/N
- located in the "S" building



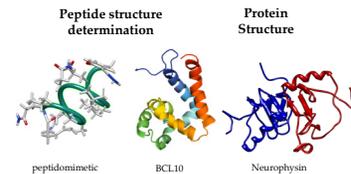
Bruker Avance III 500 MHz

- small molecular characterization
- broad band ¹H, ¹³C, ¹⁵N, ³¹P detection
- located in the "S" building
- funded by S10 RR023694

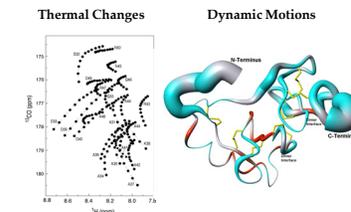
Binding and Association of Biomolecules



Structural Analysis



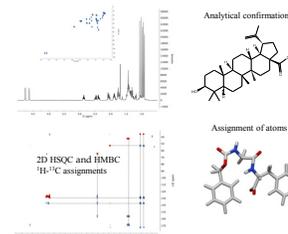
Dynamic Analysis



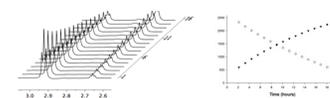
Sequence specific analysis of thermal unfolding of proteins and peptides. Both folded and unfolded protein conformations display linear NMR temperature shifts. The degree of curvature indicates regions of structural transitions.

NMR relaxation measurements identify mobile (wide) and rigid (narrow) regions within a protein.

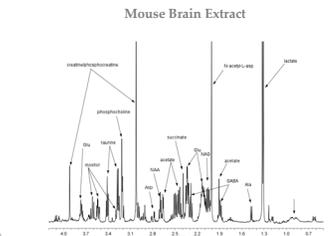
Chemical Analysis



Kinetic Analysis



Metabolomics Analysis



Consultation, Workshops and Training

Consultation on project design and data analysis.

Educational workshops and hands-on training.

Seminars on emerging NMR technologies and applications.

Coordinated project design consultation and image analysis support available with the CLC synthetic and analytical chemistry, proteomics and metabolomics, genomics and epigenomics, flow cytometry, imaging (including optical microscopy, multiphoton microscopy, electron microscopy, high content screening, MRI, PET/CT, and ultrasound), biorepository, bioinformatics, and advanced technology assessment core facilities.

Contact Information

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