Varian Mercury 300 NMR spectrometer

High performance research spectrometer featuring:

- Linear, high dynamic range RF system
- Two RF channels with observe, pulse, and decouple functions
- Direct digital synthesis for accurate frequency and phase synthesis
- High sensitivity broadband preamplifier
- High sensitivity highband preamplifier for 1H and 19F observe with high speed active T/R switch
- 2H Lock with high sensitivity quadrature detection, compatible with pulsed field gradients and automated 1H and 1H gradient shimming
- Real time data acquisition system
- Ethernet TCP/IP interface to host workstation
- 16 bit ADCs, digital filters, high dynamic range receiver
- Frequency shifted quadrature detection capability for elimination of zero frequency and quadrature artifacts

Oxford 300/54 Magnet Operating Data

- Magnet No: B0390
- Cryostat No: Low field DLN 2273
- Project No: 102399
- Room temperature bore diameter: 54mm
- Central field: 7.05 Tesla
- Field current: 39.60 Amps
- Field current ratio: 0.1769 Tesla/Amp
- Current control setting: 41 Amps
- Overfield current: 250 mA
- Inductance: 70 Henry
- Switch open resistance: 10 Ohms
- Switch heater resistance: 100 Ohms
- Switch heater current: 60 mA
- Distance between cryostat base plate and magnet centre line: 235mm
- Distance between Varian RT Shim coil mounting flange and magnet centre line: 251 mm
- RT Shim coil spacer length: 16mm

Cryogenic Performance

- Liquid nitrogen required during commissioning: 100 liters

- Liquid helium required during commissioning: 100 liters
- Liquid nitrogen evaporation rate: less than 95 cc/hr
- Liquid nitrogen refill volume: 32 liters
- Liquid nitrogen refill interval: 14 days
- Liquid helium evaporation rate: less than 13.5cc/hr
- Liquid helium refill volume: 26 liters
- Liquid helium refill interval: 80 days

General Varian Mercury 300

Varian designed the ***MERCURY* NMR** spectrometer with built-in modularity, permitting easy selection of configurations for the experimental requirements of a specific laboratory. The *MERCURY* NMR spectrometer operates at proton frequencies of 200, 300, and 400 MHz, depending on the model. The 200 and 300 systems are also each available in a lower power, 4-nuclei version. A superconducting magnet bore of 54 and 89mmis available, with standard liquids probes accepting sample tube diameters of 5 and 10 mm.

System Components

A *MERCURY* system intended for liquids operation has three major groups of components:

• *Host computer system* – Includes a Sun Microsystems workstation with networking capabilities, keyboard, mouse, color monitor, hard disk drives, optional plotters and
printers, optional CD-ROM drive, and optional tape units for data storage.

• *Magnet and magnet console interface* – Includes the probe, upper barrel, preamplifiers and related electronics, and air supply controls.

• *NMR console* – Includes rf and digital cardcages, rf amplifiers, and power supplies. The magnet is a superconducting solenoid contained within a dewar system. Without refilling, the 200/54 and 300/54 magnets provide an 80-day temperature hold. The 200/89 and 300/89 magnets are available in 235-day and 365-day long-hold versions. The 400/54 magnet is available with 183- or 365-day temperature-hold capabilities.

The NMR probe and its matching upper barrel, as well as the room temperature shim coils, are located in the magnet's ambient temperature bore. The upper barrel typically contains the sample insertion, spinning, and ejection systems and a circuit that senses the sample spinning rate. The NMR probe contains rf circuits that apply the observe, lock, and decouple transmitter frequencies to the sample and detect the resulting NMR signals.

Most probes can be tuned to detect NMR signals at several frequencies. Many probes also contain provisions for controlling the sample temperature. The preamplifiers that receive the NMR signals from the probe amplify the input and send the resulting signal to the Receiver board and processing circuits in the console. The preamplifiers are located near the magnet in the magnet legs.

The NMR console contains circuits that generate the rf energy to irradiate the sample, detect the NMR signal from the sample, and digitize that signal for processing by the host computer system. Support functions in the NMR console include power supplies, magnetic field shimming current sources, and optional modules, including the variable temperature controller and the pulsed field gradient amplifier. There are options available that permit pulsed field gradient measurements, variable temperature control, homonuclear decoupling, autospin control, and autosample changing. An optional Serial Interface board provides the interface to the spectrometer for the sample changer and the Autospin board. The spectrometer operator performs experiments using VNMR (the Varian NMR software package that runs on Sun workstations), Solaris, and CDE (Common Desktop Environment) software.

Magnet

The magnet assembly consists of a superconducting, gradient-compensated solenoid enclosed in a low-loss liquid nitrogen and liquid helium dewar. The ambient-temperature bore tube through the solenoid axis is provided for insertion of the room temperature shim coils and probe assembly.

Probe and Upper Barrel

The probe assembly for the magnet consists of two parts: a unit that extends through the top of the dewar, called the upper barrel, and a lower unit, called the probe. These two units are mounted within the vertical axis of the magnet and are tightly mated, with the probe insert from the bottom of the magnet, and the upper barrel mounted from the top. Pulsed field gradient measurements may require a PFG upper barrel and a PFG probe. The probe contains tuned rf circuits that transmit energy to the sample and receive the resulting NMR signal. In most probes, for NMR observations at different frequencies, these circuits are tunable through controls located on the probe. Systems equipped with the variable temperature (VT) module have probes incorporating heating and sensing elements. Good thermal isolation results because these elements are located within a dewar jacket inside of the VT probe. The optional PFG probe has additional coils that permit modification of the magnetic field for pulsed field gradient measurements. The upper barrel contains the sample spinning mechanism, tachometer (to sense rotational speed), and pneumatic sample insertion and ejection system. The sample is placed into the upper barrel and conveyed by a cushion of air to the air bearing, which allows the turbine and sample to rotate at a controlled rate. The PFG probe may require a PFG upper barrel. An assortment of probes are available, including 1H/13C computer-switchable, broadband, auto (four-nucleus), and Nano probes.

Magnet Leg

The *MERCURY* lock and observe channel preamplifiers, optional Auto Spin board, and optional Spinner Sense/Tach Interface board are contained in the magnet leg. The rf tune interface and the sample handling pneumatics are also located in the magnet leg. The 200- and 300-MHz spectrometer magnets are actually mounted on the magnet legs containing the electronics. In the case of

the 400- MHz system, the magnet is on mechanical legs, and the preamplifiers, pneumatics, and options are in separate “legs” adjacent to the magnet.

NMR Console

The *MERCURY* NMR console consists of one small, compact cabinet. The front door is hinged to swing open and can be removed. The optional PFG amplifier and optional variable temperature unit are accessible through this door.

When the NMR console is viewed from the rear, the left-hand cardcage contains the digital printed circuit boards, including the acquisition CPU. The right-hand cardcage contains the rf printed circuit boards and the shim/DAC driver. The system power supply module contains the power supplies for the rf cardcage and two rf power amplifiers. The power supply for the digital cardcage is inside the console and is attached to the back of the digital cardcage. Access is obtained by removing the console side panel.

System Options

MERCURY spectrometers can be equipped with the following options:

- Homonuclear Decoupler board
- Computer Controlled Insert/Eject Module
- Pulsed field gradient (PFG) amplifier
- Variable temperature (VT) unit
- Sample changers (9, 50, or 100 samples)
- CD-ROM drive
- Additional disk or tape drives for increased data storage
- Printers and plotters for color and higher-resolution data output