

2. Safety

GNIRS is a large, heavy and complex instrument, which operates at low temperatures and under vacuum. This section is intended as an overview of relevant safety considerations, which identifies procedures or precautions that may be necessary when working on the instrument, in order to avoid injury to individuals or damage to the instrument.

This section is *not* intended as a manual covering general laboratory or observatory safety procedures. Refer to observatory safety manuals for that purpose.

2.1 Mechanical Handling Precautions

Many components of GNIRS are too heavy to be handled without proper lifting equipment, and at times two or more people may be needed. In some cases, specific lift points or procedures are required for proper safety. Refer to section 8.1, and to the individual procedures (sections 4 and 8). It is important to follow all procedures carefully, as well as general safety procedures associated with the use of lifting equipment.

2.2 Cryogenic System Precautions

The primary cooling for GNIRS is provided by four cryocoolers, which operate using high-pressure, high-purity helium. Failure to follow proper procedures (section 4.2.3) can lead to contamination of the telescope helium supply system, and possible damage to cold heads on GNIRS and other instruments using the system. In addition, the high pressures involved pose a potential risk during disassembly of the cryocoolers; follow the specified procedures.

If the liquid nitrogen precool system is used for initial cooling of the instrument, large quantities (approximately 1000 liters) of liquid nitrogen are involved. These large volumes require not only the precautions appropriate when handling cryogenic liquids, but also adequate ventilation to avoid asphyxiation. In addition, operation of the pre-cool system presents a noise hazard, and hearing protection is strongly recommended. See Section 4.2.4.

2.3 Electrical System Precautions

The thermal enclosures contain voltages up to 220V. These voltages may be present in individual racks even when front panel switches are "off". Power down all racks completely or take other precautions as indicated in section 6.5. Similar voltages may also be present inside the dewar if the thermal enclosures are connected and powered on. For procedures involving partial disassembly of the instrument, one should therefore always fully power down or disconnect the thermal enclosures.

In addition, many components, especially detectors, are sensitive to electrostatic discharge. It is essential to take proper ESD precautions when working on the thermal enclosures, electronics mounted on the dewar, or in the vicinity of the detector and detector mount. See sections 8.8 and 6.5.

2.4 Vacuum Precautions

The dewar is normally under vacuum. Loss of vacuum or deliberate pressurization while cold can lead to damage to optics, detectors, and possibly other components. It is important to pressurize the dewar *only* when the insides are near ambient temperature, and to do so slowly. See section 4.2.6 for details.

If the dewar is sealed, verify that it is at ambient pressure before attempting to remove dewar shells, covers, etc. Damage to components and even injury to people is possible if this is not done. Note that variations in ambient pressure over time or between sea level and the telescope are significant for an instrument this size; always verify that pressure has been equalized immediately prior to any disassembly procedures.

2.5 Optics Precautions

The optics in GNIRS are susceptible to thermal and mechanical shock and to contamination. Proper handling by experienced personnel is required; see section 8.7 for details.

2.6 Cleanliness

The instrument should always be opened in a clean-room environment, in order to avoid contamination. Contamination can lead to degraded optical, vacuum, and cryogenic performance. Contamination of the science array can be irreversible. If the instrument has been in use for any length of time, the dewar outside and the thermal enclosures should be cleaned off prior to bringing it into the clean room. These precautions apply to *any* procedure that involves access to the inside of the instrument, not just the major operations covered in section 8.