LINC-NIRVANA

The **L**BT **IN**terferometric **C**amera and **N**ear-**I**nfra**R**ed / **V**isible **A**daptive i**N**terferometer for **A**stronomy

A collaborative project of the MPIA Heidelberg, INAF-Arcetri, Universität zu Köln, and MPIfR Bonn

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# LINC-NIRVANA

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## Services

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# Document Change Record

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| 1.0 | 20 April 2005 | All | new document |
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# 1 Scope

This document describes the services from the telescope to the instrument. In the case of LINC-NIRVANA this is cooling water-glycol (50%/50%), electricity and Ethernet. There is no need of dry air or pressurized air as we know up to now. The building of humidity on the cryostat windows could bring the need of a dry air flow.

# 2 Applicable documents

| No. | Title | Number & Issue |
|---|---|---|
| 1 | Interface document GWS – Services | LN-MPIA-FDR-INT-302 |
| 2 | Interface document MHWS – Services | LN-MPIA-FDR-INT-312 |
| 3 | Interface Document Cryo Cooler – Services | LN-MPIA-FDR-INT-502 |
| 4 | Interface document Cabinets – Services | LN-MPIA-FDR-INT-101 |
| 5 | Computer Architecture | LN-MPIA-FDR-ICS-007 |

# 3 Acronyms and abbreviations

All acronyms and abbreviations are explained where they appear.

# 4 Introduction

The telescope supplies central distribution points for cooling water, electricity and Ethernet. As we need these services at several places on the instrument we need a distribution on systems for the different consumers. The number of consumers and if applicable the amount of consumption is listed in this document.

# 5 Functions

Water-glycol distribution panel on the instrument platform

Water-glycol distribution at the cooler

Electricity distribution on the instrument platform

Electricity distribution at the cooler

Ethernet distribution

# 6 Water-glycol distribution panel on the instrument platform

## 6.1 Purpose

On the instrument platform, there are two connection points with cooling water-glycol for LINC-NIRVANA. The connectors are placed below the telescope derotator flange, each side with a supply and a return line. From these points, we have to distribute the cooling water to the different consumers and feed it back to the return line.

## 6.2 Requirements

Water flow and heat input has to be balanced between the right and the left sides.

Overall water flow has to stay almost constant

Water temperature in the return line <1.5°C above ambient.

Reliable and safe connectors

Suitable for the coolant type and the ozone concentration on the mountain.

Working in the temperature range of the coolant

The water distribution should be connected to the optical bench to make transport easier

## 6.3 Parts

Supply line distribution panel with

- Adjusting valve (for each line)
- 3 way control valve (for each line which is connected to a rack)
- flow meter (for each line)
- shut off valve (for each line)
- Swagelok quick connector (for each line)
- flow meter (for over all consumption)
- Swagelok quick connector (for over all consumption)

Return line panel

- Shut off valve (for each line)
- Swagelok quick connector (for each line)
- Swagelok quick connector (for over all consumption)

Tubes

Hoses

Mounting board

Temperature controller with temperature sensors as described in LN-MPIA-FDR-ELEC-003

## 6.4 Layout

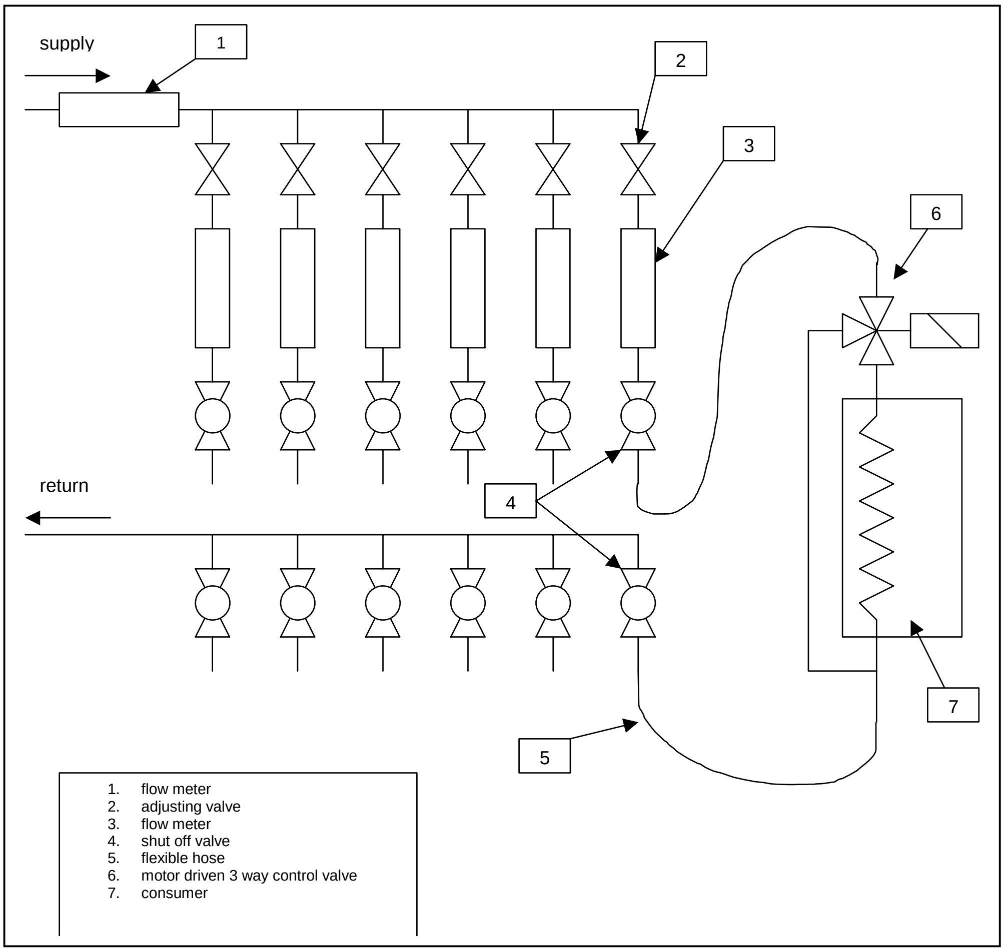


Figure 1: schematic diagram of the water distribution panel

## 6.5 Functionality

The supply line from the telescope is distributed on each side into 6 lines, each with a flow meter and an adjusting valve. With the adjusting valve, the flow in a line can be set to the required value, read from the flow meter. Every line has a shut off valve. The overall consumption is measured with a flow meter in the supply line. For the racks, a 3-way valve feeds either cooling water through the air to water heat exchanger or through a by-pass line to the return line. So even with changing water consumption, the overall flow stays constant. For the racks, the 3 way valve is controlled by a PID temperature controller. The temperature inside the rack is measured and compared with the outside temperature. If the outside temperature falls below the working temperature of the electronics the controller switches of the cooling water flow and stabilizes the inside temperature to a value of about 10°C. The CCD cameras at the MHWS and the GWS have a constant flow of cooling water. There is no control with 3 way valve. A bypass line is not needed for them, because they can work at the ambient temperature from –20 to 25°C.

## 6.6 Specification

Location tbd, mounted on the optical bench

| | | |
|---|---|---|
| Dimensions | tbd | |
| Hoses | from EPDM, ID 13mm, OD 20 | |

Consumption/flow right side

| | Watt | l/min |
|---|---|---|
| • Rack R1 | 1400 | 6- 8 |
| • Rack R2 | 1400 | 6 – 8 |
| • Rack M1 | 1000 | 6 – 8 |
| • CCD (GLWS) | 10 | 1 |
| • CCD (MHWS) | 10 | 1 |
| • CCD (Patrol camera) | 10 | 1 |

Consumption/flow left side

| | Watt | l/min |
|---|---|---|
| • Rack L1 | 1400 | 6 – 8 |
| • Rack L2 | 1400 | 6 – 8 |
| • Rack M2 | 1000 | 6 – 8 |
| • CCD (GLWS) | 10 | 1 |
| • CCD (MHWS) | 10 | 1 |
| • CCD (Patrol camera) | 10 | 1 |

Cooling water temperature: 1° below ambient, –25 to +25°C

## 6.7 Availability

All parts are standard size water piping equipment conforming to LBTO standard. They can easily be exchanged and replaced by other standard parts.

# 7 Water distribution at the cooler

## 7.1 Purpose

The cooler of the LINC cryostat will be placed on level 4. It will need its own cooling water connection. The cooler will have a thermally isolated housing to reduce the amount of heat loss to air. Therefore, the air inside the housing has to be cooled.

## 7.2 Requirements

| | |
|---|---|
| Cooling water temperature: | 6°C constant |
| Water flow: | for cooler 850 l/h (14 l/min) |
| | for air to water heat exchanger < 200 l/h |

Cooling power: for cooler 12kW
for air 2 kW

## 7.3 Parts

Supply line with

- Adjusting valve
- 3 way control valve
- flow meter
- shut-off valve
- Swagelok quick connector

Return line with

- Shut-off valve
- Swagelok quick connector

Tubes
Hoses

## 7.4 Layout

See chapter 6.4. The layout is similar to the water distribution on the platform. Here, we only have two consumers and no control valve is needed.

## 7.5 Functionality

There will be a constant water flow through the cooler. The supply temperature will in any case be constant. This will be sufficient to keep the cooler at working temperature at any outside temperature. The flow is measured and can be adjusted with a needle valve to the required value. For fast and reliable connection, we use the telescope-standard quick connectors Swagelok QTM series. The thermally-isolated housing will have a built in heat exchanger to remove the power loss inside. The flow through the heat exchanger will be set to a constant value. In case of cold outside temperature, the water will keep the inside above 0°C. In case of high outside temperature the water flow will keep the inside temperature below 20°C. We will therefore always stay in the required working temperature range.

## 7.6 Specification

| | |
|---|---|
| Cooling water temperature: | 6°C constant |
| Water flow: | for cooler 850 l/h |
| | for air to water heat exchanger < 200 l/h |
| Cooling power: | for cooler 12kW |
| | for air 2 kW |
| Cooling water temperature: | 6°C |

## 7.7 Availability

All parts are standard size water piping equipment. They can easily be exchanged and replaced by other standard parts.

# 8 Electricity distribution on the instrument platform

## 8.1 Purpose

On the instrument platform, there are two connection points with power supply. The connectors are placed below the telescope derotator flanges, one on each side. From this point we have to distribute the power to three cabinets.

## 8.2 Requirements

- Easy access to the power service points.
- Terminal blocks for AWG 11
- Through hole for two cables (3AC and UPS) with strain relief
- The power (3AC and UPS) must be disconnectable for the installation
- Maximum rate current (208/3AC 60Hz): 15 A / Phase
- Maximum rate current (120/1AC 60 Hz UPS): 25 A

## 8.3 Parts

Distributor cabinets
Terminal blocks
30AMP 1Phase 3W 125VAC Connector (Mennekes ME 330C4)
30AMP 1Phase 3W 125VAC Inlet Plug (Mennekes ME 330B4)
20AMP 3Phase 5W 120/208VAC Connector (Mennekes ME 520C9)
20AMP 3Phase 5W 120/208VAC Inlet Plug (Mennekes ME 520B9)

## 8.4 Layout

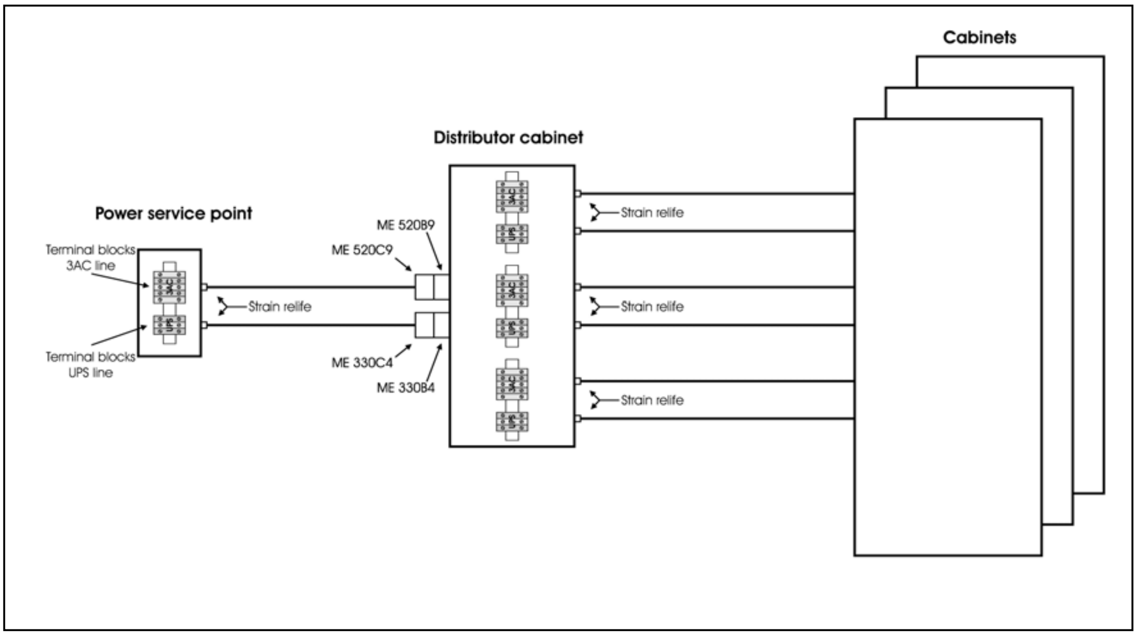


Figure 2: schematic diagram of the power connection

## 8.5 Functionality

From this connection point, we will distribute the power to the different cabinets using a small power distribution cabinet (one on each side), which is mounted on the instrument substructure. The cabinets for the electronics are mounted on the substructure, too. To remove the instrument it is only necessary to disconnect four power connectors (two on each side) from the distributor cabinets. The distribution cabinet includes only terminal blocks and a service outlet (120 VAC) for all devices.

## 8.6 Specification

Power consumption left: Cabinet L1: 2200W
Cabinet L2: 1800W
Cabinet M1: 1200W
Power consumption right: Cabinet R1: 2200W
Cabinet R2: 1800W
Cabinet M2: 2600W

Power supply cables (208/3AC 60Hz) from service point to distributor cabinet: 5 x 4mm²
Power supply cables (208/3AC 60Hz) from distributor cabinet to cabinets: 5 x 2.5mm²
Power supply cables (120/1AC 60Hz UPS) from service point to distributor cabinet: 3 x 4mm²
Power supply cables (120/1AC 60Hz UPS) from distributor cabinet to cabinets: 3 x 2.5mm²

# 9 Electricity distribution at the cooler

## 9.1 Purpose

The cooler of the LINC-NIRVANA cryostat will be placed at level 4. It will need its own power connection.

## 9.2 Requirements

- Easy access to the power supply connector.
- Power supply connector from type ME560MI9 (3x208AC, 60A) on Level 4
- Power supply connector from type ME560MI9 (3x208AC, 60A) on integration area

## 9.3 Parts

- Rital chassis for the terminal blocks and fuses
- Strain relief
- Terminal blocks and fuses
- Service outlet (120VAC)
- 60AMP 3Phase 5W 120/208VAC Connector (Mennekes ME 560P9W)

## 9.4 Layout

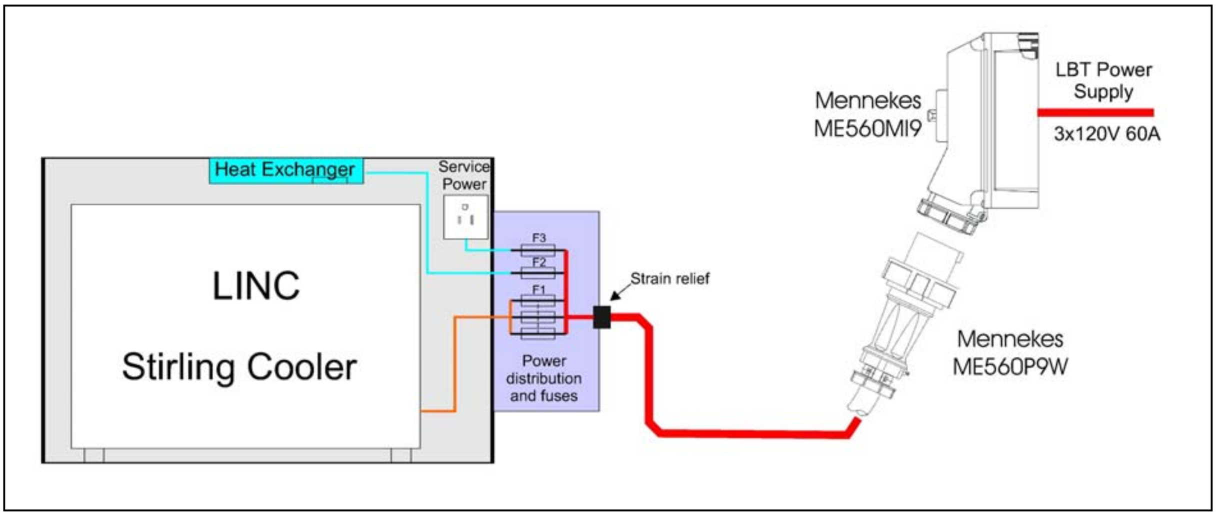


Figure 3: schematic diagram of the power distribution at the cooler

## 9.5 Functionality

A small chassis on the noise- and vibration protection cover will house the strain relief for the power cable and will also include the fuses for the compressors and heater exchanger. The cooling unit is removable and it is easy to disconnect the power.

## 9.6 Specification

Power consumption for the Stirling cooler: 14 kW (3x208AC, 40A)

Power consumption for the heat exchanger: 500 kW (1x120AC)

# 10 Ethernet at the instrument platform and lower tree-house

## 10.1 Purpose

Several electronic components of LN will be operated remotely. All of these need Ethernet connection. It may also be necessary to mount some of the real-time computer needed for Adaptive Optics, detector readout or fringe tracking on the instrument platform or in the lower tree house. They need Ethernet connection as well.

## 10.2 Requirements

- Easily accessible on the bench and each cabinet.
- No hanging cables, easily detach and attachable. Therefore it is suggested to have an access point right and left on the instrument for internal cabling. This access point will be connected with the LBT service connection point.
- Separate right and left access point.
- Ethernet to/in the computer room.
- Ethernet to/at the lower tree house
- Ethernet to/at the instrument platform (SCP)

## 10.3 Parts

- Cabling SCP to IAP (right and left).
- Ethernet switch at IAP (right and left).
- Commercial hub at top of bench (right and left).
- Cabinet cabling
- Component cabling (i.e. web cam)

## 10.4 Layout

To full fill the requirements, a separate cabling from SCP to IAC is suggested, which can be detached. The instrument internal cabling can be fixed since the instrument will be installed fully integrated. A HUB placed on the top of the bench makes it easy to connect with a Laptop while testing the instrument.

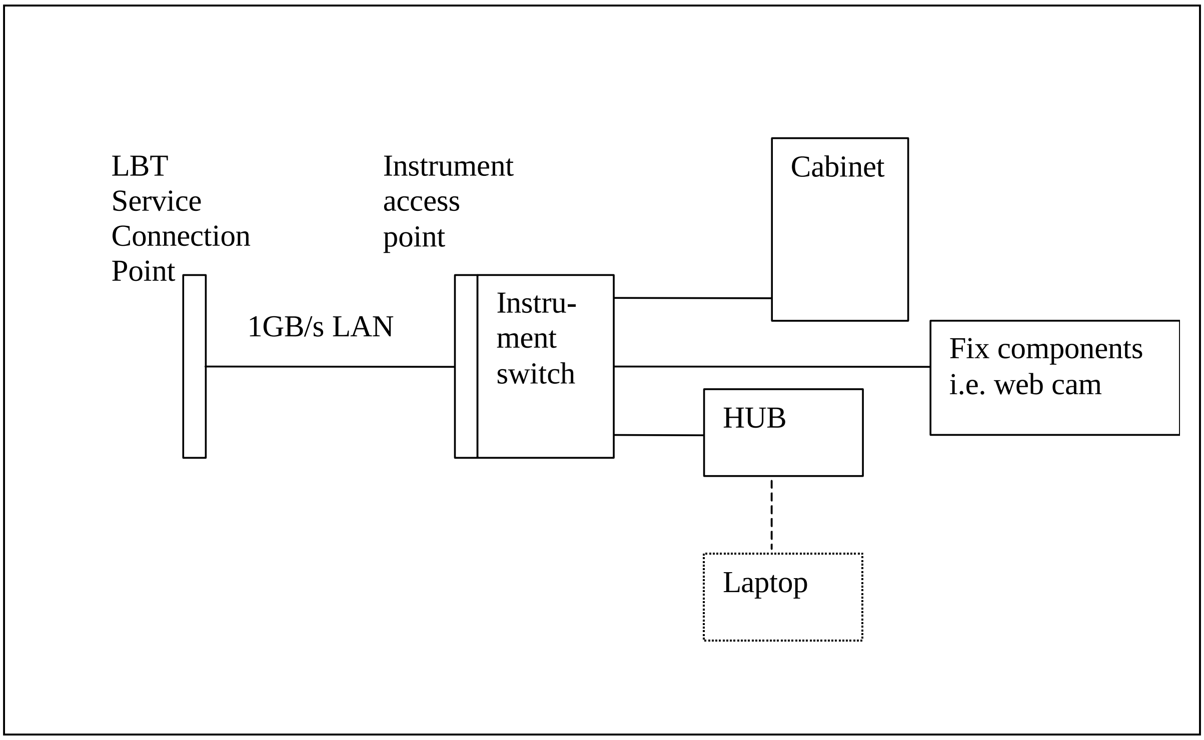


Figure 4: schematic diagram of the Ethernet distribution

## 10.5 Functionality

The HUB on top of the bench will provide Ethernet connection for all kind of components and Laptops which are not permanently mounted on the bench and need some connection.

The Switch at the IAC will do the dispatching of the Ethernet to each cabinet and component.

## 10.6 Specifications

- All components should be commercial 1GB/s Ethernet components.
- Number of ports at the Switch: (TBD)
- Number of ports at the HUB: > 3.

## 10.7 Availability

All components are commercially available within days.

# 11 Dedicated Fiber connections

## 11.1 Purpose

LN needs dedicated fiber connections for electronic components which have to be operated in real-time conditions, i.e. the deformable mirrors, piston mirror stage, etc. A more detailed layout and description of the dedicated fibers can be found in LN-MPIA-FDR-ICS-007 "Computer Architecture".

## 11.2 Requirements

- Fiber patch board at instrument platform with fiber connections to computer control room and/or lower tree house.
- Number of fibers: ≥26

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