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Specs and Design Options for a 8”-flat-panel MCP-PMT Fabrication Facility

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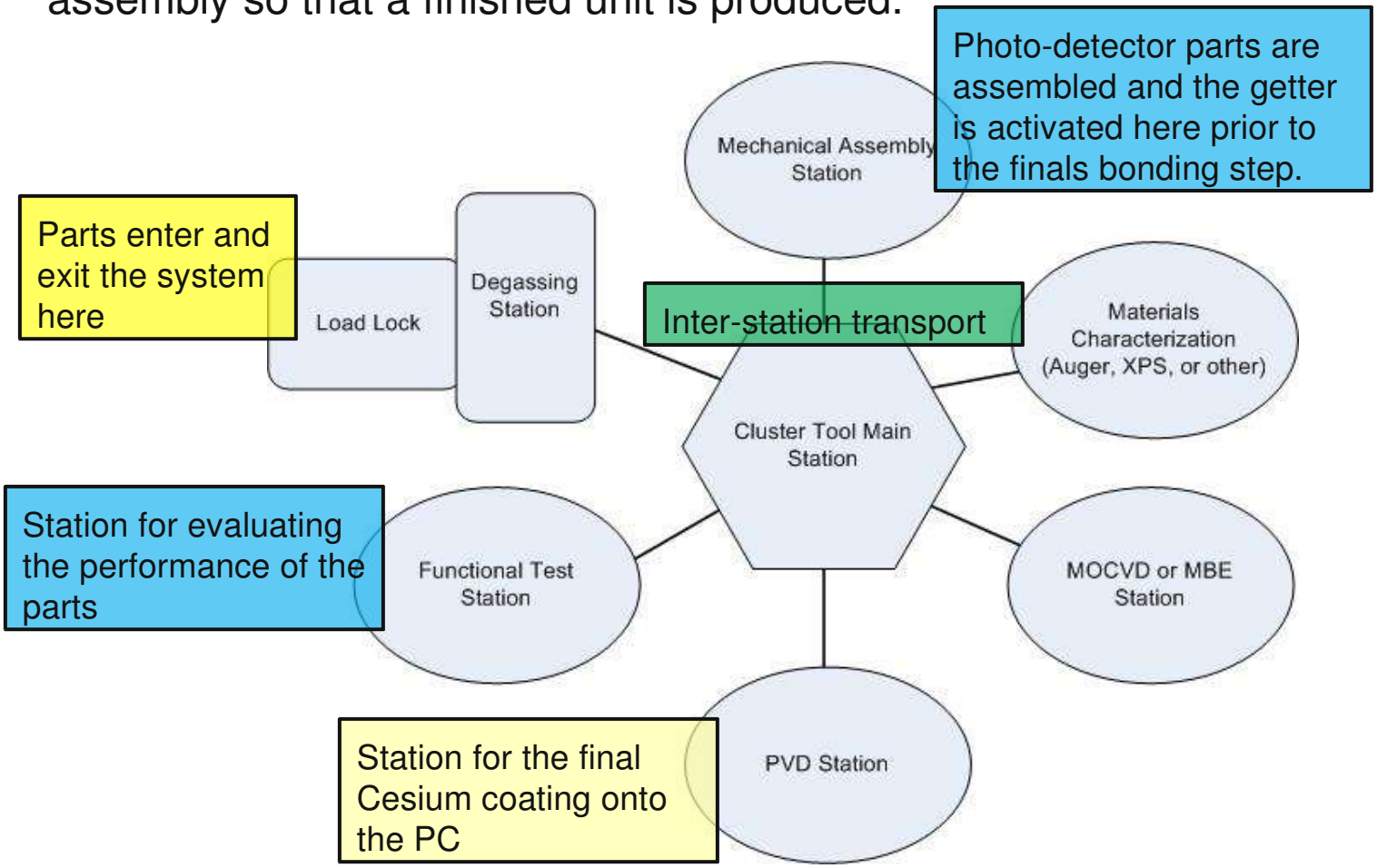
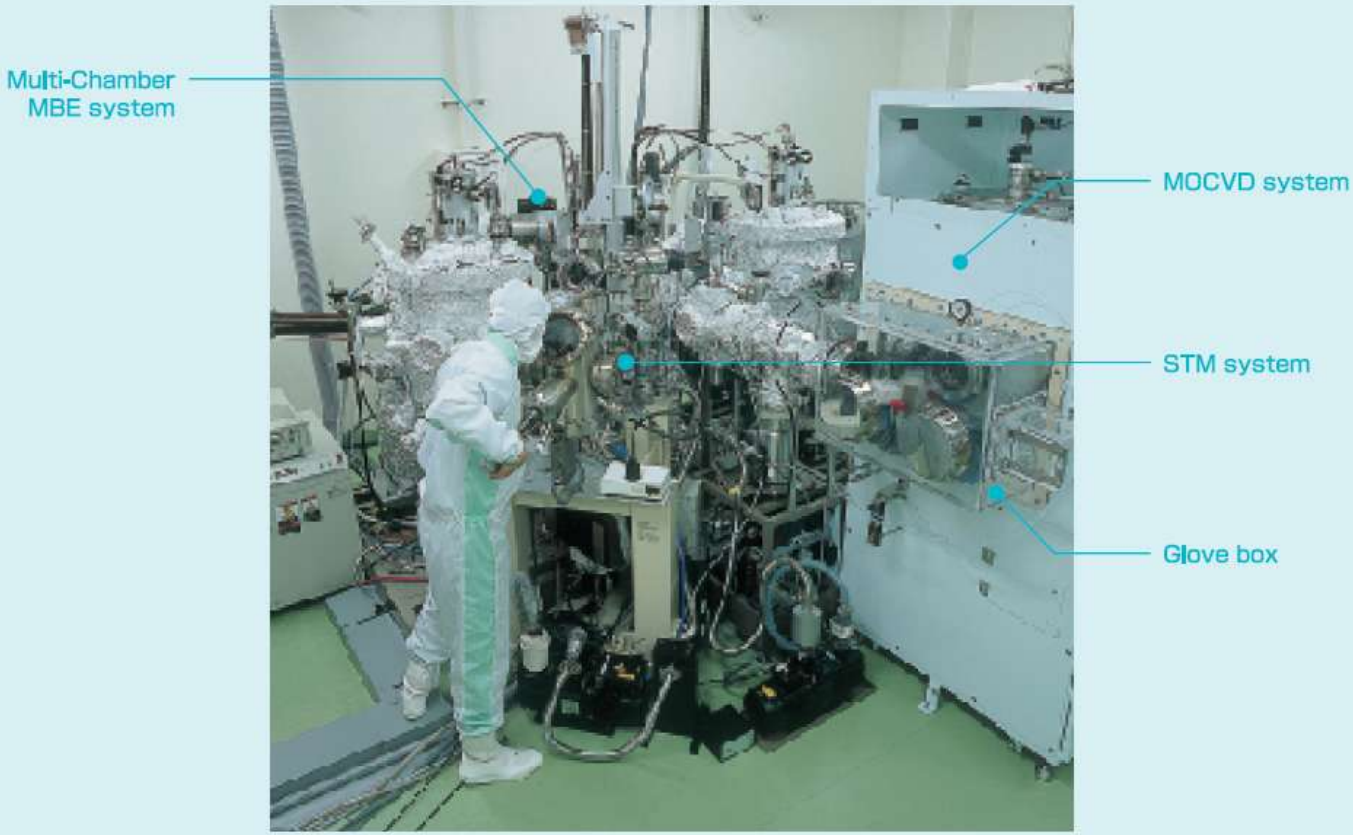
Outline

- Photocathode Process Modules
- Progression of systems
- Functional Test System
- Photo Detector Assembly System
- Processes for Photocathode Fabrication
- Cluster Tools
- Facilities for Equipment

Photocathode Process Modules

- The diagram below depicts a general system for applying the photo-cathode films and bonding it to the other parts of the photo-detector assembly so that a finished unit is produced.



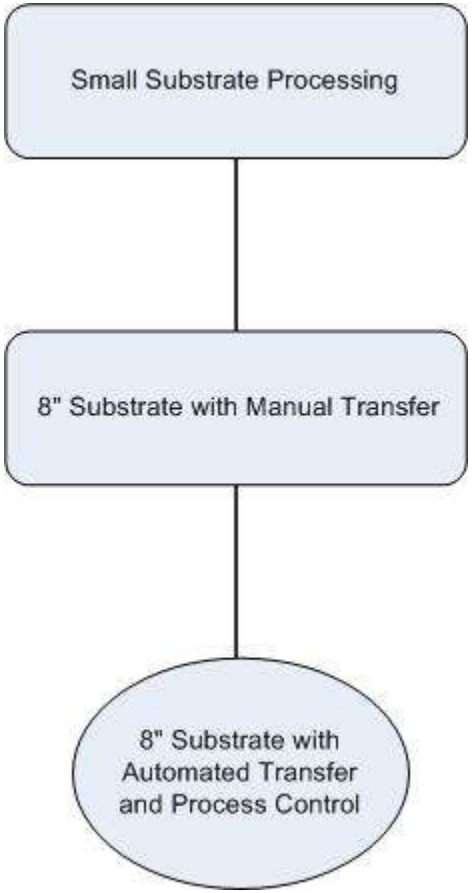


Multi-Chamber MBE system (RC2100M)/MOCVD system (SH2001)
supplied to Toyohashi University of Technology

In this system, an MBE system for Si MBE growth and a compound semiconductor MBE system are connected by means of the transfer chamber that incorporates rotation, expansion and contraction arm transfer system, and further, they are connected to the compound semiconductor MOCVD system by means of a vacuum lorry. This configuration enables growth of different types of materials that uses both MBE and MOCVD systems without exposing the materials to the atmospheric air. In addition, an STM chamber is also connected to the transfer chamber located on the multi-chamber side, and thus we can analyze the surface immediately after the growth.

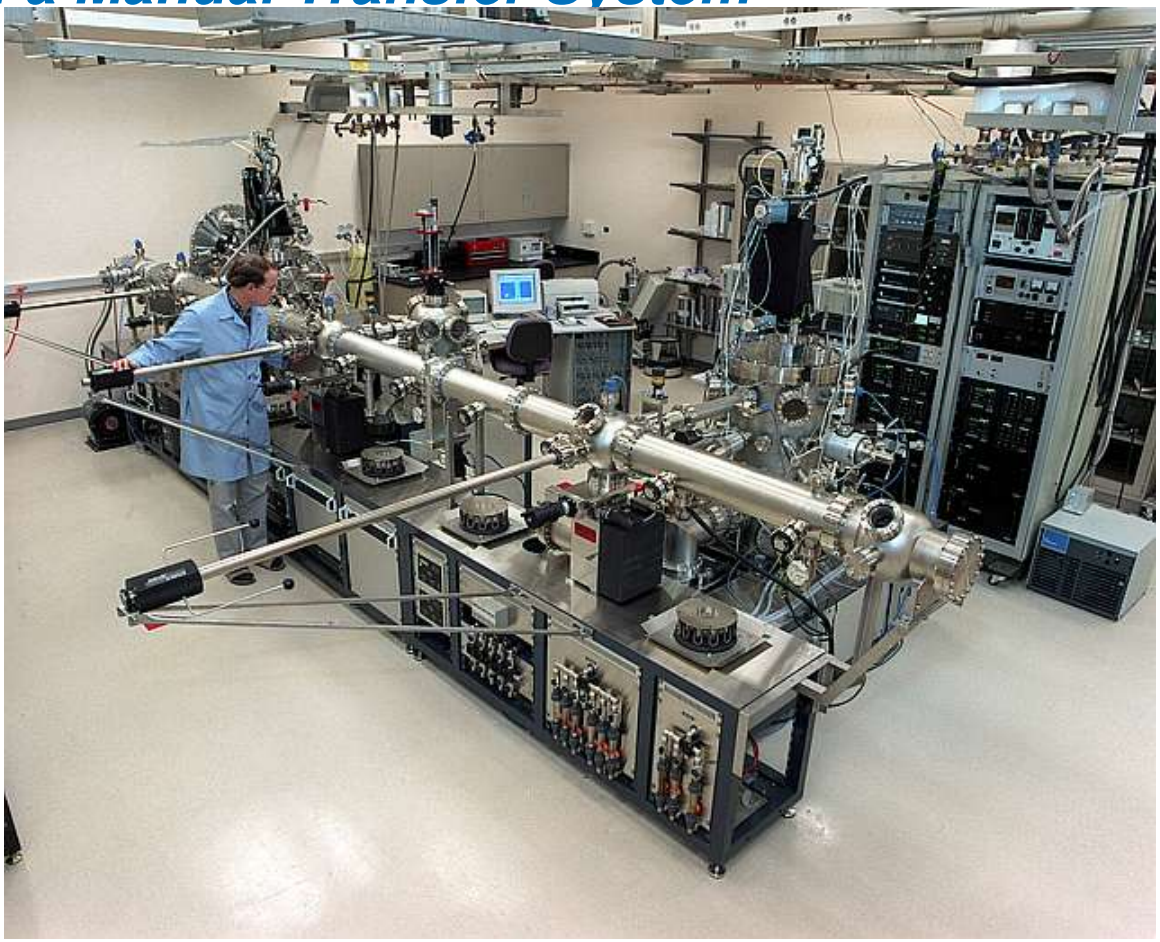
Taken from the EPI Quest site

Progression of Photocathode Process Development



- Initial process equipment will have the ability to handle 2”-4” substrates using standard tooling. The process tools will be self-standing and the parts will have to be moved between tools by some kind of vacuum box
  - Manual transfer equipment purchased to handle 8” substrates. In this case there will be better integration of the tools by using a common vacuum transfer environment.
- Final system possesses an automated substrate transfer system besides computerized process control. This system has the ability to fabricate photo-detectors without an operator so that it can make very long runs

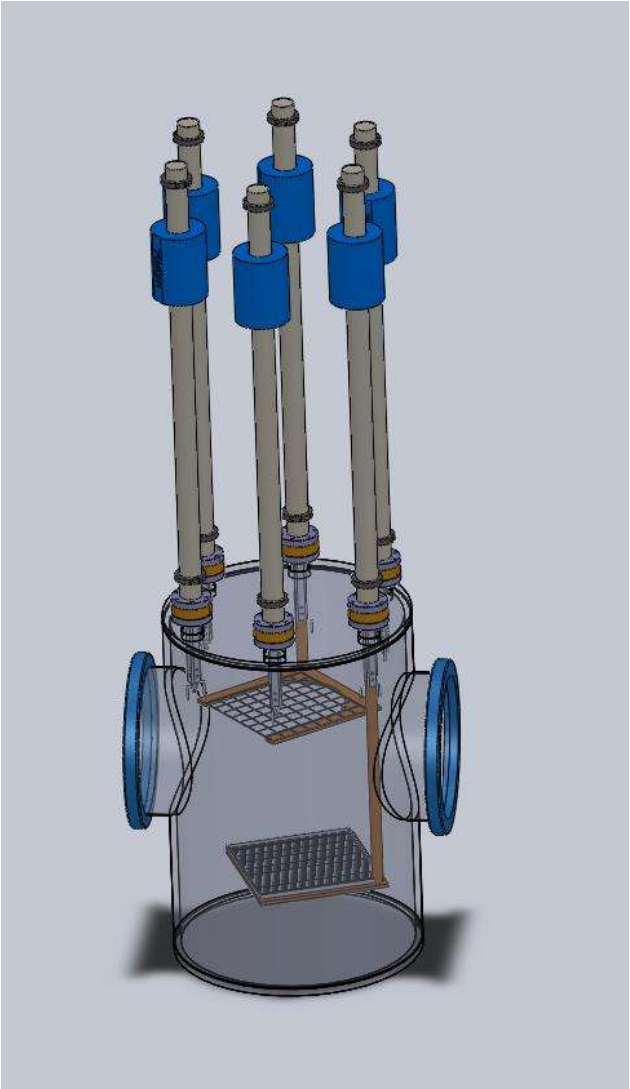
Example of a Manual Transfer System



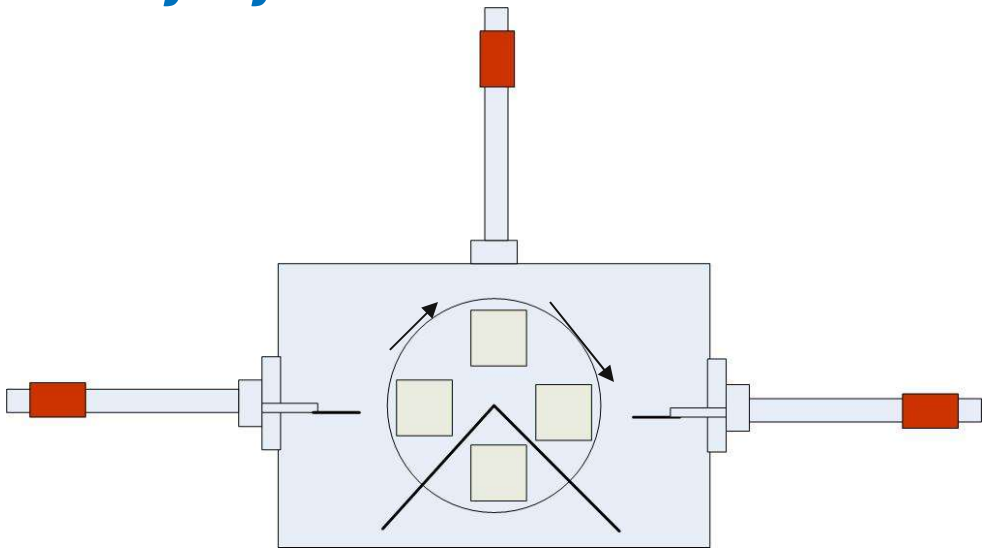
- Molecular Beam Epitaxy System in the William R. Wiley Environmental Molecular Sciences Laboratory is used to grow and characterize thin crystalline films of oxides and ceramics to understand in detail the chemistry that occurs on oxides and ceramic surfaces. By studying these films, we can develop a deeper knowledge of the chemistry that controls important processes in environmental restoration and waste remediation.

Functional Test system

- This is a chamber where functional tests are performed prior to sealing the individual parts into the detector housing.
- These are tests of resistivity and others that can be performed at a variety of temperatures
- The pressure in the chamber will be quite low (< 10^{-8} Torr) to mitigate any unwanted oxidization.
- This will allow for process development of the fabrication steps and the cross checking of results with the attached surface science station.



Mechanical Assembly System

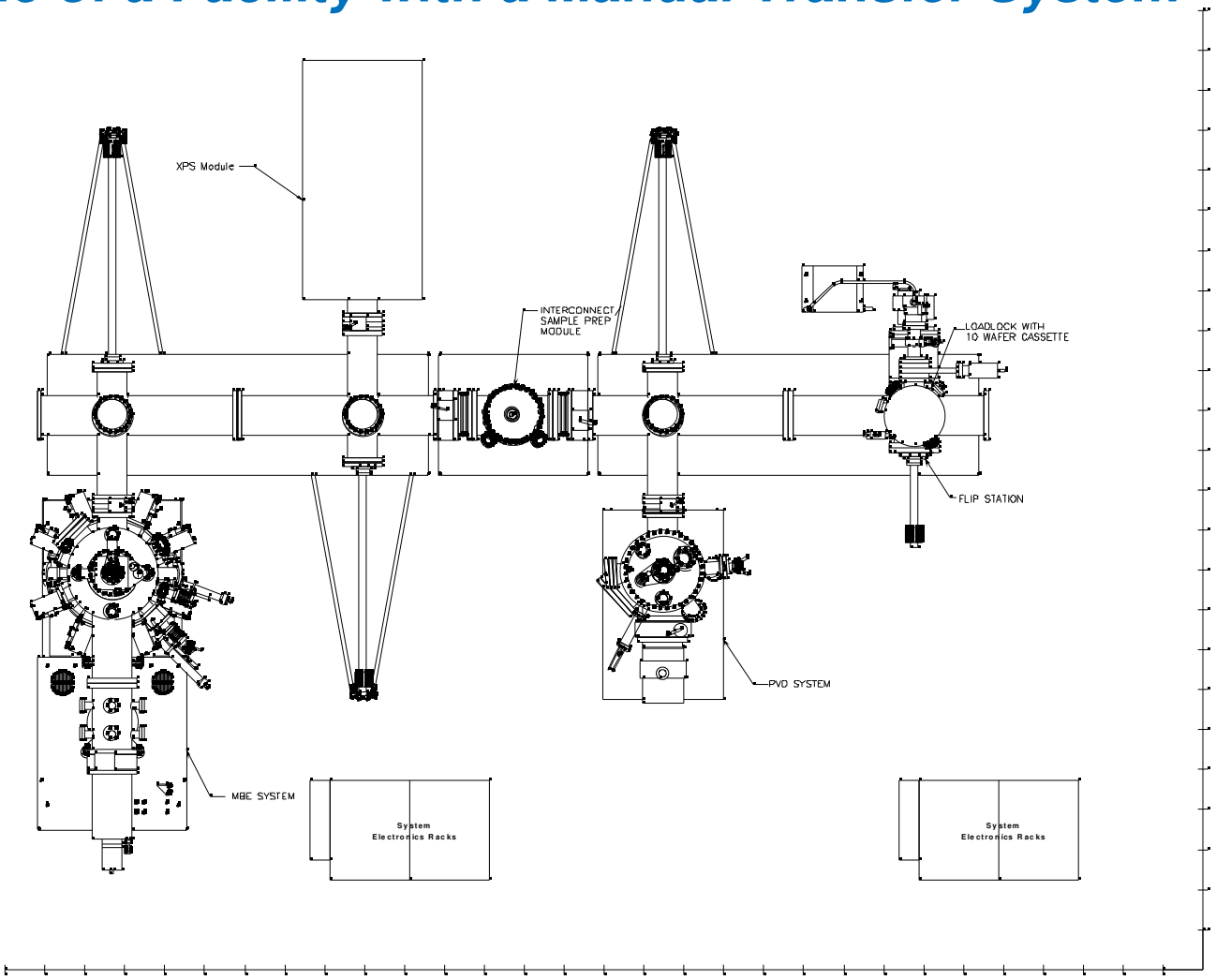


- This is a chamber where mechanical assembly tasks are performed.
- Initially this manual pick/place system will be where the precision component assembly takes place.
- This vacuum chamber will have ample pumping so that getter activation can take place within it.
- There will also be an area within it to implement the final seal between the tray and the top plate.
- Later versions of this system will incorporate automated part assembly, getter activation, and sealing

Systems for Advanced Photocathode Fabrication

- Initially there are two processes for making GaAs and GaN photo-cathodes that are being considered.
  - Metalorganic chemical vapour deposition (MOCVD)
  - Molecular Beam Epitaxy (MBE)
- Both of these processes have the ability to make the composition of materials needed for a PC
- Both processes can make the layers in the desired thicknesses.
- It is possible that Atomic Layer Deposition (ALD) will be a consideration in the future.
  - The current effort is focused on the fabrication of MCP's.

Example of a Facility with a Manual Transfer System



Courtesy of SVT Associates

Facility Services to Operate the MBE System

Facility Requirements

208 VAC 250A 3Ø 50/60Hz

The system requires 2 main power connections, that should be rated at 150A - 3Ø & 100A-3Ø. The power is connected through the power distribution enclosure that is located on the side of the electronics racks. All of the power required for the system is supplied to the system through this distribution enclosure. A 15 foot 'pigtail' will be provided for the hook-up between the lab service disconnect box and the power distribution enclosure, as shown by the dot in the drawing. Each pigtail is a 1-1/2" flexible metallic conduit, that contains 5 wires: 3 Hot, 1 Neutral, and 1 Ground.

Cooling Water - 40000BTU 12000W

Cooling water is required for the operation of the system. The lab will be required to provide the following circuits of filtered cooling water. Each of the zones will be for a particular piece of equipment and the fitting size is shown with each. A water distribution with shut-off valves and flow indicators is advised.

Dry Air or N2 - 75 Psi

Dry Air or Nitrogen is required to operate the gate valves, shutters and pneumatic shut-off valves for the gas lines. The minimum required pressure is 75 psi. A 1/4" Swagelock connection will be provided on the end of the system approximately 4" off of the floor as shown for the attachment of the line. The typical flow rate is very minimal per actuation of the individual valves. In most cases the will be no flow.

Dry N2 - 10 PSI

Dry Nitrogen is required to vent the chamber. A 1/4" Swagelock connection will be provided on the end of the system approximately 4" off of the floor as shown for the attachment of the line. The Dry Nitrogen is to be used for venting the system. Flow requirements will be dependent on the specific use of the system.

Liquid Nitrogen - 75 l/hr

The requirement for the cryopaneling is 75 l/hr of Liquid Nitrogen. There are two seperate cryo panels on the growth chamber. A line will be provided to connect the 2 panels in series. The connections for the LN2 are 1/2 Swagelock fittings. The return connection is shown in the drawing and is a tube pointing toward the ceiling. The supply connection for the LN2 is directly below the return connection and is pointed toward the floor.

Exhaust Port

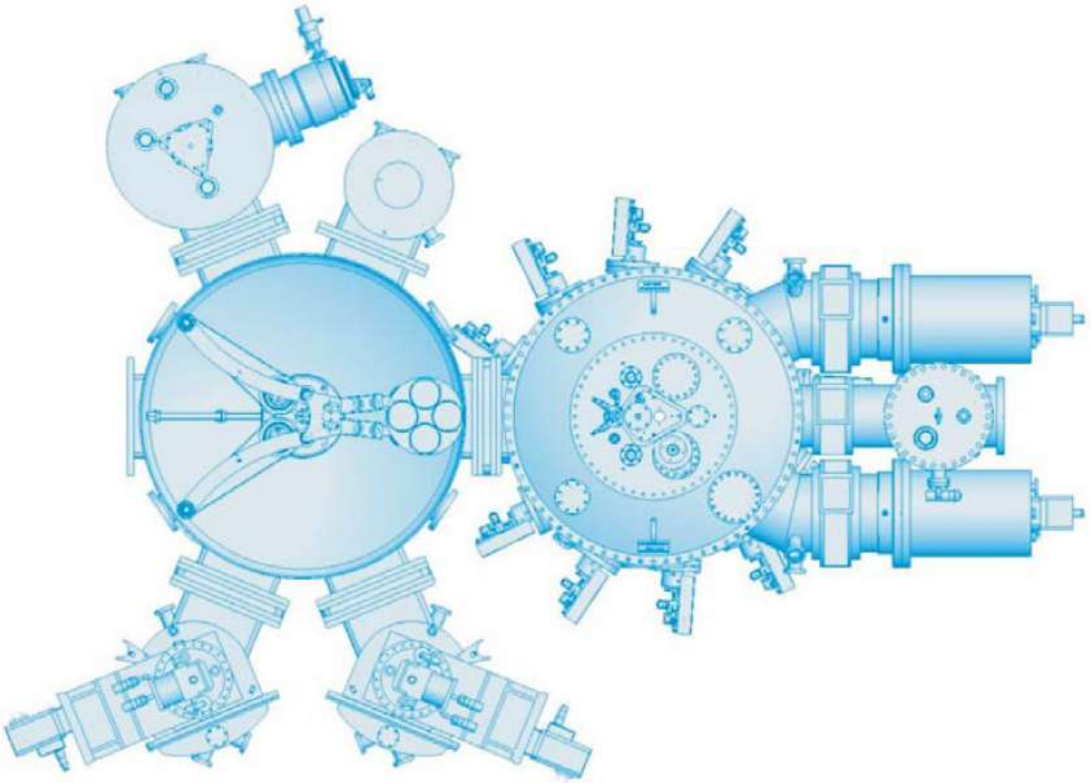
The Exhaust Port for the roughing pump is located on the top of the rough pump. The pump comes with a silencer that will vent gases pumped into the installation room. An optional fitting for the exhaust hook-up (NW25 Quick Flange) can be fitted if gases pumped need to be exhausted to other than installation room. The maximum through put of the exhaust system is 3.3 m /hr. Depending on the nature of the gases that will be used, this exhaust system may need to be corrosion resistant.

Courtesy of SVT Associates

Cluster Tool Configuration

Cluster Tools are designed for handling 3”, 4”, and 6” substrates.

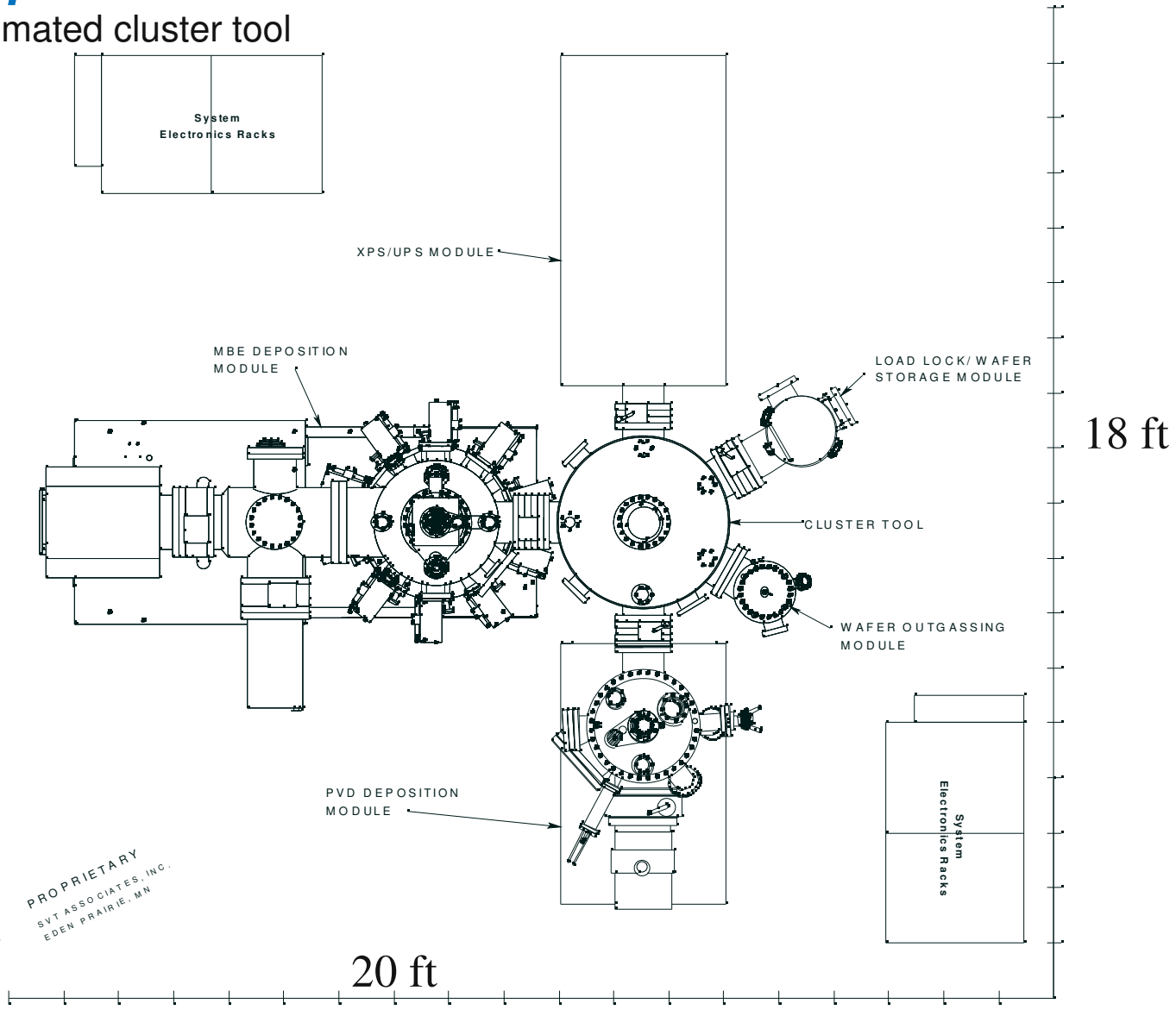
The ability to handle and 8” square substrates will need modification of the holders. The size allows for it as the system cur



Courtesy of Veeco MBE

Facility for equipment

- Example of an automated cluster tool



Courtesy of SVT Associates

Any Questions?

- Thanks to:
  - Greg Carpenter of SVT Associates
  - John Larson of Veeco MBE Systems

  &

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