Cornell University
Laboratory for Elementary-Particle Physics

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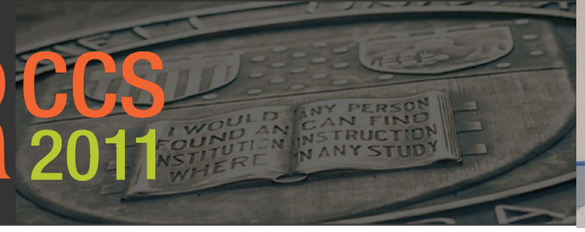


Summer Research for Community College Students – 2011

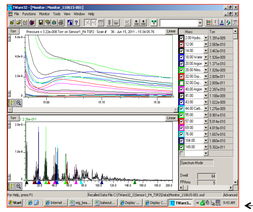
Automatic Bake-Out Assembly (A.B.O.A.)

Introduction: The Focus of this summer's project is to create an automated Bake-Out Assembly. for Cornell's High Energy Synchrotron Source (CHESS).

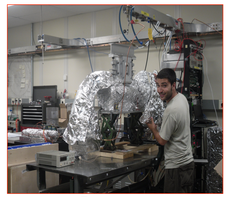
A Bake-Out is a process in which an object that will be placed under Ultra High Vacuum is "cooked" up to very high temperatures (ranging from 140-400 degrees Celsius) for an extended period of time.

This process is necessary to remove chemicals and particles on the molecular level. If excess particles are present in a part, it will not pump down to a sufficient pressure. Therefore, a Bake-Out is necessary for all ultra high vacuum parts in a particle accelerator.

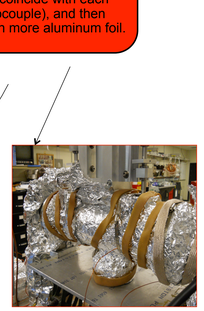
Bake-Out Process



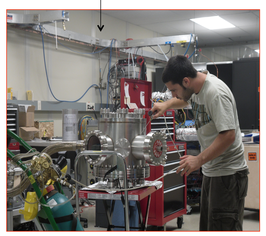
Part is pumped down to Ultra High Vacuum using roughing and turbo pumps and an RGA (Residual Gas Analysis) is performed along with an initial leak check.



Thermocouples are placed on each different heat zone and part is then wrapped in aluminum foil, heat tapes (which coincide with each thermocouple), and then wrapped in more aluminum foil.



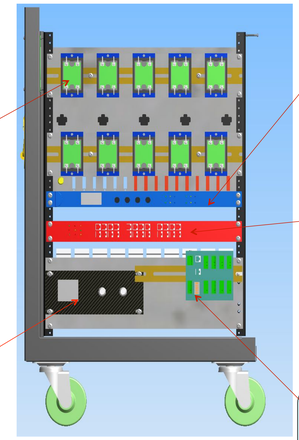
Heat tapes and heated nitrogen gas heat part up to desired temperature, after which a "soaking period" commences.



Part is cooled down to room temperature and another RGA scan is performed to compared to the first. A "leak check" is also performed with Helium gas.

Inventor Prototype

(Front View)



10 Solid State Relays and Heat Sinks mounted by Din-Rail and Panel (for support) switch power from Logic Control and switch power to Heat Tapes

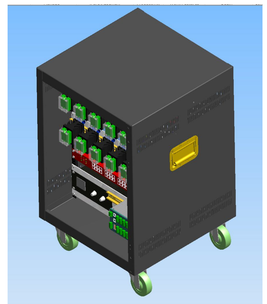
Serial Converter converts Ethernet communication to Serial and vice versa.

Ethernet Box used to connect ABOA and other devices to local servers, internet, and one another via Ethernet cables

Gauge Controller measures pressure and sends signal to temperature controller.

Logic Control mounted to Din-Rail/ Panel used to compare signals from thermocouples and switches power to Solid State Relays

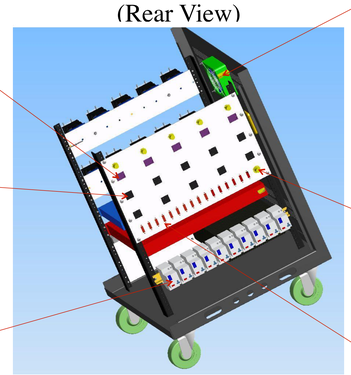
(Isometric View)



Cooling Fan used to vent heat from Solid State Relays and other components

5 Power-ins receive 120V power from wall source

(Rear View)

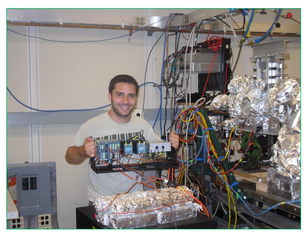


10 Power-outs sends 120V to heat tapes to heat specimen

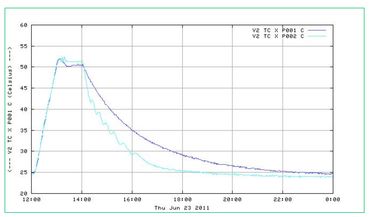
10 Amp Fuse used to protect Logic Control from circuit shorts

10 GFCI Breakers safely stop shorts in circuit and allow for a quick shut-down of ABOA.

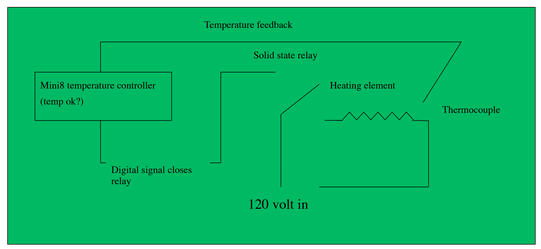
16 Thermocouple Ports allow for multiple thermocouples to switch power to Logic Control

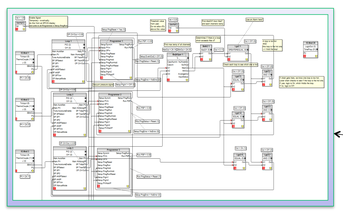


Original Prototype Test Results

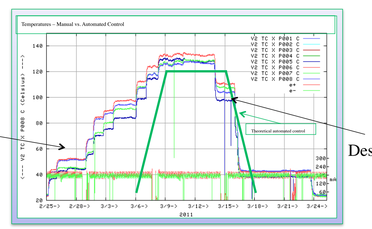


Basic Control Schematic





Prototype testing is periodically performed on assembly and iTools logic program



Desired Test Results