Fermilab

Particle Physics Division
Mechanical Department Engineering Note

Number: MD-ENG-140 Date: 1/20/08

Project Internal Reference:

Project: DECAM

Title: Ion pump failure in the MCCDTV, What If analysis

Author(s): Herman Cease

Reviewer(s): 1/23/08

Key Words: Vacuum, MCCDTV, What If

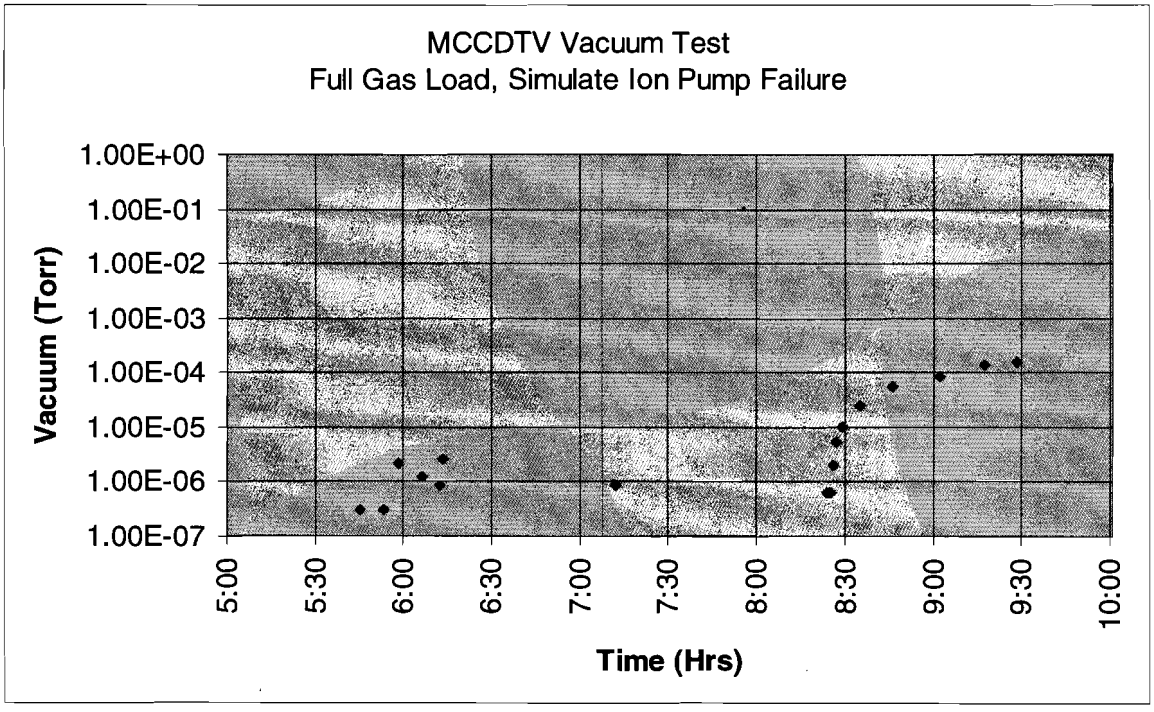
Abstract Summary:
In the event of an ion pump failure, the vacuum rate of rise in the Imager Vessel needs to be slow enough to have time to diagnose the problem and drive the telescope to a position where a backup turbo pump can be attached and put into operation. If the rate of rise is too fast, then additional mitigation on the vacuum system is needed. Rate of rise results when the ion pump is OFF is shown using the Multi-CCD Test Vessel.

Applicable Codes: N/A

Introduction

The Ion pump failure was simulated using the Multi-CCD Test Vessel. In the event of an ion pump failure, the vacuum rate of rise in the Imager Vessel needs to be slow enough to have time to diagnose the problem and drive the telescope to a position where a backup turbo pump can be attached and put into operation. If the rate of rise is too fast, then additional mitigation on the vacuum system is needed. Rate of rise results when the ion pump is OFF is shown. The Multi-CCD test vessel operated using the V1 heat exchanger. The V1 heat exchanger has a large copper mass with an operating temperature of 77K. A sheet of Kapton with a surface area equivalent to 69 CCD cables was placed in the MCCDTV to simulate the full gas load in the vessel. The Kapton was located near the outer vacuum shell and remained at room temperature throughout the test.

Results



Summary

Rate of Rise:
It took approximately 1 hour for the vacuum to rise from about 7e-7 torr to 2 e-4 torr.

The expected rate of rise can be calculated.
From Doc Db #6 the expected gas load for gases that are not cryopumped is

Non Cryo-pumped gas load = 8.4e-6 Torr.L/sec.
After 1 hour the gas load in the vessel is then
8.4e-6 Torr.L/sec * 3600 sec = 0.03 Torr.L

The volume of the Multi-CCD Test Vessel is
V = (0.5 * 24 inch)^2 * PI * 28 inch length = 12,660 in^3
V = 207 Liters

The expected pressure inside the MCCD Test Vessel after 1 hr with an ion pump failure is

0.03 Torr.L / 207 L = 1.4 e-4 Torr

The measured rate of rise inside the Multi-CCD test vessel closely matches the predicted rated of rise. The rate of rise is due to gasses that are not expected to be cryopumped.

Ultimate Vacuum Pressure in the Imager Vessel:
It is expected that the ultimate pressure of the vessel with the vacuum pumps operational will continue to improve even beyond 7e-7 as the Kapton dries out. The majority of the gas load comes from water outgassing from the cables. Doc Db #006.