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Australian Nuclear Science & **Technology** Organisation

Problems with High Voltage During Commissioning of New 2MV Tandetron Accelerator

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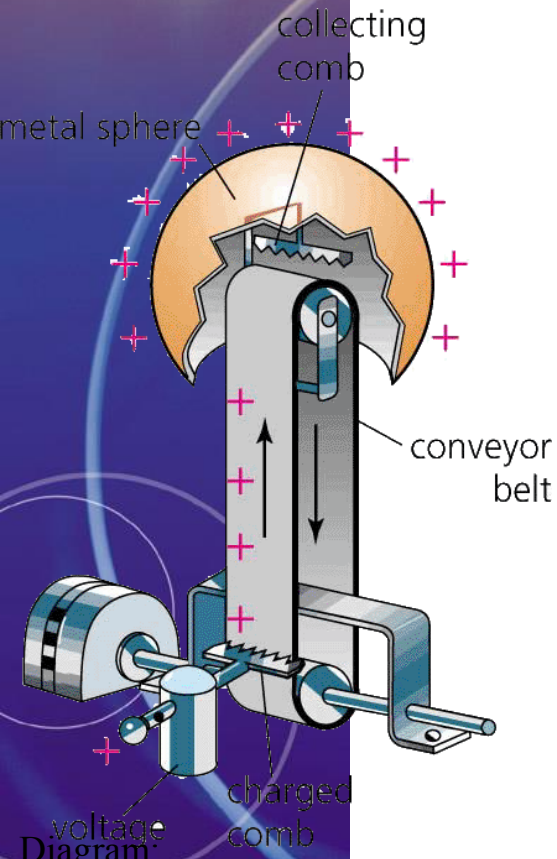
Items to be Covered

- Brief Background on ANSTO's 3 Accelerators
- Problems Encountered During Commissioning of STAR
- Discussion of Actions Taken to Solve Problems
- Lessons Learned

ANSTO's 3 Accelerator's

3MV Van de Graaff Accelerator

- Single Ended
- Belt Driven Van de Graaff High Voltage Generator



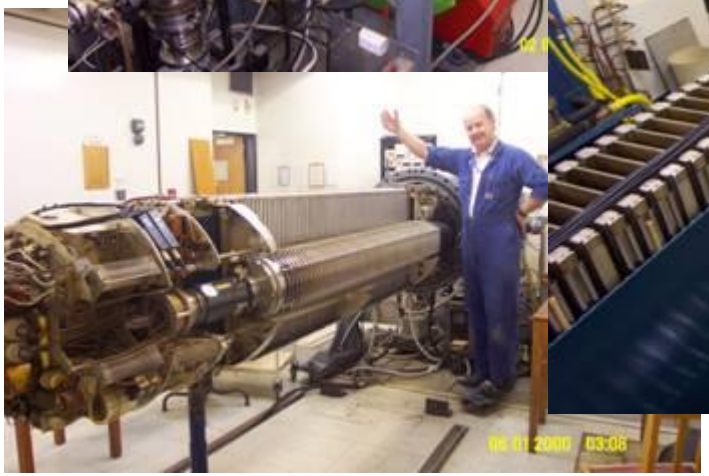
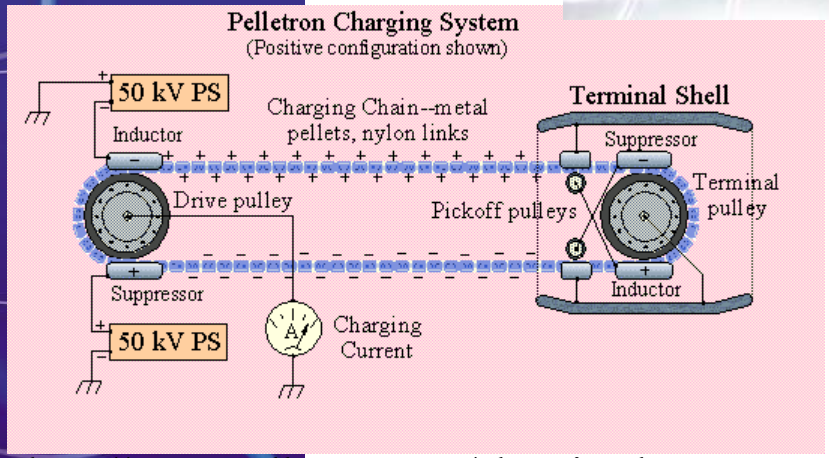


Diagram:
http://chem.ch.huji.ac.il/~eugeniik/history/graaff.html

ANSTO's 3 Accelerator's

10MV Tandem Accelerator

- Double Ended
- Pelletron Chain Driven High Voltage Generator

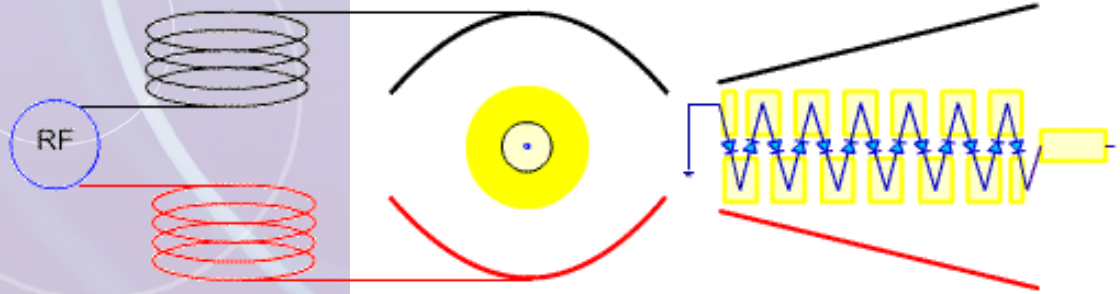


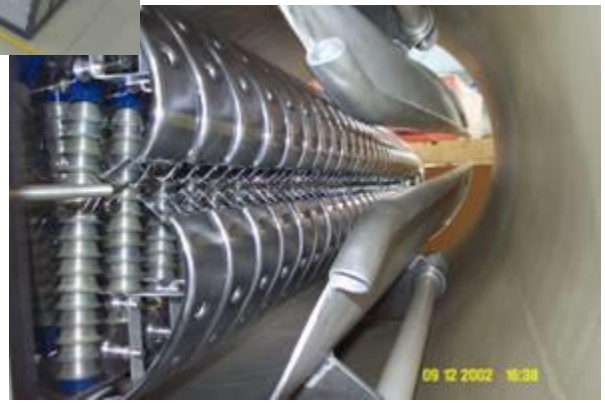
http://www.pelletron.com/charging.htm

ANSTO's 3 Accelerator's

2MV Tandetron Accelerator

- Double Ended
- Solid State High Voltage Generator

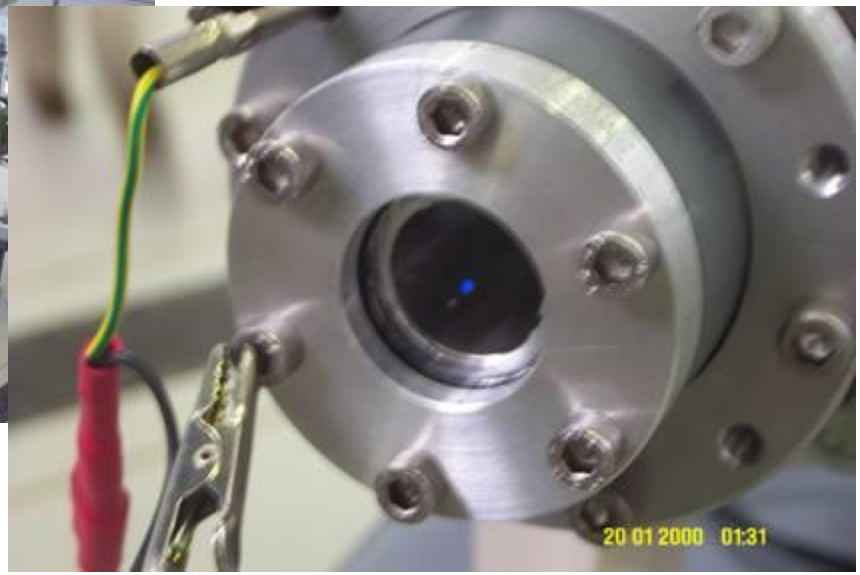




Problems Encountered During Commissioning of STAR

High Voltage Generator and Tubes achieved 2.2MV and testing of beams through the system became a focus.

- *Milestone met for installation team.*

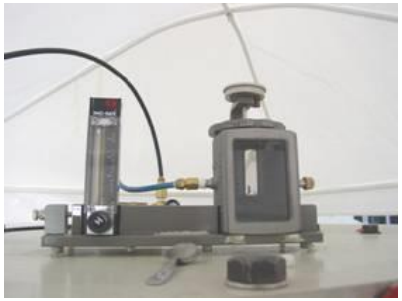


Problems Encountered During Commissioning of STAR

- *Tank sparks began and their frequency increased*
- *Repetitive damage to Q-Snout Power supply*
- *Inability to achieve 2MV*
- *External discharges from the accelerator*

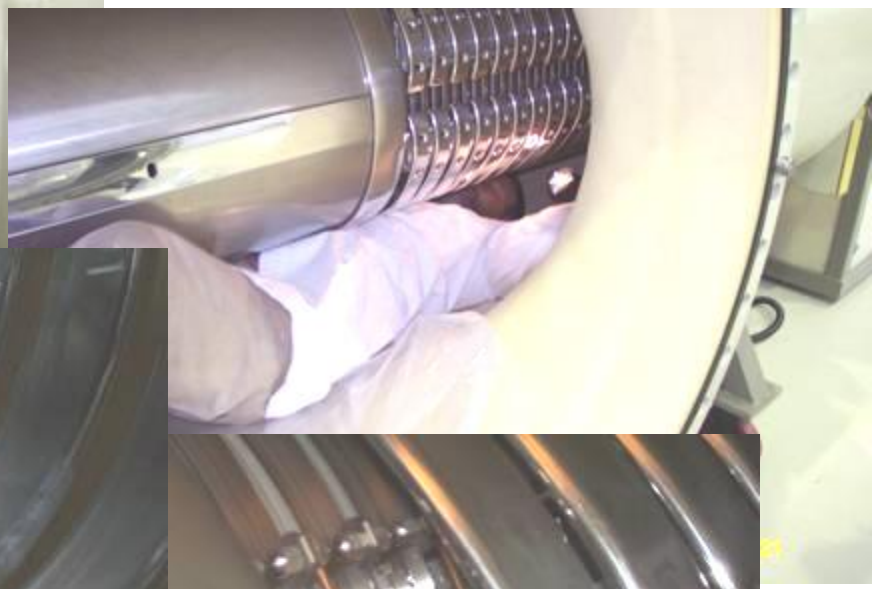
Discussion of Actions Taken to Solve Problems

- In line with best practice the SF6 gas was checked and continually dried to achieve a dew point less than -40°C.



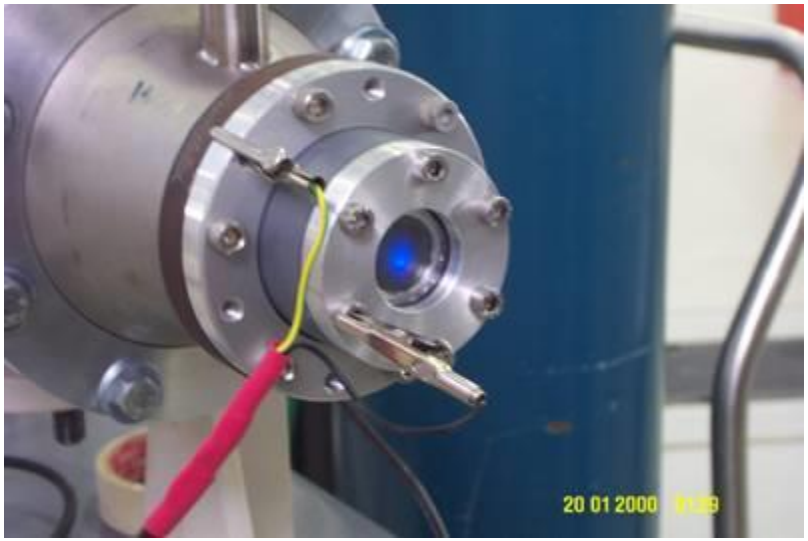
- Damage to Q-Snout Power supply was decided to be a secondary problem caused by the tank sparks.
- With a good dew point the tank sparks remained.
- A tank off to inspect internal components was decided.

Discussion of Actions Taken to Solve Problems



Discussion of Actions Taken to Solve Problems

Problem Solved?



After a short time the High Voltage Generator was unable to achieve 2.0MV.

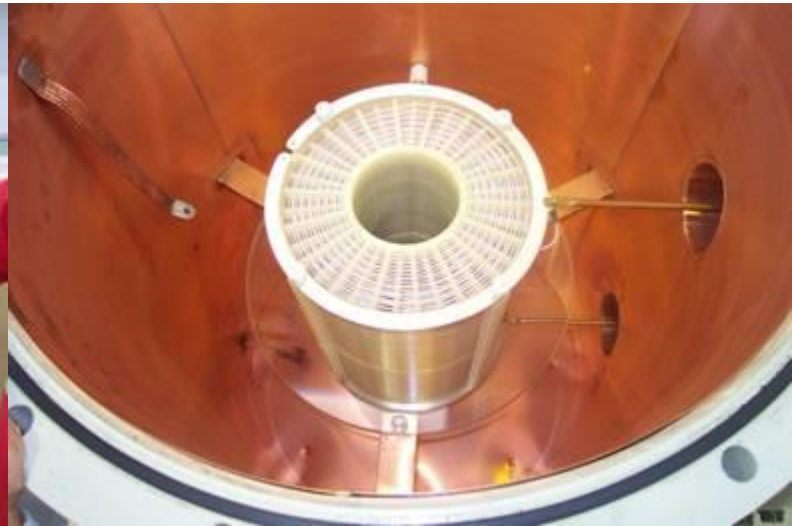
Discussion of Actions Taken to Solve Problems

Testing of the High Voltage Generator

- The Q factor of the driver was tested to check the performance of the coils, capacitive plates, and diode stacks.
- The Q factor should be between 1000 - 1100, we achieved 650 - 700.

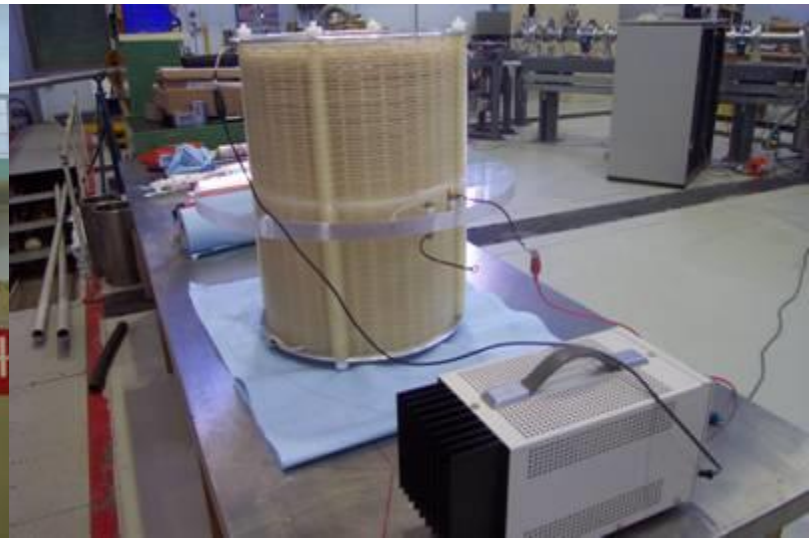
$$Q_{factor} = \frac{f_{I_{peak}}}{f_{I_{upper}=\left(I_{peak}\frac{1}{\sqrt{2}}\right)} - f_{I_{lower}=\left(I_{peak}\frac{1}{\sqrt{2}}\right)}}$$

$$Q_{factor} = \frac{f_{I_{peak}}}{Bandwidth}$$



Discussion of Actions Taken to Solve Problems

After testing of the diode stacks and inspection of the assembly of the High Voltage Generator, the two inductive coils were replaced.



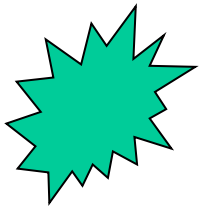
Discussion of Actions Taken to Solve Problems

Problem Solved?

- Q factor returned to 1000.
- The High Voltage Generator reached 2MV again

Tank sparks remained and occurred regularly from approx 1.5MV - 2.0MV, but 2.0MV still achievable.

Problem Takes Different Turn



External discharges occurred.

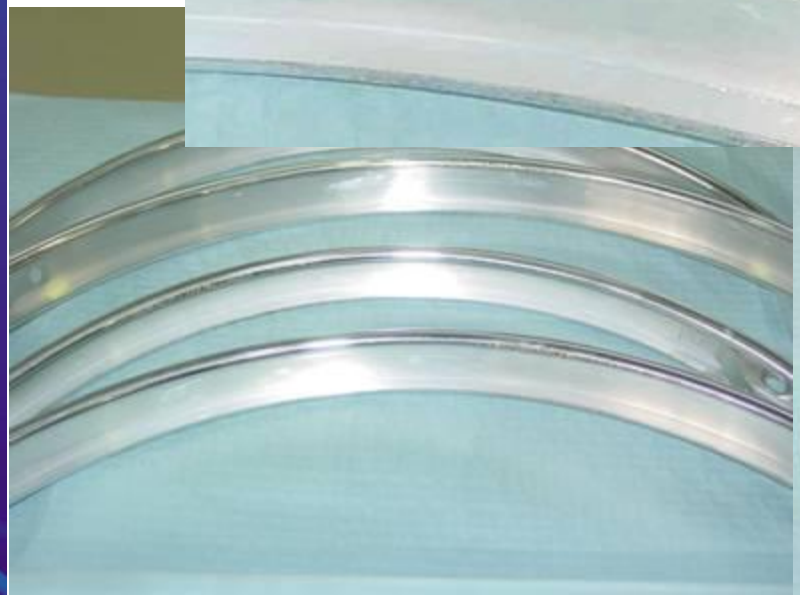
Discussion of Actions Taken to Solve Problems

- Initial action was installing additional earth straps to suspected areas.

- External sparks still appeared occasionally during tank sparks.

Discussion of Actions Taken to Solve Problems

- Another Inspection of the internals of the accelerator revealed damage by the fibre optics lying along the equal potential rings.



Discussion of Actions Taken to Solve Problems

- In an attempt to increase insulation, the SF6 gas pressure was increased from 6 bar to 7 bar.

- The purity of the gas was questioned as was the possibility of a leak of an Argon leak from the stripper supply.

Discussion of Actions Taken to Solve Problems

- The re-polishing and assembly of the High Voltage Generator was preformed as the next attempt to locate the fault.

Discussion of Actions Taken to Solve Problems

1. There where witness marks across some of the flanges from discharges.

2. The upper and lower copper skin plates in the coil housing had been assembled the wrong way around.

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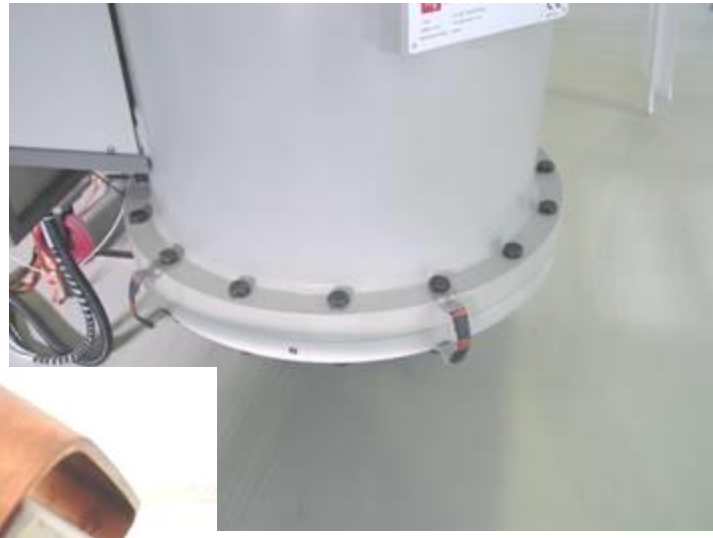
Discussion of Actions Taken to Solve Problems



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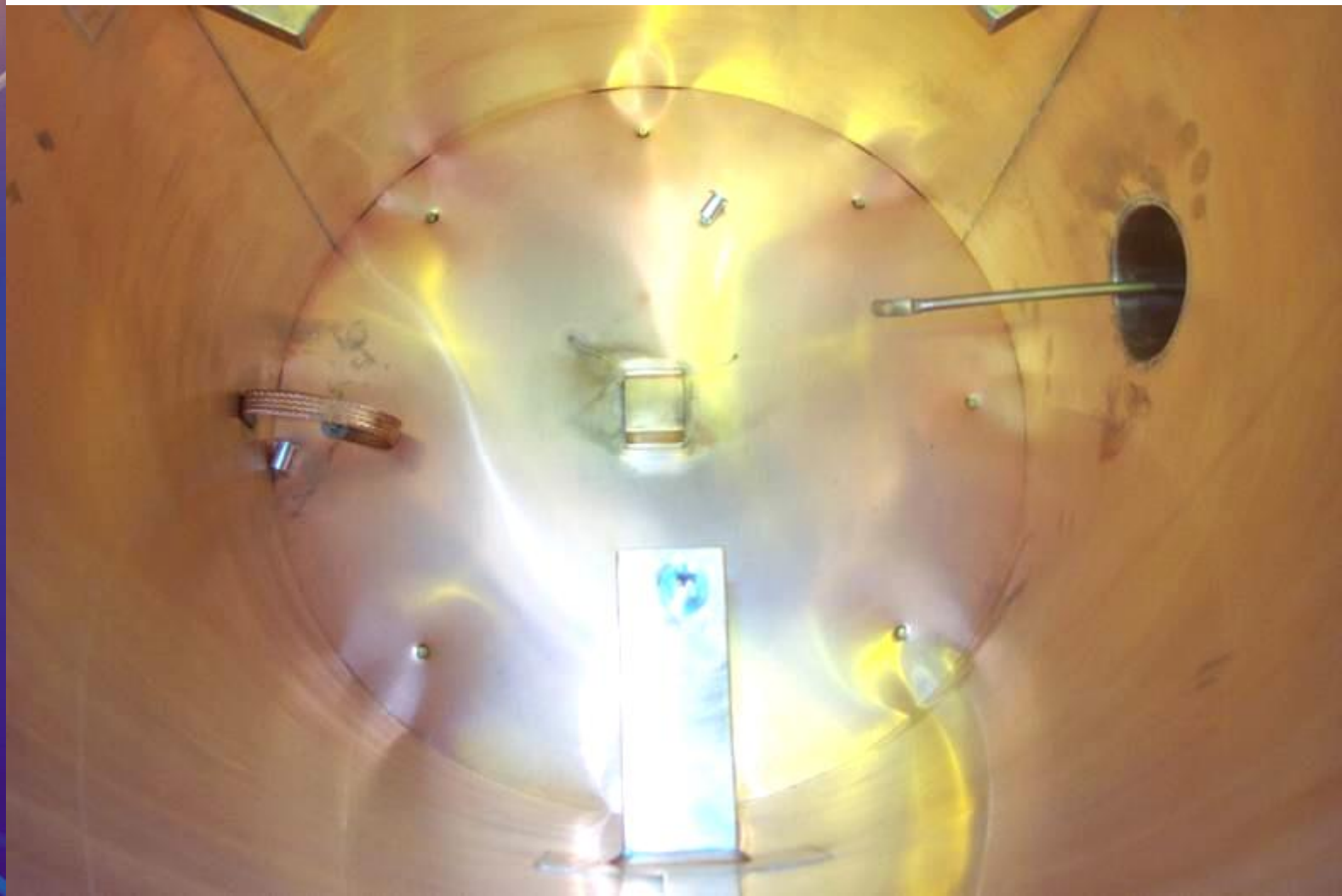
Discussion of Actions Taken to Solve Problems



Discussion of Actions Taken to Solve Problems

In addition, a leakage chain of resistors were placed between the Q-Snout and the first segment of the tube to help inhibit sudden discharges to the power supply.

Discussion of Actions Taken to Solve Problems

Problem Solved?

After re-assembly of the accelerator, it was operated at full voltage with no further tank sparks.

Lessons Learned

Symptoms which may be common to all 3 of the accelerators can be cause by totally different faults.

Originally what looked like a brake down in the insulation gas of the accelerator, turned out to be due to earthing and High Voltage Generator faults.

Thank You

Acknowledgments:

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