Simulating and Testing the Damping of Targets in Accelerator Based Experiments

Tonie Butler
Supervisors: Patrick Hurh, Katsuya Yonehara

Project Introduction

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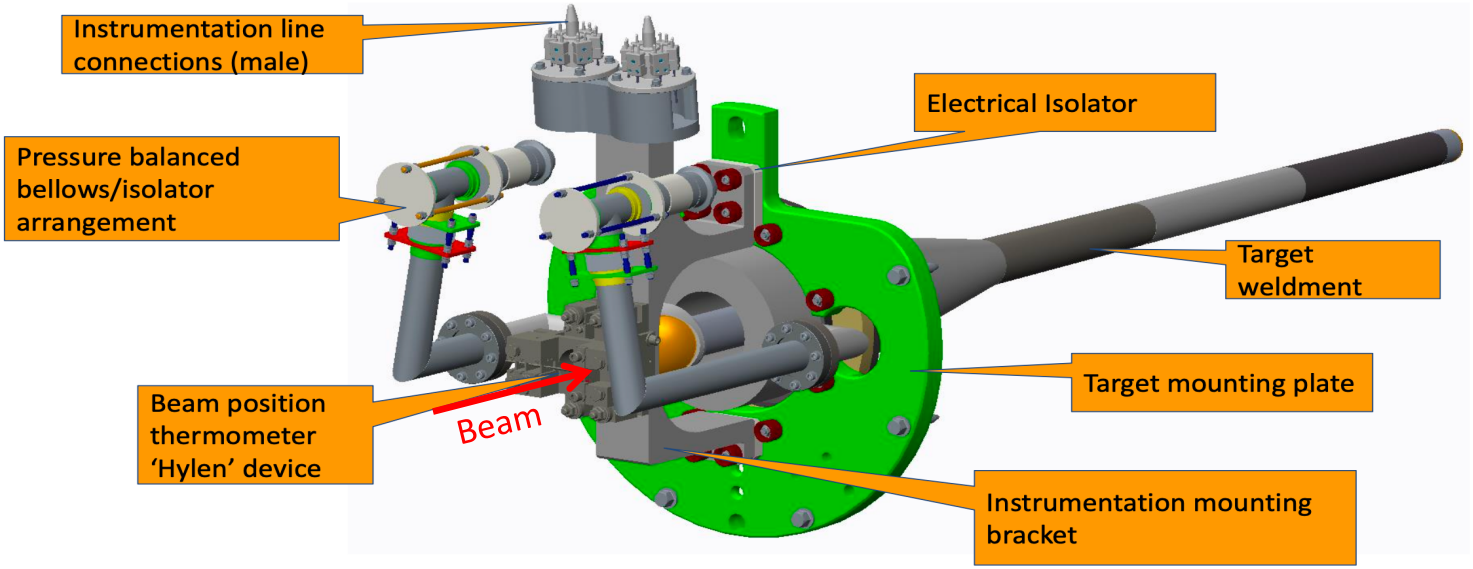
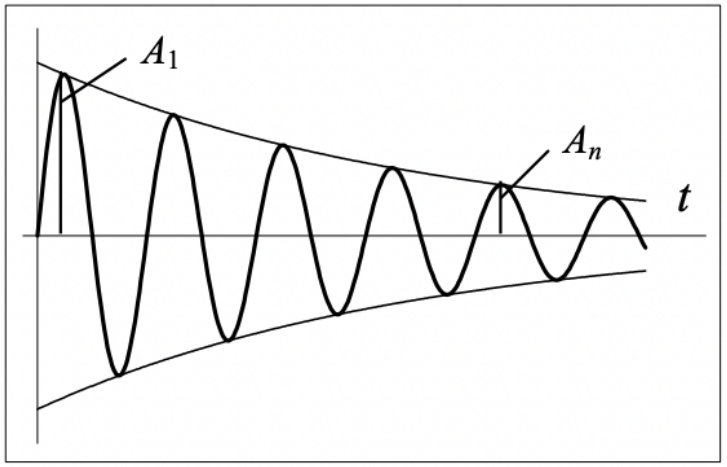
Background

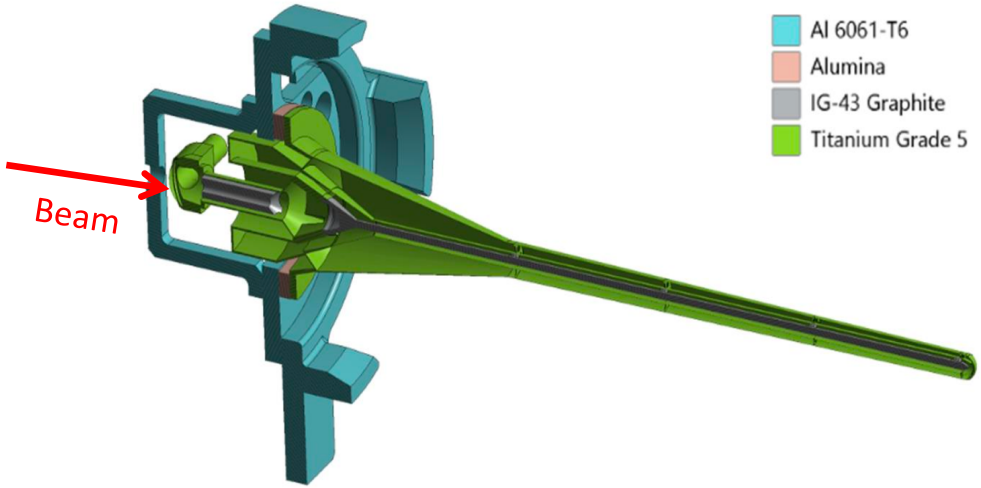
- Target Systems Department
- All accelerator based experiments use targets
- Targets are used to convert high-energy proton beams into new particles
  - Results in the target undergoing stresses, high temperatures, radiation damage, and corrosion
- The proton beam is delivered to the target in pulses (~1.5 million pulses per year)
- Targets need to be able to withstand the damage



Project Overview

- Simulating and observing the damping and oscillations of a target under beam operating conditions
- When the particle beam pulse hits, the target is subject to oscillate and vibrate from the thermal shock
  - Causes concern regarding fatigue failure and the number of oscillations the target experiences after each beam pulse





Process

- Dynamic simulation using modelling tool (ANSYS®: Finite Element Analysis)
- Start with a simple cantilever beam design that is fixed at one end
- Test the base design then add complexities and make modifications
  - Clamping method
  - Modified target dimensions
  - Material
  - Gap element verses a solid rod
  - Internal fluids with high viscosity
  - Added materials
- Compare damping characteristics to determine which additions increased the damping, which ones had no effect, and which ones reduced damping
- Design an experiment for eventual physical testing to benchmark the simulation methods

Conclusion

- Goals:
  - To simulate damping for more accurate target life-span prediction
  - To explore methods to increase the damping in target designs, thereby reducing the number of cycles the target experiences from each beam pulse
  - Thus increasing target lifetime
- Future Target Halls
  - LBNF/DUNE
  - Mu2e
  - Upgraded Target Halls