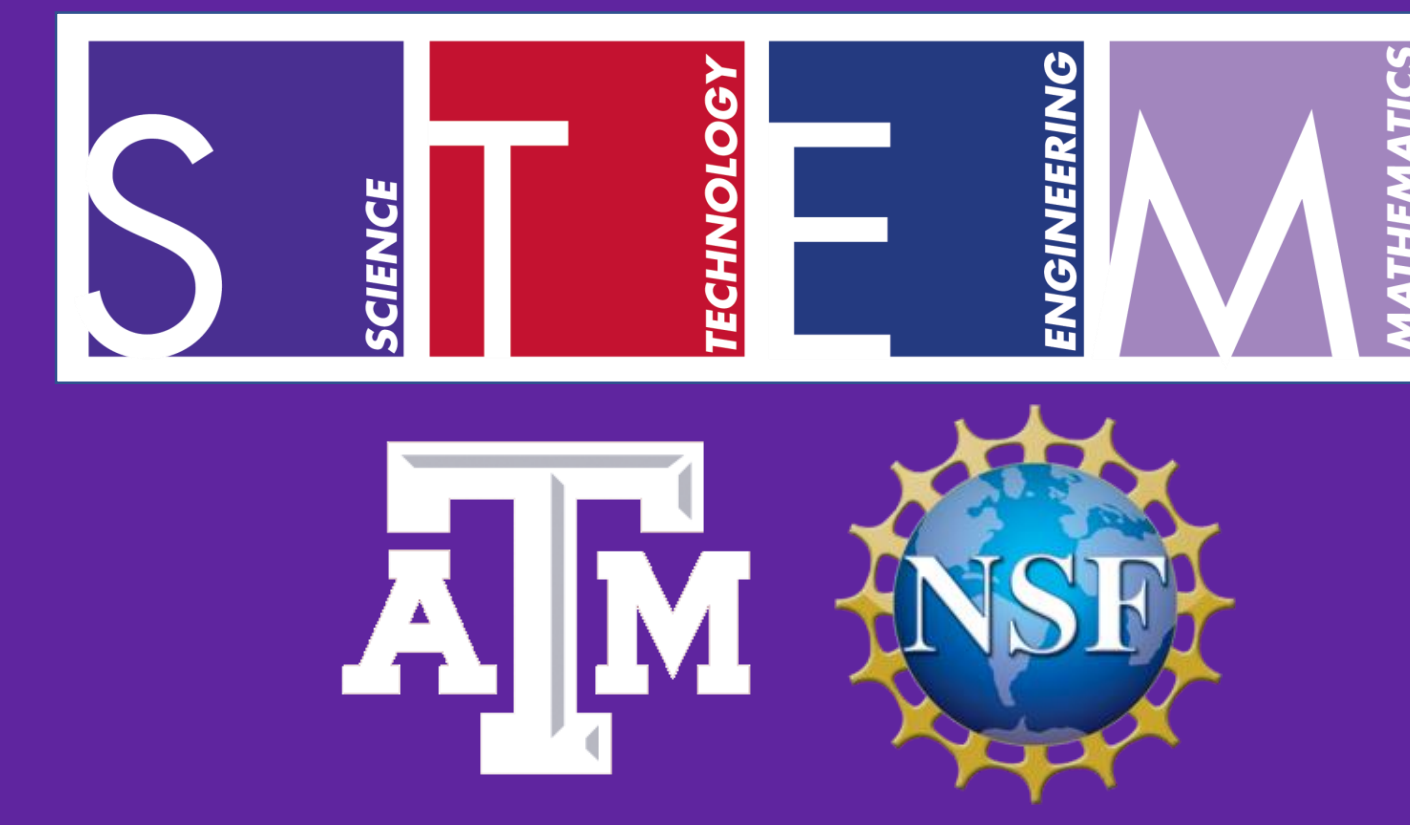




Shock Tube for Gas Dynamics and Chemical Kinetics Research

Jordan Garcia, Clark Norris, and Christopher Aul
Department of Physics, Engineering, and Astronomy; Stephen F. Austin State University



Introduction and Operations

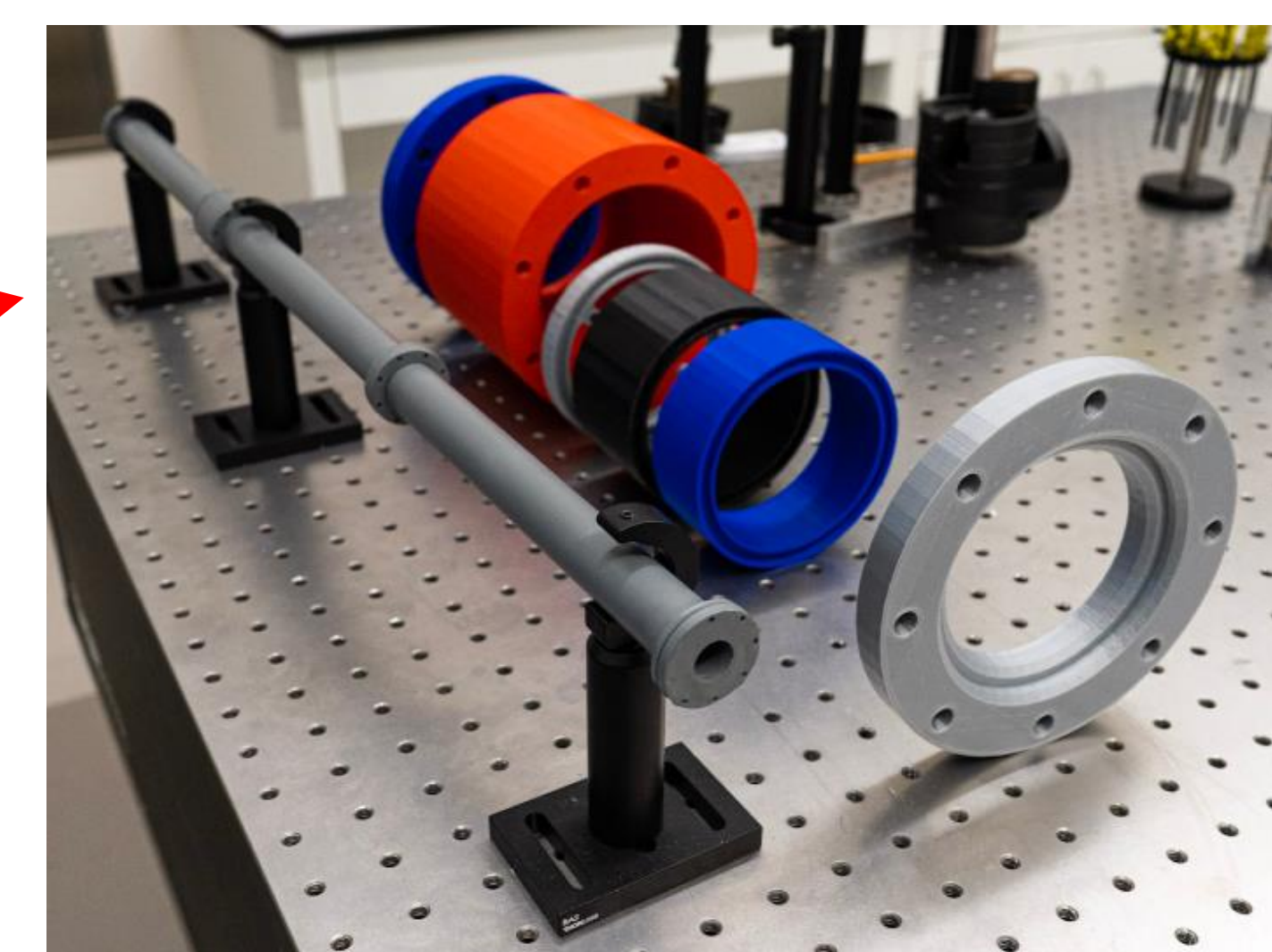
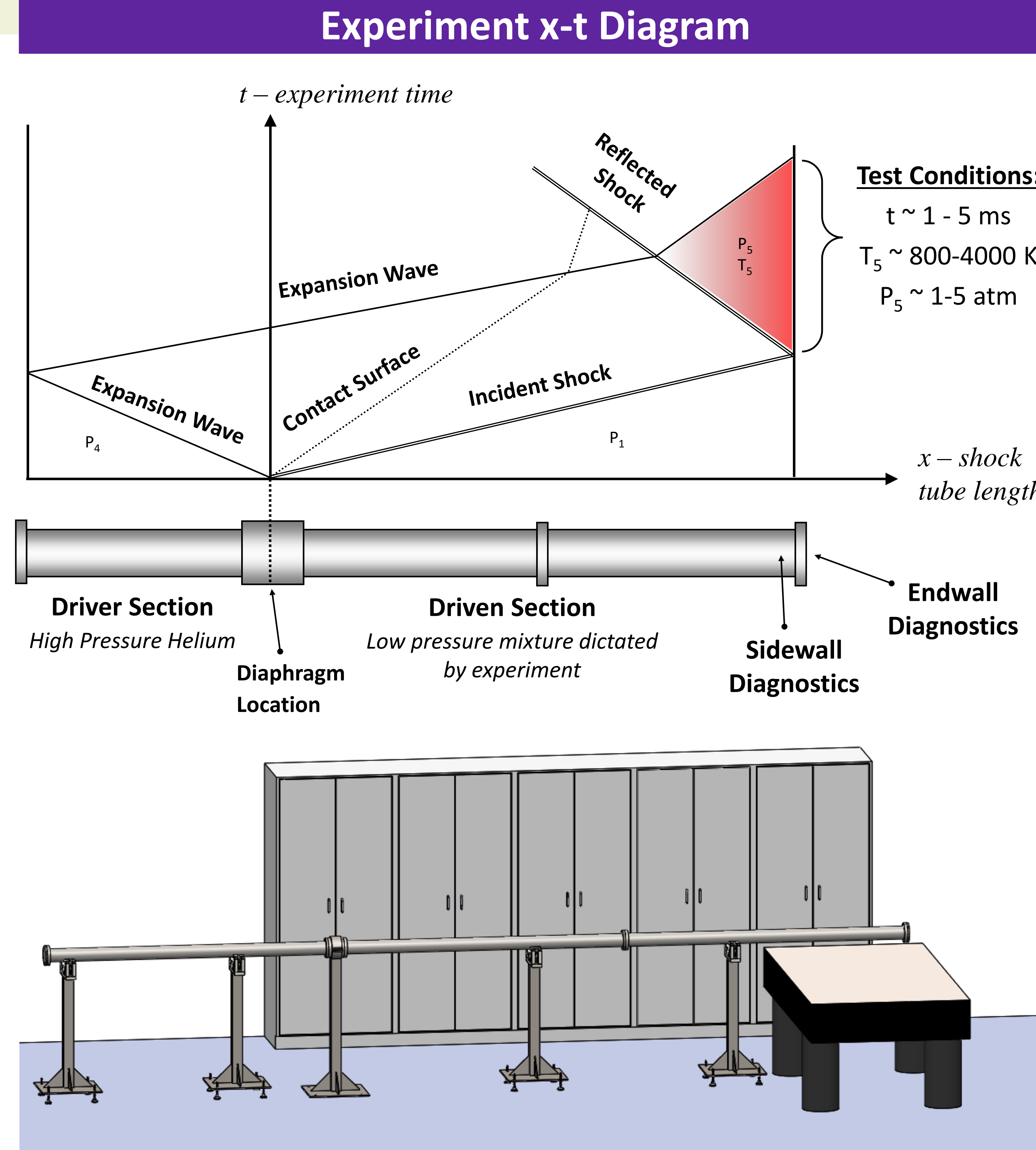
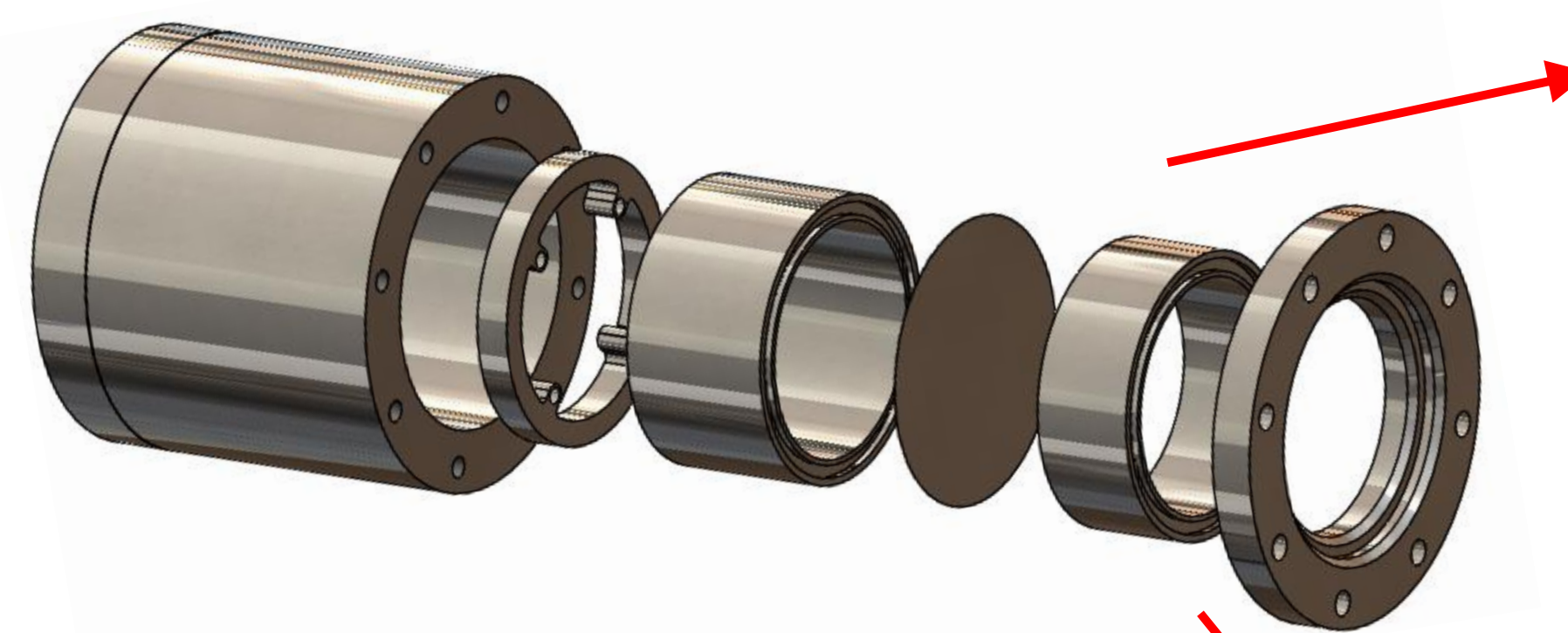
- The Stephen F. Austin State University (SFASU) shock tube is a bursting-diaphragm type with an all stainless steel construction. The tube is comprised of two sections, the driver and driven section, separated by a diaphragm.
- The driver section is pressurized until the diaphragm breaks. The sudden change in pressure sends a shockwave through the driven section and reflects off the end of the tube creating the desired test region of high temperature and pressure (T_5, P_5).
- The speed of the incident shockwave is measured using calibrated fast-acting pressure transducers in series. This speed is used to determine test conditions, labeled as T_5 and P_5 in above image, from Rankine-Hugoniot 1D shock relations [1].
- Venting, vacuuming, and diaphragm replacement is then done. Total process takes 30-45 minutes depending on mixture being tested.
- Shock tubes can generate repeatable conditions of elevated temperature and pressure after the reflected shock while maintaining quiescent flow [2].
- Shock tubes for research of chemical kinetics in extreme conditions have been used for decades in various applications at other institutions [3-5].

Configuration and Dimensions

- Bursting diaphragm type
- Pocket-flange design to allow for concentricity through entire tube
- 2.14 m Driver and 4.28 m Driven Section lengths
- 8.75 cm inner diameter throughout entire tube

Diaphragm Loader:

- Breech-loading mechanism
- Replace diaphragm between each experiment

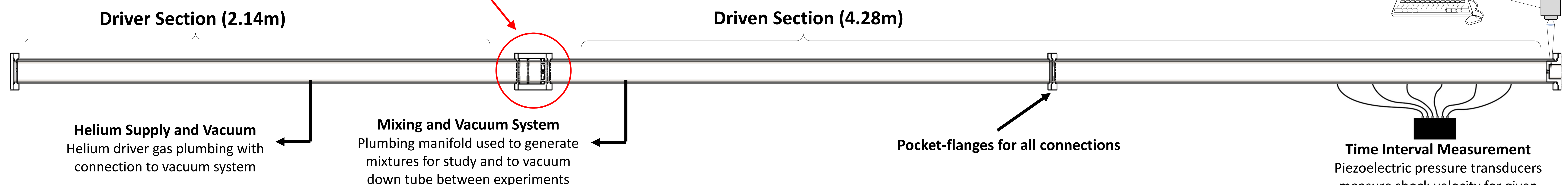


3D Printed Diaphragm and Shock Tube Replica



Jordan with 3D Printed and Fabricated Flange

CAD Model of Shock Tube Assembly in Laboratory Space



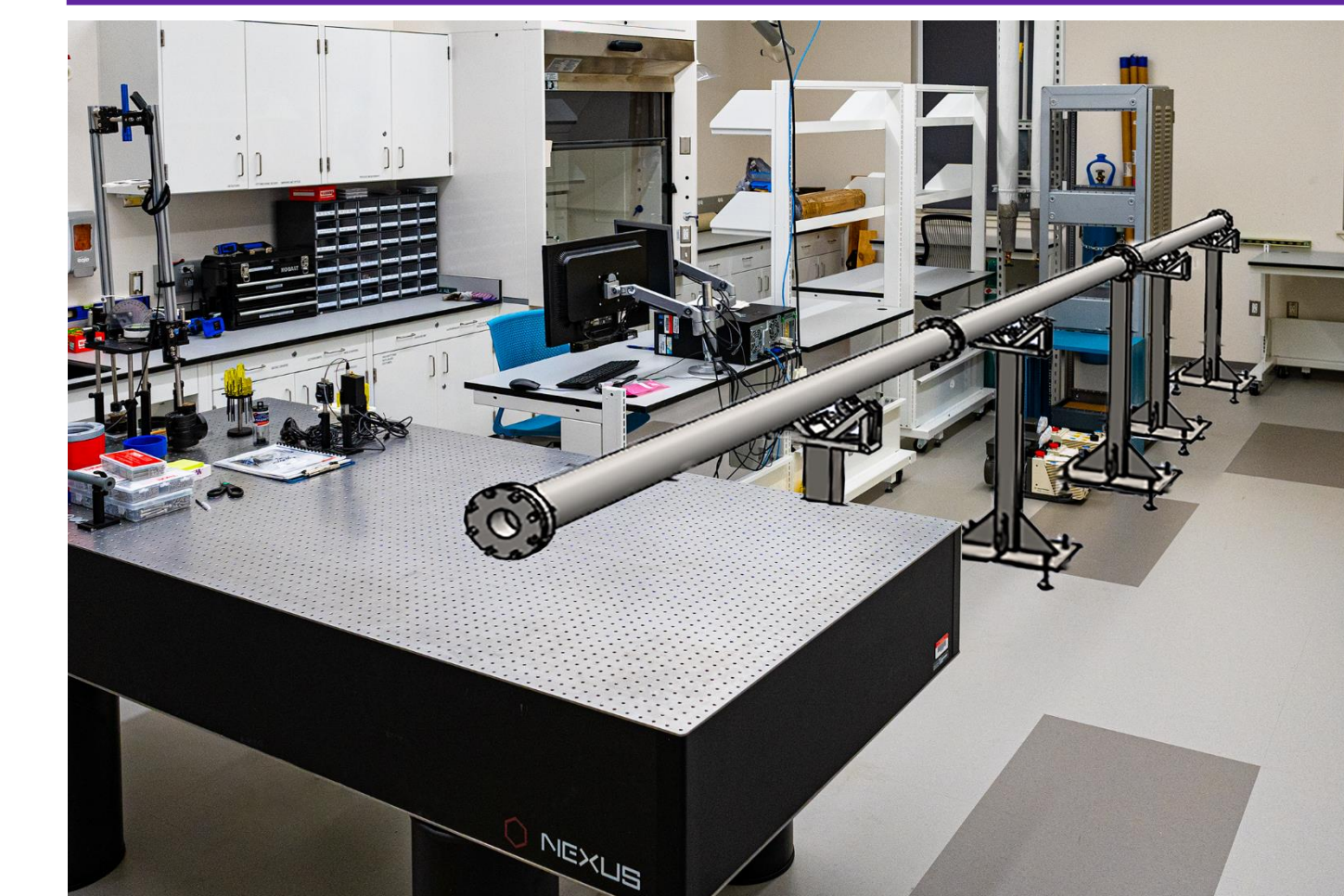
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Acknowledgements

This research was supported by the College of Sciences and Mathematics as part of the Summer Undergraduate Research Experience. This material is based upon work supported by the National Science Foundation under Grant No. (grantee must enter NSF grant number).

Fabrication of Shock Tube Components



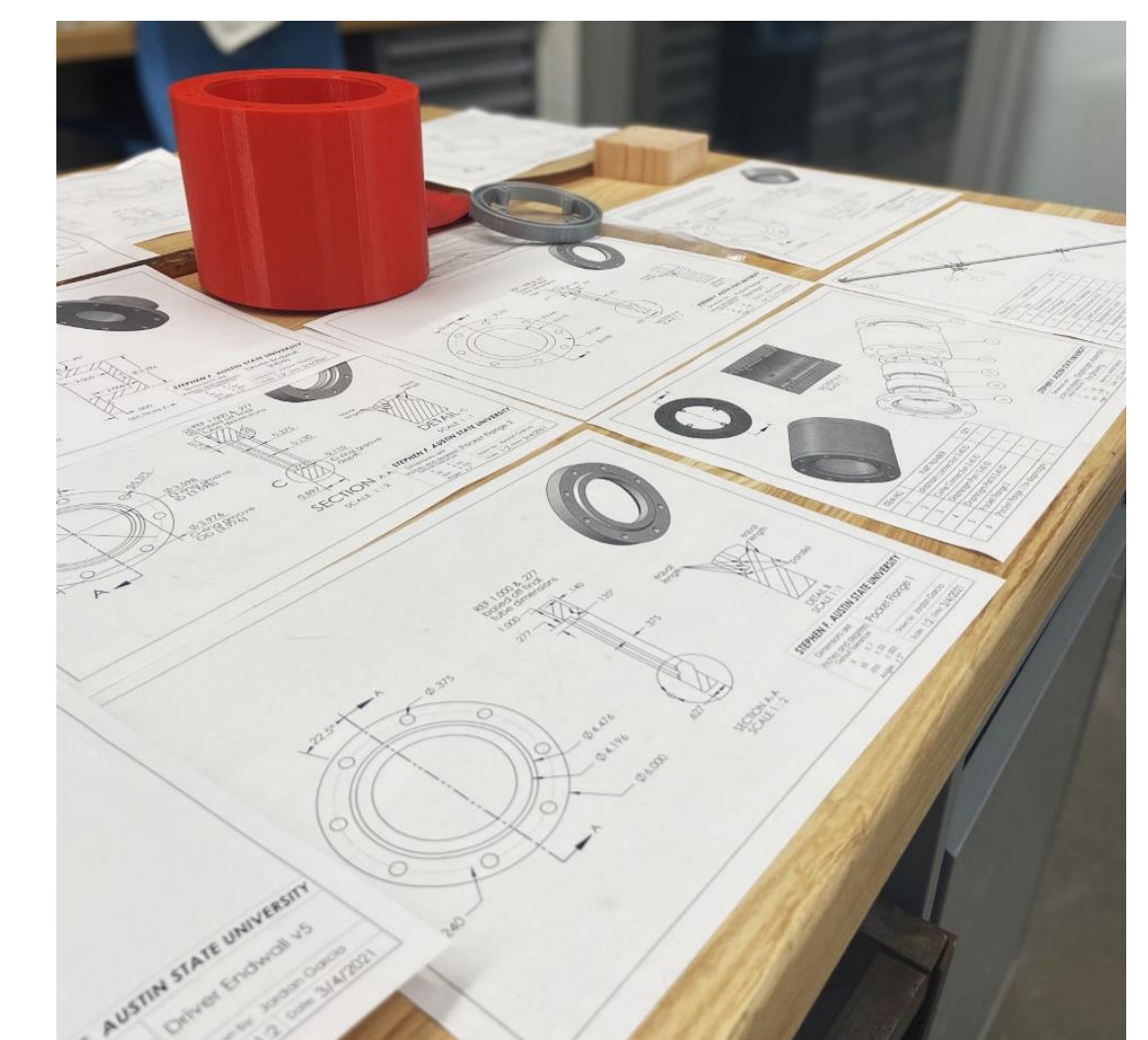
Projected CAD Model of Shock Tube in Laboratory



Comparing 3D Printed and Fabricated Steel Flanges



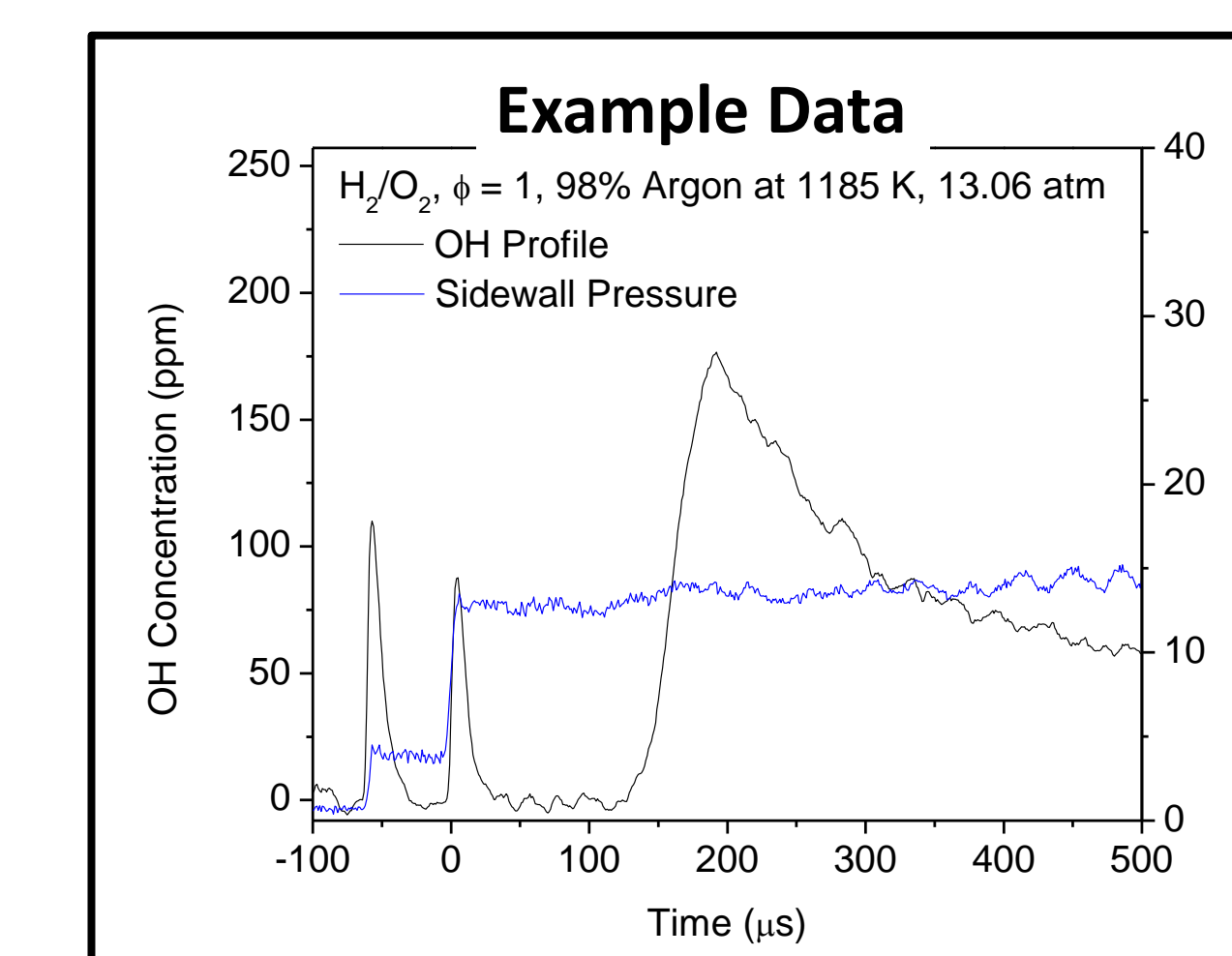
Finished Steel Tubes



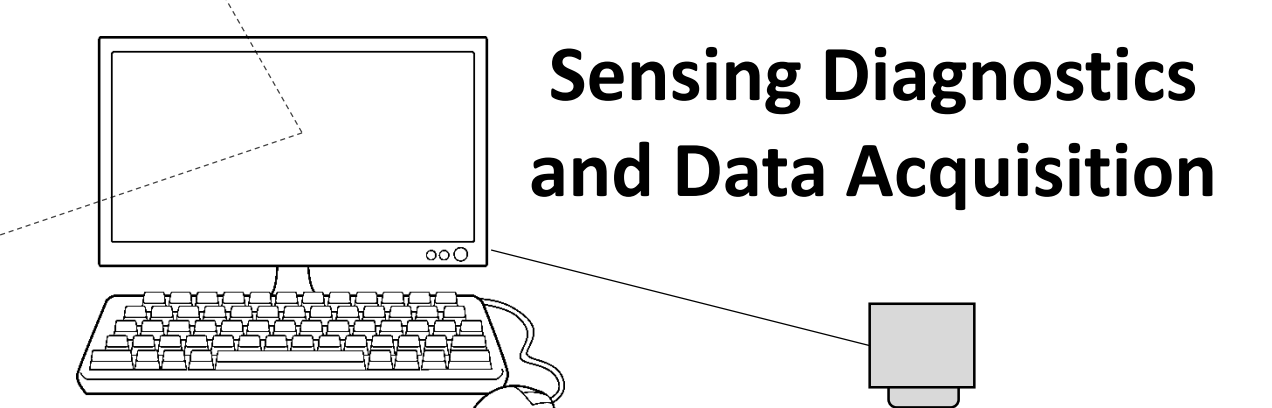
Machine Drawings

Future Applications and Experiments

- Design of the SFASU shock tube is complete and manufacturing is underway as of Spring 2021
- Initial tests will consist of light emission of simple hydrocarbons to validate with known kinetics mechanisms
- More advanced diagnostics are being developed to measure species profiles through reaction, example work from author shown here [6]:



- Blue data trace shows pressure measured in a typical shock tube experiment from sidewall location – note initial and reflected shock



Sensing Diagnostics and Data Acquisition

Time Interval Measurement
Piezoelectric pressure transducers measure shock velocity for given Rankine-Hugoniot shock equations