

ADDITIVE MANUFACTURING GAS FLOW



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INTRODUCTION

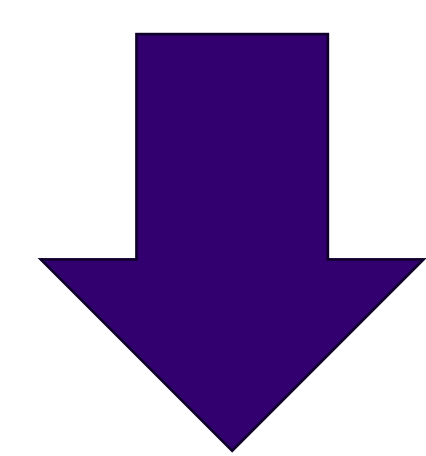
- *Laser Powder Bed Fusion is a process that 3D printers, such as the EOS M290, utilize to print titanium parts*
- *The printer requires an inert gas flow in the build chamber to prevent oxidation and remove smoke and ejected condensate during the melting process*
- *The gas flow inside the build chamber has not been fully characterized*

PURPOSE

The gas flow inside the EOS M290 printer must be characterized to analyze its effect on material properties throughout the build chamber

CORE FUNCTIONS

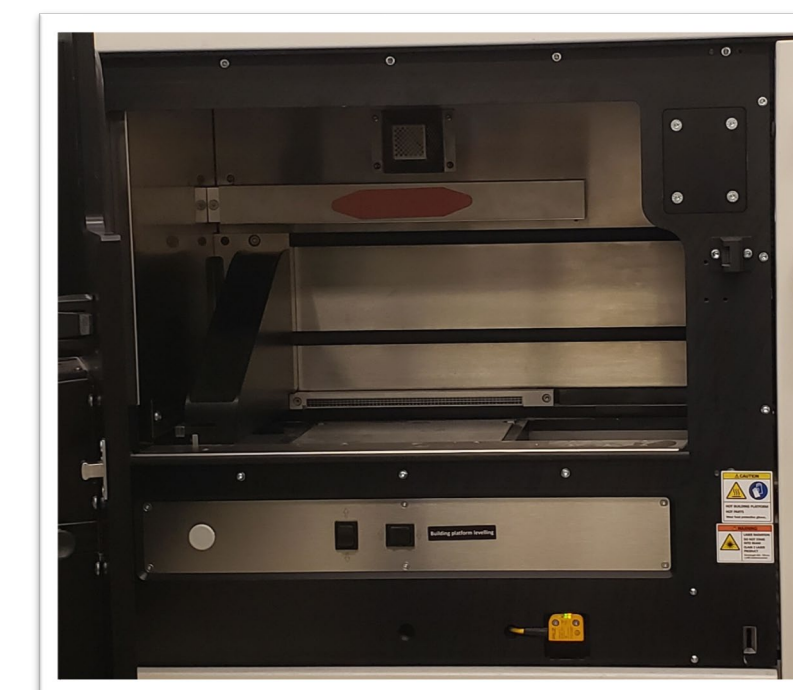
- *Model the gas flow in the EOS M290 printer*
- *Accurately characterize the flow in the model chamber*



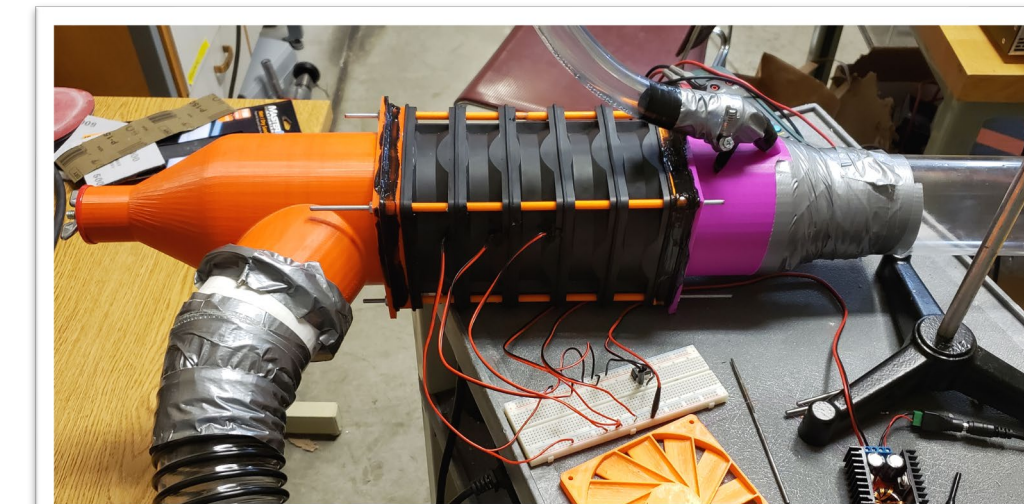
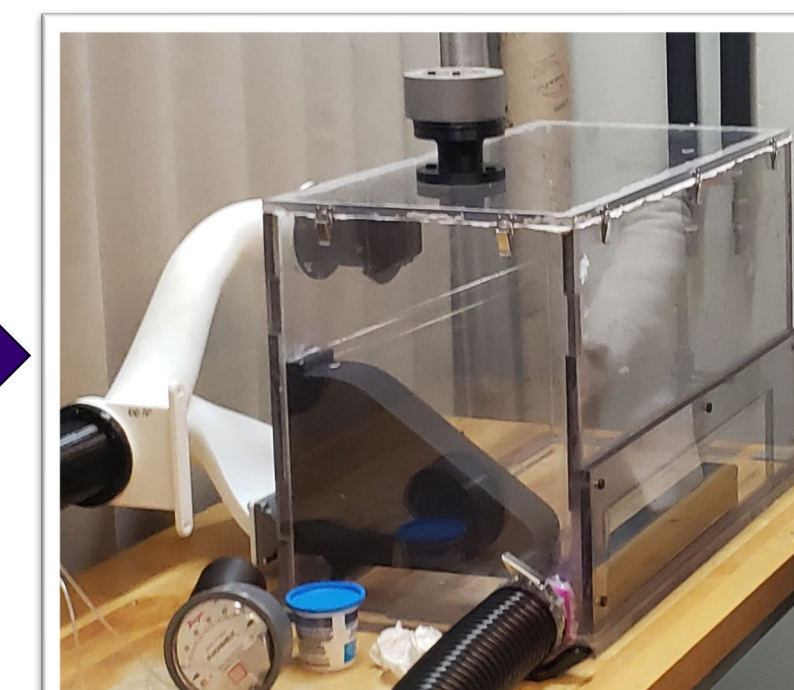
Particle Image Velocimetry

- *Velocity field is constructed from pairs of images of tracer particles in the flow*
- *Particles illuminated by laser sheet*

DESIGN AND DEVELOPMENT



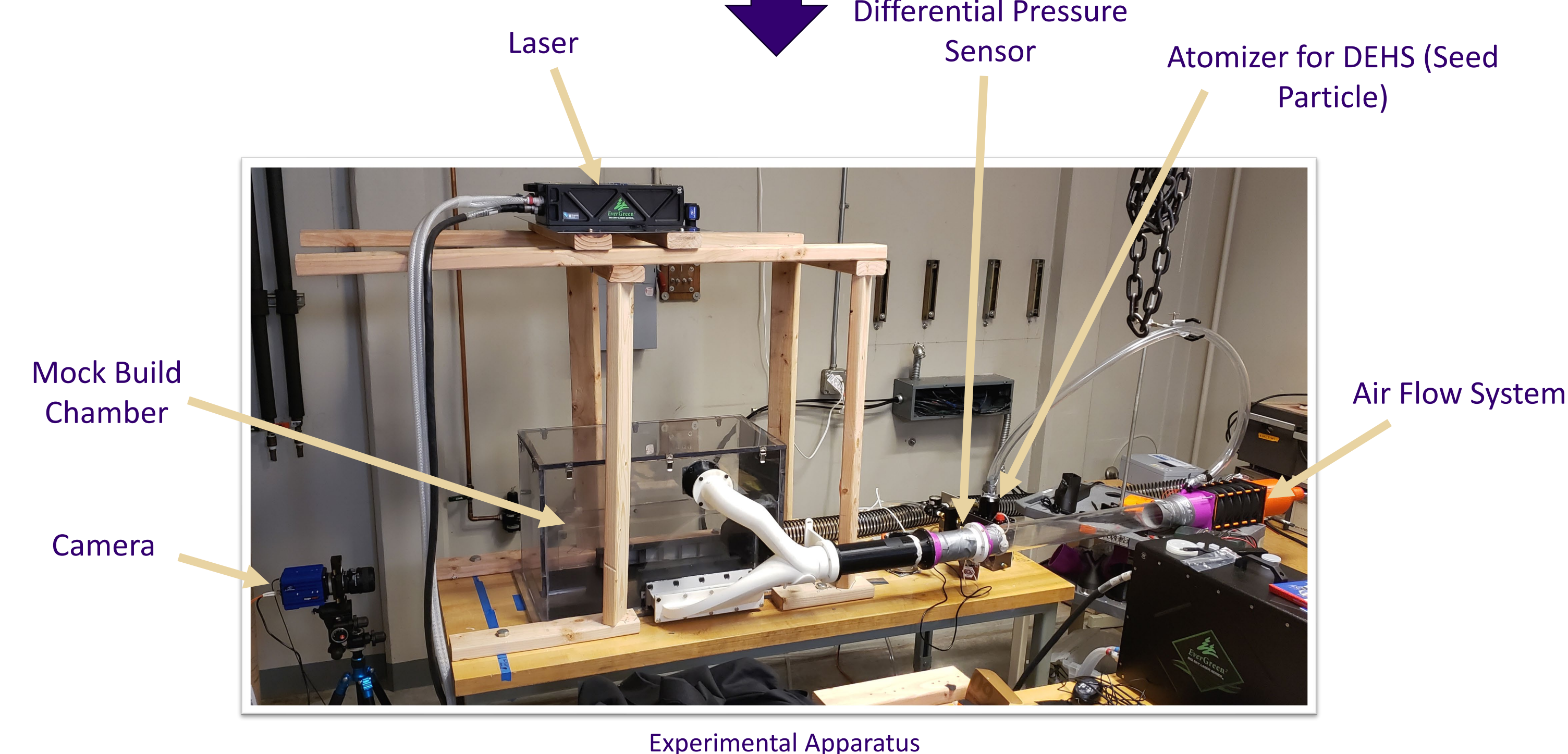
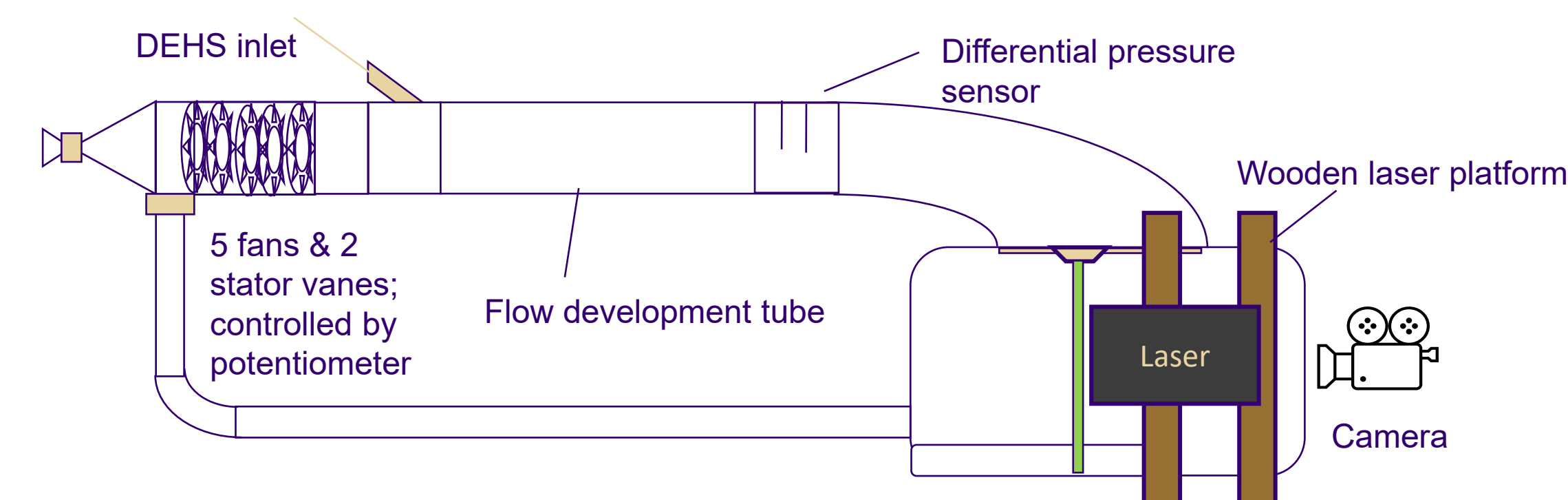
EOS M290 build chamber and mockup system



CPU fan air flow system

EXPERIMENTAL PARAMETERS

- *Boeing tests: 120 m³/h flow rate*
- *Visualize flow at inlet vents and outlet baffle*

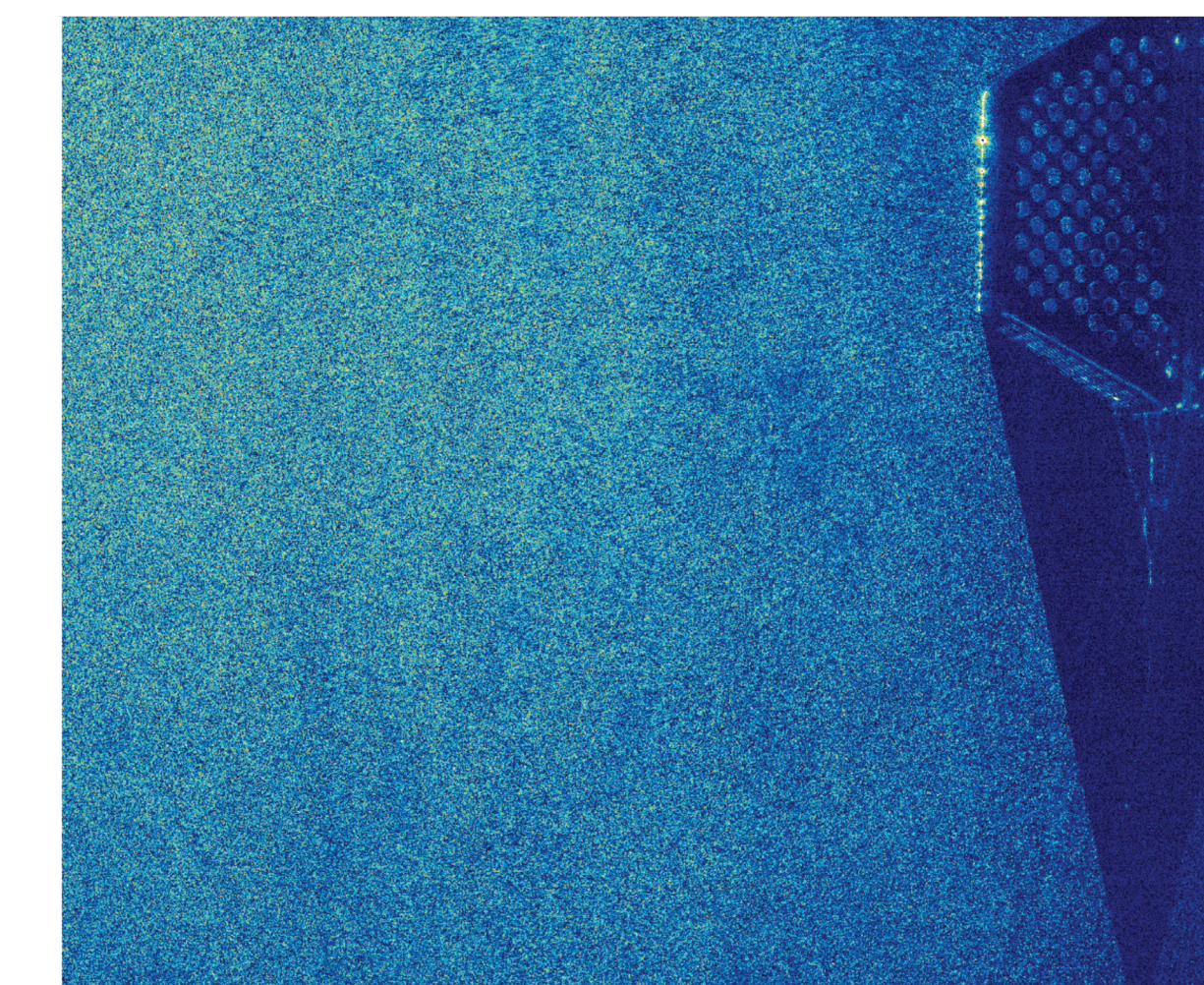


Experimental Apparatus

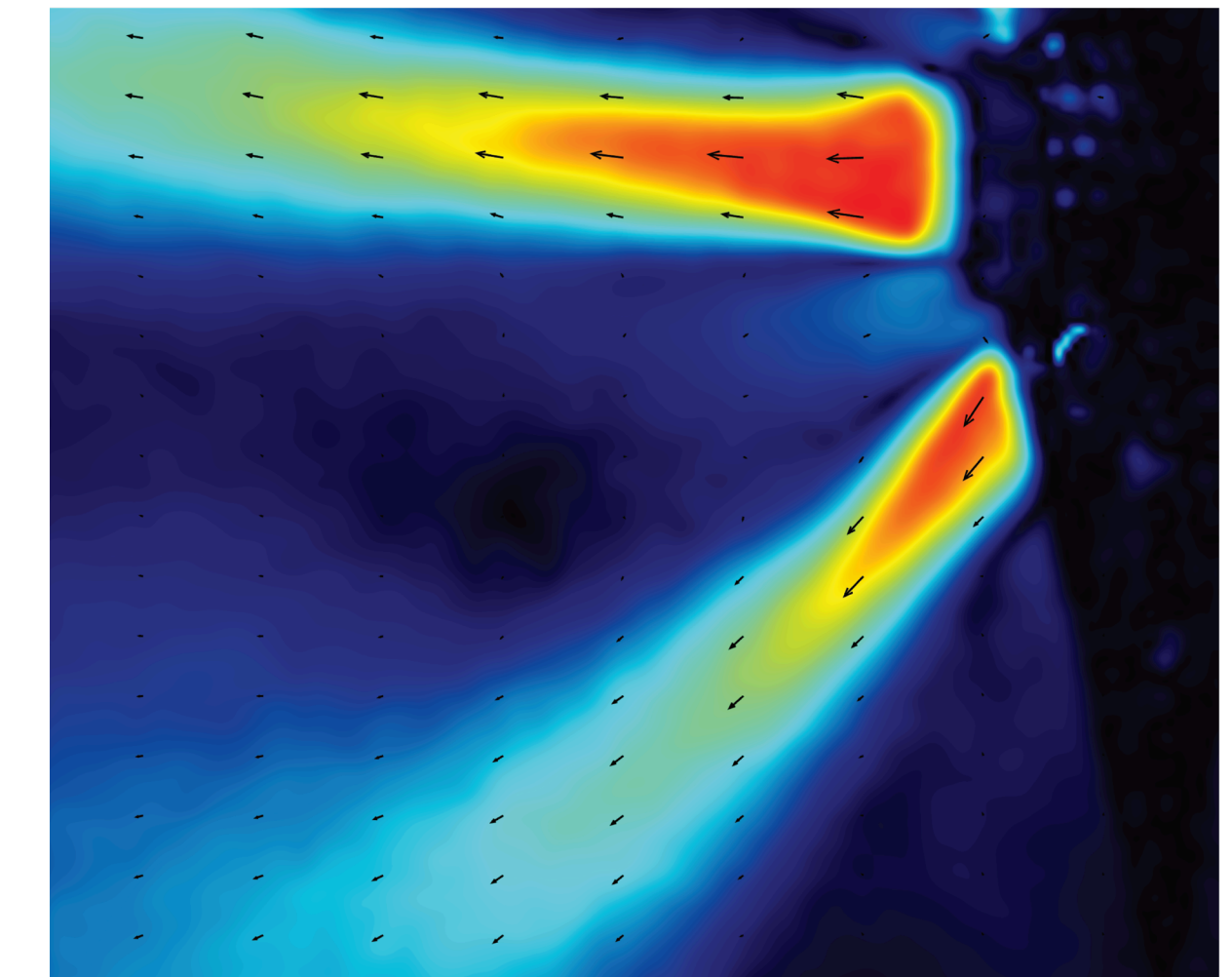
PIV SYSTEM DETAILS

- *Evergreen 200 mJ pulsed laser (532 nm wavelength)*
- *5.5 Megapixel CMOS Camera*
- *Flow seeded with DEHS*
- *Controlled by Programmable Timing Unit (PTU) and DaVis software*

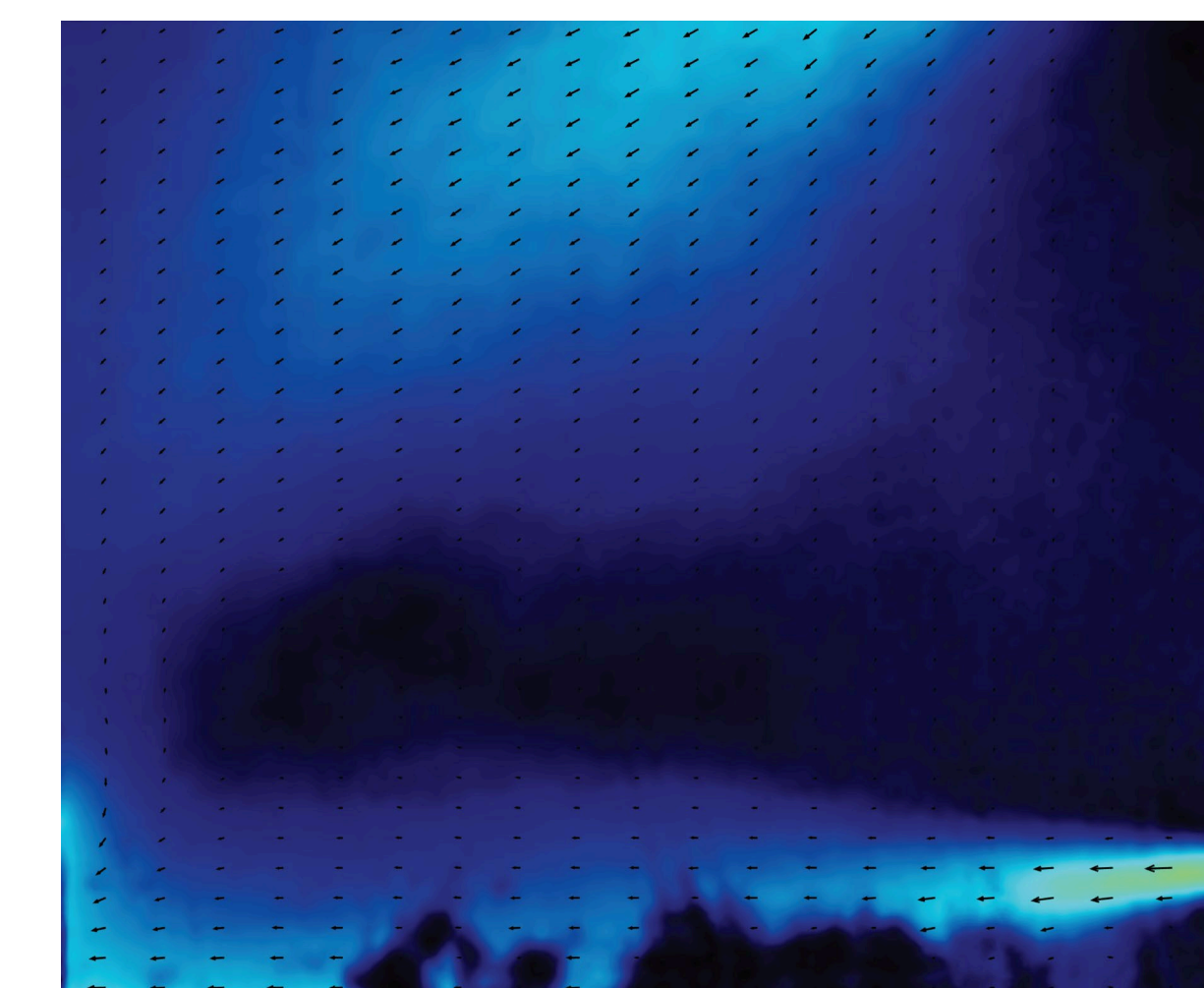
RESULTS



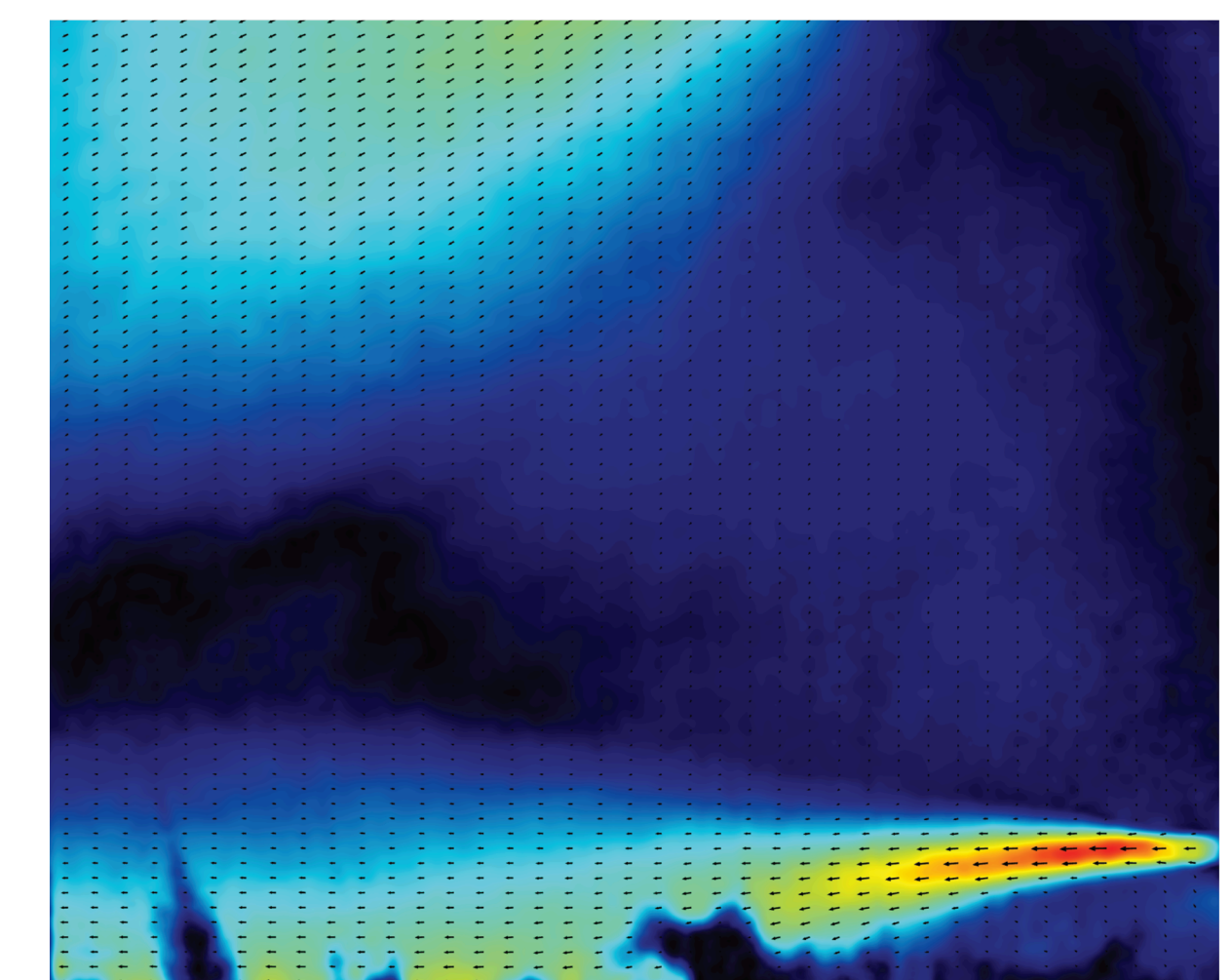
Illuminated particles of DEHS



Average velocity at top vent



Average velocity at outlet baffle



Average velocity at bottom vent

- *Multiple dead zones in the chamber*
- *Turbulent flow in bottom vent*
- *Flow rate drops from 7.2 m/s to 3 m/s at upper inlet*

CONCLUSION & FUTURE WORK

- *Nonuniform flow in chamber*
- *Large dead zone in center of build chamber can trap unwanted vapor*
- *Improved upper inlet design should be investigated to more effectively move air across box*
- *Stereoscopic PIV for 3D flow field*

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Mechanical Engineering Capstone Exposition

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