Effects Of Collision Of Water Droplets Onto Surfaces In High Speed Air

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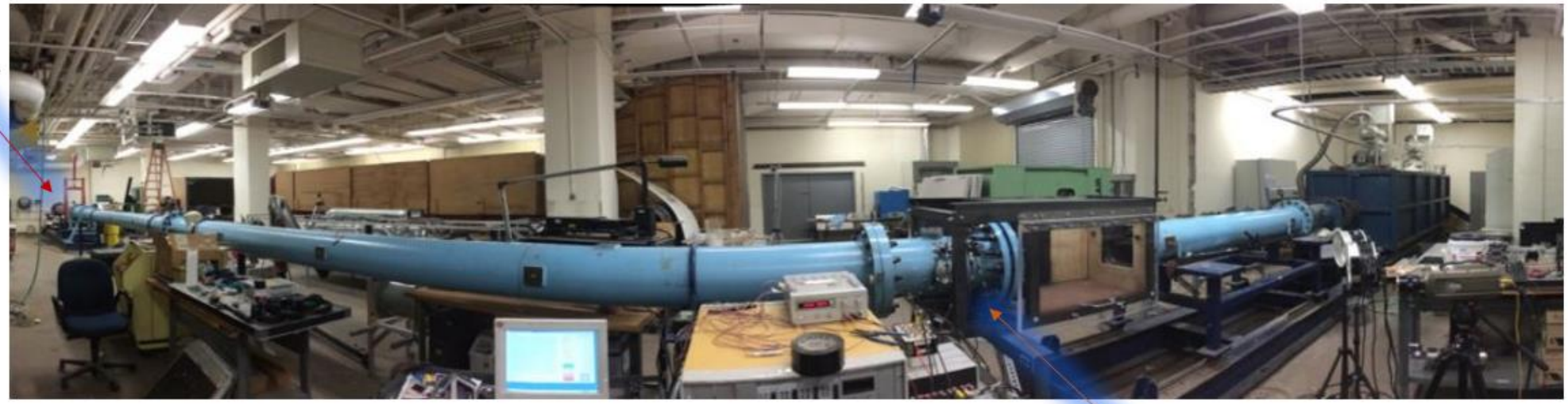
Research being done in the Aero Lab (Room C32) at Steinman Hall at CCNY

What are we studying?

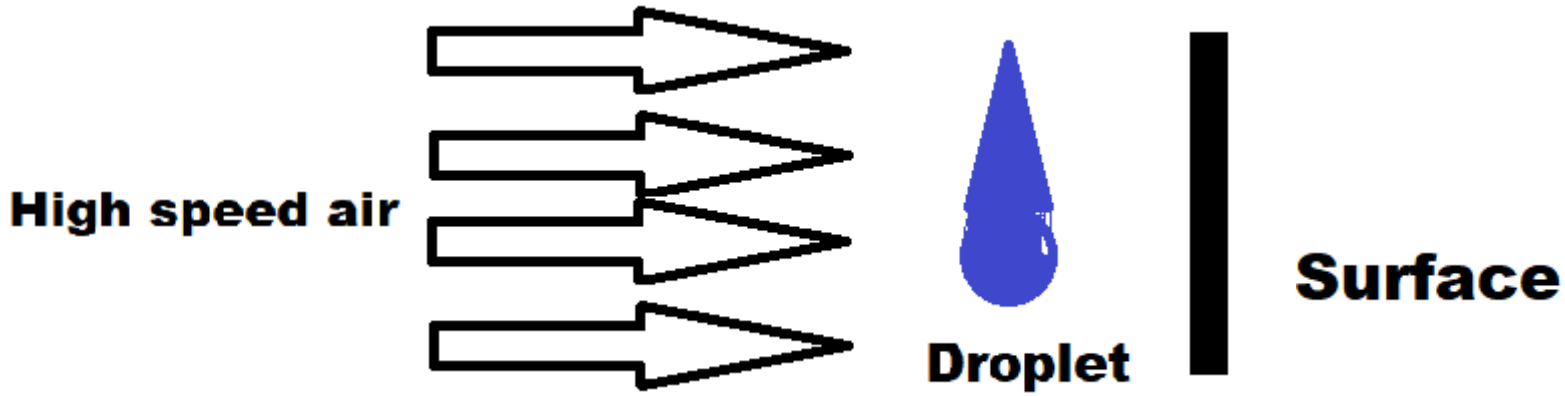
- In fast moving projectiles and vehicles, the influence of fluids the body travels through has a strong impact on the movement of the body, as well as many stresses acting upon the body.
- When fluids impact an airfoil surface, the flow of the fluid will change, for example when a drop of water hits the ground, it will splatter.
- We are studying the behavior of the fluid during this impact, as well as the effect of the collision onto the surface itself.

- Lets look at the SSR Blackbird (SR-71) as an example.
- This plane is designed to fly at 70,000-90,000 feet high.
- At Mach 3 the surface of the plane easily reaches up to 900 degrees Fahrenheit (315-480 degrees Celsius) due to friction with air.
- Now if simply air can cause this much heat to generate, imagine how much of an impact a water droplet can have on the surface of the airframe. (Water droplets at 830 times denser than air at STP)

Pressure Chamber



Observing Window



Pressure Chamber:
This chamber is designed to accommodate up to 2000 PSI of pressure!!

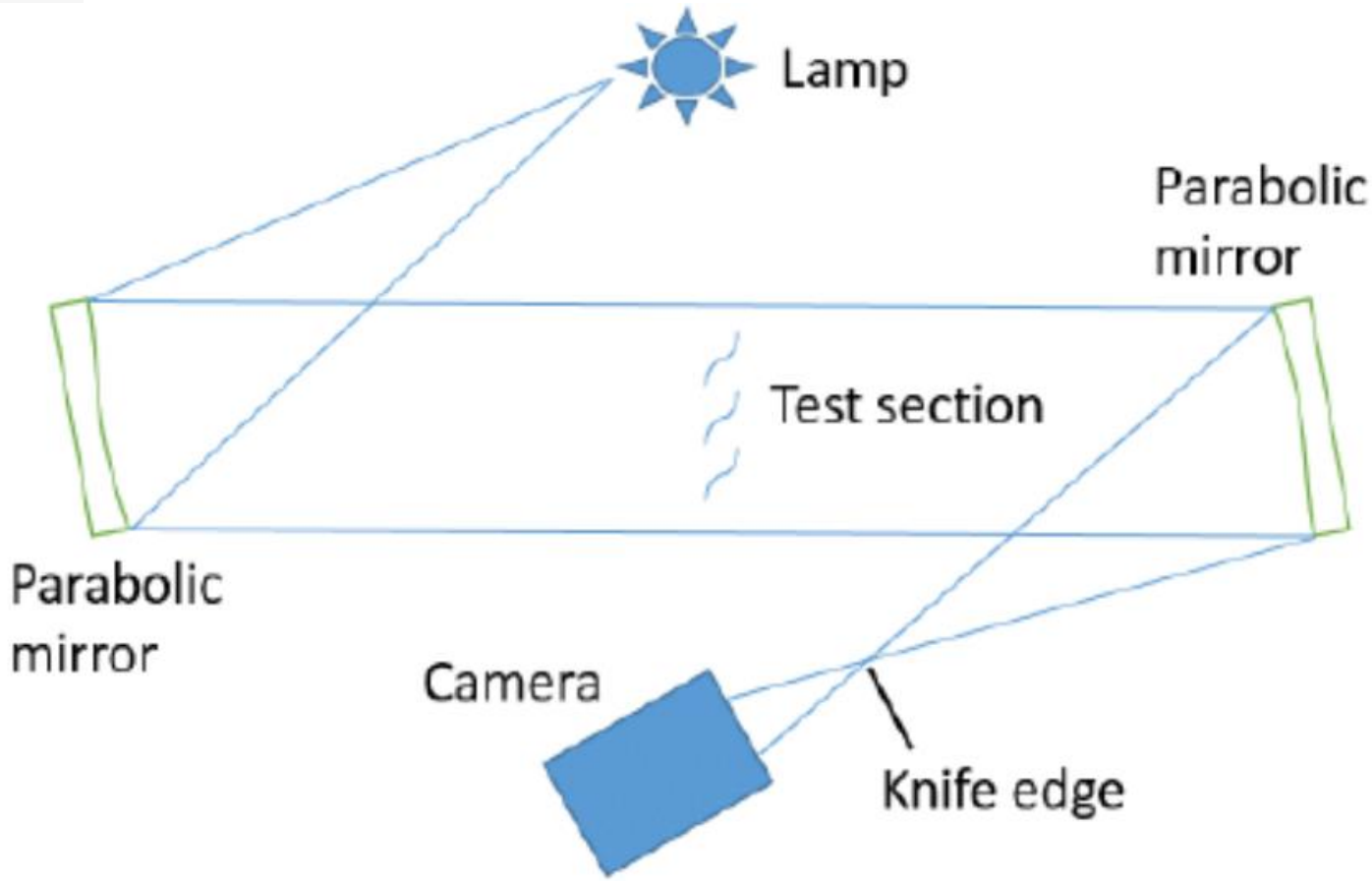
- Air Compressors:

-The new backup green compressor both a way to store compressed air long term (rectangular box) and compress air able to compress 2000 PSI of air.

- The large grey cylinder stores compressed air, and there is a separate air compressor for it behind the pillar, capable of generating up to 2000 PSI.

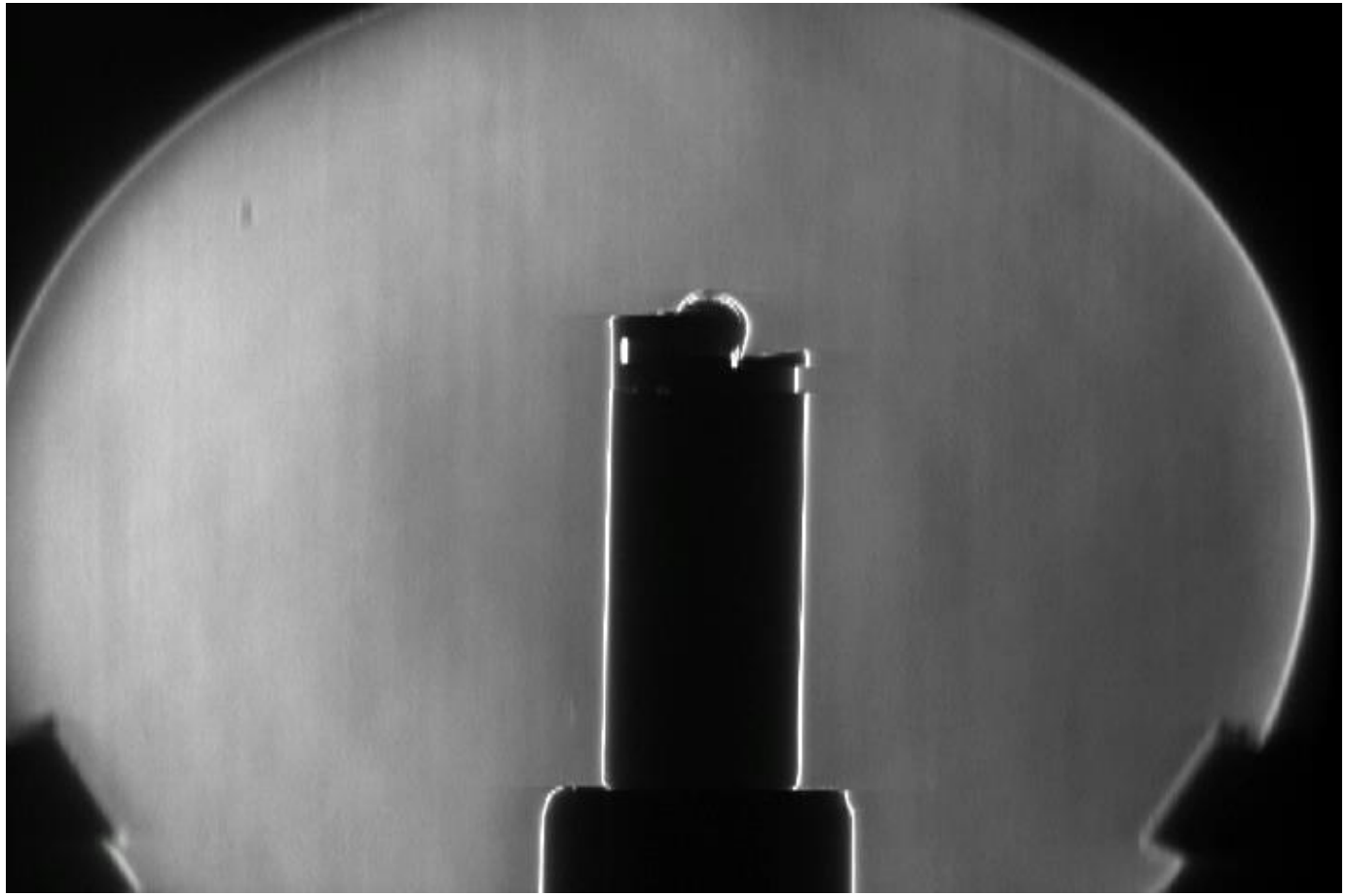
- Aluminum diaphragms that ruptures under high pressure to generate very high speed air.
- When the diaphragm bursts, all the high-pressure air will suddenly be released at once causing very high speed air to shoot out.

- High speed camera we will be using in order to record the Schlieren image of collision. This camera can capture up to 200 million frames per second!! Although this insane speed isn’t necessary for our experiment, we might require around 200,000 fps.

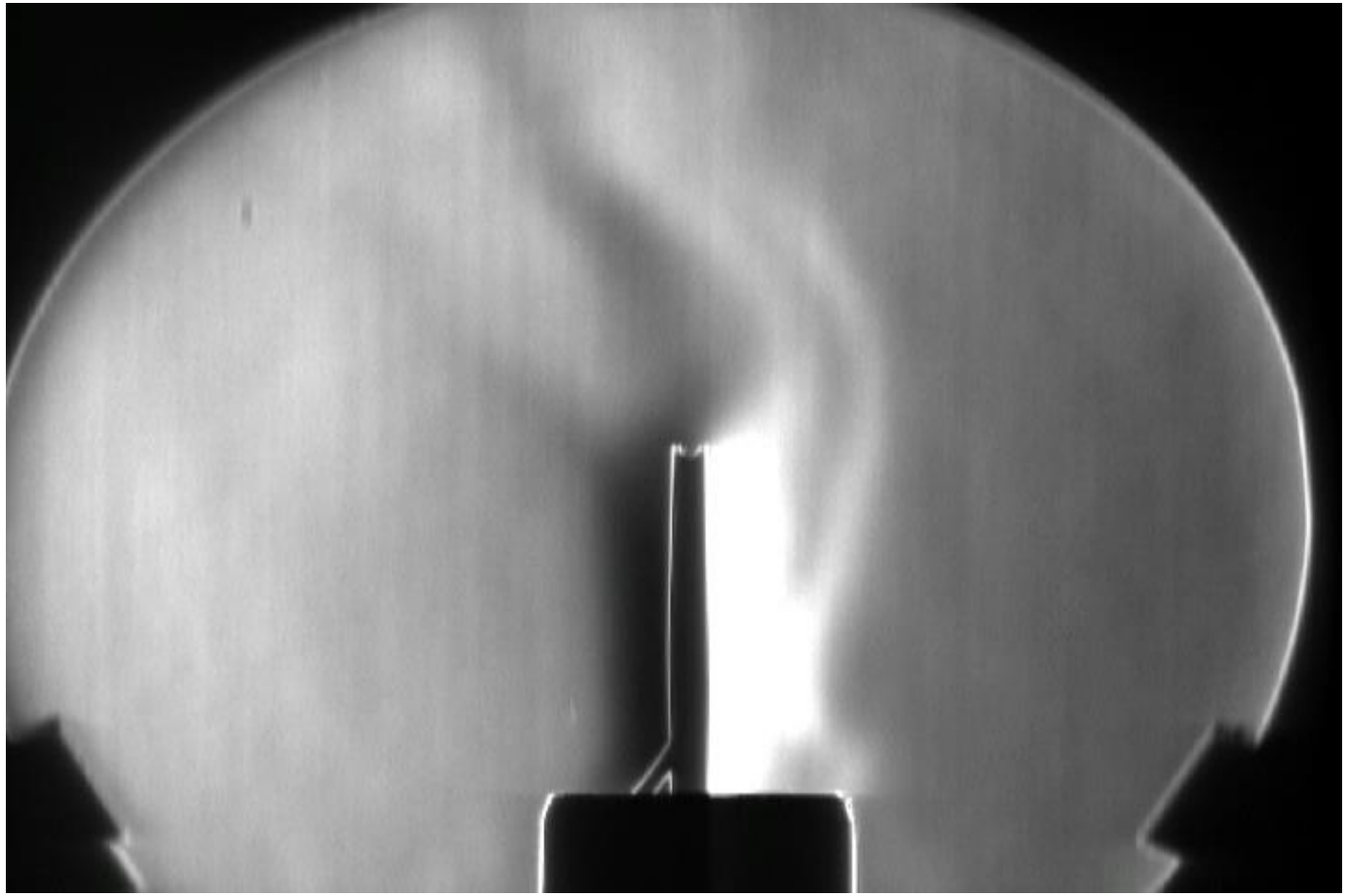


- Z-Type Schlieren imaging will be used to see the fluid movement in the observation window. This imaging uses the refractive index based on different densities of fluids to visualize airflow.

Schlieren Imaging Tests!



Schlieren Of Peltier Module



Shock Tube Test Blast!!

THANK YOU