Liquid Nitrogen Flow Visualization

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I created a video of the water vapor created when the end of a pool cue was dipped into liquid nitrogen along with video footage of liquid nitrogen being poured out onto table, shirt, and various surfaces. I was trying to show the negative bouncy of the cold water vapor that is denser then surrounding air and also what happens to liquid nitrogen when exposed to room temperature air.

For this video we first poured liquid nitrogen out onto the table where it froze surrounding water vapor and maybe CO2 into solid ice, which bounced off of

the table. The rest of the video footage was a pool cue dipped in liquid nitrogen and held in the air. The liquid nitrogen cooled down the pool cue so much that when the pool cue was exposed to surrounding air it caused the air to condense at such a cold temperature into water vapor. This water vapor was very cold which made it denser than the warm surrounding air. Due to this denser water vapor it created negative bouncy where the water vapor fell down rather than water vapor that is less dense than surrounding air and rises. The cold created from the liquid nitrogen dipped pool cue caused the surrounding air to condense and attached to nucleation sites in the air such as dust particles to grab onto.

We also poured liquid nitrogen into a bowl lined with a black t-shirt to examine the flow in that situation. This created waves of water vapor that were condensed from the liquid nitrogen, eventually falling over the side of the bowl and descended downward. The flow changed over time because after more and more liquid nitrogen evaporated there was less of it to cool and condense surrounding air into water vapor. The water vapor slowly became less visible with time as liquid nitrogen evaporated.

The visualization technique used was using liquid nitrogen to cool surrounding air into cold water vapor. This was done inside my living room in dusty warm air conditions.

The lighting used was two LED lights both on one side of the water vapor. These illuminated the water vapor created from the liquid nitrogen by giving them sidelight, which caused the white vapor to be illuminated and more visible. The pool

stick dipped in liquid nitrogen was then held about 5 inches from the lights to get the water vapor as illuminated as possible.

I choose to shoot the liquid nitrogen with a macro lens in order to get the close up detail and flow physics of 3-inch section of vapor. I used an f-stop of f-16 in order to get an amount of depth of field where the front and back of the vapor was in focus for each shot.

• Size of the field of view

3 inches x 2 inches

• Distance from object to lens

5 Inches from Lens

• Lens focal length and other lens specs

EF 100mm f/2.8 Macro USM lens

• Type of camera

Canon EOS 7D DSLR Camera

1920x1080 pixels

• Exposure specs:

Aperture: F-16

Frame Rate: 24 frames per second

ISO setting: 400

Post-processing:

Edited in Final Cut Pro in order to put all of the video clips together in a sequence. Only effects used were fade in/out and cross dissolves in order to flow from one movie clip to the next.

The Video I created reveals the physics of liquid nitrogen when brought out into room temperature air. It shows the condensation of water vapor around the super cooled liquid nitrogen and the physics of dense cold water vapor.

I like that the video show various angles and properties of how the liquid nitrogen behaves. If I had to choose something to dislike it would be the background of the shots. A question that I have is if you made the liquid nitrogen even colder would it become a solid. I fulfilled my intent of capturing the physics of liquid nitrogen although I didn't fulfill my initial idea of capturing objects breaking after being submerged in liquid nitrogen.

If I could improve an aspect of this project it would be to get a better backdrop so that the background is more uniformly black and contrasts well with the water vapor created in the air. If I developed the idea furthur I would try adding the liquid nitrogen to different liquid to see if they react in a certain way that had appealing flow visualization.