



UiT The Arctic University of Norway

UQAC
UNIVERSITÉ DU QUÉBEC
À CHICOUTIMI

Investigating Ice Nucleation and Heat Transfer Dynamics in Supercooled Liquid Water Using Thermography

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Presentation Overview

What is ice nucleation?

Why nucleation is important?

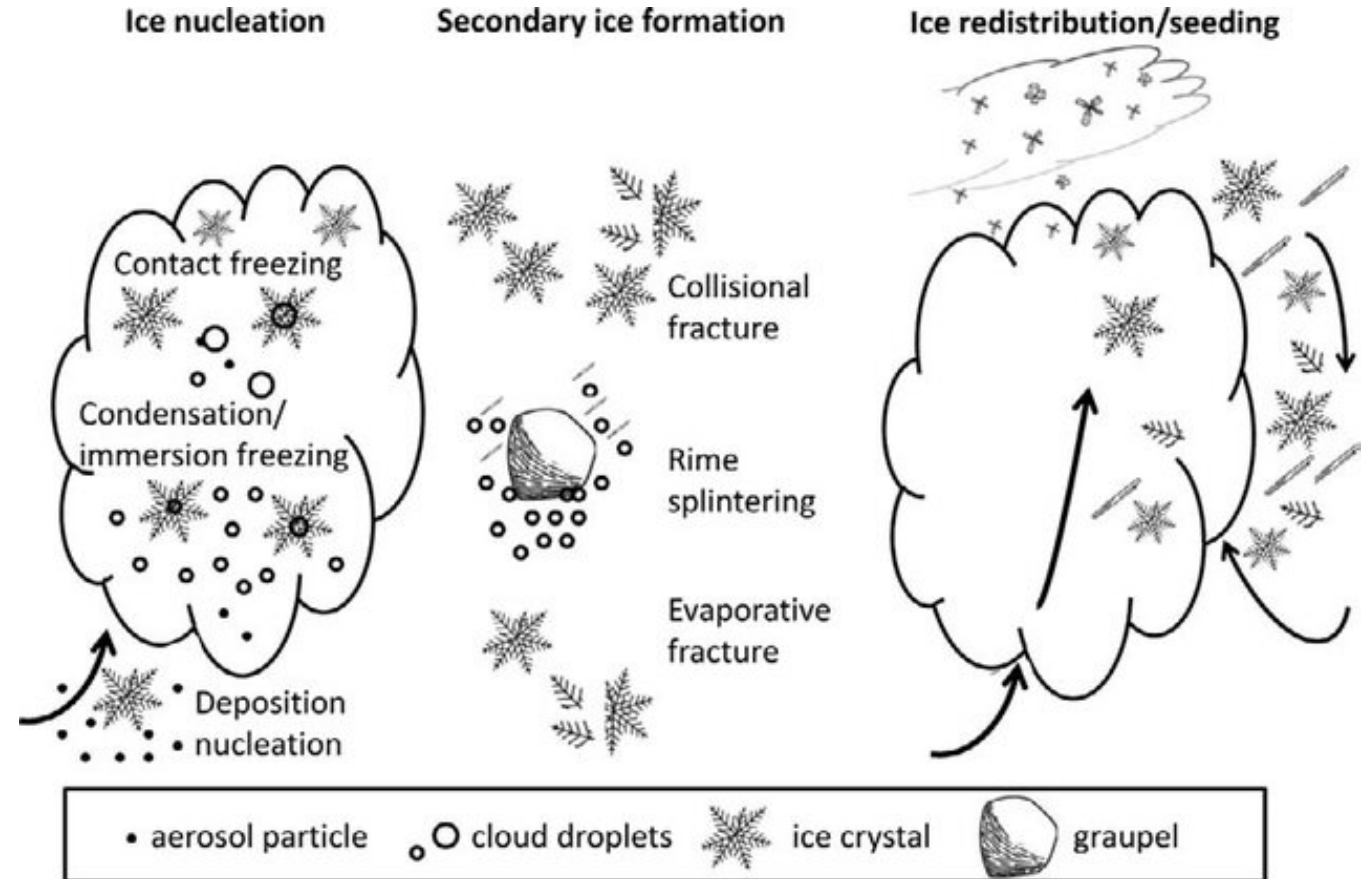
Ice nucleation thermodynamics

Methodology - Experiment Settings

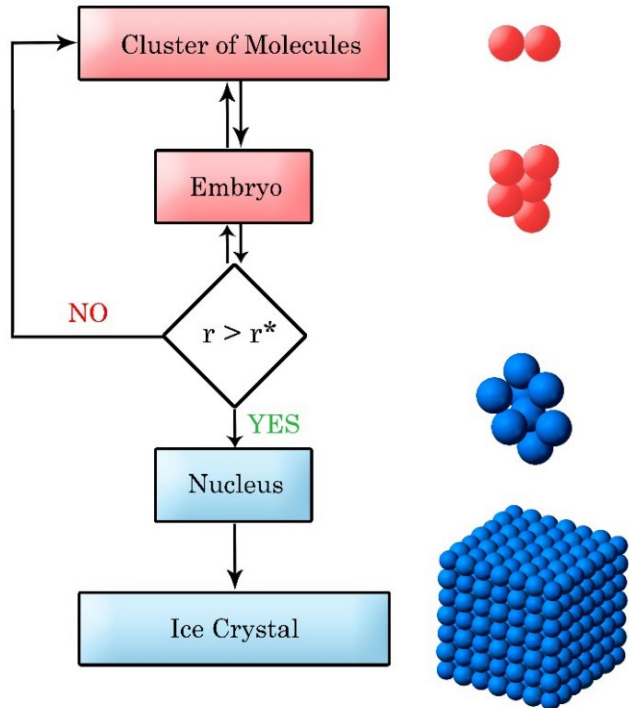
Results & Discussion

- High speed imaging
- High speed thermography
- Temperature with time plot

Conclusion



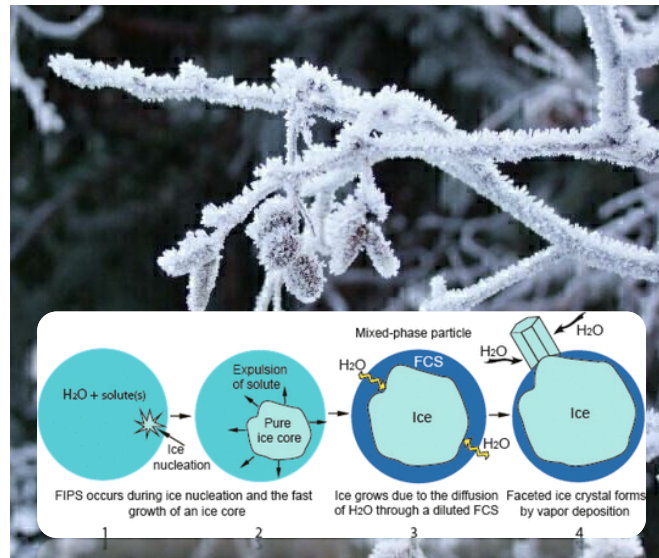
What is ice nucleation?



Changing equilibrium condition and achievement of driving force

Nucleation

Growth of the nuclei into ice crystals

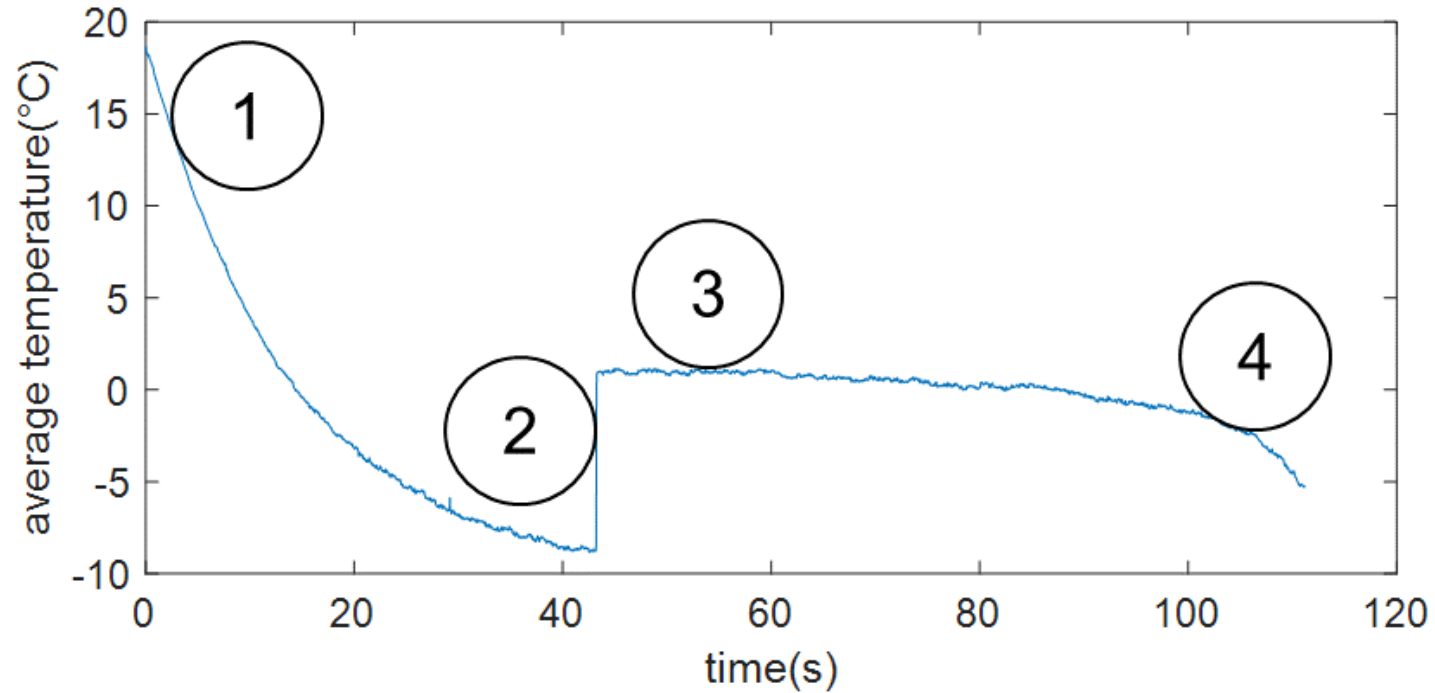


The process of ice nucleation occurs when small ice crystal embryos form on membrane that act as nucleation sites. These facilitate the aligning of water molecules, which promotes freezing.

Why nucleation is important?

anti-icing strategy: avoid (delay) ice nucleation

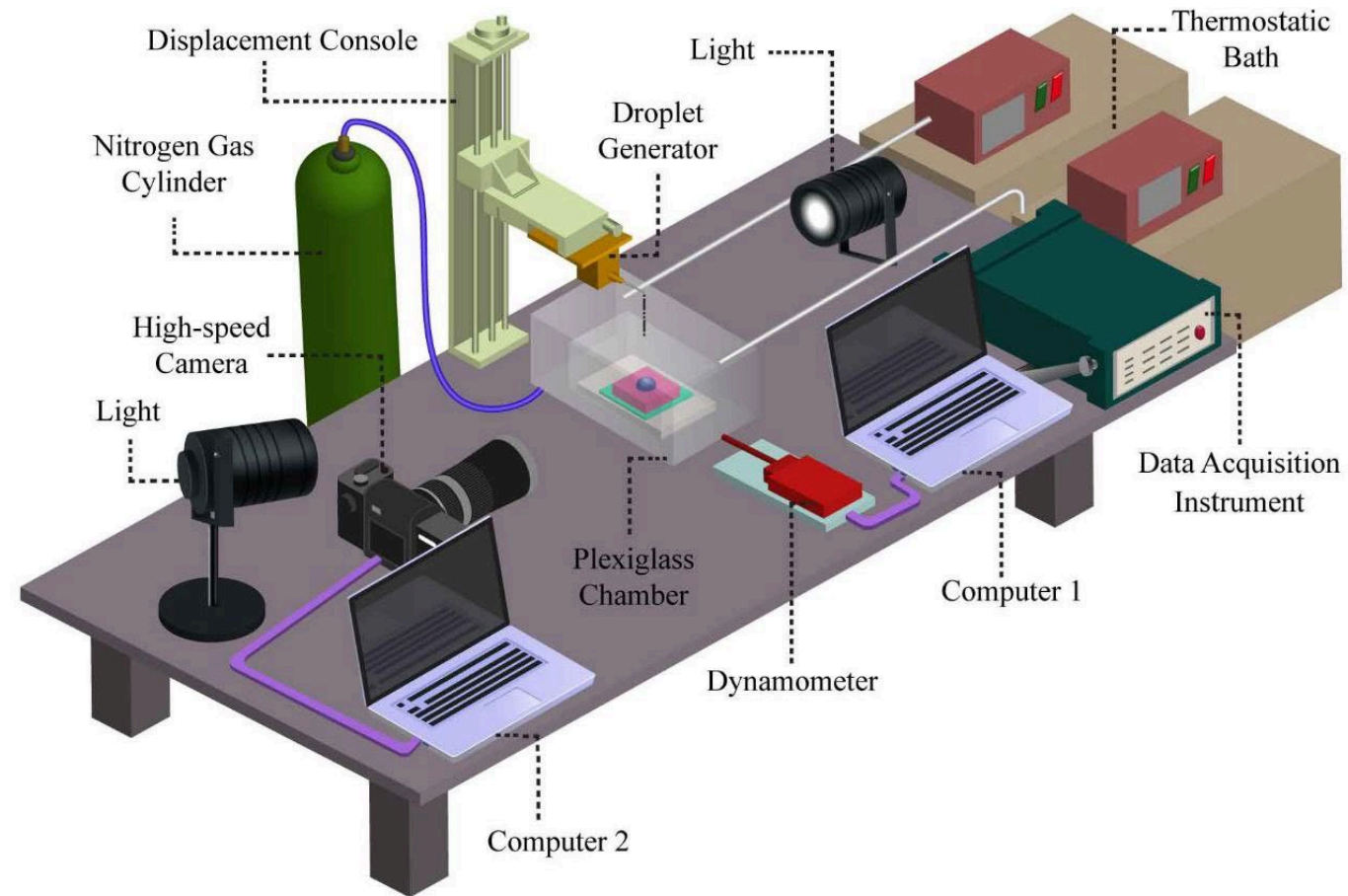




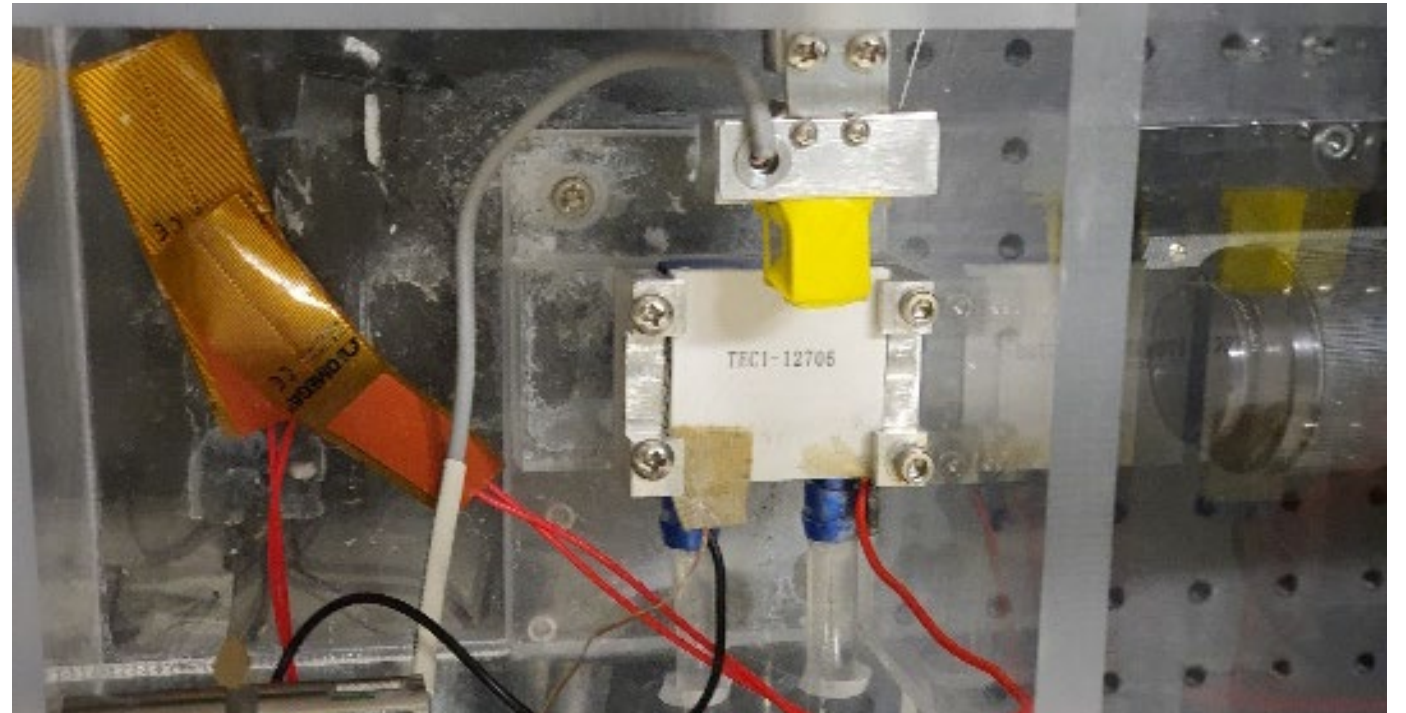
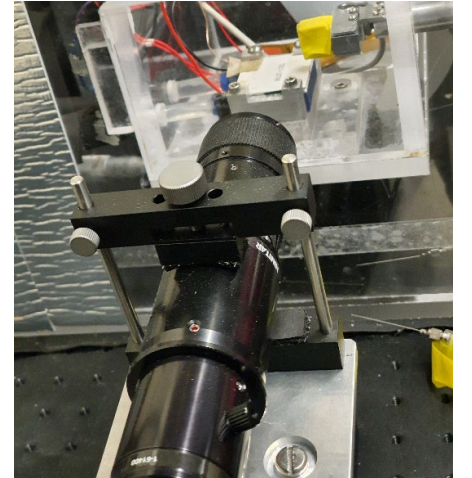
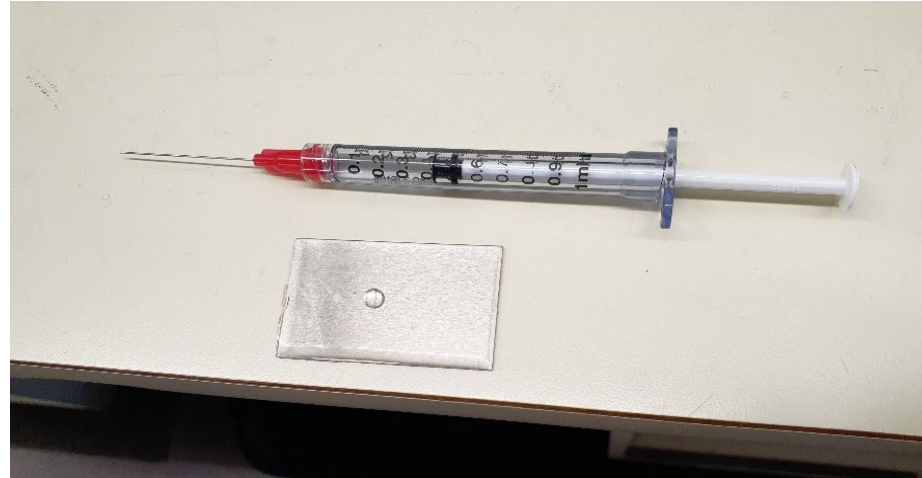
Ice nucleation thermodynamics

1. Newtonian cooling curve, heat capacity (first order)
2. Nucleation event (sudden release of latent heat of fusion) (Least Understood)
3. Phase change (constant temperature)
4. Newtonian cooling curve, heat capacity (first order)

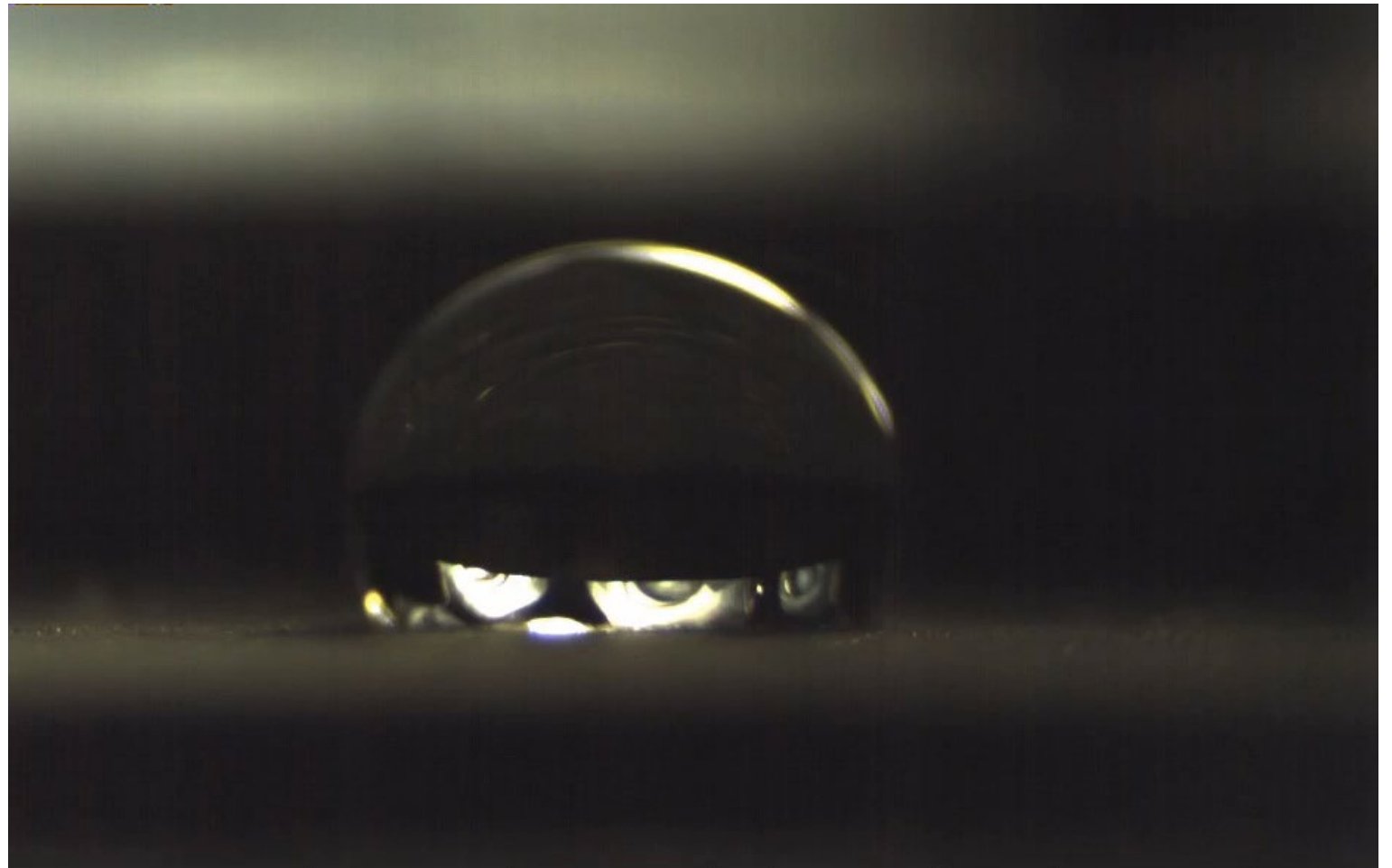
Methodology – Experiment Settings



Methodology – Experiment Settings

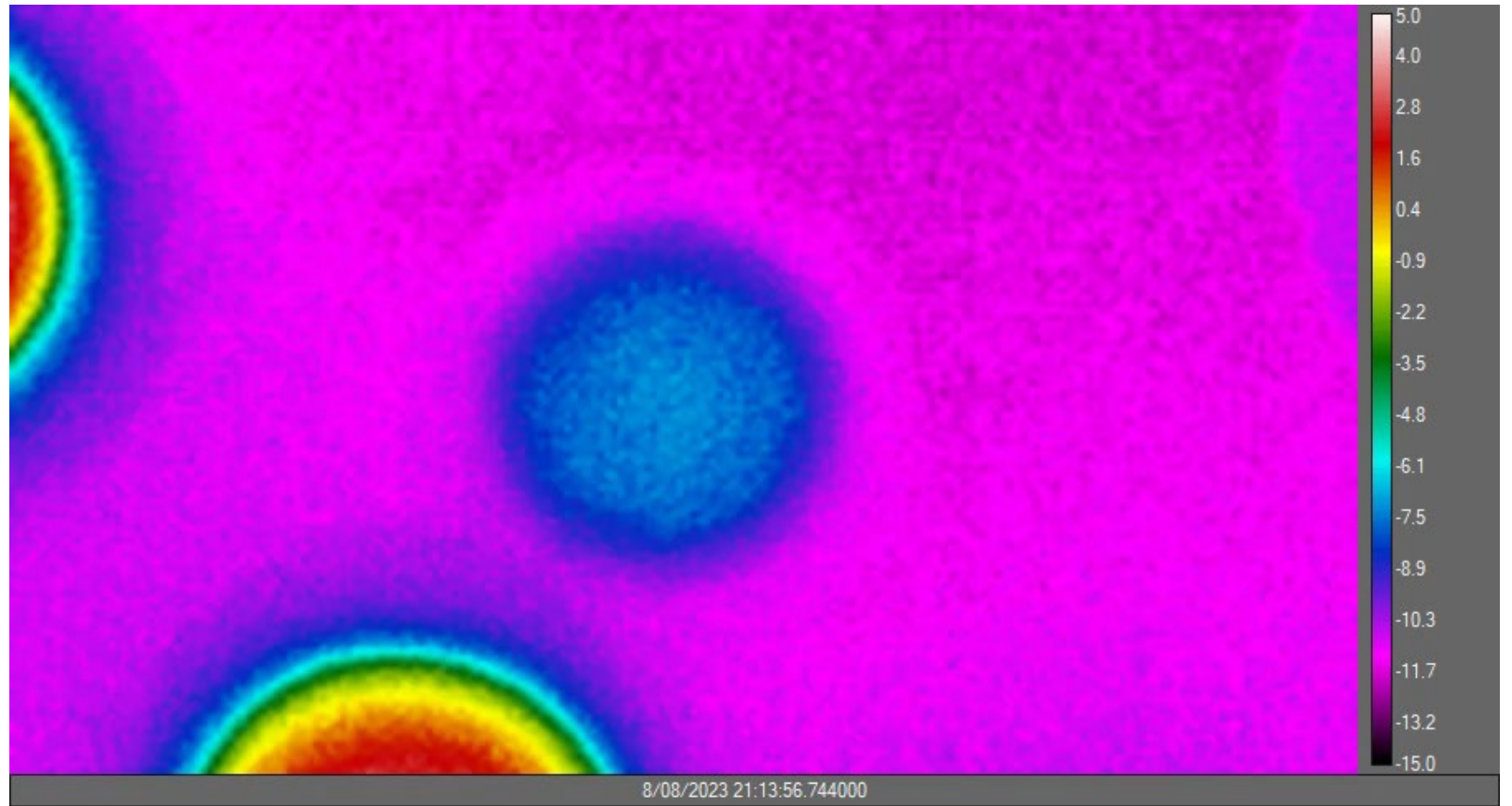


Results &
Discussion
(high-speed
imaging)

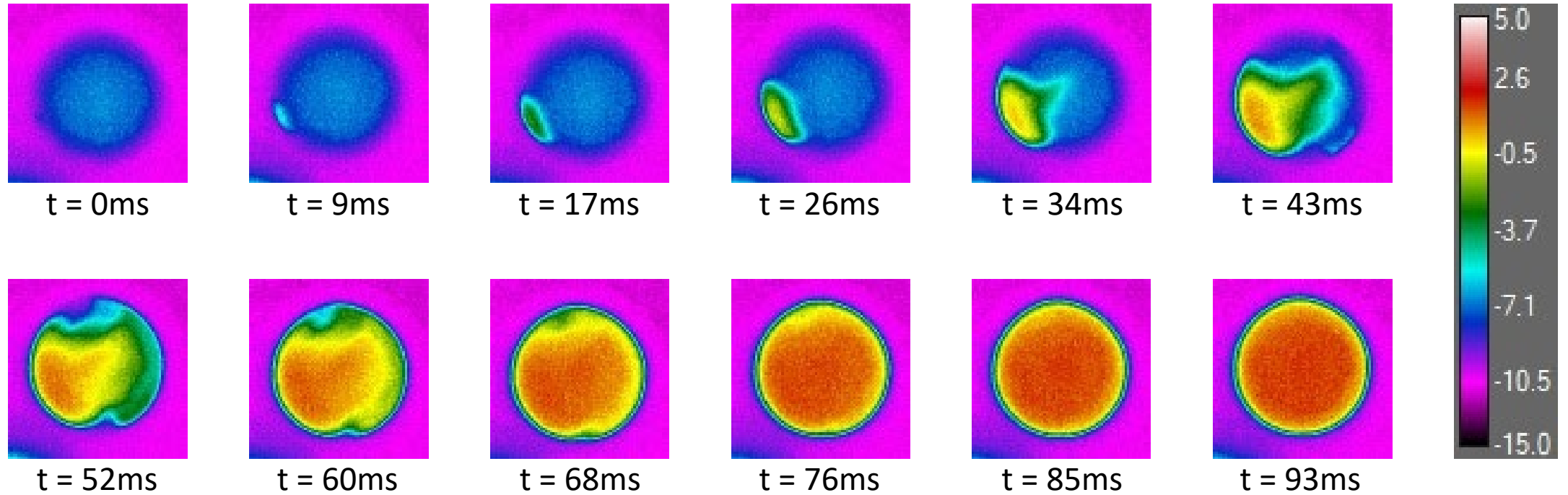


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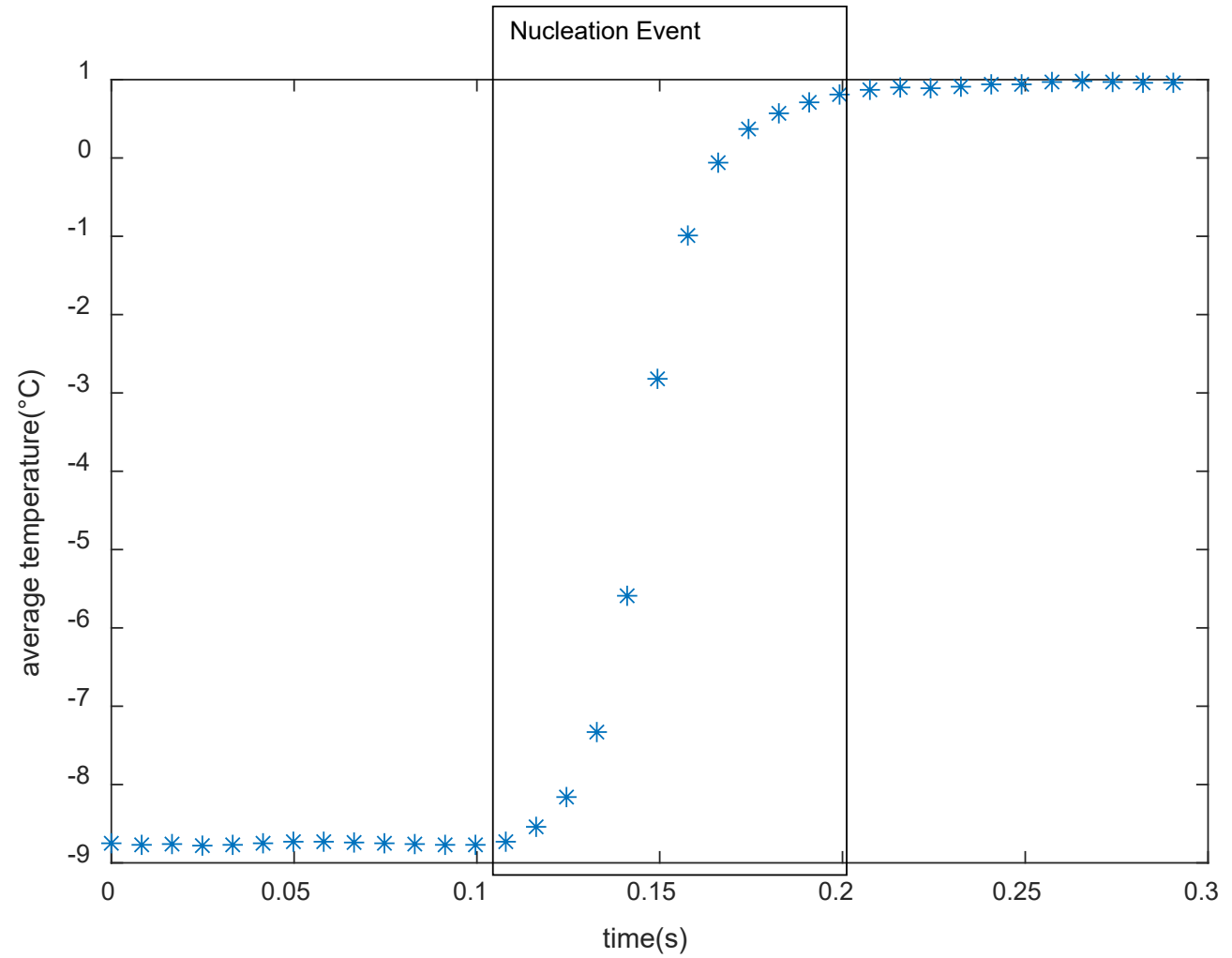
Results &
Discussion
(high-speed
thermography)



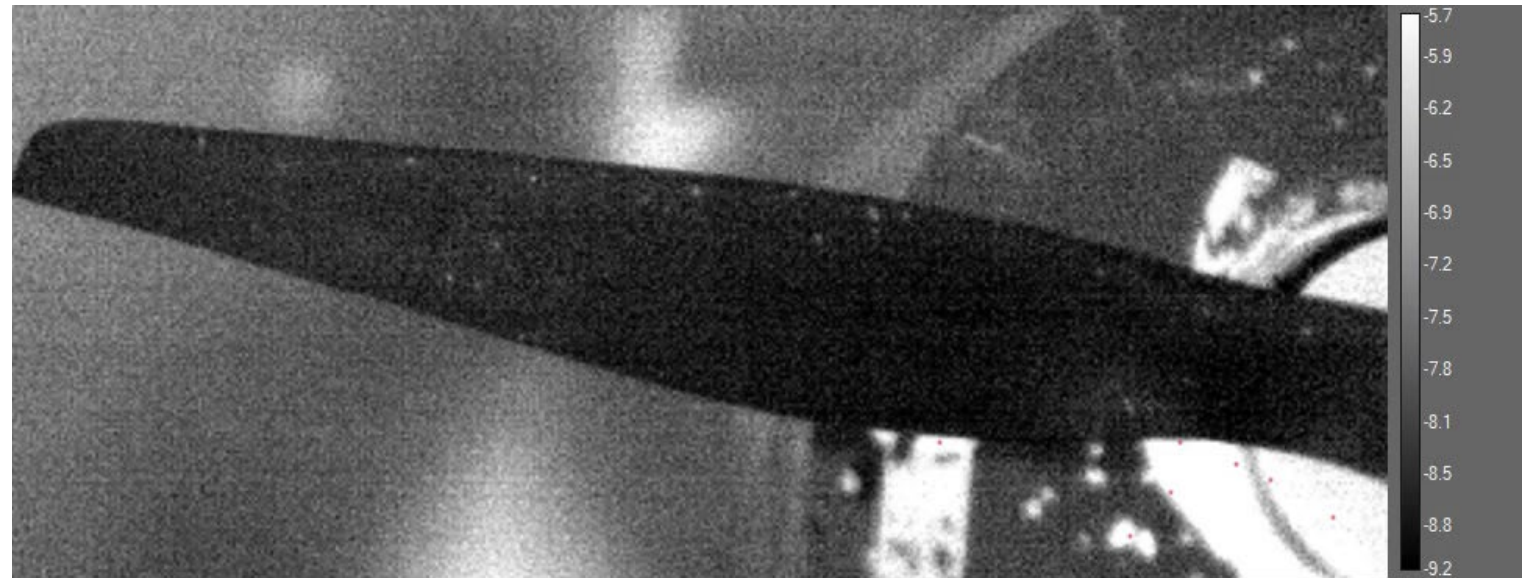
Results & Discussion (high-speed thermography)



Results &
Discussion
(high-speed
thermography)



Results &
Discussion
(rotor blade)



Conclusion

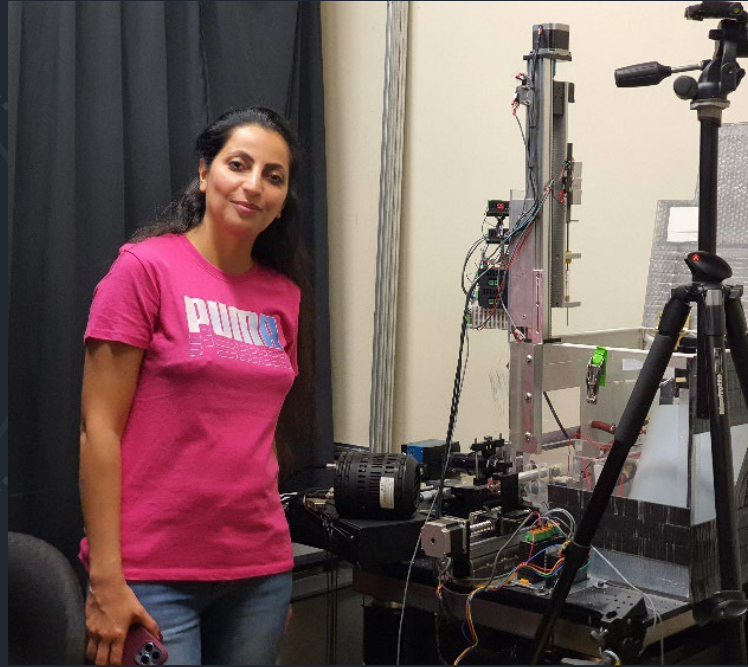
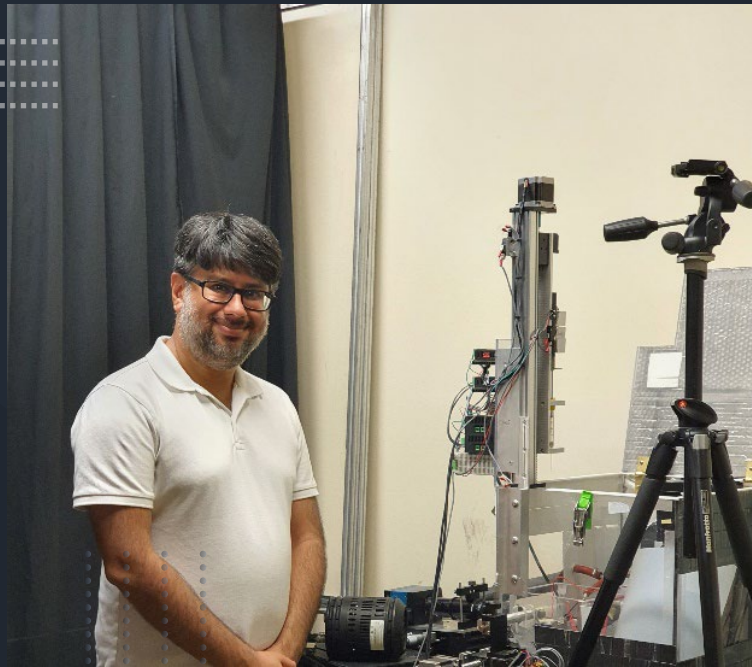
First ever
high-definition (1024 X 768 pixels)
at maximum zoom capacity (4x zoom)
high-speed (120 Hz)
thermography
of ice nucleation event.

Our work decoded the thermal profile of nucleation event
(so far perceived to be a step change).

Acknowledgement

Special Thanks to Nathan Dube' and other technical staff at UQAC to make this research possible.

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**Thank you
and
Questions**

