Growth velocity and thermophysical properties of materials using Electromagnetic Levitation

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Introduction

- Engineering degree at Ecole des Mines de Nancy – France Major in Energy, Environment & Process Engineering

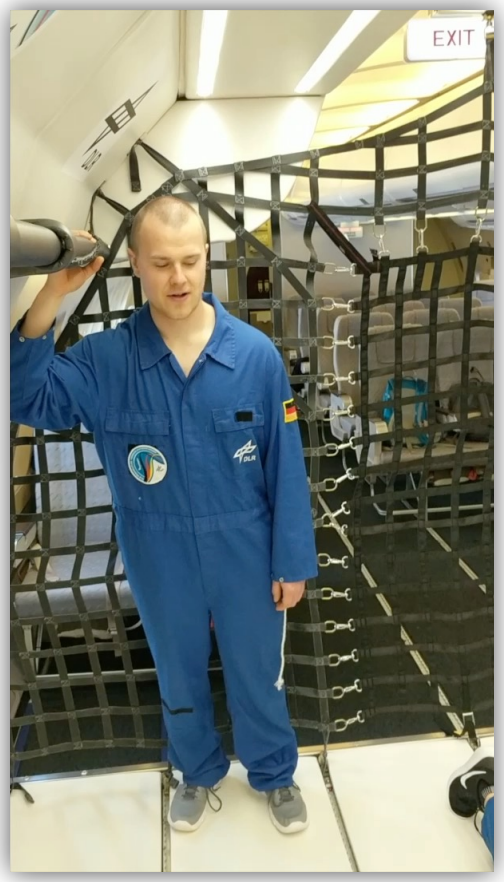
- Phd in Materials Engineering at the University of Alberta – Canada
- 3rd year PhD candidate working on the measurement of material thermophysical properties

AMPL Advanced Materials & Processing Laboratory University of Alberta

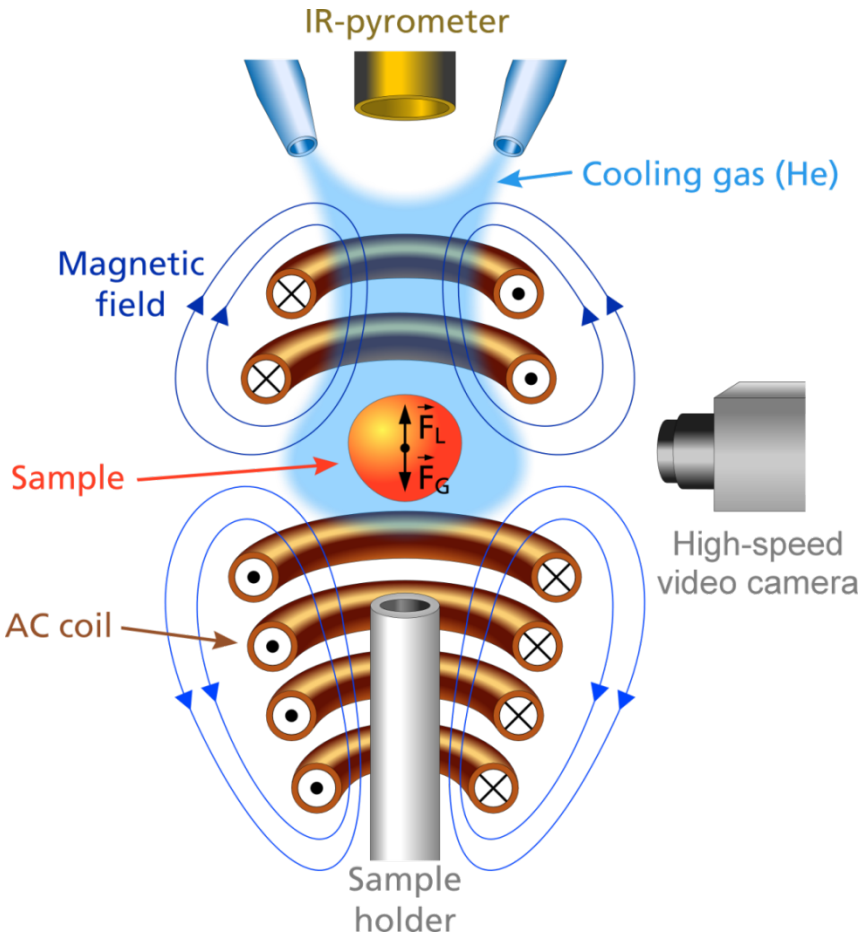
UNIVERSITY OF ALBERTA QUAECUMQUE VERA

Our research under microgravity

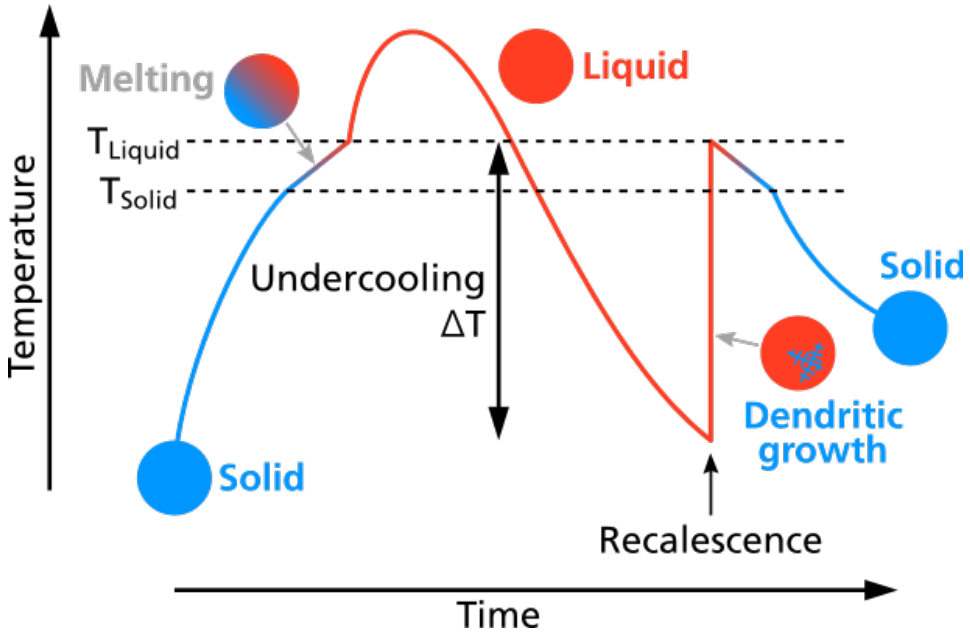
- Electromagnetic levitation to study solidification and thermophysical properties of materials
- Dendritic growth velocity and microstructure
- Density, surface tension, and viscosity



ElectroMagnetic Levitation (EML)

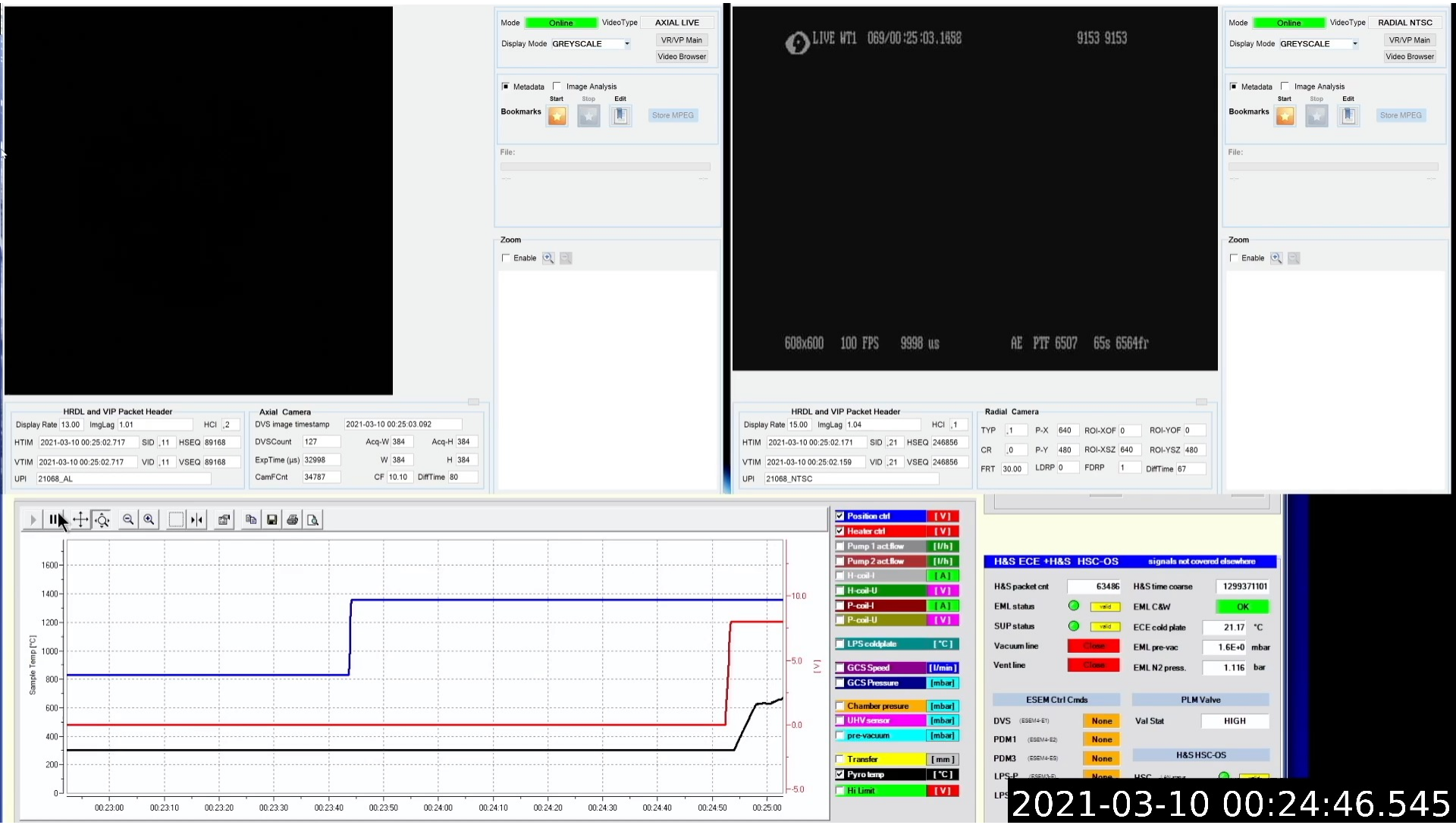


- ✓ **Direct observation** of solidification
- X **Forced convection** (~ 0.3 m/s*)
  → Influence on heat and mass transport



* R. W. Hyers, Meas. Sci. Technol. (2005)
J. Lee et al., Met. Mat. Trans. B (2014)

Oscillating drop experiments $Al_{89}Cu_{11}$



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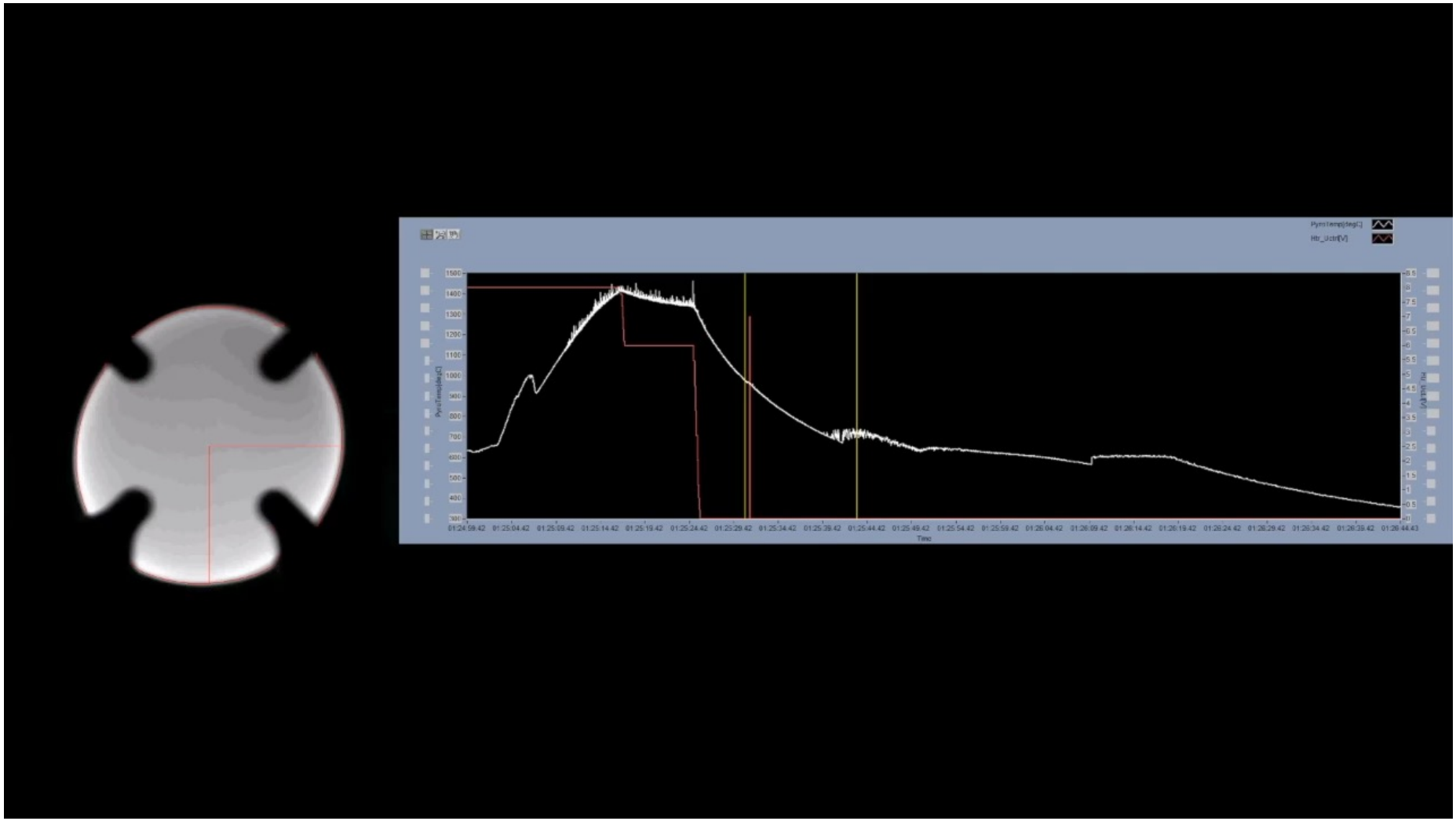
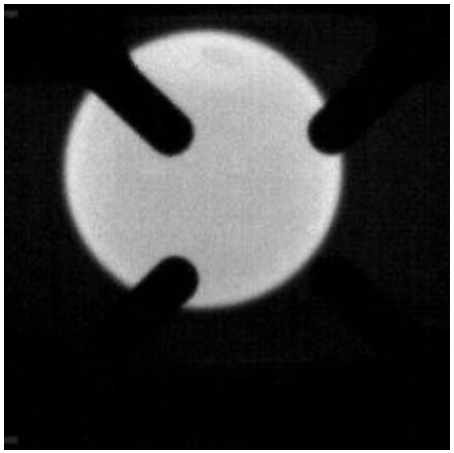


Microgravity EML

TEMPUS PF campaign, Sept. 2013

30‘000 FPS

Duration: 50 ms



ΔT ≈ 130 K

v ≈ 0.19 m/s

Dendritic front

42‘000 FPS

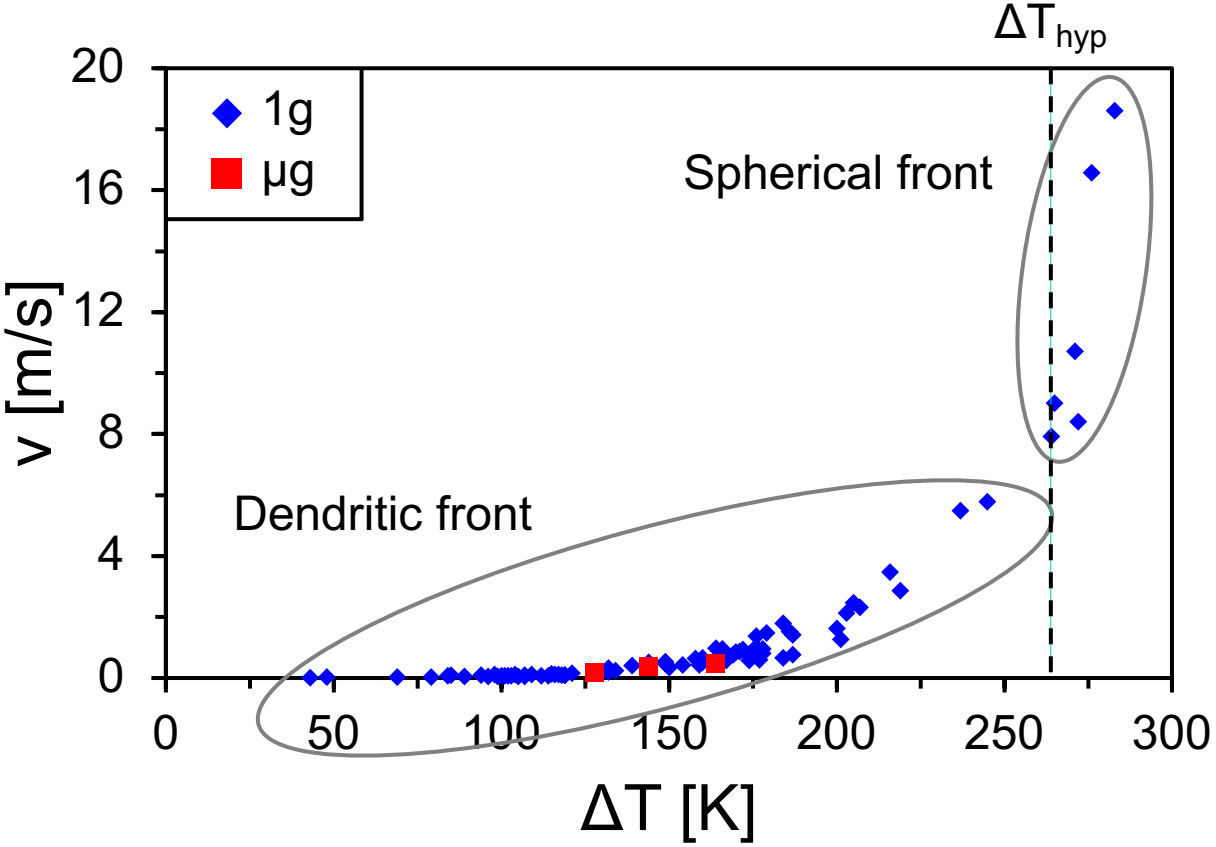
Duration: 0.6 ms

ΔT ≈ 272 K

v ≈ 8.4 m/s

Spherical front

Growth velocity for D2 tool steel



- Microgravity data fits with ground-based experiment
- No observed effect of convection on growth velocity
- Change of the growth front morphology observed above $\Delta T_{hyp} \approx 264$ K

Acknowledgments and contact

- ESA within the NEQUISOL and CCEMLCC projects

- DLR

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