## Vita

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Universities Attended:

St. Francis Xavier University (2020)
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**Conference Presentations/Publications:**

D. Osmond, W. Selby, L. Romero-Zeron, I. Mastikhin, "Bulk NMR measurements of spray dynamics", Journal of Applied Magnetic Resonance, 2023.

S. Ahmadi, D. Osmond, K.M. Bade, I. Mastikhin, "Magnetic Resonance Imaging (MRI) measurements of sprays", Canadian Association of Physicists (CAP) Congress, Fredericton, NB, June 18-23, 2023

S. Ahmadi, G. Wilbur, D. Osmond, I. Mastikhin, "Sea spray freezing with Magnetic Resonance Imaging (MRI) and portable Nuclear Magnetic Resonance (NMR)", Arctic Science Summit Week, Vienna, Austria, February 19-24, 2023

D. Osmond and I. Mastikhin, "Evaluating high-velocity particles with dynamic magnetic resonance scattering", CAP Congress 2022, Hamilton, ON, June 6-9, 2022 (poster)

G. Wilbur, S. Ahmadi, D. Osmond, I. Mastikhin, "Seaspray icing with MRI and portable NMR", Congress of Canadian Association of Physicists (CAP), Montreal, QC (Virtual), June 7-10, 2021

# Measurements of spray system dynamics with NMR

UNIVERSITY OF NEW BRUNSWICK

THESIS DEFENCE AND EXAMINATION

in Partial Fulfillment

of the Requirement for the Degree of
Master of Science

by

**Duncan J. Osmond**

in the Department of Physics

U.N.B., Fredericton, N.B.

**Monday, August 28th, 2023**
**1:30 p.m.**

Via MS TEAMs

Examining Committee

| | |
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| Dr. Igor Mastikhin | Supervisor |
| Dr. Ben Newling | Internal Examiner |
| Dr. Andrew Gerber | External Examiner |
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# Abstract

Spray systems present unique challenges for fluid mechanics research due to their complex dynamics. Non-optical techniques such as synchrotron X-rays and Magnetic Resonance Imaging (MRI) are promising measurement avenues for non-invasive studies of opaque or enclosed sprays. Previous MRI studies of sprays employed sophisticated pulse sequences possible only with an MRI scanner. In this work, the potential of simple bulk MR techniques, Pulsed-Field-Gradient (PFG), Time-Of-Fight (TOF), and Dynamic Magnetic Resonance Scattering (DMRS) are evaluated to investigate spray dynamics in three distinct regions. The PFG measurements of mechanical dispersion using MR are the first of their kind to our knowledge, yielding dispersion coefficients in the range of 10-4 – 10-3 m2 /s. Velocity measurements successfully detected velocities surpassing 30 m/s near the nozzle, with flow slowing down to several m/s downstream. These techniques show potential for investigating spray dynamics and simple gradient requirements make them suitable for portable MR applications and in-situ measurements.