## Vita

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**Presentations/Conferences/Publications:**

K. Song, K. Meziane, A. Kashcheyev, P. T. Jayachandran (2021), Multifrequency observation of high latitude scintillation: A comparison with the phase screen model, IEEE Transactions on Geoscience and Remote Sensing

K. Song, P. T. Jayachandran (2020), Scintillation Characteristics Across GPS Frequency Band, Division of Atmospheric and Space Physics (DASP) conference, University of New Brunswick, Canada, February 19-21 2020

# Multifrequency observation of high latitude scintillation

UNIVERSITY OF NEW BRUNSWICK

THESIS DEFENCE AND EXAMINATION

in Partial Fulfillment

of the Requirement for the Degree of
Master of Science

by

**Kaili Song**

in the Department of Physics

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

**Monday, August 30th, 2021**
**10:00 a.m.**

Via MS TEAMS

Examining Committee

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|---|---|
| Dr. P.T. Jayachandran | Supervisor |
| Dr. Zong Chao Yan | Internal Examiner |
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## Abstract

Ionospheric scintillation, random amplitude and phase fluctuations of a trans-ionospheric radio signal, is caused by the Fresnel scale electron density irregularities in the ionosphere. Understanding the plasma instability mechanism that generates these ionospheric irregularities requires proper understanding and interpretation of the scintillation measurements made by the receivers on the ground. Using multifrequency Global Positioning System (GPS) measurements from the Canadian High Arctic Ionospheric Network (CHAIN), an assessment of the weak scattering theory (phase screen model) of ionospheric scintillation at high latitudes is performed. Scintillation data collected by Global Navigation Satellite System (GNSS) Ionospheric Scintillation and TEC Monitor (GISTM) receivers of the CHAIN provide a good background for testing the phase screen theory given the weak nature of the scintillation amplitude. In this study, sixty-four scintillation events are studied in items of their spectral characteristics and fluctuation levels. Both amplitude ($S_4$) and phase ($\sigma_\phi$) scintillation indices, as well as the power spectral index, are determined at multiple carrier frequencies (L1 1575.42 MHz, L2 1227.60 MHz and L5 1176.45 MHz). Using the weak scatter theory, we found that the average frequency dependence of $S_4$ is $f^{-1.27}$. This implies that ionospheric irregularity spectra are steeper compared to those obtained directly from the power spectral density of signal amplitude fluctuations. Our results suggest that the frequency scaling of amplitude scintillation fails to account for the ionospheric irregularities of the smallest scales. Otherwise, the multifrequency scrutiny of the signal amplitude spectrum rollover frequency and the signal phase variation index provide results that are in good agreement with the weak scatter theory.