

Logan Francis



Title

Dust-depleted Inner Disks in a Large Sample of Transition Disks through Long-baseline ALMA Observations

Abstract

Transition disks with large inner dust cavities are thought to host massive companions. However, the disk structure inside the companion orbit and how material flows toward an actively accreting star remain unclear. We present a high-resolution continuum study of inner disks in the cavities of 38 transition disks. Measurements of the dust mass from archival Atacama Large Millimeter/Submillimeter Array observations are combined with stellar properties and spectral energy distributions to assemble a detailed picture of the inner disk. An inner dust disk is detected in 18 of 38 disks in our sample. Of the 14 resolved disks, 8 are significantly misaligned with the outer disk. The near-infrared excess is uncorrelated with the mm-dust mass of the inner disk. The size-luminosity correlation known for protoplanetary disks is recovered for the inner disks as well, consistent with radial drift. The inner disks are depleted in dust relative to the outer disk, and their dust mass is uncorrelated with the accretion rates. This is interpreted as the result of radial drift and trapping by planets in a low α ($\sim 10^{-3}$) disk, or a failure of the α -disk model to describe angular momentum transport and accretion. The only disk in our sample with confirmed planets in the gap, PDS 70, has an inner disk with a significantly larger radius and lower inferred gas-to-dust ratio than other disks in the sample. We hypothesize that these inner disk properties and the detection of planets are due to the gap having only been opened recently by young, actively accreting planets.

LOGAN FRANCIS

PERSONAL INFORMATION

Email: loganfrancis3@uvic.ca

EDUCATION

PhD Physics, Astronomy Concentration Jan 2019 - Present
 Institute: University of Victoria
 Supervisor: Doug Johnstone

MSc Physics, Astronomy Concentration Sept 2016 - Dec 2018
 Institute: University of Victoria
 Thesis: Constraining Variable Accretion in Deeply Embedded Protostars with Interferometric Observations
 Supervisor: Doug Johnstone

Bachelor of Science, Physics Sept 2010 - May 2014
 Institute: Saint Mary's University
 Distinction: magna cum laude
 Thesis: Magnetohydrodynamical Simulations of the Fragmentation of Molecular Cloud Cores
 Supervisor: David A. Clarke

PUBLICATIONS

Francis, L. Johnstone, D., Herczeg, G.H, Hunter, T.R., Harsono, D.
 On the accuracy of the ALMA flux calibration in the time domain and across spectral windows
 Submitted to the Astrophysical Journal June 2020
 ADS: <https://ui.adsabs.harvard.edu/abs/2020arXiv201002186F/abstract>

Francis, L. & van der Marel, N.
 Dust-depleted Inner Disks in a Large Sample of Transition Disks through Long-baseline ALMA Observations
 Published in the Astrophysical Journal Apr 2020
 DOI: <https://doi.org/10.3847/1538-4357/ab7b63>

Francis, L., Johnstone, D., Dunham, M.M., Hunter, T.R., Mairs, S.
 Identifying Variability in Deeply Embedded Protostars with ALMA and CARMA.
 Published in the Astrophysical Journal Jan 2019
 DOI: <https://doi.org/10.3847/1538-4357/aaf972>

EMPLOYMENT

Teaching Assistant Fall 2016 to Fall 2019
 Employer: Dept. of Physics and Astronomy, University of Victoria, Victoria, BC, Canada
 Job Description: Coordinated exercises and marked reports for students in laboratory sessions of introductory physics and astronomy courses.

Research Assistant Jan 2016 - May 2016
 Employer: Dept. of Astronomy and Physics, Saint Mary's University, Halifax, NS, Canada
 Supervisor: David A. Clarke
 Job Description: Tested and debugged v3.6 of the fluid dynamics code ZEUS-3D and created a new website (<http://ap.smu.ca/~dclarke/zeus3d/version3.6/>) for its release in June 2016.

AWARDS

Nora & Mark Degoutiere Memorial Scholarship Fall 2019
 Award Source: University of Victoria
 Description: Received \$14,375 donor award on recommendation of the Physics and Astronomy department.

University of Victoria Fellowship Sept 2016 - August 2017
 Award Source: University of Victoria Physics and Astronomy Department
 Description: Received \$17,500 in funding for the first year of my MSc in Astronomy on the basis of my undergraduate academic performance.

Best Undergraduate Science Paper May 2014
 Award Source: Saint Mary's University Undergraduate Writing Awards
 Description: Received \$100 and publication in the Saint Mary's University journal *Afficio* for my paper *A Comparison of Physical Random Number Generators* written for an experimental physics course.

Admission to Presidents Hall of Academic Excellence May 2014
 Award Source: Saint Mary's University
 Description: Awarded for maintaining a 4.05/4.30 GPA over the course of my Honours Physics degree and graduating with distinction.

CONFERENCE, WORKSHOP, AND OBSERVING ACTIVITIES

Meeting Attendee: Scipy 2020 - Scientific Computing with Python Virtual Conference July 2020
 Location: Virtual Conference

Meeting Attendee: Astrochemical Frontiers - Quarantine Edition June 2020
 Location: Virtual Conference

Poster Presentation: Dust-depleted Inner Disks in a Large Sample of Transition Disks through Long-baseline ALMA Observations May 2020
 Event: Canadian Astronomical Society (CASCA) Conference 2020
 Location: Virtual Conference

Seminar: Dust-depleted Inner Disks in a Large Sample of Transition Disks through Long-baseline ALMA Observations March 2020
 Location: Herzberg Astronomy and Astrophysics Research Center, Victoria, BC

Seminar: Variable Accretion in Deeply embedded Protostars June 2019
 Location: European Southern Observatory, Garching, Germany

Meeting Attendee: Fifty AU Study of the chemistry in the disk/envelope systems of Solar-like protostars (FAUST) 2nd meeting Oct 2019
 Location: Socorro, NM, USA

Poster Presentation: Gas Structure and Accretion Flow in the DM Tau Transition Disk May 2019
 Event: New Horizons in Planetary Systems Conference
 Location: Victoria, BC

Oral Presentation: Identifying Variability in Deeply Embedded Protostars with ALMA and CARMA Nov 2018
 Event: Astronomy NWxSW - A meeting of professional astronomers from around the Cascadia region.

Location: University of British Columbia, Vancouver, BC

Poster Presentation: Stellar Growth Spurts: Probing Variable Accretion in the Youngest Protostars with ALMA and CARMA June 2018

Event: Astrophysical Frontiers in the Next Decade and Beyond: Planets, Galaxies, Black Holes, and the Transient Universe

Location: Portland, Oregon, USA

Poster Presentation: Stellar Growth Spurts: Probing Variable Accretion in the Youngest Protostars with ALMA and CARMA May 2018

Event: Canadian Astronomical Society (CASCA) Conference 2018

Location: Victoria, BC, Canada

Workshop Attendee: 16th Synthesis Imaging Workshop May 2018

Event: Attended lectures on interferometry and radio astronomy at an event hosted by the National Radio Astronomy Observatory and New Mexico Institute of Mining and Technology

Location: Socorro, NM, USA

Observing Runs: James Clerk Maxwell Telescope (JCMT) Nov 2016 and January 2018

Event: Observed at JCMT for one week as part of the JCMT Transients program (PIs: Doug Johnstone, Greg Herczeg) to measure variability of protostars in star forming regions.

Location: Hilo/Mauna Kea, HI, USA

Poster Presentation: Stellar Growth Spurts: Identifying Protostar Variability with ALMA

May 2017

Event: Canadian Astronomical Society (CASCA) Conference 2017

Location: Edmonton, AB, Canada

Oral Presentation: MHD Simulations of Fragmenting Molecular Cloud Cores January 2014

Event: Atlantic Undergraduate Physics and Astronomy Conference (AUPAC) 2014

Location: Halifax, NS, Canada

VOLUNTEER EXPERIENCE AND LEADERSHIP

Uvic Physics and Astronomy Graduate Student Association (PAGSA) May 2018 - Present

- Activities:
- Currently acting as the PAGSA Astronomy representative. Responsibilities include facilitating communication with Astronomy graduate students and the PAGSA executive committee and attending department meetings.
 - Organization of the “software plumbing” committee to organize a series of workshops which will provide training in software tools and techniques for physics and astronomy research throughout the 2018 and 2019 academic years.
 - Worked on the summer 2018 committee to organize SPACE talks - a series of non-technical and science related talks delivered by graduate students in an informal setting.

Nerd Nite Victoria Organizer

September 2019 - Present

- Activities: Organized a series of monthly public talks on scientific and otherwise “nerdy” topics in a casual pub setting.

Outreach and Public Speaking

University of Victoria Observatory Tour Host

2016 - Present

Description: Gave tours of the 0.8m telescope and answered astronomy questions for groups of school children, exchange students, and seniors at various times throughout the academic year.

SPACE Talk: Juggling by the Numbers October 2019
Description: Gave an interactive talk on the mathematical analysis of juggling patterns to an audience of graduate students as part of Nerd Nite Victoria, a series of casual science and technology talks delivered by Victoria residents.

Public Talk: The Origins of your Favourite Organic Molecules from Comets to Kombucha August 2018

Description: Gave a public talk on the connections between organic molecules produced in brewing and those formed in astrophysical environments as a part of Nerd Nite Victoria.

October 16, 2020