MICHAEL CRUMRINE

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EDUCATION

Ph.D Physics: Experimental Cosmology **In Progress**
University of Minnesota - Minneapolis, MN **Expected Fall 2021**
School of Physics and Astronomy

B.Sc: Physics and Mathematics **May 2013**
Beloit College - Beloit, WI

- Graduated *Magna Cum Laude* with departmental honors in Physics

WORK EXPERIENCE

Graduate Research Assistant **2016 - Present**
University of Minnesota - Minneapolis, MN

- Lead the thermal and mechanical design of a new cryogenic receiver for the Bicep Array experiment including extensive CAD modelling in Solidworks and multiphysics simulation in Comsol.
- Managed hardware requirements and interfaces between collaborating groups across six institutions. Oversaw manufacturing, integration, testing, and first operations of these new receivers.
- Deployed to the South Pole for maintenance, re-assembly, and calibration of the Keck and Bicep3 telescopes. Commissioned the new Bicep Array telescope at the geographic South Pole over an intensive 14 week summer season.
- Responsible for quality analysis of incoming data and investigation of anomalous features to diagnose and solve root-cause problems during operation.
- Lead analysis of the first year of raw data from the new Bicep Array experiment to produce stricter constraints on polarized galactic synchrotron emission.
- Prepared and presented technical reports at weekly meetings with 30 + collaborators across six institutions.
- Mentored incoming graduate students and undergraduate students in experimental procedures and techniques.
- Deployed to the South Pole:
  - Nov. 2016 - Jan 2017
  - Nov. 2019 - Feb 2020

Teaching Assistant **2014 - 2016**
University of Minnesota - Minneapolis, MN

- Courses: Introduction to Physics for Science and Engineering (2 semesters) and Biology and Pre-Medicine (3 semesters)

SULI Intern **2013**
Lawrence Berkeley National Laboratory - Berkeley, CA

- Developed a new CBED/STEM imaging mode for the TEAM I transmission electron microscope resulting in increased imaging resolution

Fermilab Seasonal Employee **2013**
Fermi National Accelerator Laboratory - Batavia, IL

- Decommissioned the Collider Detector at Fermilab (CDF)

Scenic Shop Supervisor **2010 - 2013**
Beloit College - Beloit, WI

- Constructed sets and scenery to specifications for performing arts department
- Oversaw small groups of student employees, taught proper power tool use, safety, and fabrication techniques

SKILLS AND EXPERIENCE

Physics, Experiment, Cosmology, Cryogenics, Computer Aided Design (CAD), Finite Element Analysis (FEA), Solidworks, COMSOL,Data Analysis, Matlab, Octave, Mathematica, C++, LaTeX, Python, Scientific Computing

SELECTED PUBLICATIONS

- M. Crumrine and The Bicep2 and Keck array Collaborations. BICEP Array cryostat and mount design. *Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy IX*, Jul 2018. doi: 10.1117/12.2312829. URL https://arxiv.org/abs/1808.00569

- The Bicep2 and Keck Array Collaborations. Constraints on primordial gravitational waves using Planck, WMAP, and new BICEP2/Keck observations through the 2015 season. *Physical Review Letters*, 121(22), Nov 2018. ISSN 1079-7114. doi: 10.1103/physrevlett.121.221301. URL http://dx.doi.org/10.1103/PhysRevLett.121.221301. doi:10.1103/physrevlett.121.221301

- Jae Hwan Kang and The Bicep2 and Keck Array Collaborations. 2017 upgrade and performance of BICEP3: a 95GHz refracting telescope for degree-scale CMB polarization. *Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy IX*, Jul 2018. doi: 10.1117/12.2313854. URL http://dx.doi.org/10.1117/12.2313854

- Howard Hui and The Bicep2 and Keck Array Collaborations. BICEP Array: a multi-frequency degree-scale CMB polarimeter. *Millimeter, Submillimeter, and Far-Infrared Detectors and Instrumentation for Astronomy IX*, Jul 2018. doi: 10.1117/12.2311725. URL http://dx.doi.org/10.1117/12.2311725