

## **Probing Dark Matter with LSST**

Vera C. Rubin Observatory | Operations PCW | 7-11 August 2023



## **Reminder - Code of Conduct**



Project & Community Workshop 2023 7-11, August 2023 | Marriott University Park Tucson | Tucson, AZ

Agenda Register Travel & Venue Code of Conduct

Harassment and unprofessional conduct (including the use of offensive language) of any kind is not permitted at any time and should be reported to:

- Andrew Connolly (ajc@astro.washington.edu),
- John Franklin Crenshaw (jfc20@uw.edu), and/or
- Alysha Shugart (<u>ashugart@lsst.org</u>).



Rubin Observatory adheres to the principles of kindness, trust, respect, diversity, and inclusiveness in order to provide a learning environment that produces rigor and excellence. Check name-tags for these contact

Elbow/Fist Bump OK

Wear a mask if you want to!

Use the confidential email <u>rubin2023-covid@lists.lsst.org</u> to request a test, report your test results, or ask questions.

Need My Space



Handshakes OK

If someone is wearing a pin like this, and it indicates a low social battery, please give them their space or offer to restart the conversation at a later time.

If you feel unsafe at any time send an email to rubin2023-helpline@lists.lsst.org

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## **Reminder - Virtual Participation**



Virtual participants should be muted when they're not speaking.



In-person participants should speak into the room microphone(s), or the chair should repeat all questions into the microphone, so that the virtual participants can hear what is said.

In the Rubin2023\_PCW Slack Space, all participants can use the session's channel for Q&A and discussion. The channel name convention is, e.g.:

#day1-mon-slot3a-intro-to-rubin



In Zoom, use the chat to:

- request to unmute to ask a question, or
- type your question so someone can speak it aloud.

The Zoom "raise hand" feature is generally harder for moderators to track, and is not preferred, but may be used at the discretion of the session chair.

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- Quick intro to dark matter constraints with LSST

- Discussion of our interests related to dark matter

- Brainstorming the papers we want to write with early science data?





• Our goal is to use LSST to contribute to our understanding of the fundamental nature of dark matter. We use a variety of astrophysical probes to understand the composition of dark matter, and the microphysics that govern it.

• Current conveners Nora Shipp and Peter Ferguson

• Please reach out to us if you would like to get involved, give a talk, or get more information about our activities. **New members are very welcome!** 



## **Constraining Dark Matter with LSST**

(from LSST DKM white paper Drlica-Wagner et al. 1902.01055)

#### Minimum halo mass



Halo profiles



### Compact objects



#### Large scale structure



### Anomolous stellar energy loss





## How do observations turn into constraints?

### example: minimum halo mass

Cold Dark Matter



Warm Dark Matter



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## How do observations turn into constraints?





An incomplete list that spans many of our science collaborations





An incomplete list that spans many of our science collaborations





## What can we do with early data?

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## **Context: Rubin Obs Early Science Program**

### Early Science program (<u>RTN-011</u>) includes multiple components

- Public Alert Stream
- Data Preview 1 / Data Preview 2
- LSST Processed Visit Images (as prompt products)
- LSST DR1

#### **Rubin Operations Top Milestones**

- Jun 2023 Sep 2023 Complete Delivery of Data Preview 0.3 (DP0.3)
- Oct 2024 Feb 2025 System First Light with LSSTCam
- Dec 2024 Apr 2025 Complete Delivery of Data Preview One (DP1)
- Feb 2025 Sep 2025 LSST Survey Start
- Aug 2025 Mar 2026 Complete Delivery of Data Preview Two (DP2)
- Feb 2026 Nov 2026 Complete Delivery of Data Release One (DR1)
- Feb 2027 Nov 2027 Complete Delivery of Data Release Two (DR2)

- ( = System First Light with LSSTCam + 2 months)
- ( = Science Validation Surveys Complete + 1 day)
- ( = Science Validation Surveys Complete + 6 months)
- ( = LSST Survey Start + 12 months)
- ( = LSST Survey Start + 24 months)



### Example Data for DP2

**Deep:** 100 sq degrees, LSST WFD 10 year depth in ugrizy, all taken within 1 month (>10x of visits per night)

Overlap with an LSST Deep Drilling Field

**Wide:** 1000 sq degrees, 20 visits per filter, griz, also taken in a month to one year depth (r~26)

We don't know exactly where the observations will be, but for the purpose of this exercise, imagine that some portion includes ~equatorial fields that overlap with eBOSS/DESI, DES, HSC



## Small group discussion

Take ~20 min to chat with folks around you, feel free to group with others interested in similar probes

Fill out a slide on what **you** want to do with early data in this presentation

We will not have the full survey but we can:

- test algorithms / analysis methods
- characterize systematic uncertainties
- identify /characterize the first examples of galaxy clusters / supernovae / strong lenses / ultra-faint galaxies / etc.
- make serendipitous discoveries (!)



### [Title of one of the very first papers using on-sky LSSTCam data]

Abstract: [your 2-3 sentence abstract here]

**Representative figure(s):** [paste or sketch placeholder representative figure(s)]





## Whole Group Discussion

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# What do we need to do in the next 1.5 years to make these analyses possible?

### What tools/data products need to be developed?

What external datasets do we need?

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