2018
Osterbrock Sierra Conference

Fir Campground
Sequoia National Forest

http://milkywaychasers.com/
2017/07/31/royce-bair-in-sequoia-natl/

Welcome!

According to UC Astronomy lore, many years ago there existed an inter-campus gathering of graduate students known as the SIERRA Conference. This was a meeting organized by graduate students for graduate students, to encourage collaboration and networking within the astronomy community in California. Originally more true to its label of a scientific conference, it involved numerous talks on topics of interest solicited from the astronomy community at large. It eventually evolved into more of a camping retreat inviting grad students from different schools around California, still allowing for the mission of encouraging collaboration and networking across institutions. Unfortunately, this meeting has not taken place since 2014, and few of the current UC graduate students seem to know anything about it, suggesting that many schools have not participated in an even longer time. In general, there exist few opportunities for interaction between students of different UC campuses, despite all belonging to the same University of California, and having access to many of the same resources. The main exception is the Observational Astronomy Workshop at Lick Observatory, which allows for some networking across UC campuses, but is mostly limited to first- and second-year students interested in observations. It was at this event that most of the organizers learned about the SIERRA Conference, and discussed the idea of bringing it back. Thanks to the generous support of the Osterbrock Leadership Program, we have reincarnated the meeting as the Osterbrock Sierra Conference, an inter-campus meeting for all UC graduate students in astronomy, to help build a network and community of UC astronomers while enjoying the beauty of our state.

Meet our Organizers!

Felipe Ardila - PI, UC Santa Cruz

Nathan Sandford - Co-PI, UC Berkeley

Dr. Katherine Alatalo - Mentor, STScI

Co-Is

Arianna Brown, UC Irvine

Erin George, UC San Diego

Jessica Hirtenstein, UC Davis

Isabel Lipartito, UC Santa Barbara

Anthony Pahl, UC Los Angeles

Derek Nathaniel Diaz Wilson, UC Irvine

M. Katy Rodriguez Wimberly, UC Irvine

Code of Conduct

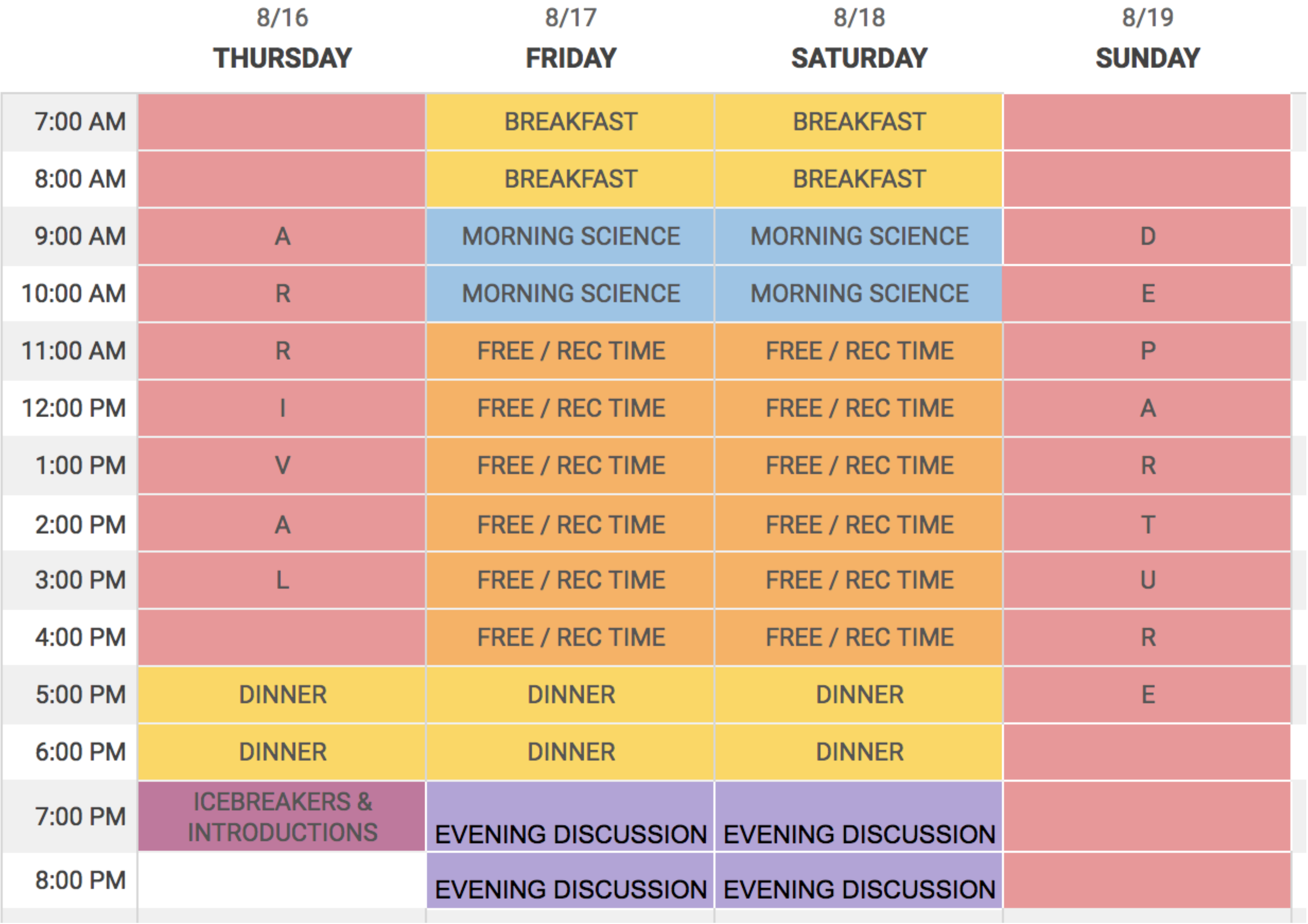
We are dedicated to providing a harassment-free Sierra Conference experience for everyone. Harassment includes offensive verbal comments related to gender, gender identity and expression, age, sexual orientation, disability, physical appearance, body size, race, ethnicity, religion, technology choices, sexual images in public spaces, deliberate intimidation, stalking, harassing photography or recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome sexual attention.

We do not tolerate harassment of conference participants in any form. If a participant engages in harassing behavior, the conference organizers may take any action they deem appropriate, including warning the offender, or expulsion from the conference. Participants asked to stop any harassing behavior are expected to comply immediately.

If you are being harassed, notice that someone else is being harassed, or have any other concerns, please contact one of the conference organizers immediately.

We expect participants to follow these rules during presentations, discussions, all leisure and recreational activities throughout the duration of the conference, and in any social media posts relating to the conference.

Conference Schedule



	8/16 **THURSDAY**	8/17 **FRIDAY**	8/18 **SATURDAY**	8/19 **SUNDAY**
7:00 AM		BREAKFAST	BREAKFAST	
8:00 AM		BREAKFAST	BREAKFAST	
9:00 AM	A	MORNING SCIENCE	MORNING SCIENCE	D
10:00 AM	R	MORNING SCIENCE	MORNING SCIENCE	E
11:00 AM	R	FREE / REC TIME	FREE / REC TIME	P
12:00 PM	I	FREE / REC TIME	FREE / REC TIME	A
1:00 PM	V	FREE / REC TIME	FREE / REC TIME	R
2:00 PM	A	FREE / REC TIME	FREE / REC TIME	T
3:00 PM	L	FREE / REC TIME	FREE / REC TIME	U
4:00 PM		FREE / REC TIME	FREE / REC TIME	R
5:00 PM	DINNER	DINNER	DINNER	E
6:00 PM	DINNER	DINNER	DINNER	
7:00 PM	ICEBREAKERS & INTRODUCTIONS	EVENING DISCUSSION	EVENING DISCUSSION	
8:00 PM		EVENING DISCUSSION	EVENING DISCUSSION	

FELIPE ARDILA
he/him/his
Extragalactic / Cosmology
UC Santa Cruz

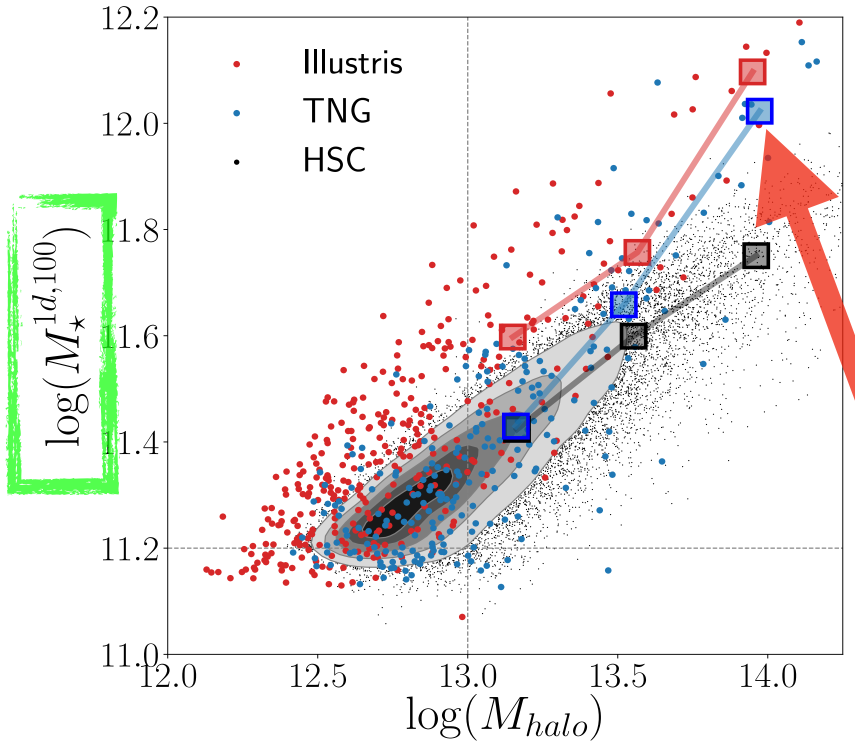
I am soon to be a second year grad student at UCSC. I am originally from Colombia, but grew up in Miami, Florida. I finished my undergrad at the University of Florida and then did a 2-year post-baccalaureate fellowship at Princeton University. When I am not thinking about galaxies, I like to go outside to enjoy nature, and sometimes organize camping trips. I am also into dogs, rock climbing, and data visualization.

Contact Info

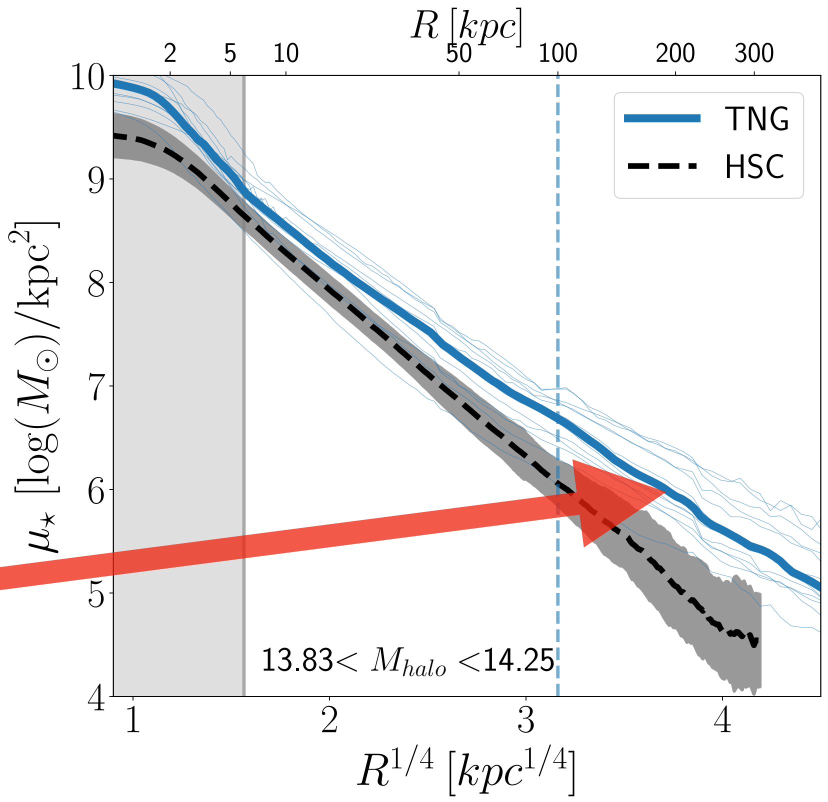
fardila@ucsc.edu
github.com/f-ardila
@felife

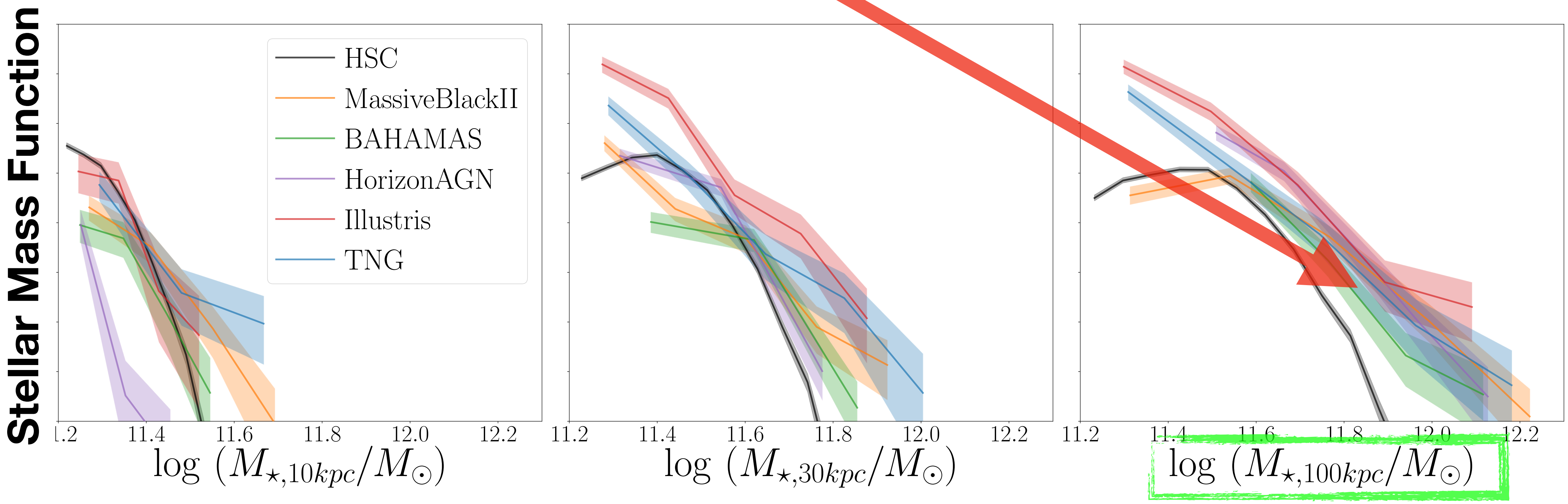
Hydrodynamic simulations of galaxies are commonly tuned to match the stellar mass functions (SMFs) of observed galaxies. However, there are different ways of measuring stellar mass in both simulations and observations. In this work we compare the effect of using these different masses on the stellar profiles of massive central galaxies (log(M_star)> 11.6) in the Hyper Suprime-Cam (HSC) Survey, versus those in several hydrodynamic simulations (Illustris, TNG, BAHAMAS, MassiveBlack-II, and Horizon-AGN) which have different prescriptions for the evolution of stellar mass in galaxies. We find that the SMFs of simulations agree well with each other and with HSC for masses within smaller apertures (e.g. 30kpc), but but begin to diverge from each other, and especially from HSC, when stellar mass is measured at larger apertures (e.g. 100kpc). This suggests that galaxies in simulations have stellar profiles that are more extended (`puffier') than what we see in observations and are therefore more massive in their outer regions. We are still working to figure out what exactly is causing this excess mass buildup.

STELLAR PROFILES OF MASSIVE GALAXIES:



Hydrodynamic simulations (e.g. IllustrisTNG) agree well with observations (Hyper Suprime-Cam) in inner regions, *not so well* ***(too much mass)*** ***in extended stellar envelopes***





ARIANNA BROWN
she/her/hers
High-z SMGs + AGN
UC Irvine

Hi everyone! I'm going into my second year at UCI and I am a transplant from the DC Metro area. My path to astrophysics was winding - I received my bachelors in applied mathematics after originally setting out to become a math teacher, then spent some time in business consulting beefing up my PowerPoint and spreadsheet skills. When I'm not science-ing, you can find me reading sci-fi/fantasy fiction, trying new plant based recipes, gardening, asking the department to fund yet another outreach or professional development activity, and taking long walks (or long netflix binges...) with my dog and fiance.

In the 1990s, astronomers launched COBE to observe the cosmic infrared background and found an energy density similar to that of the well known optical background. However, nearly half of this infrared background light could not be attributed to all of the galaxies in optical surveys; soon after, mankind discovered a huge population of dust obscured, optically dim, starforming powerhouses, otherwise known as submillimeter galaxies (SMGs). But studying these objects would soon prove difficult. I will discuss the extreme nature of SMGs, their important role in our Universe, some of the observational hurdles encountered when studying them, and some of the tools I use to overcome those hurdles.

Contact Info

✉ ariannb@uci.edu

@astroarianna

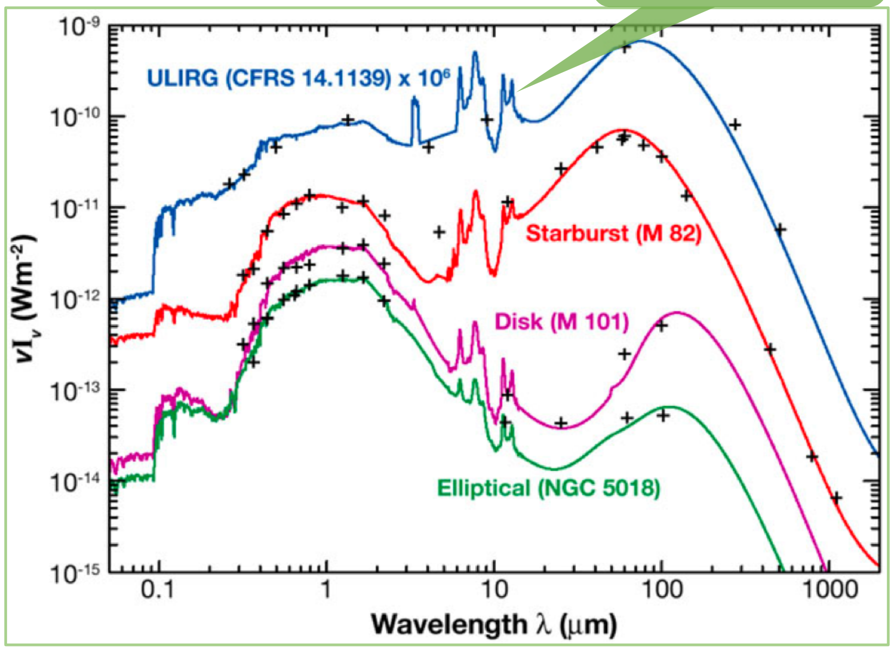
@astroarianna

SUBMILLIMETER GALAXIES

Defining Characteristics

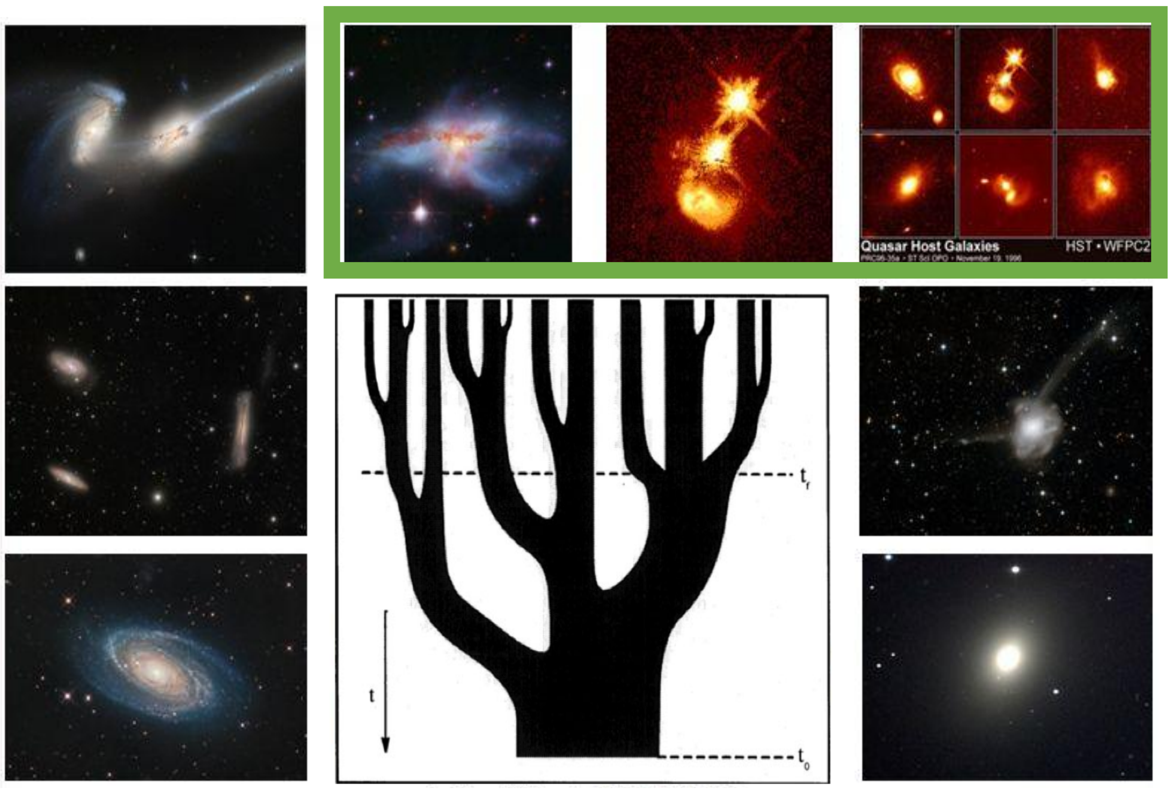
- $L_{IR} > 10^{12} L_{\odot}$ (ULIRG-like)
- Brightest in the far-IR / submm range
- *Super* dusty
  - Majority of thermal emission from heated dust grains
  - AGN vs Star Formation

Local analog to high-z SMG



Galliano, F. 2004, PhD Thesis. Paris XI Univ.

Why do we care about them?



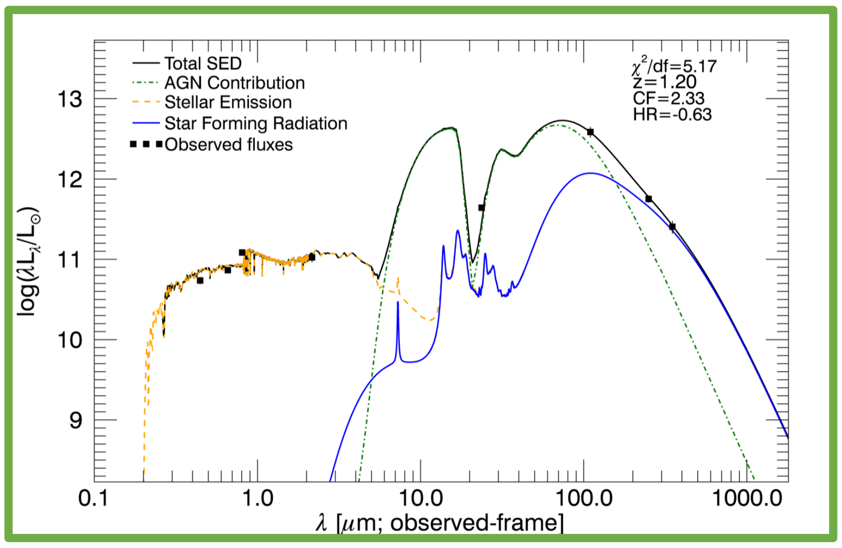
Evolutionary diagram of a major merger between two gas-rich disks. Green boxed area are periods of bursty star formation and AGN ignition / rapid mass accretion. Middle section is often referred to as a galaxy merger tree.

SMGs (aka DOGs, aka starbursts) are extreme objects with a lot of activity and mass compacted into a small volume.

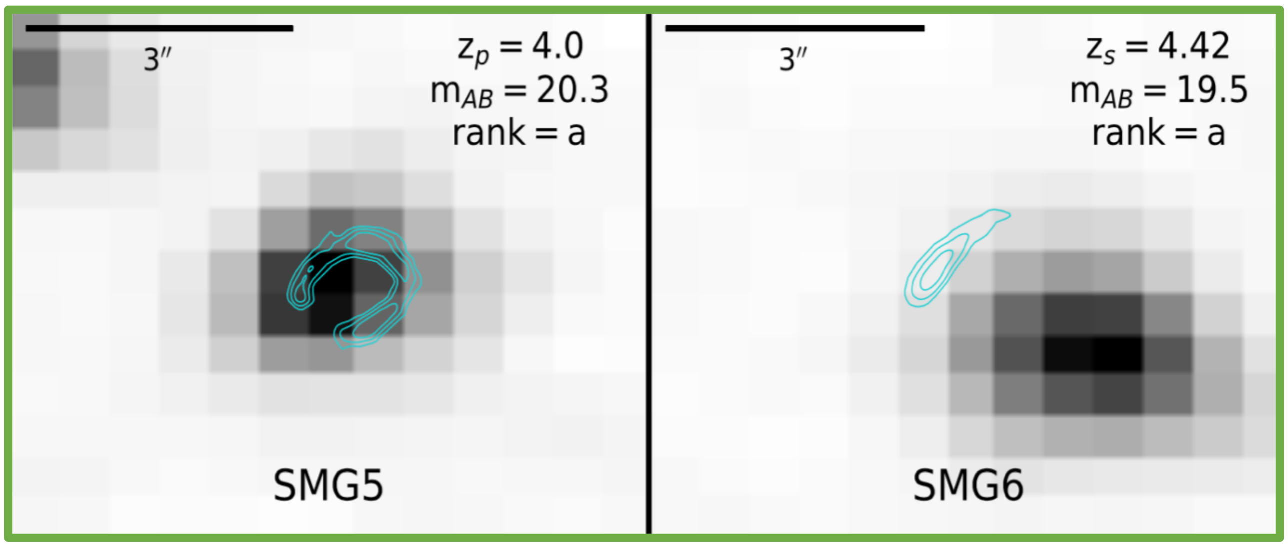
- *Discovered in the 90s when probing for the CIB*
- *Known to produce hundreds to thousands of solar masses per year*
- *Responsible for intense SMBH mass accretion*
- *Likely progenitors of massive early-type galaxies*
- *Extremeness of SMG populations has yet to be reproduced by simulations*

What does Arianna do with SMGs?

Case 1: AGN Contamination



Case 2: IR Decomposition



XINNAN DU

she/her/hers
Extragalactic (ISM/CGM)
UC Los Angeles

Xinnan Du is a graduating PhD student in the Department of Physics and Astronomy at UCLA. Her research focuses on the physical properties of the interstellar and circumgalactic gas in distant star-forming galaxies. Xinnan is very enthusiastic about K-12 STEM outreach and inquiry-based teaching, and has received formal training in science education. Having led the departmental outreach program and coordinated the educational groups for the annual UCLA science fair, she is seeking a career in informal science education.

Contact Info

xinnandu@astro.ucla.edu

www.linkedin.com/in/xinnan-du-46852076/

www.facebook.com/anna.du.5203

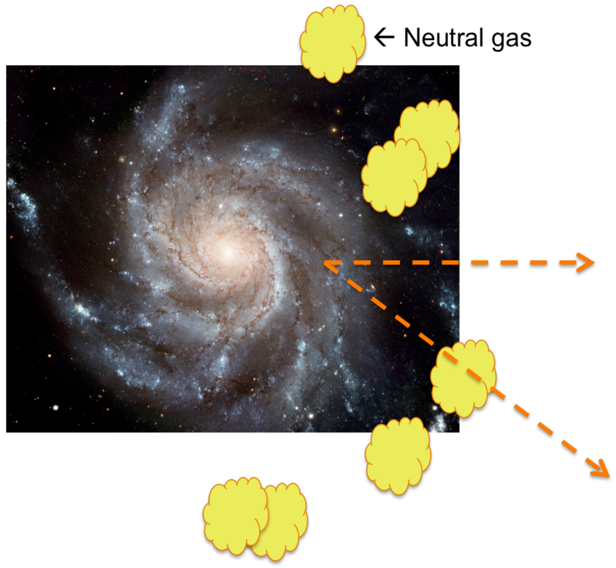
Rest-frame ultraviolet (UV) and optical spectroscopy provides valuable information on the physical properties of the neutral and ionized interstellar medium (ISM) in star-forming galaxies. In my dissertation work, I investigated the physical properties of ionized gas in star-forming regions, and the kinematics and evolution of the multi-phase outflowing ISM/CGM in distant star-forming galaxies spanning the redshift range $z \sim 1$-4. More specifically, I have presented a comparison of kinematics between the low- and high-ionization absorption features at $z \sim 1$, and investigated the origin of the highly ionized gas by examining the correlations between the spectral properties of C IV and various galaxy properties. Additionally, I have shown that the nebular C III] emission at $z \sim 1$ is much weaker compared to the detections from galaxies observed during the epoch of reionization ($z > 6$), and explored the factors that modulate the strength of this nebular feature. Finally, I have investigated the evolution of the ISM/CGM at $z \sim 2$-4 as probed by rest-UV spectroscopy. I discovered redshift-independent correlations among Lya emission, low-ionization interstellar absorption lines, and dust extinction. I further showed that the covering fraction of neutral gas decreases with increasing redshift at multiple fixed galaxy properties. With exceptional capabilities in the near-IR and excellent spectroscopic sensitivity, the next generation of large telescopes will enable rest-UV and rest-optical spectroscopic studies of star-forming galaxies out to $z > 10$.

The Redshift Evolution of Rest-UV Spectroscopic Properties in Lyman Break Galaxies at z ~ 2-4

Xinnan Du[1]; Alice E. Shapley[1]; Naveen A. Reddy[2], Tucker Jones[3], Daniel P. Stark[4], Charles C. Steidel[5], and 5 more
[1]UCLA, [2]UC Riverside, [3]UC Davis, [4]U Arizona, [5]Caltech

Introduction

Rest-frame UV spectra of star-forming galaxies provide rich insights into the physical properties of the multi-phase interstellar medium (ISM) and circumgalactic medium (CGM). The low-ionization interstellar (LIS) absorption features primarily trace the neutral phase of outflows, while high-ionization (HIS) lines mainly trace the ionized phase. The HI Lyα feature, on the other hand, is produced by recombination in HII regions, and then propagate through the ISM, interacting with both neutral hydrogen and dust grains.



- Weak low-ionization absorption lines
- Strong Lyα emission

- Strong low-ionization absorption lines
- Weak Lyα emission

Samples and Measurements

Data and redshift samples: the z~2-3 galaxy spectra were observed with Keck/LRIS, and the z~4 spectra were observed with Keck/DEIMOS and VLT/FORS2. The redshift bins were divided according to boundaries at z = 2.7 and z = 3.4.

Controlled samples: we further constrained the z~2, 3, and 4 samples to span the same dynamic range in stellar mass and UV luminosity, in order to compare galaxies at different redshifts with similar properties.

Measurements: the spectral line measurements and SED fitting were performed in a uniform manner for galaxies in different redshift bins to avoid potential systemic biases.

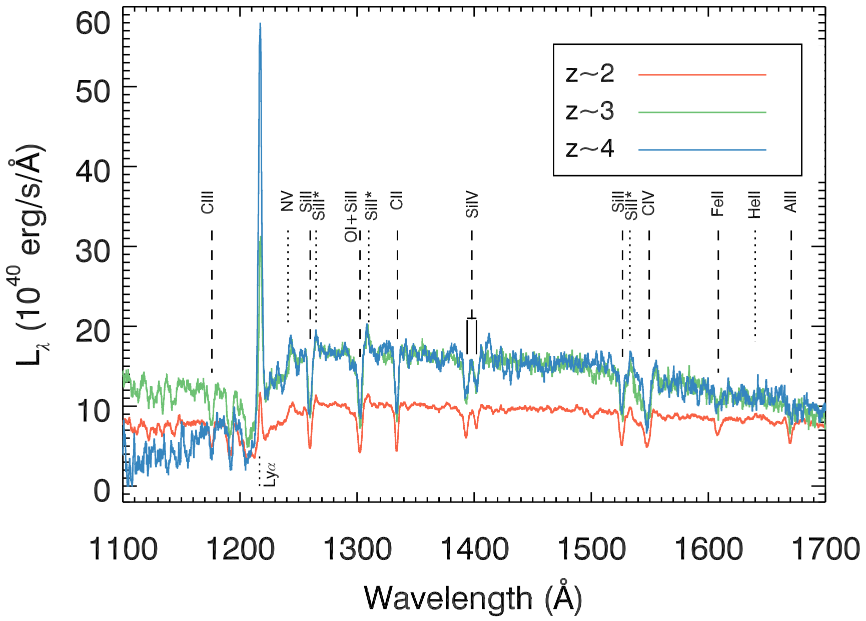


Figure 2. Composite UV spectra of the LBGs in the z~2 (red), z~3 (green), and z~4 (blue) samples with UV luminosity and stellar mass constrained.

← **Figure 1.** Cartoon representation of the correlation between observed Lyα strength and the neutral gas covering fraction.

Results

1. The correlations among Lyα, LIS lines, and dust extinction are redshift-independent. This means a) the covering fraction of neutral gas modulates the strengths of both Lyα and LIS lines in the same manner at all redshifts; and b) dust and metal ions are coupled with the outflowing HI gas.
2. The strength of Lyα emission decreases with decreasing redshift at fixed stellar mass, UV luminosity, and SFR, which likely results from a larger covering fraction of the neutral gas and higher dust extinction at lower redshifts.
3. We observe variations in the intrinsic Lyα production among galaxies in our samples. Galaxies with larger observed $EW_{Ly\alpha}$ may not only have lower HI gas covering fractions, but also intrinsically produce more ionizing (and Lyα) photons per unit mass of stars formed.

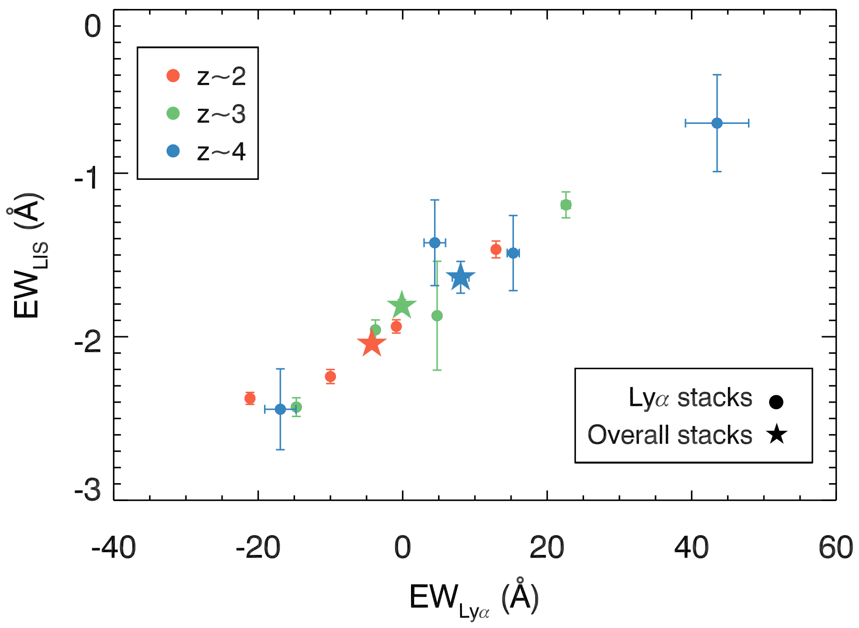


Figure 3. EW_{LIS} vs. $EW_{Ly\alpha}$ in the composite spectra binned according to $EW_{Ly\alpha}$ (circles) and in the overall composite spectra (stars).

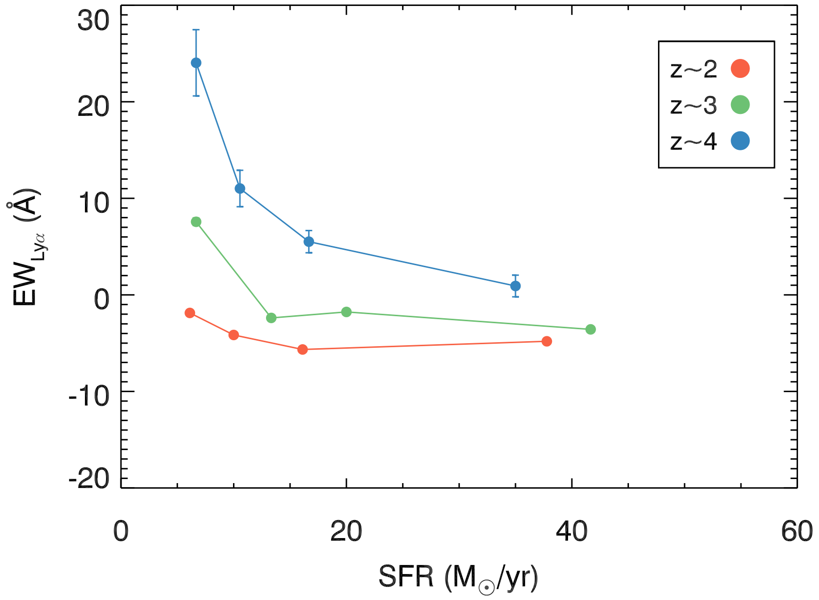


Figure 4. $EW_{Ly\alpha}$ vs. star-formation rate in the composite spectra

More Discussion

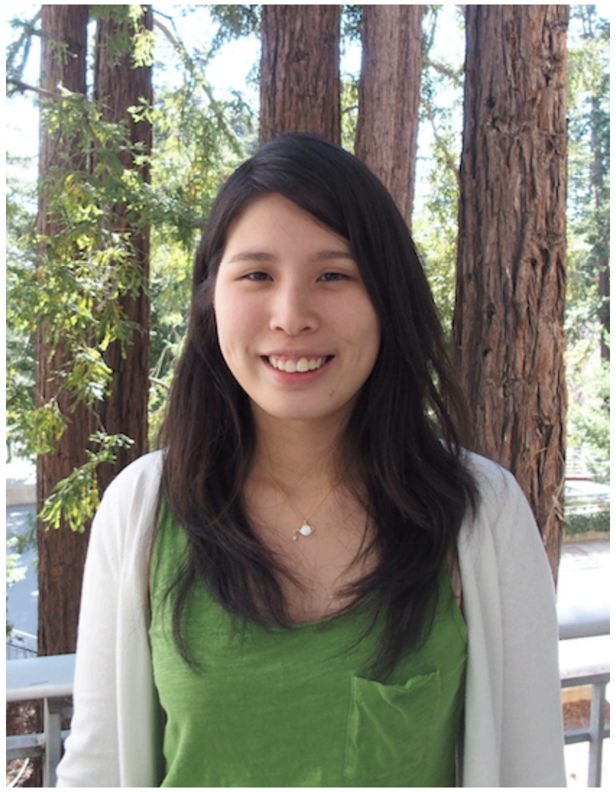
Check out the full paper here if you are interested in more details: Du et al. (2018), ApJ, 860, 75

Contact

Xinnan Du (杜辛楠)
University of California, Los Angeles
475 Portola Plaza, Los Angeles, CA 90095
xinnandu@gmail.com

References

1. Shapley et al. (2003), ApJ, 588, 65
2. Jones et al. (2012), ApJ, 751, 51
3. Kornei et al. (2010), ApJ, 711, 693
4. Steidel et al. (2010), ApJ, 717, 289
5. Reddy et al. (2016), ApJ, 828, 108
6. Stark et al. (2014), MNRAS, 455, 3200



KAT FENG
she/her/hers
Exoplanets
UC Santa Cruz

I grew up in Pennsylvania, Beijing, and Singapore. Mostly thanks to the movie Contact, I became interested in astronomy. I now work on the atmospheres of exoplanets and try to accurately infer their properties. I like tea, cafe-hopping, and watching cooking competitions. Walks are great! Movies are great! I also love a good analogy.

Contact Info

kat.feng@ucsc.edu

@cloudfreekat

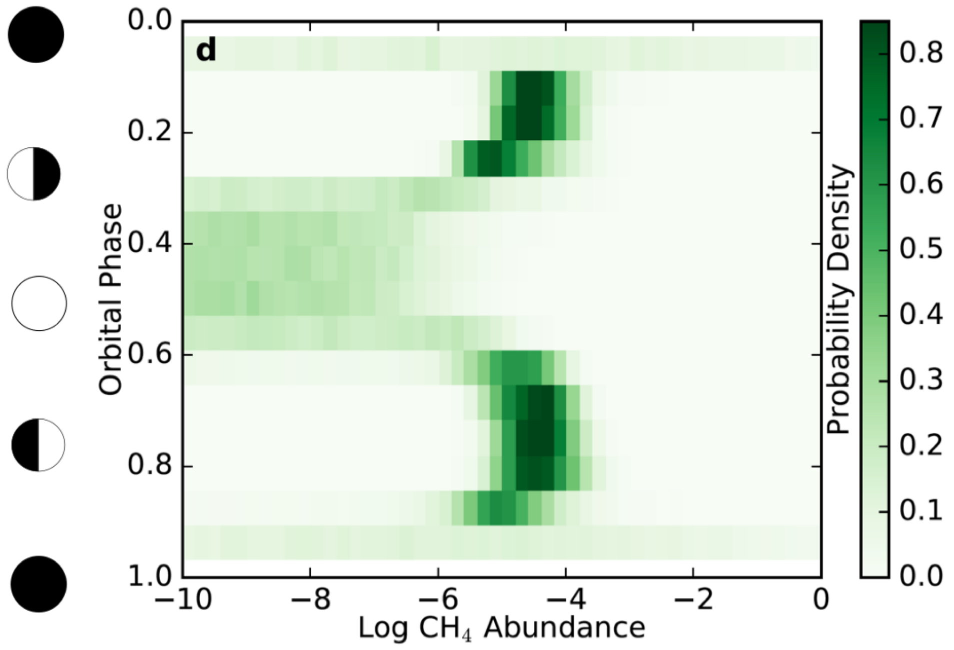
@cloudfreekat

Suppose in front of you, there is a cake. And you are given the task of understanding the cake without tasting it, much like having to understand an exoplanet's atmosphere without being able to send a probe there. What could be the chemical composition of the frosting? What kind of interior structure might the cake have? How about formation conditions? I will discuss how I am using inverse modeling in my scientific kitchen to investigate the atmospheres of hot Jupiters and Earth-like planets.

Advancing spectral retrievals in the era of large space-based telescopes

Given data, what should retrievals get?

How do assumptions inherent in the retrieval model lead us astray?



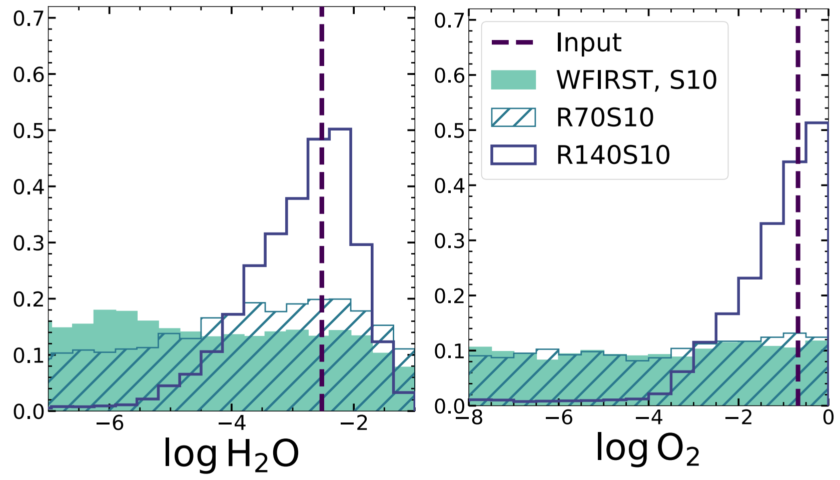
Stevenson et al. 2017

- Assume “2D” atmosphere instead of 1D, uniform: 2 contrasting pressure-temperature profiles
- Modify model to accommodate phase-resolved data from hot Jupiters
- Examine the consistency of e.g., CH_4 inference vs. phase

Given retrievals, what data should we get?

How do we quantitatively evaluate the science return of proposed missions?

- Simulate reflected-light data as observed with future direct imaging missions
- Vary instrument resolution and signal-to-noise ratio
- Examine detection and constraint of indicators of habitable conditions



Feng et al. 2018

kat.feng@ucsc.edu

STEVEN GIACALONE
he/him/his
Exoplanet Observation &
Planet Formation/Migration
UC Berkeley

I attended college and the University of Chicago from 2013-2017, where I majored in physics and specialized in astrophysics. I first became involved in astro research during my second year, when I worked on a project involving exoplanet orbital dynamics. I later worked on projects exploring the migration mechanisms of giant, close-in exoplanets and dust transport in protoplanetary disks. Currently, I'm working on a tool that will help validate TESS exoplanet candidates.

Contact Info

steven_giacalone@berkeley.edu

Over the next few years, TESS will detect thousands of exoplanets and even more eclipsing binaries. Due to the size of TESS's pixels, it is an inevitability that some will receive flux from more than a single star. In these cases it can be difficult to determine if a signal is due to a transiting planet around a target star or an eclipsing binary around a different star hidden within the aperture. But there is hope. Since TESS target stars are relatively bright and nearby, they are ideal targets for followup observation programs and large-scale stellar characterization missions (e.g. Gaia). By considering the information collected from these observations, we can identify and place constraints on the properties of all visible stars within a given TESS pixel and calculate the probability of each star hosting a transiting planet or eclipsing binary consistent with a given trnsitlike signal. By incorporating this process into a larger validation procedure, we can produce a tool that can reliably confirm or deny the existence of any exoplanet candidate.

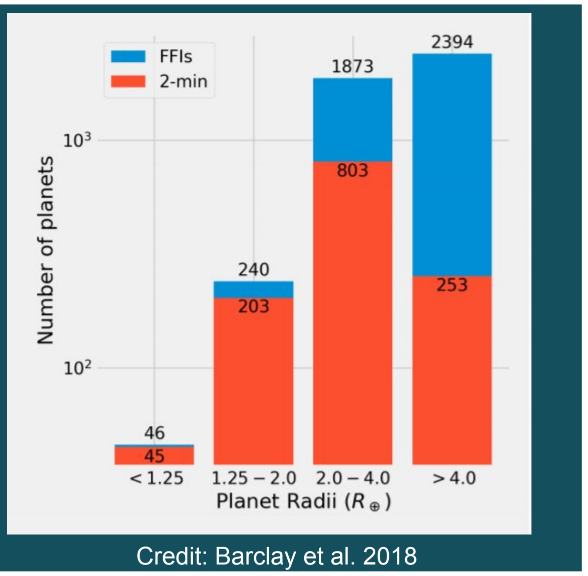
A Validation Tool for TESS Exoplanet Candidates

Steven Giacalone[1,2] and Courtney D. Dressing[1]

[1]UC Berkeley Department of Astronomy [2]steven_giacalone@berkeley.edu

Expected TESS Planet Yield

TESS is expected to detect thousands of exoplanets and even more eclipsing binaries.



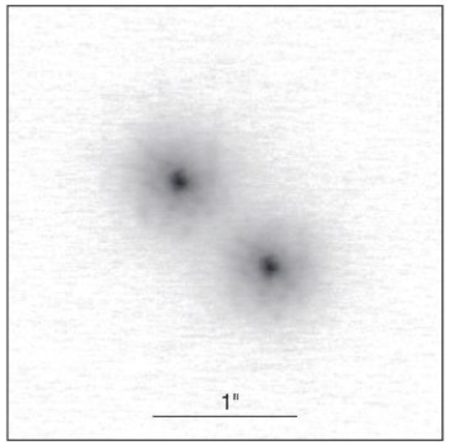
Credit: Barclay et al. 2018

Leveraging Follow-Up Observations

Unknown star properties and the presence of binary companions can be revealed using follow-up high-resolution imaging, spectroscopy, and photometry.

KOI 2174

Keck/NIRC2 0.01''/pixel



Credit: Furlan et al. 2017

Purpose of Validation

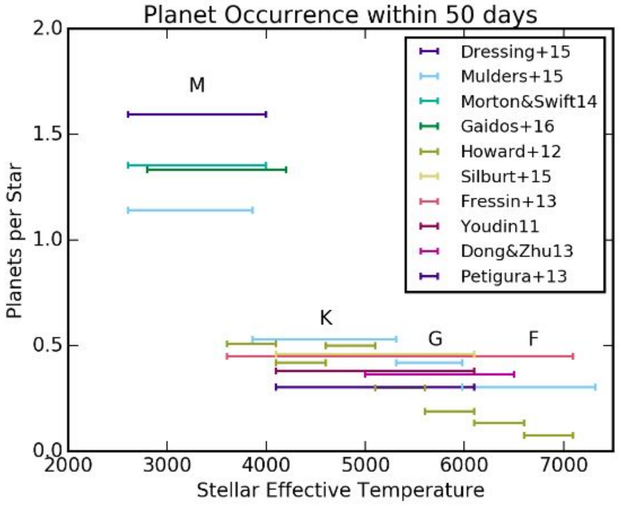
Determine the best targets for mass measurement and atmospheric characterization.

Facilitate growth of statistical sample of confirmed exoplanets.

Credit: NASA/MIT/TESS

Star-Specific Priors

Planet occurrence and stellar multiplicity rates are dependent on the properties of the target star. Considering these properties allows more accurate validation.



Credit: Mulders 2018

JESSIE HIRTENSTEIN

she/her
Galaxy Evolution
UC Davis

Hi, I'm Jessie Hirtenstein and I'm a 4th year graduate student at UC Davis. I love baking (most recent/ successful masterpieces include Swedish princess cake from Great British Bake-Off, and a cake shaped like pusheen), all things broadway and I just retired from cheerleading after 12 years so I am currently on the market for new hobbies!

We present spatially resolved spectroscopy and kinematic maps for 12 star forming dwarf galaxies between $1.2 < z < 2.3$. These are the first results of the OSIRIS Lens-Amplified survey (OLAS), targeting galaxies with masses and redshifts where feedback is most effective. If feedback alters the gravitational potential of dwarf galaxies, thereby resolving the core-cusp problem, we expect a specific relationship between specific star formation rate (sSFR = star formation rate (SFR)/M_star) and galaxy kinematics as predicted in simulations. Preliminary analysis comparing OLAS observations to the Feedback in Realistic Environment (FIRE) simulations show agreement in the relationship between sSFR and velocity dispersion.

Contact Info

jhirtenstein
@ucdavis.edu

@j_hirtenstein

@canonlyodd

EFFECTS OF STELLAR FEEDBACK IN HIGH-Z DWARF GALAXIES

Jessie Hirtenstein, University of California, Davis

OSIRIS Lens-Amplified Survey (OLAS)

Science Goals: Can feedback driven outflows erase central dark matter cusps and produce constant density cores?

Sample: 12 star forming dwarfs galaxies, 7.9 < log ($M_*/M_\odot$) < 9.8, 1.2 < z < 2.3

Instrument: OSIRIS, Mauna Kea Integral Field Unit → spatially resolved kinematics

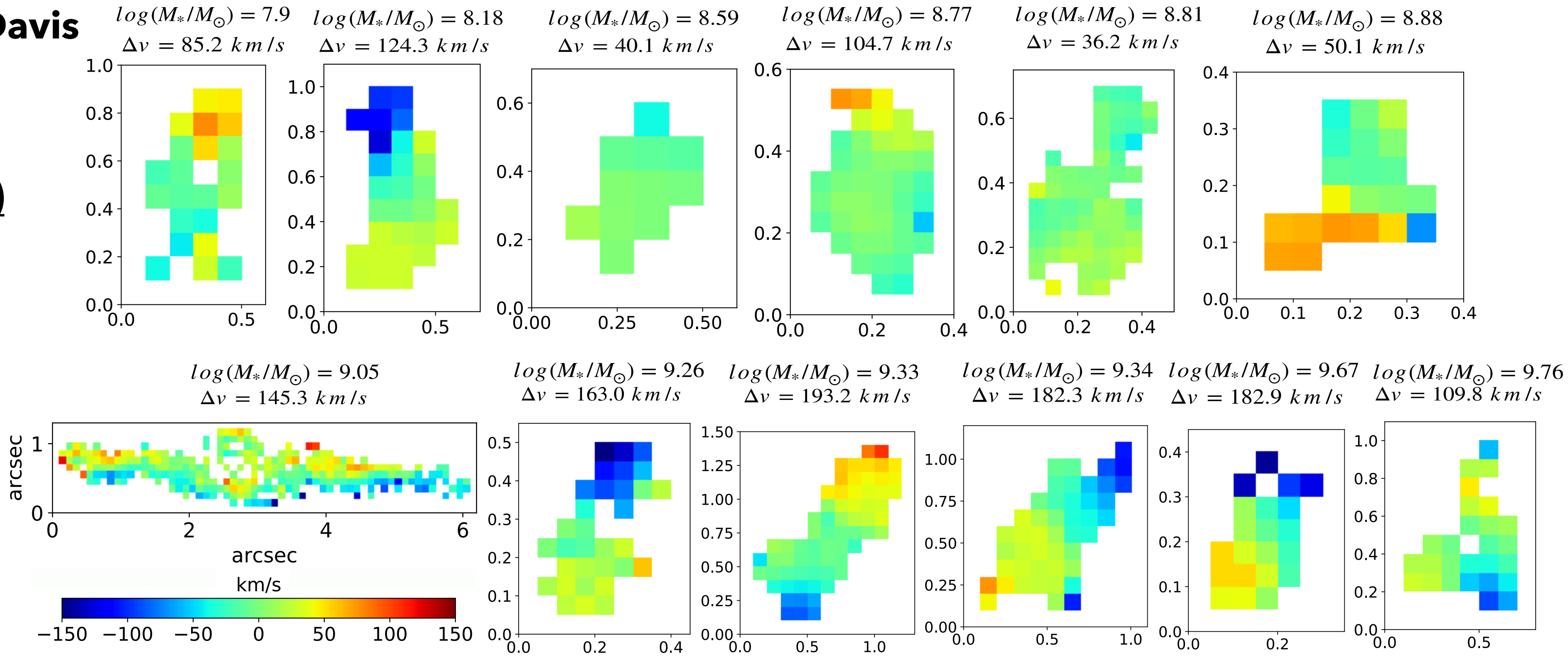


Figure 1. Hα velocity maps for 12 star forming galaxies in our sample. The galaxies are sorted by stellar mass ranging from log (M*/M☉) = 7.9-9.76, shown with a common velocity scale (bottom left). Targets with log (M*/M☉) <9 (top row) typically have lower velocity shear and disordered kinematics (dispersion-dominated in most cases), whereas the more massive galaxies on the bottom row predominantly show ordered rotational motion.

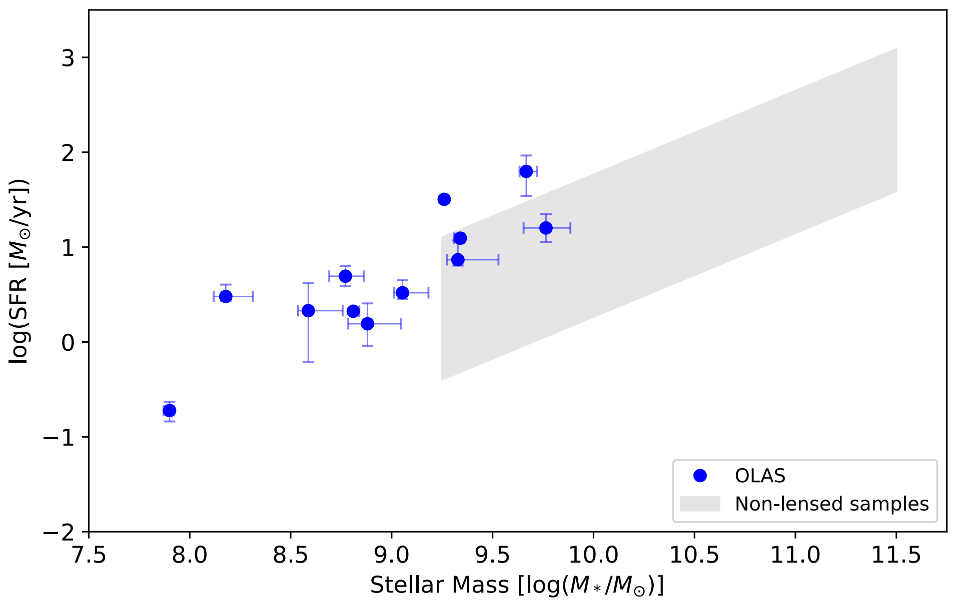


Figure 2. Comparison of OLAS sample to other, non-lensed, kinematic surveys. This study pushes down roughly two orders of magnitude lower in stellar mass, as well as as one order of magnitude higher in spatial resolution than other kinematic surveys, due to the unique combination of adaptive optics and gravitational lensing.

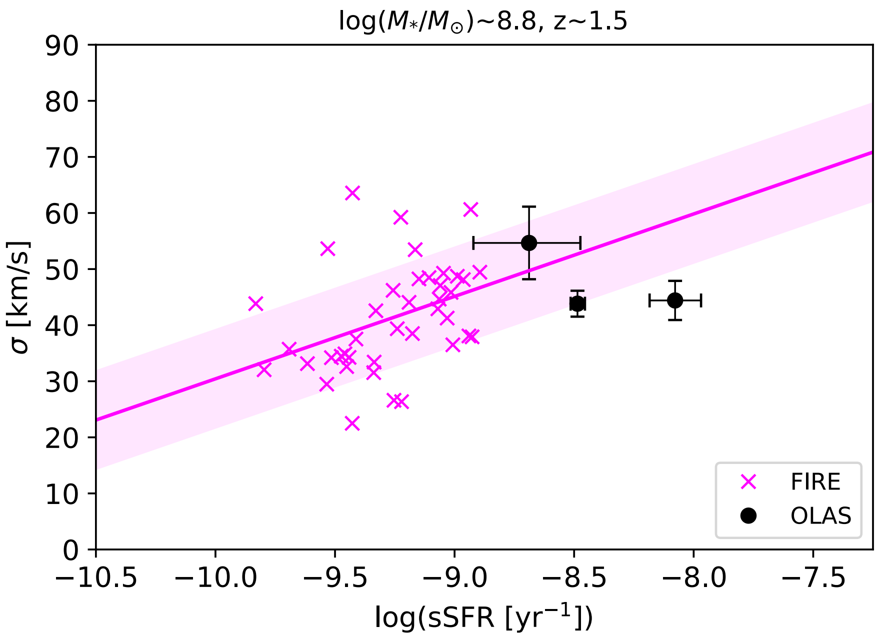
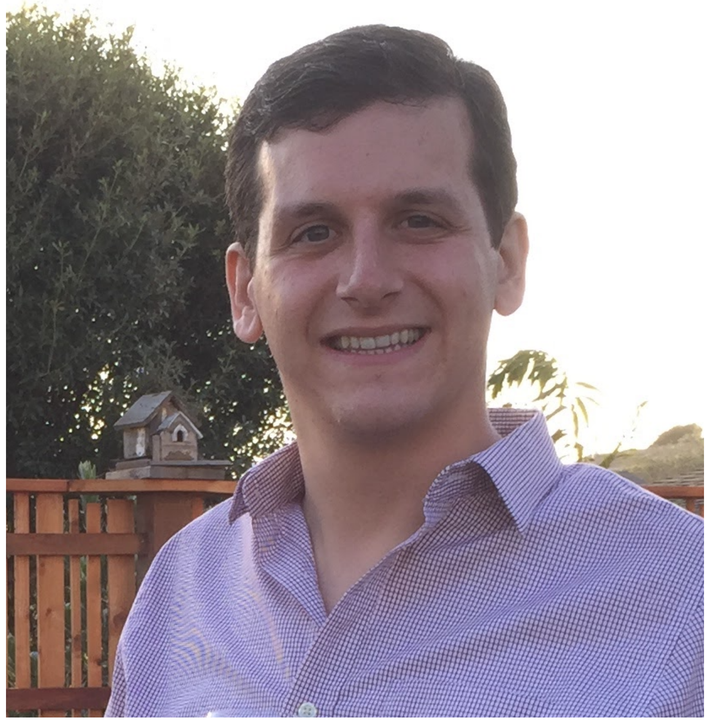


Figure 3. Comparison of sSFR and σ from OLAS (this work, black circles with error bars) to FIRE simulations (pink). The crosses are data from a single simulated galaxy at different snapshots, the solid line is the best fit and the shaded region represents the one sigma scatter.

Take-aways:

- Sample probes masses and redshifts where simulations predict **feedback to be most effective**
- If feedback resolves the core-cusp problem, it must be able to **alter the potential** of dwarf galaxies
- Simulations predict galaxies with a **higher sSFR** and hence more active feedback will have **higher intrinsic velocity dispersions**, resulting from the rapid change in their gravitational potentials (El-Badry et al. 2017)
- Preliminary analysis shows agreement in the σ vs sSFR relationship between observations and simulations



MICHAEL MEDFORD

he/him
Observation of Optical Transients
in Time-Domain Surveys
UC Berkely

After studying Theatre and Physics at Northwestern University, I lived for several years in Chicago as an actor and physics teacher. I decided to attend graduate school to participate in the future of big-data astronomy and develop my enthusiasm for science communication. Outside of science I enjoy playing chess, throwing around a frisbee, and have an odd passion for budgeting and all things personal finance.

Contact Info

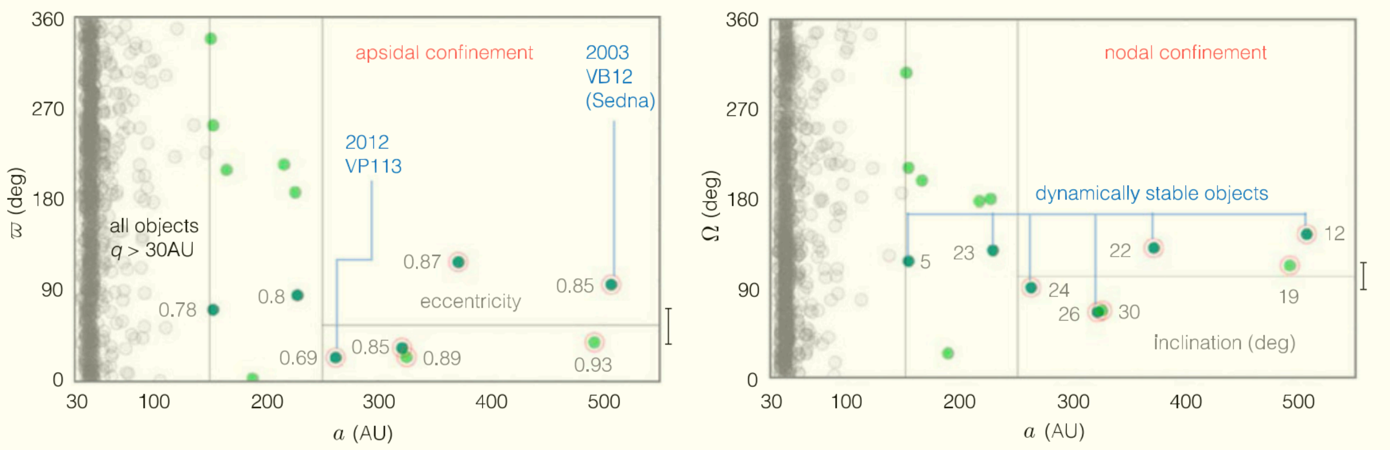
MichaelMedford@berkeley.edu

www.MichaelMedford.com

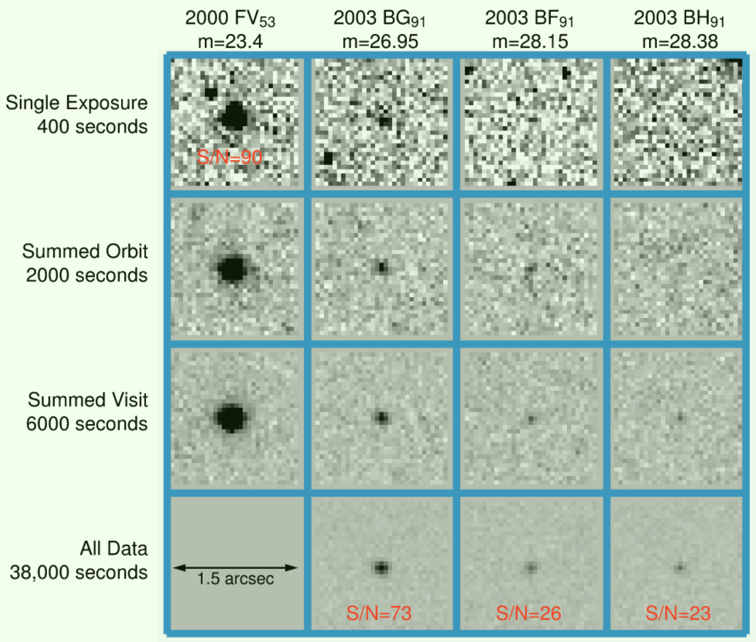
My current work involves leveraging sophisticated computational techniques in large optical time-domain datasets to discover new and exciting transients. I am currently finishing up a search for the proposed "Planet Nine" in the 10 years of Palomar Transient Factory data using a novel "shift-and-stack" technique. I am also beginning a search for photometrically lensed black holes as a member of the Zwicky Transient Facility collaboration.

The Hunt for Planet Nine

Distant Solar System Object Detection via Wide-Sky Shift-and-Add Method

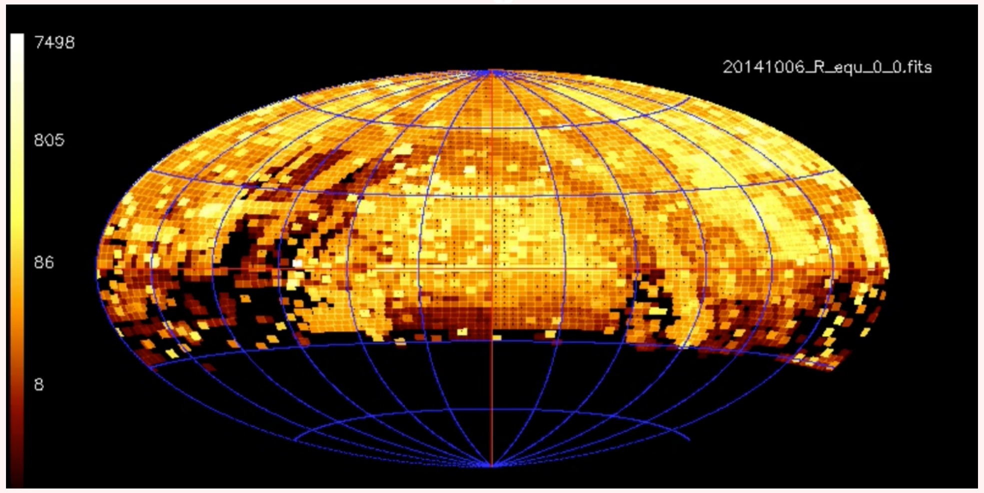


Observation of the clustering in ω, ϖ, and Ω for extreme trans-Neptunian objects (TNOs) with perihelion distances greater than 30 AU and semi-major axes greater than 250 AU with only 0.007% chance due to random scattering, by Batygin & Brown (January, 2016)

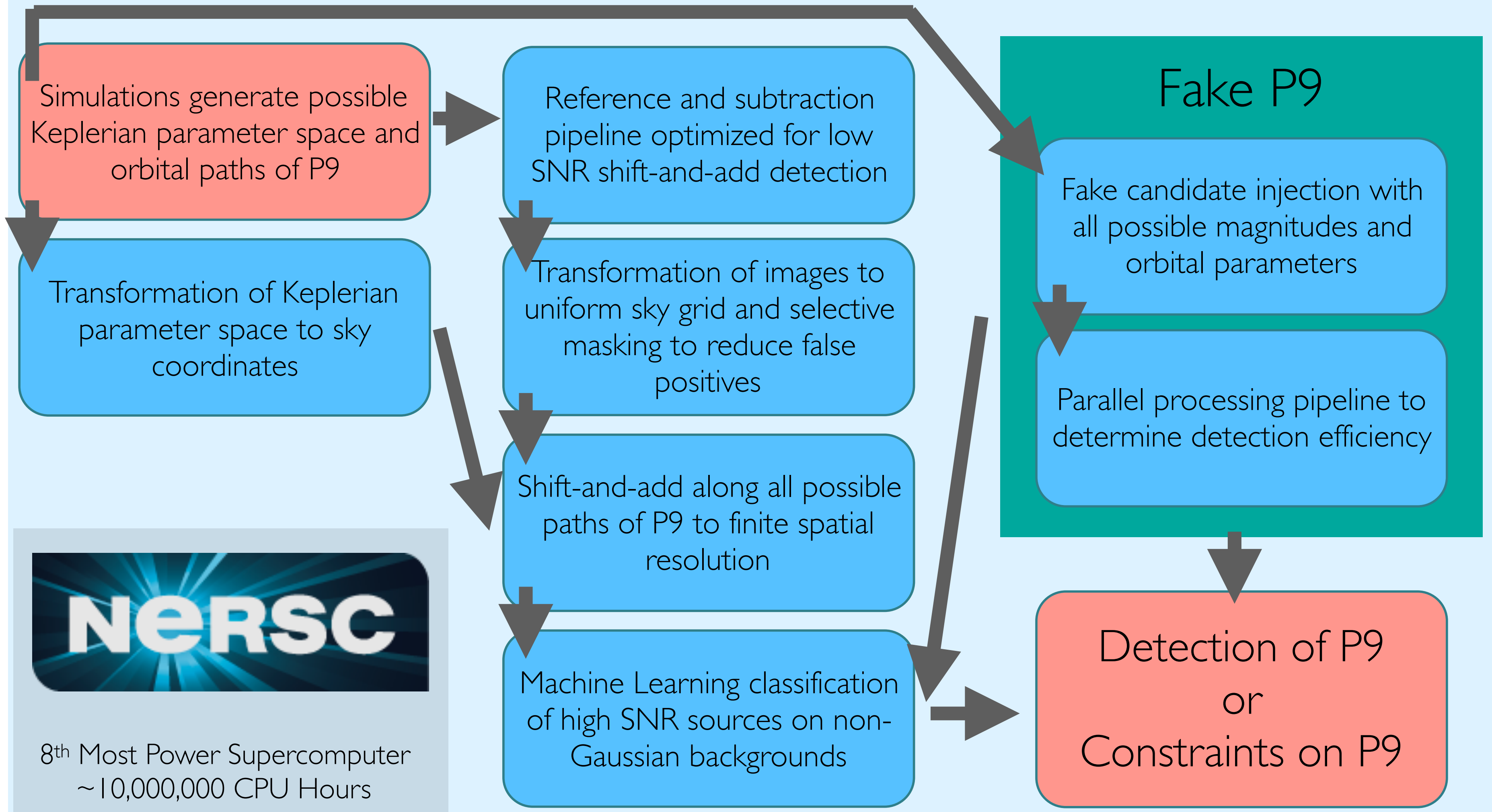


- Gary Bernstein et al. 2004 (including Trilling, Brown, and Malhotra!) executes a TNO search using ACS on 0.02 deg^2 over all possible orbits
- Re-parameterizes Keplerian orbits into on-sky coordinate system to maximize search efficiency
- Discovers faintest solar system body 2003 BH91 (m_R = 28.38), breaking the record by ~3 magnitudes

- Palomar Transient Factory (PTF) and intermediate Palomar Transient Factory (iPTF)
- 2.9 million images over 10 years from Mt. Palomar, California on the 1.2-meter Samuel Oschin Telescope at Palomar Observatory (1".01/pixel, R ~ 20.5, g ~ 21.0)
- Multiple simultaneous surveys (including a one night cadence survey, a wide and slow survey, fast-moving asteroid survey, fast 2 hour cadence survey, and so on) resulted in a highly heterogenous dataset



PTF R-Band Sky Coverage as of 2014



Simulations generate possible Keplerian parameter space and orbital paths of P9

Transformation of Keplerian parameter space to sky coordinates

Reference and subtraction pipeline optimized for low SNR shift-and-add detection

Transformation of images to uniform sky grid and selective masking to reduce false positives

Shift-and-add along all possible paths of P9 to finite spatial resolution

Machine Learning classification of high SNR sources on non-Gaussian backgrounds

Fake P9

Fake candidate injection with all possible magnitudes and orbital parameters

Parallel processing pipeline to determine detection efficiency

Detection of P9
or
Constraints on P9

NERSC

8th Most Power Supercomputer
~10,000,000 CPU Hours

University of California: Berkeley
Lawrence Berkeley National Laboratory

Michael Medford

Osterbrock Sierra Conference
August 16th-19th, 2018

I am a 5th year grad student. Home town is San Diego. Grew up in Bulgaria (Eastern Europe).

Contact Info

petiay@ucsd.edu

PETIA YANCHULOVA MERICA-JONES

she/her/hers
Dust & Interstellar Medium in Nearby Galaxies
UC San Diego

I study dust extinction in the Magellanic Clouds (MCs). The low-metallicity environment of the MCs may be responsible for conditions which harbor dust with different properties than Milky Way dust. The MCs are therefore often used as a template to account for dust in distant galaxies due to the low metallicity nature of both types of galaxies. Despite this, dust in the MCs is still relatively poorly understood. I use HST multiband photometric observations to study the dust extinction curve in the Small Magellanic Cloud. I do this by analyzing the location on a color-magnitude diagram (CMD) of red clump and red giant branch stars which can be significantly displaced from their theoretical location in the presence of dust. The stellar location holds information about not only the dust but also the 3D geometry (position of the dust relative to the stars and the galactic depth along the line of sight). I use a tool (MATCH, Dolphin (2002)) to generate CMD models with given star formation histories to which I apply varying 3D geometry and dust parameters (the latter using the Bayesian Extinction and Stellar Tool, Gordon (2016)). The goal is to find the best-fit dust and geometry parameters when I match the model to the observed CMDs. In the MCs on needs to consider both the dust extinction and the galactic 3D structure when using stars to map the dust.

I want to encourage astronomy grads who are considering starting a family while in grad school that it's not impossible and that it can be very rewarding and totally doable.

UC San Diego

Center for Astrophysics and Space Sciences

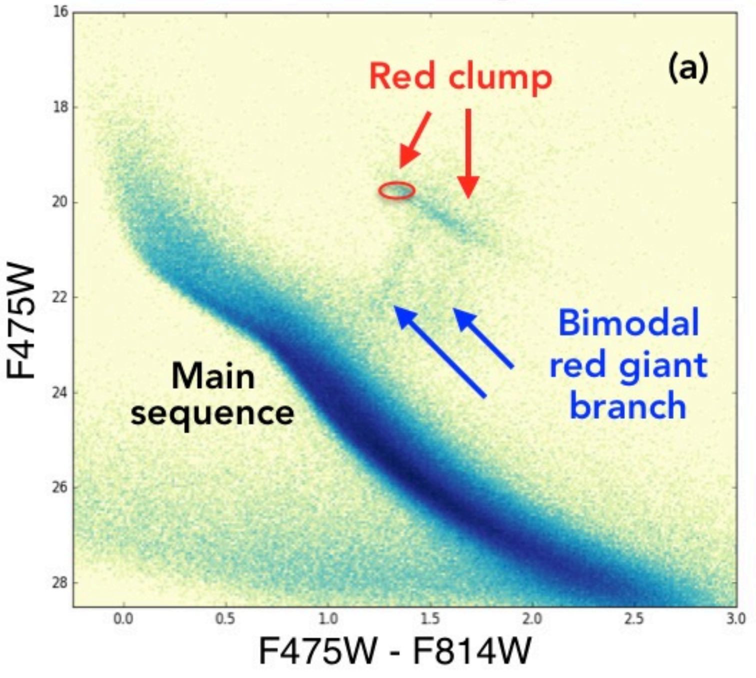
Dust extinction properties and 3D structure of the Small Magellanic Cloud with SMIDGE

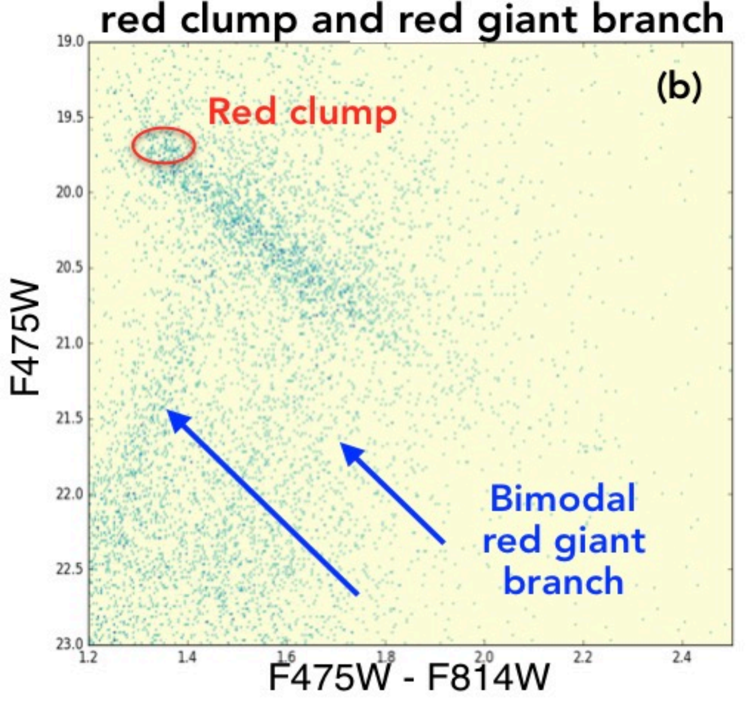
Petia Yanchulova Merica-Jones[1], Karin M. Sandstrom[1], L. Cliff Johnson[2], Julianne Dalcanton[3], Andrew E. Dolphin[4], Karl Gordon[5,6], Julia Roman-Duval[5], Daniel R. Weisz[7], Benjamin F. Williams[3]

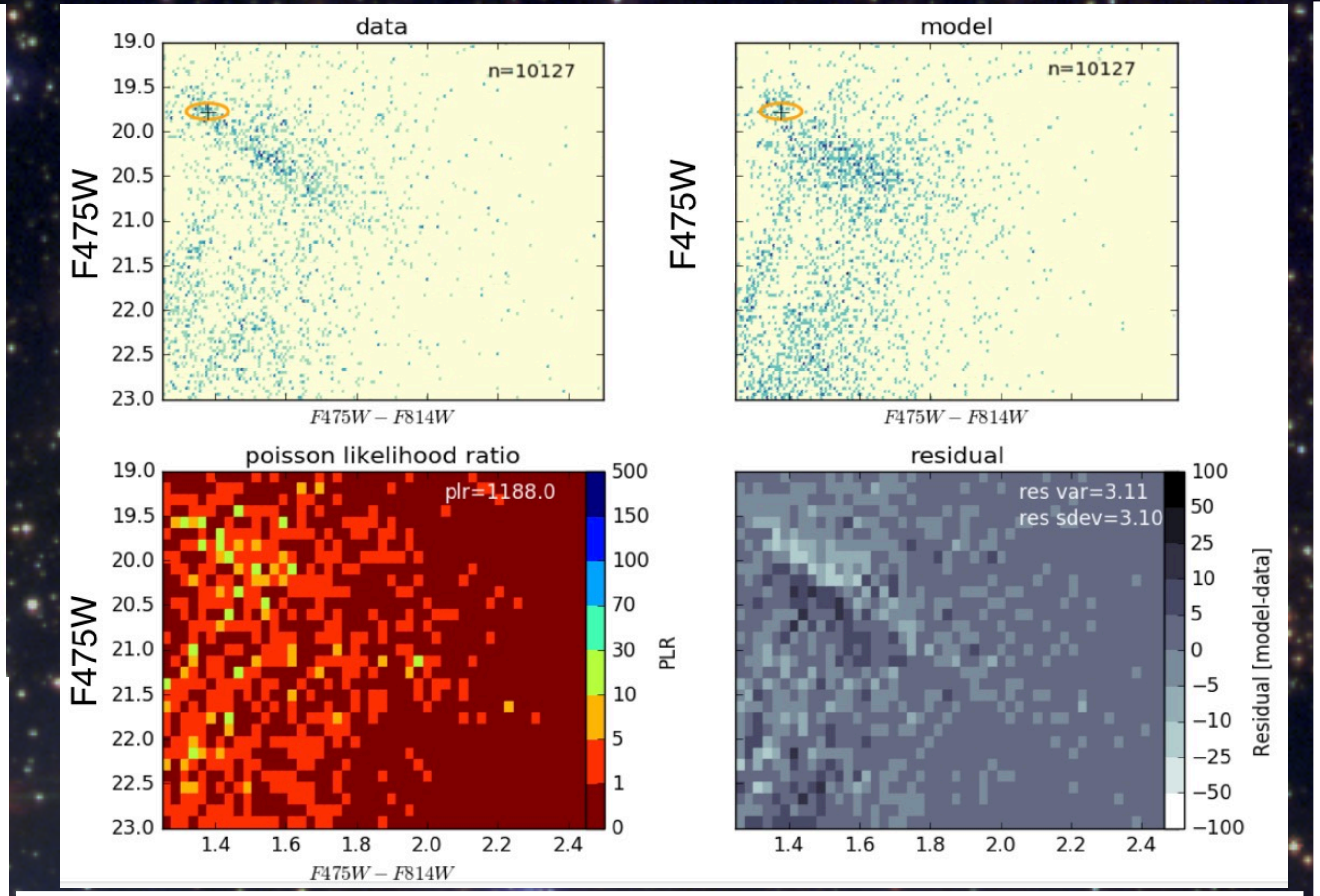
[1]University of California, San Diego, [2]Northwestern University, [3]University of Washington, [4]Raytheon, [5]Space Telescope Science Institute, [6]Sterrenkundig Observatorium, [7]University of California, Berkeley

petiay@ucsd.edu

Small Magellanic Cloud Investigation of Dust and Gas Evolution







Conclusions:

1. In the Magellanic Clouds when using stars to map the dust, one should consider **both the dust extinction and the galactic 3D structure**.
2. The SMC shows a **significant line-of-sigh depth** and **dust** positioned **in front of the stars**.

Method:

1. Generate **theoretical CMDs**
2. Add **dust**:
   - Extinction law
   - Log-normal extinction, Av
   - Log-normal width, σ(Av).
3. Add **distance**:
   - SMC Line-of-sight depth
   - Stars-dust relative position
4. Compare model and observed CMDs:
   - Bin reddened CMD in color & magnitude (red panel)
   - Find Poisson Likelihood Ratio (PLR) for each bin
   - Minimum PLR gives best-fit model

Anthony Pahl
he/him/his
Galaxy Evolution
UC Los Angeles

I'm a rising 2nd year astronomy graduate student at UCLA. I'm a big fan of far away objects, high-powered computing, and x-treme sports like rock climbing, surfing, and slow jammin.

Contact Info

✉ pahl@astro.ucla.edu
@tonyminus
@tonyplus

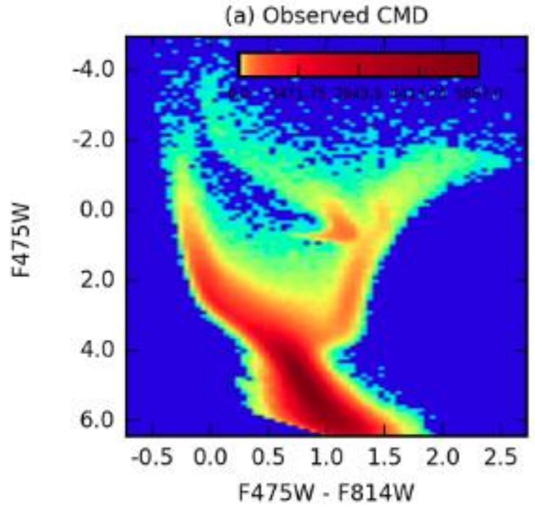
Studying nearby galaxies allows for the advantage of measuring each star individually to construct a resolved stellar population. When plotted as a color-magnitude diagram, the galaxy can be fitted for parameters such as star-formation history and metallicity. This technique has been used widely since its inception, but there is some debate concerning optimal observing strategies of nearby galaxies. We study the effectiveness of different filters and depths to recover SFHs of model galaxies using sophisticated simulation tools of both the ACS instrument on the Hubble Space Telescope and NIRCAM instrument of the upcoming James Webb Space Telescope and recommend in-depth observation strategies that will result in the most useful data to the nearby galaxy community. With the advent of the James Webb Space Telescope launching in 2018, our ability to construct color-magnitude diagrams for nearby galaxies will increase, motivating a further understanding of the efficiency and effectiveness of different observing strategies.

Anthony Pahl, University of California: Los Angeles
pahl@astro.ucla.edu

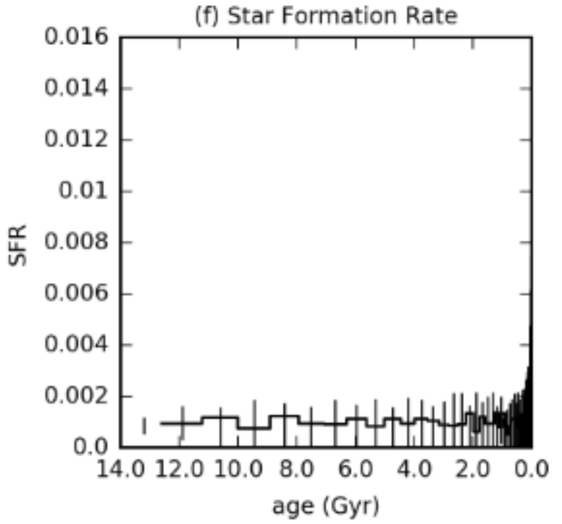
Optimizing JWST Observing Strategies for Nearby Galaxies

Resolved Stellar Population

Color-Magnitude Diagram



Star-Formation History



Choose:

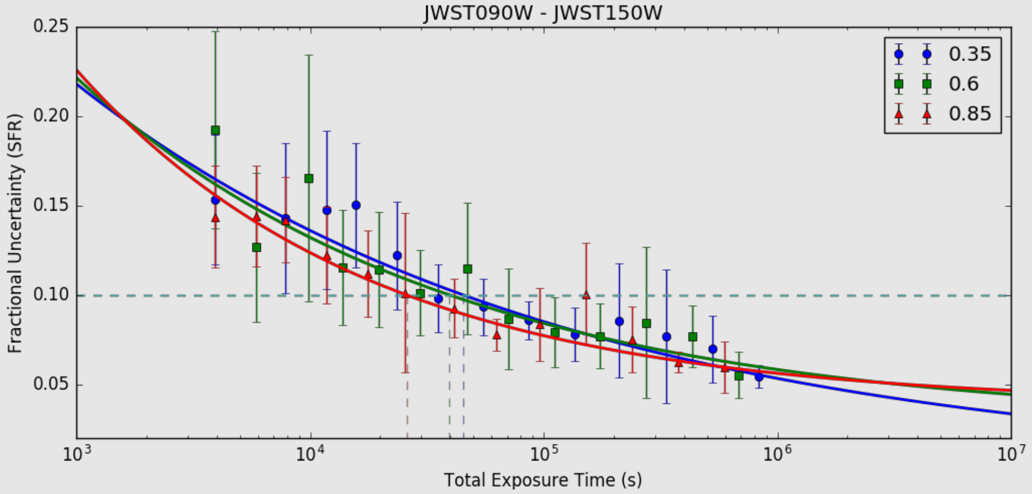
- Red filter, Blue filter
- Length of exposure in each

Maximize:

- S/N of the SFH in the oldest time bin

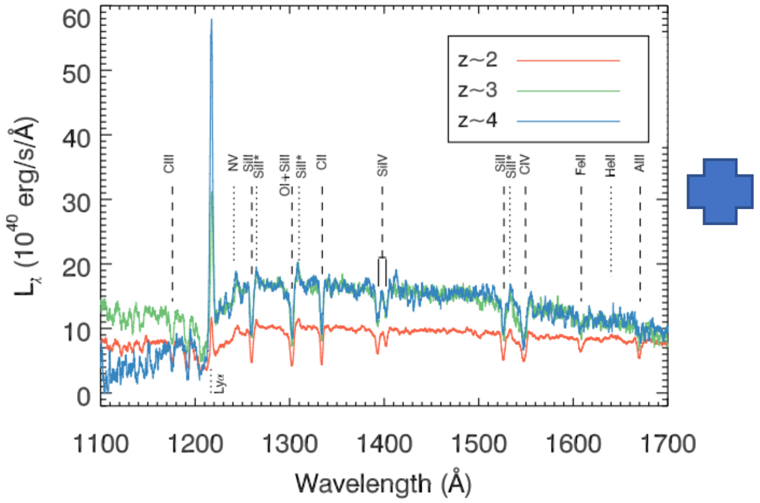
Minimize:

- Total exposure time ($$$)



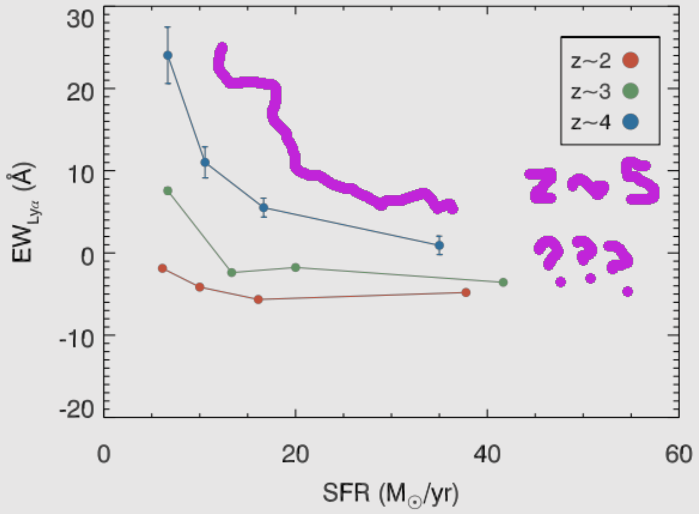
Redshift Evolution of Rest-UV Spectrosc. Properties in Lyman-break Galaxies Beyond z~5

Stacked Spectra (w/ Lya, IS absorption)



Galaxy Properties
(from photometric
fits)

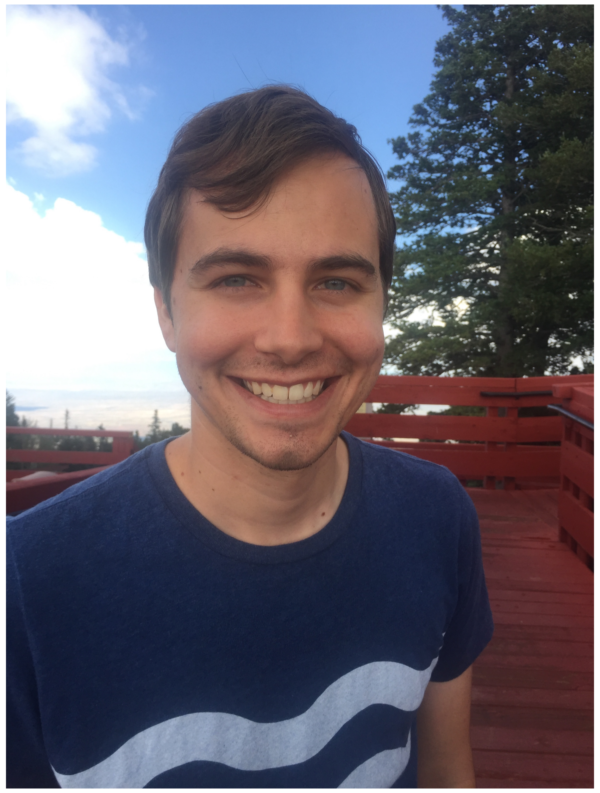
Relationships ~~



Probe:

- Neutral gas covering fraction
- Gas inflow/outflow
- CGM properties

As a function of redshift!



NATHAN SANDFORD

he/him/his
Stellar Spectroscopy
Galactic Chemical Evolution
UC Berkeley

I am a second year graduate student at UCB interested in stellar spectroscopy and the chemical evolution of the universe. I grew up in Santa Clara, CA and earned my BA in Physics and Astronomy from Pomona College in 2017. Outside of astronomy I am a novice D&D DM, coffee fanatic, and aspiring cook.

Contact Info

nathan_sandford@berkeley.edu

http://w.astro.berkeley.edu/~nathan_sandford/

https://github.com/NathanSandford

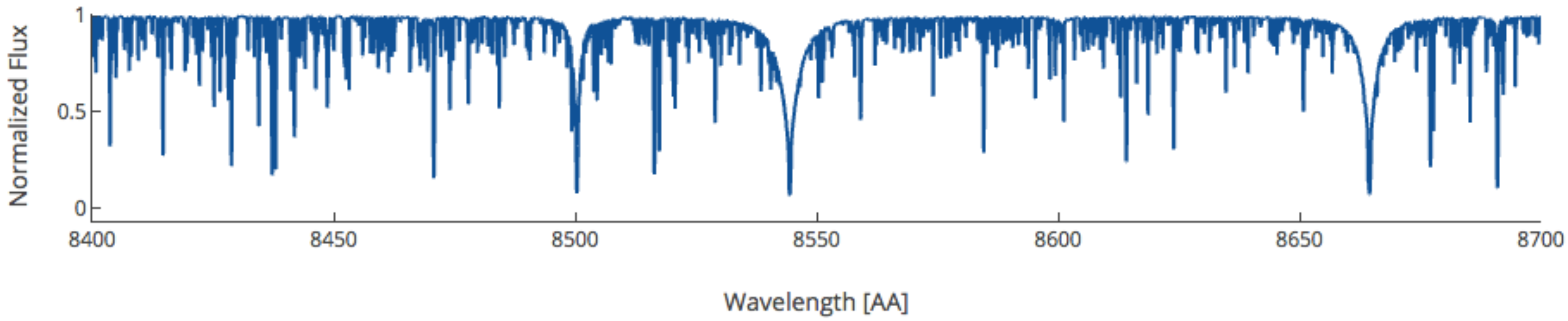
My research involves using the full spectral fitting code, the Payne, to fit low resolution spectra of resolved stars in local group satellite galaxies for their stellar properties and abundances. I then plan to use these abundance measurements and the flexible chemical evolution model, Chempy, to constrain aspects of galaxy evolution. Through this project, I have also become familiar with calculating Cramer-Rao bounds for stellar spectra, which provide upper limits to the precision at which abundances and other stellar parameters can be recovered from spectra with a given wavelength range and spectral resolution.

D-Payne

Adaptation of The Payne to DEIMOS spectra
The Payne: self-consistent ab initio fitting of stellar spectra (Ting+ 2018)

Fitting Spectra: *(A very preliminary version of this code: github.com/NathanSandford/D-Payne)*

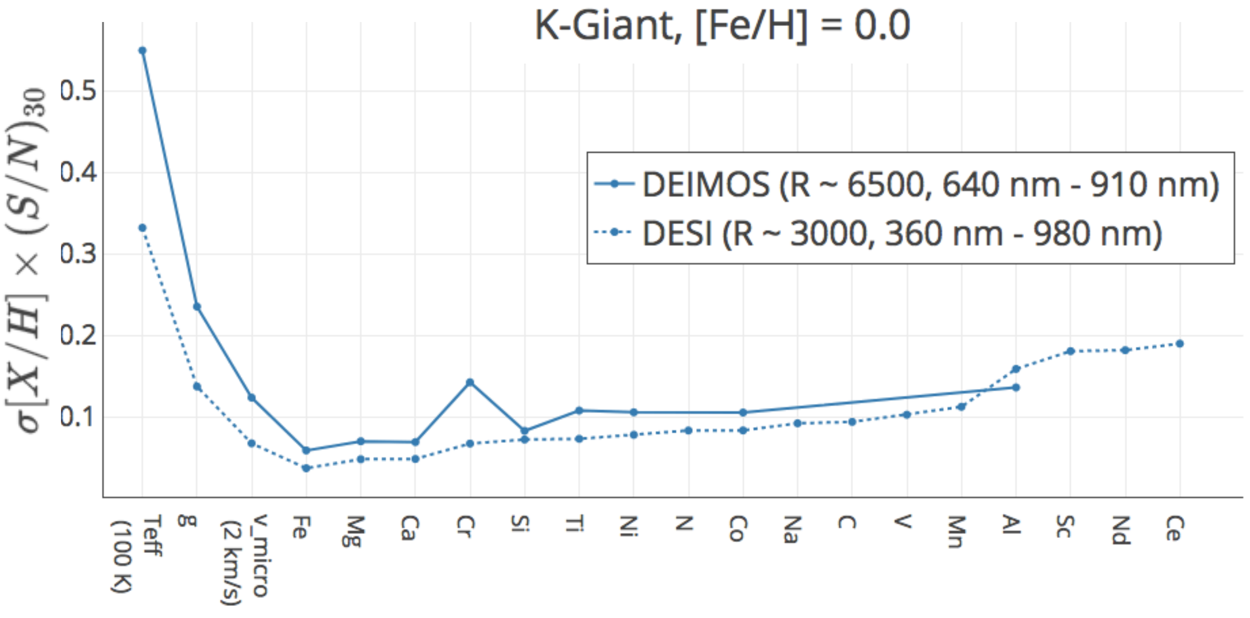
1. Generate high resolution (R~300,000) synthetic spectra using ATLAS12 and SYNTHE codes maintained by R. Kurucz



2. Convolve to DEIMOS resolution (R ~ 6500) and normalize
3. Train neural network on convolved and normalized synthetic spectra
4. Mask sky lines and poorly fit spectral features
5. Fit reduced DEIMOS data with trained neural network

Cramer-Rao Bounds:

- Upper limit on achievable precision of spectral fitting assuming perfect models
- Web applet coming soon!

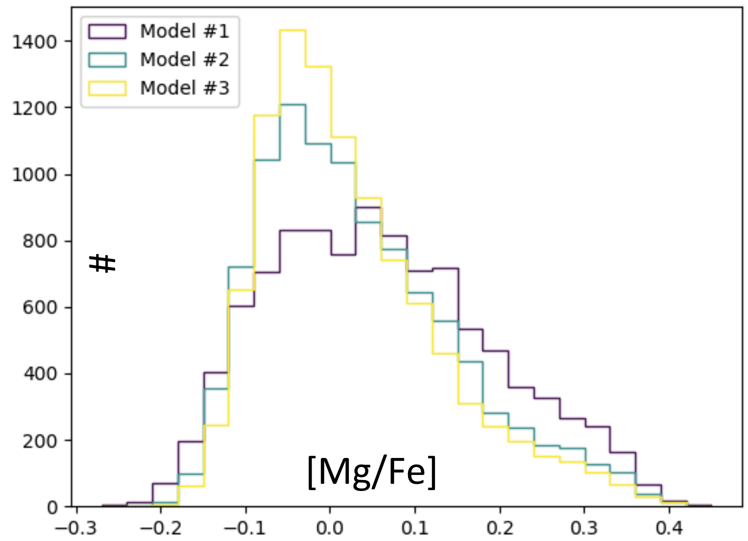


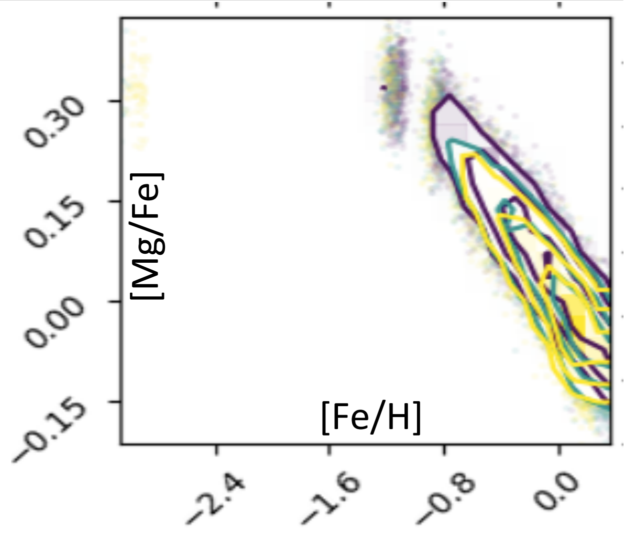
Chempy

Chemical Evolution Model *(github.com/jan-rybizki/Chempy)*
Chempy: A flexible chemical evolution model for abundance fitting (Rybizki+ 2017)

Ingredients:

- Star Formation History
- Initial Mass Function
- Yield Tables
- Inflows + Outflows
- MCMC Fitting





Chempy-Widget: *(github.com/NathanSandford/Chempy-Widget)*

SARAH STEIGER

she/her
Exoplanet Direct Imaging
UC Santa Barbara

My name is Sarah Steiger and I'm a second year graduate student working in Ben Mazin's group at UCSB developing new superconductor based detectors for exoplanet direct imaging. When I'm not coding or poking at really fragile instruments under a microscope I love to go outdoors to run, hike, and (more recently) climb. Originally from NY and then Boston I've loved experiencing all of the amazing National Parks in California and am looking forward to accomplishing my goal of visiting them all before I graduate.

Microwave Kinetic Inductance Detectors, or MKIDs, are ultraviolet, optical, and near-IR (UVOIR) photon counting, energy resolving detectors for ground and space-based astronomy. Typical semi-conductor based detectors, such as CCDs, are fundamentally limited by the band gap of the semiconductor and thermal noise sources from their relatively high operating temperatures. Cryogenic detectors such as MKIDs allow the use of superconductors with gap parameters roughly 10,000 times lower than semiconductors while operating at millikelvin temperatures. MKIDs can count single photons with no false counts while simultaneously determining the energy and arrival time (to within a microsecond) of the photon. Additionally, MKIDs have the distinct advantage of being able to perform frequency domain multiplexing - the ability to read out large arrays through a single microwave cable.

Contact Info

steiger@physics.ucsb.edu

@sarahsteiger

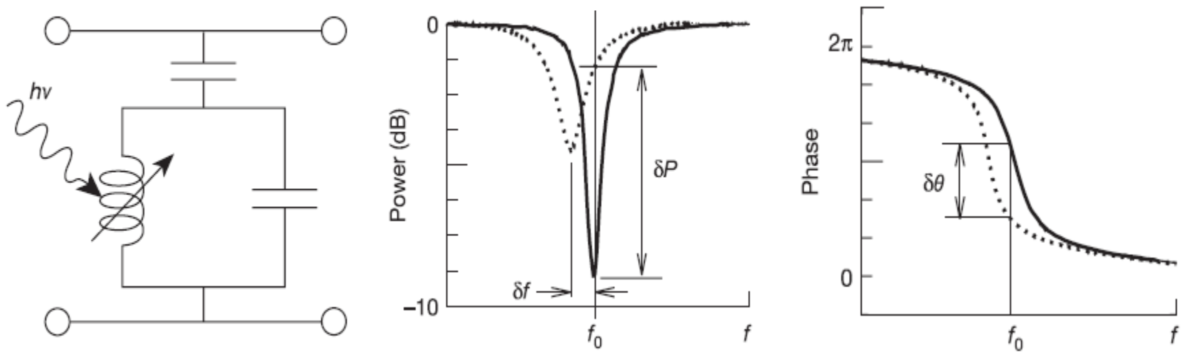
All of the wavelengths
All of the times
mazinlab.org

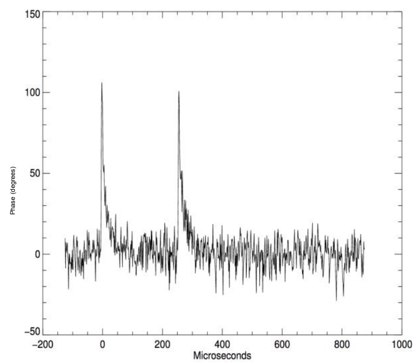
Microwave Kinetic Inductance Detectors (MKIDs) For Exoplanet Direct Imaging

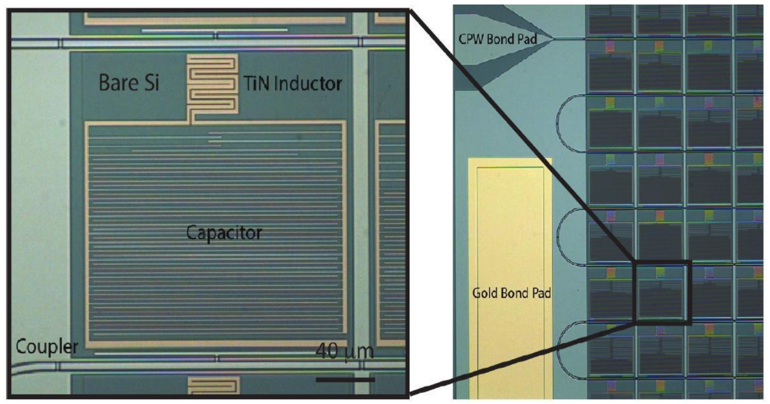
Sarah Steiger[1], Benjamin A. Mazin[1], Seth R. Meeker[2], Alex B. Walter[1], Paschal Strader[4] , Neelay Fruitwala[1], Clinton Bockstiegel[1], Paul Szypryt[3], Gerhard Ulbricht[5], Gregoire Coiffard[1], Bruce Bumble[2], Gustavo Cancelo[7], Ted Zmuda[7], Ken Treptow[7], Neal Wilcer[7], Giulia Collura[1], Rupert Dodkins[6], Isabel Lipartito[1], Nicholas Zobrist[1], Noah Swimmer[1], Miguel Daal[1], Michael Bottom[2], J. Chris Shelton[2], Dimitri Mawet[8], Jorge Llop Sayson[8], Julian C. Van Eyken[9], Gautam Vasisht[2], Eugene Serabyn[2]

[1]Univ. of California Santa Barbara, Santa Barbara CA; [2]Jet Propulsion Lab, Pasadena CA; [3]NIST Boulder, CO; [4]Dominican School of Philosophy and Theology, Berkeley, CA; [5]Dublin Institute for Advanced Studies, Dublin, Ireland; [6]University of Oxford, Oxford UK; [7]Fermi National Accelerator Laboratory, Bataravia, Illinois; [8]California Institute of Technology, Pasadena CA; [9]IPAC, California Institute of Technology, Pasadena CA

Microwave Kinetic Inductance Detectors (MKIDs)

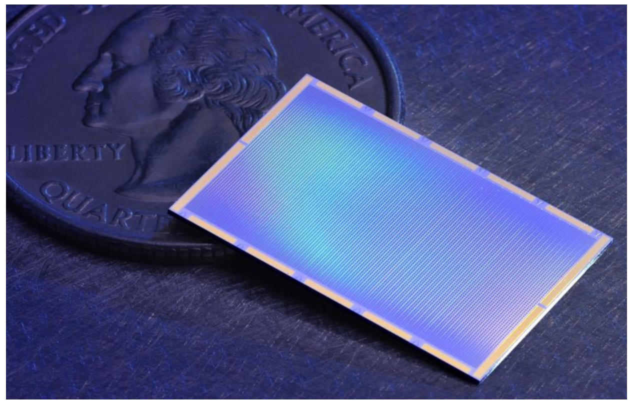






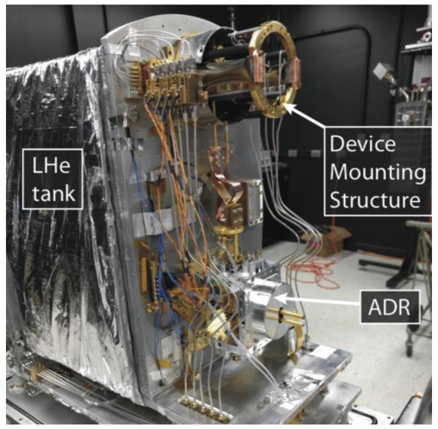
MKIDs are resonators constructed from a thin film of a superconducting material (such as TiN and PtSi) on a silicon or sapphire substrate that utilize the kinetic inductance effect. As photon counting detectors, they can resolve both energy and arrival time of individual photons. Using frequency domain multiplexing, thousands of resonators/pixels can be read out with a single microwave feedline.

DARKNESS – An Exoplanet Imager

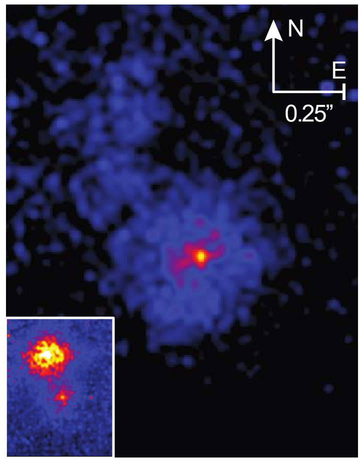


The **DARK**-speckle **N**ear-infrared **E**nergy-resolving **S**uperconducting **S**pectrophotometer is a camera that was first deployed July 2016 at the Palomar 200" behind the Stellar Double Coronagraph (SDC) and PALM-3000 (P3K) adaptive optics system. Its primary science goal is to directly image extrasolar planets.

- 10,000 pixels
- λ = 800-1400 nm
- R = 20 at 1 μm (goal)
- Capable of taking time and energy-resolved measurements of fast atmospheric speckles, enabling both real-time and ex post facto suppression



DARKNESS mounted to Palomar's AO Bench

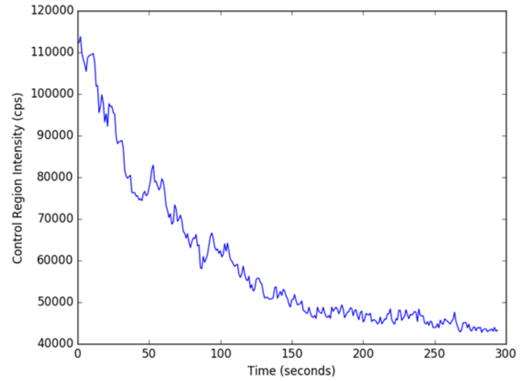


Median 1 second J Band image of spectroscopic binary 10 Uma demonstrating the coronagraphic suppression of the primary.

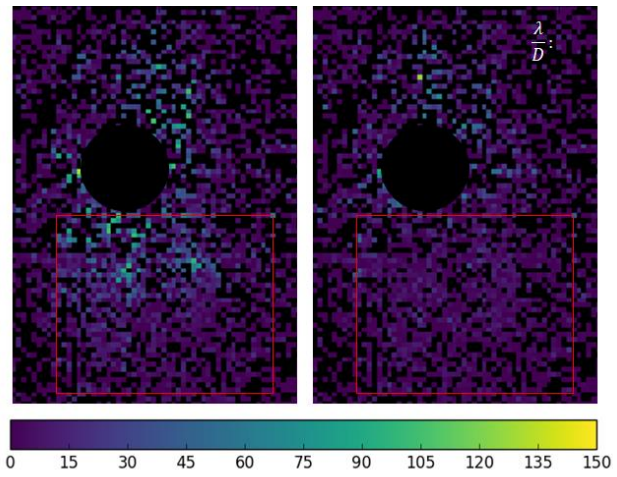
Meeker+ 2018

Speckle Nulling

- Real-time focal-plane control technique for speckle removal
- Basic algorithm uses a deformable mirror-generated probe speckle to coherently interfere (null) a real speckle
- Preliminary quasistatic nulling at ~1 Hz feedback rate



Light curve of control region during speckle nulling



Left: The initial speckle field
Right: the field right after running speckle nulling. Both images are 0.1 s, and the scale is raw counts
The black spot marks the coronagraph and the red box marks the control region

Fruitwala+ 2018

KATY RODRIGUEZ WIMBERLY

she/her/hers
Galaxy Evolution
UC Irvine

Hi! I'm Katy, a rising 3rd year at UCI. I started physics undergrad & grad school later than most - I was in the Army Reserves and studied theatre for years before finally finding my true passion - space! Now I study galaxy evolution (particularly how galaxies stop forming stars) using both telescopes and simulations. I love doing outreach with underserved populations and astro-community service in mentoring. Aside from all things astro, I watch a lot of TV & cartoons, hike and exercise! Also, there's lots of snuggling with my dog and laughing with my husband that goes on in my life. :)

The predominantly ancient stellar populations observed in the lowest-mass galaxies (i.e. ultra-faint dwarfs) suggest that their star formation was suppressed (or "quenched") by reionization. Most of the well-studied ultra-faint dwarfs, however, are within the central half of the Milky Way dark matter halo, such that they are consistent with a population that was accreted at early times and thus potentially quenched via environmental processes. To study the potential role of environment in suppressing star formation on the smallest scales, we utilize the Exploring the Local Volume in Simulations (ELVIS) suite of N-body simulations to constrain the distribution of infall times for low-mass subhalos likely to host the ultra-faint population. For the ultra-faint satellites of the Milky Way with star-formation histories inferred from Hubble Space Telescope imaging, we find that environment is highly unlikely to play a dominant role in quenching their star formation. Even when including the potential effects of pre-processing, there is a >0.1% probability that environmental processes quenched all of the known ultra-faint dwarfs early enough to explain their observed star-formation histories. Instead, we argue for a mass floor in the effectiveness of satellite quenching at roughly M_star ~ 10^5 M_sun, below which star formation in surviving galaxies is globally suppressed by reionization. We predict a large population of quenched ultra-faint dwarfs in the local field, with as many as ~250 to be discovered by future wide-field imaging surveys.

Contact Info

wimberlm@uci.edu

@astronomouse_

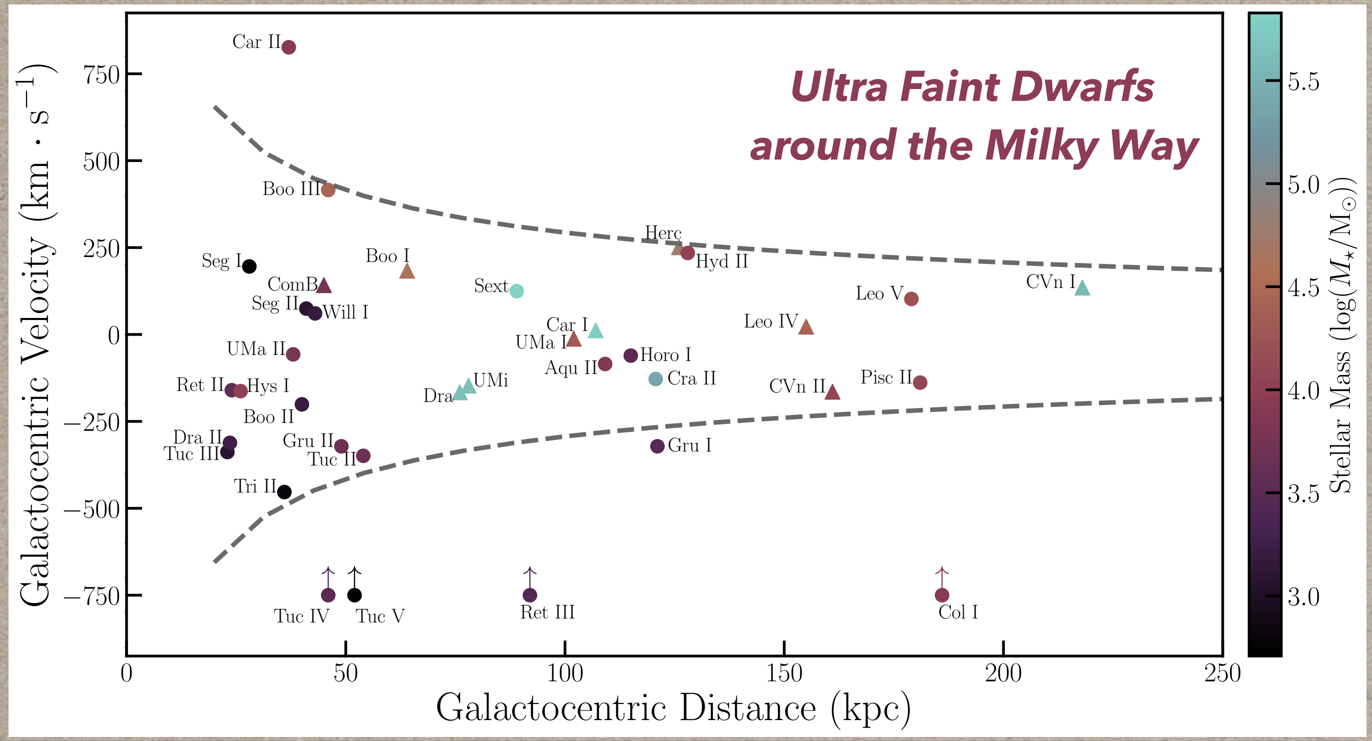
mkrodriguezwimberly.github.io

@astronomouse

SUPPRESSING STAR FORMATION ON THE SMALLEST SCALES:

WHAT ROLE DOES ENVIRONMENT PLAY?

Katy Rodriguez Wimberly, UC Irvine

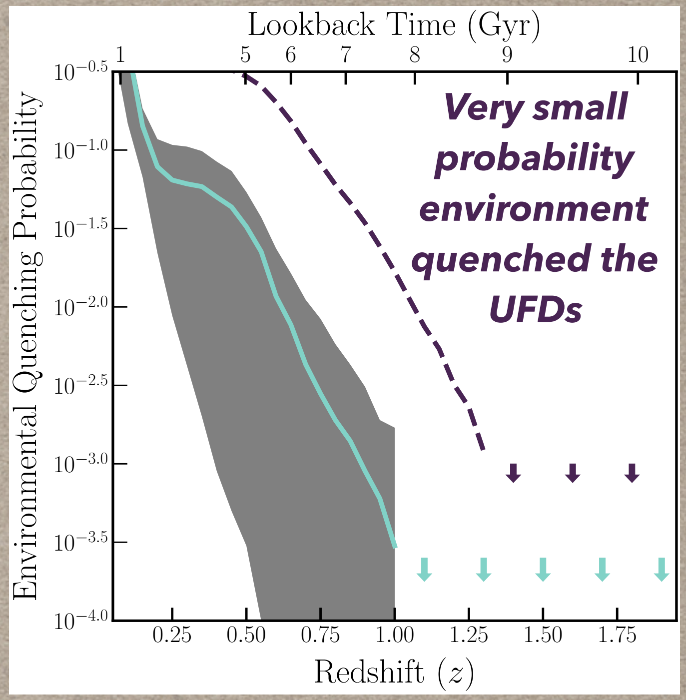


Rodriguez Wimberly et al. *submitted*

Motivated by nearby observations, we analyze subhalo accretion history in ELVIS.

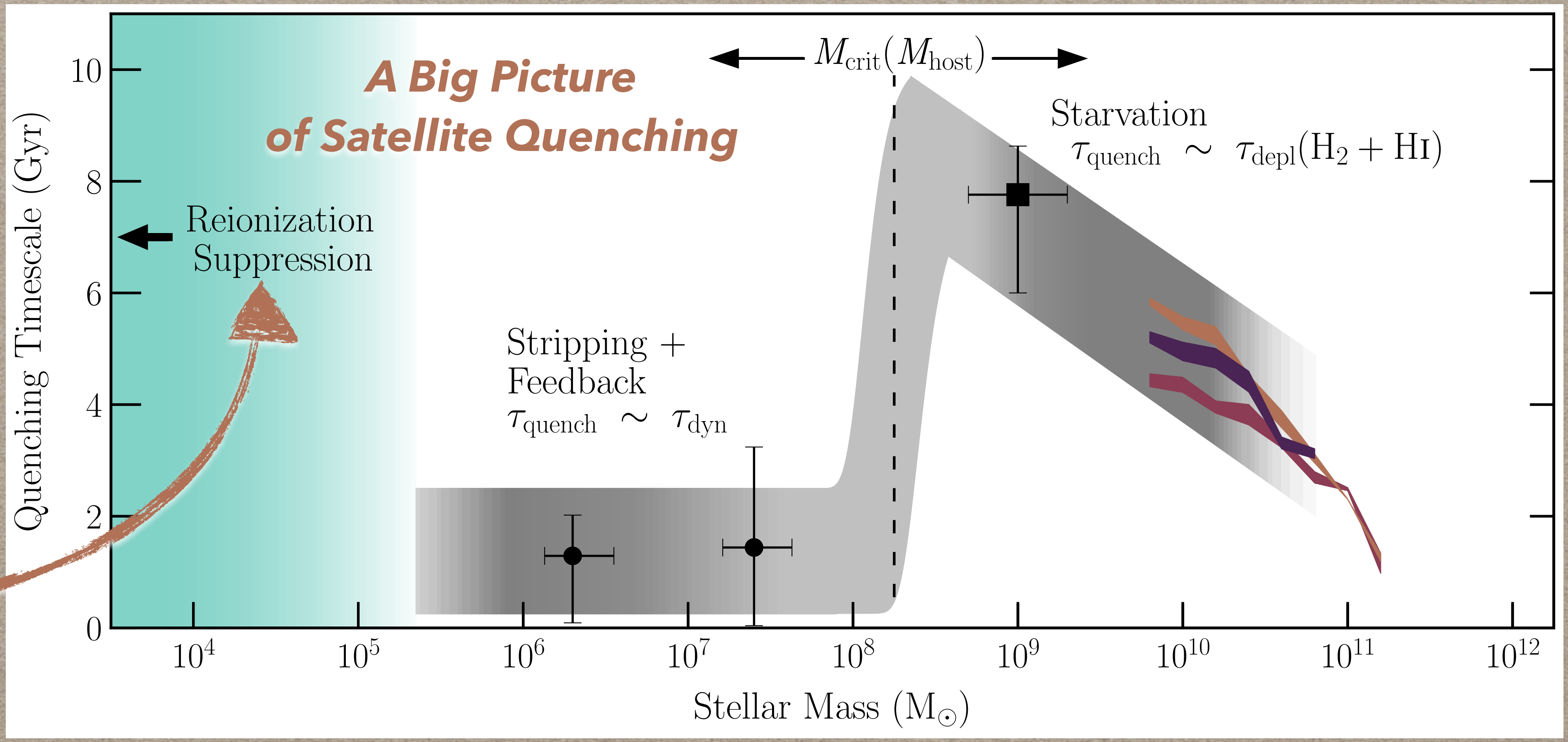
Subhalo Population

- > 15,000 halos
- $7.9 < \log(M_{\mathrm{halo}}/M_{\mathrm{sun}}) < 9.7$
- within host's dark matter halo virial radius
- mimicked baryonic destruction effects
  - cut ~25% of original population



Rodriguez Wimberly et al. *submitted*

Calculated probability for total group accretion of randomly selected samples of 6 subhalos across 10,000 trials



New piece in the puzzle!

Rodriguez Wimberly et al. *submitted*