BCCP 2023 intro slides

BCCP SUPPORT STAFF at UC

Laura Fantone

Access to 341 Campbell (fall 2023)

Events planning - overview

Reimbursements (August- September 2023)

HR support to new hires/visitors

LBL liaison

Contact via email:

lfantone@berkeley.edu

In person at BCCP Tuesdays and Fridays

New event coordinator

Mid-end September 2023

Events planning

Food orders, coffee, printer and office supplies,

Reimbursements

Access to Campbell 314

Visitors set up and support during stay

Meetings publicity

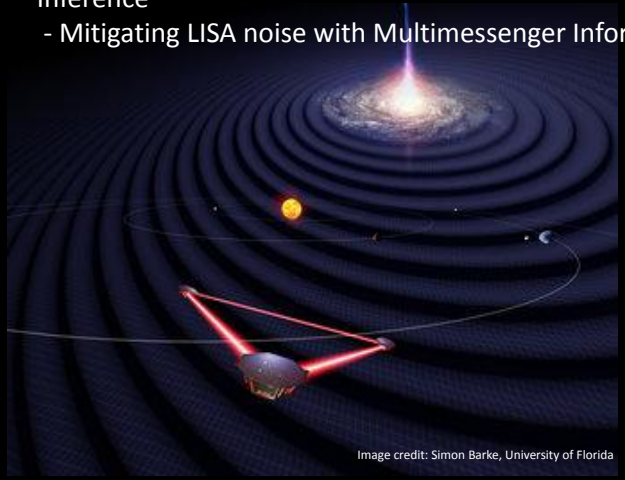
Website updates

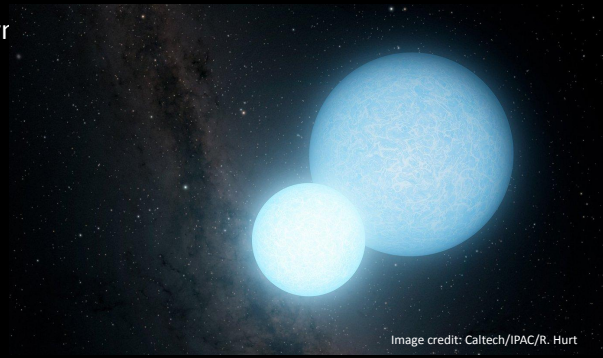
In person Tuesdays/Thursdays at BCCP, Campbell Hall

Contact info: tba


How do we measure the 21 cm signal from the Cosmic Dawn?
HERA
And what does it tell us?
Cosmic Dawn and EoR
Josh Dillon
Asst. Research Scientist, RAL

Current Research:
- Constraining White Dwarf Tides with Multimessenger Inference
- Mitigating LISA noise with Multimessenger Inforr



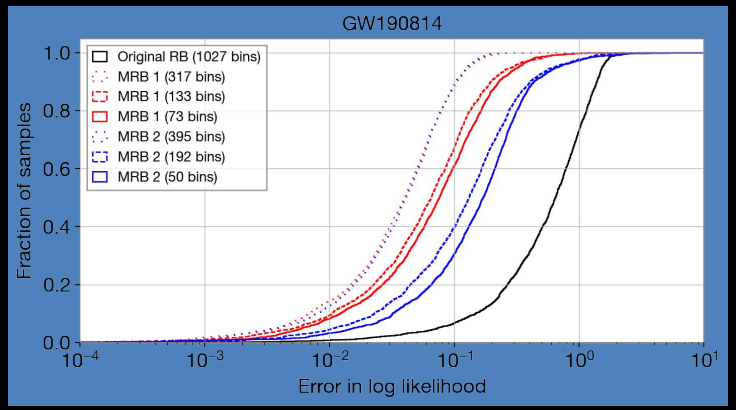


Nathaniel Leslie

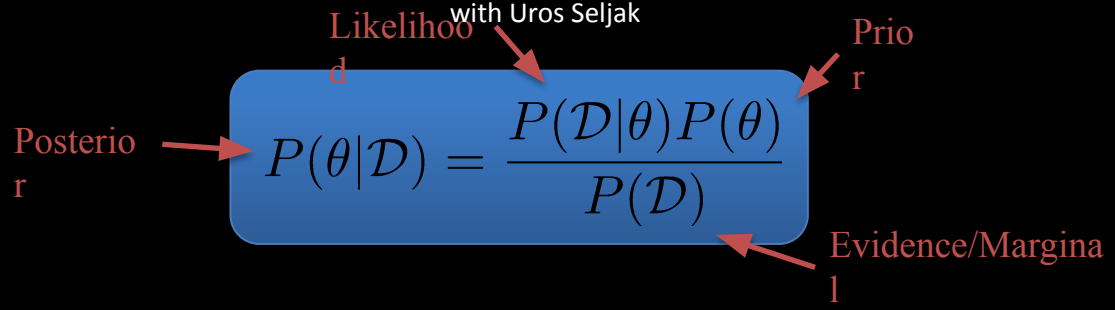
Advisor: Liang Dai

Non-Research Interests: Video games + Music

Past Research: Fast gravitational wave likelihoods



Teaching: Physics 188/288: Bayesian Statistics and Machine Learning for Physical Sciences with Uros Seljak



Zarija Lukić, Staff Scientist at LBL

Computational Cosmology Center
Building 50B, 4th floor, office 4218B
zarija@lbl.gov

Cosmological simulations

All aspects: physical models, algorithms, deployment on HPC platforms
https://amrex-astro.github.io/Nyx/

Large-scale structure

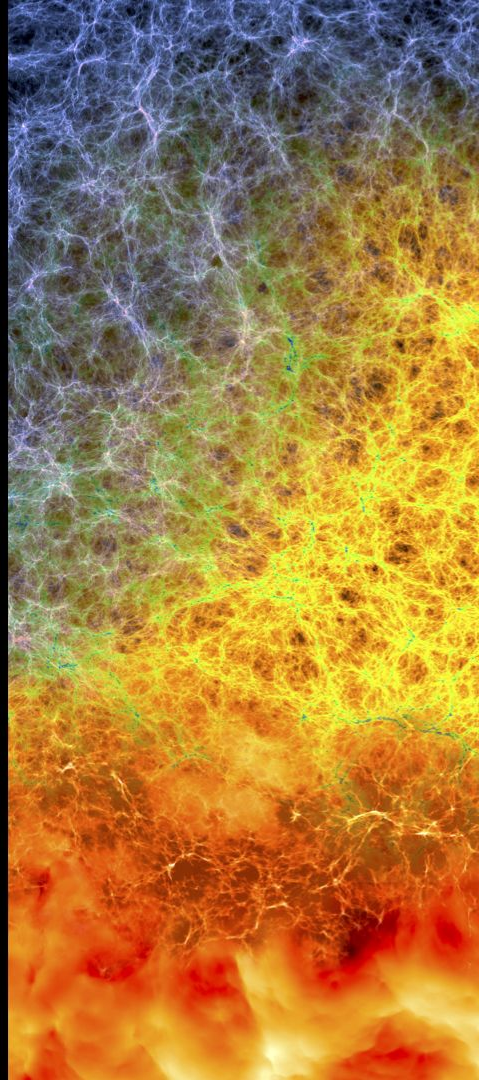
Focused on the Lyman α forest and the intergalactic medium

Inference from simulations and data

Building reliable parameter constraints using minimal number of simulations

Machine learning for cosmology

Surrogate models in simulations, computationally inexpensive mock skies, etc…



Radek Stompor (Centre Pierre Binétruy)

General interests (personal):

Data analysis and scientific interpretation of the cosmic microwave background data sets.

including:

- New statisitical and numerical algorithms;
- High performance computing software and tools;
- Robust performance forecasting (including systematic and statistical erorrs due to instrumental, environmental and astrophysical effects) and reliable scientific optimization of future instruments;
- Preparations and analysis of actual data sets (Simons Array, Simons Observatory, CMB-S4 and LiteBIRD).

Centre Pierre Binétruy (CNRS/UCB International Research Laboratory)

(across the passarelle from BCCP on the right in the Physics building within the N3AS area)

Centre Pierre Binétruy
CNRS • Berkeley

- hosting of long and short term visitors (predominantly from France but also Europe)
  - ~40 visits since March 2022 (from France, Sweden, Spain, Italy);
  - three semi-permanent visitors – Jacques Delabrouille, Elena de la Hoz, and myself;
    4th - Nicola Franchini - will join in early 2024.
- supporting and motivating common projects in diverse areas of astrophysics and cosmology.
- funding for UCB students/postdocs visits (1month+) to French laboratories (as early as this fall !) NEW
- a new science case to be prepared within the next 6 months or so. NEW

Elena de la Hoz

Sophia Risin sbrisin@berkeley.edu

Astrophysics B.A. @ UC Berkeley

Research Interests

- Cosmology (Theory + Analysis)
  - ML + Optimization
  - CIB/Galaxy cross correlations
- Tidal Disruption Events (Theory)

Current Work

- CIB cross correlation with BOSS @ LBNL
  Working with Simone, Anton, and Noah
- ML for early time detection of SN from ZTF @ UCB
  With Alex Filippenko
- TDEs as a result of second generation mergers @ UCB
  With Wenbin Lu

Big fan of side projects, always around to chat :)

kSZ ACT, Noise reduction, LAE, LyA forest: a mosaic

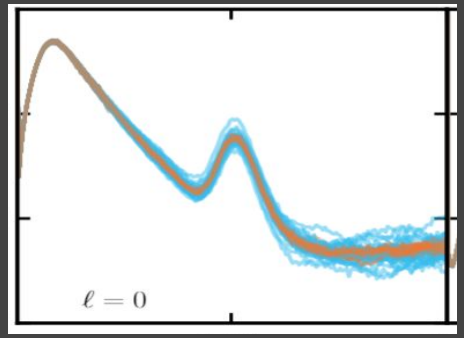
Boryana Hadzhiyska w/ S. Ferraro, M. White, X. Chen, L. Garrison, A. Cuceu, etc.

ACTxDESI: kSZ with photo-z LRGs

- ★ Velocity reconstruction on light cone simulations
- ★ Highest S/N measurement of baryon feedback to ~10 Rvir!
- ★ $f\sigma_8$ from low-z with BGS

Mitigating the noise on DESI mocks with Control Variates

- ★ Reduction of P(k) and ξ(r) noise by a factor of 5-10 for post- and pre-recon
- ★ Easy to use via abacusutils
- ★ 10x faster than nbodykit



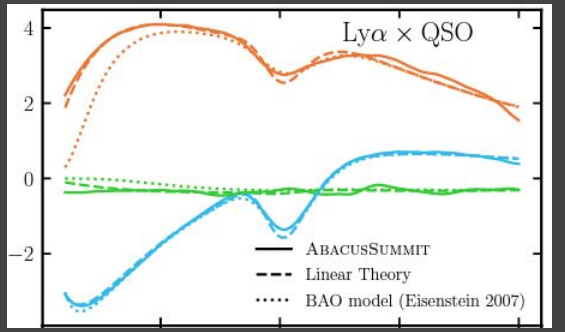
Modeling Lyα emitters for DESI-2

- ★ Identifying LAEs in hydro sims
- ★ Galaxy-halo conn. and clustering
- ★ Creating mock catalogs in *N*-body

Planting a Lyα forest on AbacusSummit

<arXiv:2305.08899>

- ★ Mocks for Lyα 3D and joint CMB analysis
- ★ Reproduces smoothing of the BAO peak due to non-linearities



DARK ENERGY SPECTROSCOPIC INSTRUMENT

U.S. Department of Energy Office of Science

BERKELEY LAB

Joanne Cohn (LBL 50-5015 and Campbell 305)

- Cosmic web at large scales
  - simple descriptions of the web at a single time, and through time
    - descriptions based upon critical points
    - estimates of web properties and effects from tracers
  - Mostly using other people's simulations if can't do analytically
- Interested but on back burner:
  - Galaxy formation and relations to structure formation, especially higher z, using simulations/simple models
- **Not** working on cluster masses to probe cosmological parameters
  - because correlated measurement errors/scatter are hard to control/model, if you want to know more about why one might worry…ask!

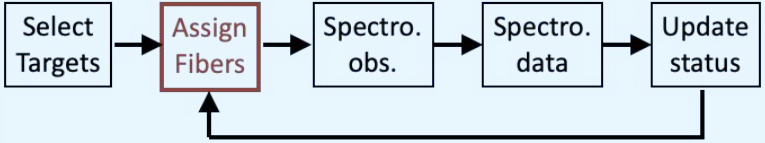
Happy to work with people on other things, too.

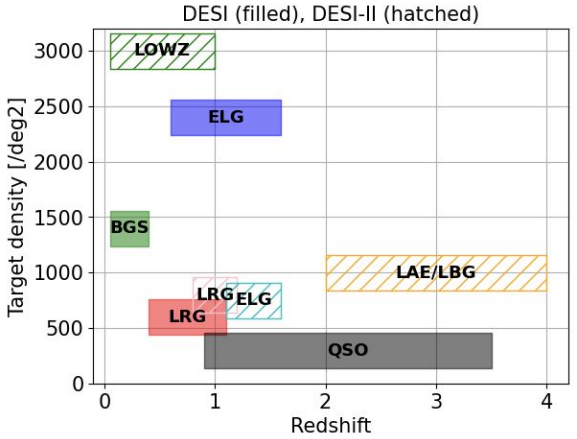
jcohn@berkeley.edu

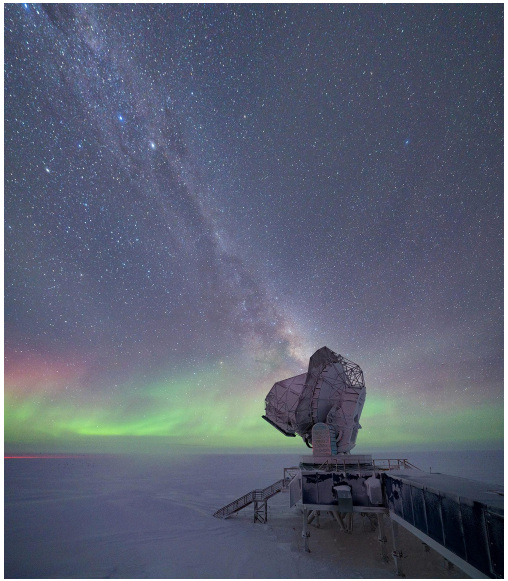
Anand RAICHOOR (LBL) — DESI

araichoor@lbl.gov

- **DESI (2021 — 2026)**
  - *4m-Mayall telescope, 5000 fibers*
  - *40M redshifts over 14k deg^2*
  - *"redshift factory" (more than 20x faster than SDSS)*
- **DESI operations**
  - *fiber assignment*
  - *data quality checks*
- **DESI science: Emission Line Galaxies (ELG)**
  - *Target Selection*
  - *Photometric & spectroscopic properties*
- **DESI-II (2026 —) preparation**
  - *2 < z < 4:*
    - *Lyman Alpha Emitters (LAE)*
    - *Lyman Break Galaxies (LBG)*
  - *1 < z < 1.5:*
    - *Emission Line Galaxies (ELG)*

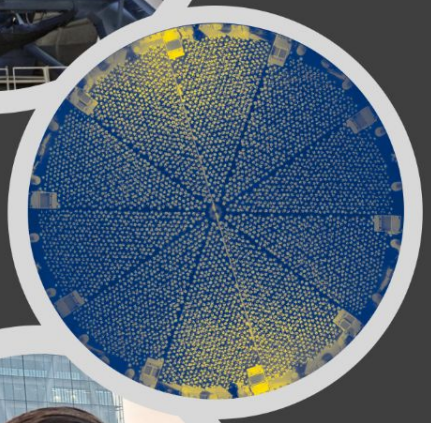






Anna Coerver (she/her)

- 4th year grad student working with Bill Holzapfel and the South Pole Telescope collaboration
- Current projects: characterizing polarized noise for SPT-3G low-ell BB power spectrum analysis, hardware for SPT-3G+ focal plane
- Outside of physics: you can find me sailing in the bay!



Anthony Kremin

Postdoc at LBNL

akremin@lbl.gov

Always happy to chat

- Research Interests:
  - Galaxy Peculiar Velocities
  - Galaxy Clusters and Cluster Dynamics
  - Software Development for Astronomy & Surveys
  - Machine Learning
- Key Roles:
  - LBL/UCB DESI Lunch Organizer
  - DESI Spectroscopic Pipeline Operations Lead
  - DESI Early Career Scientist Committee Co-Chair
- Other Interests:
  - Public Outreach
  - Hiking, playing sports, watching football

Simone Ferraro

Senior Scientist at LBNL

sferraro@lbl.gov

Research: cosmology (theory and analysis)

- CMB: secondary anisotropies (kSZ, tSZ, …) and lensing
- Inflation: primordial gravitational waves, non-Gaussianity
- Reionization: imprint of the first stars and galaxies
- Galaxy formation and evolution
- Galaxy surveys: DESI, LSST
- Statistics and Machine Learning

Interested in a research project? Visit my webpage at sferraro.lbl.gov

Minas Karamanis

BCCP PostDoc

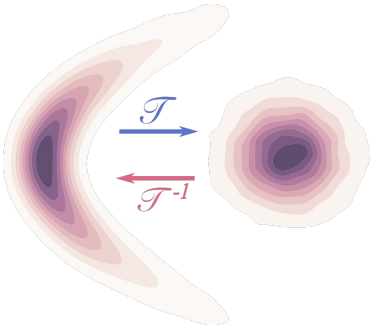
mkaramanis@berkeley.edu ♦ GitHub/minaskar ♦ Slack

Research interests

- Bayesian methodology and computation
- Development of scientific software (e.g., zeus, pocoMC)
- Gradient-free parameter estimation for 50–100 D
- Amortized Bayesian Model Comparison
- Applications to Cosmology (e.g., LSS, PNG, BAO) and Astronomy (e.g., gravitational waves, exoplanets)

Methods and techniques

- Probability and statistics
- Code (Python & Julia)
- Simulated data
- Analytic approaches
- ML & DL



zeus
Lightning Fast MCMC

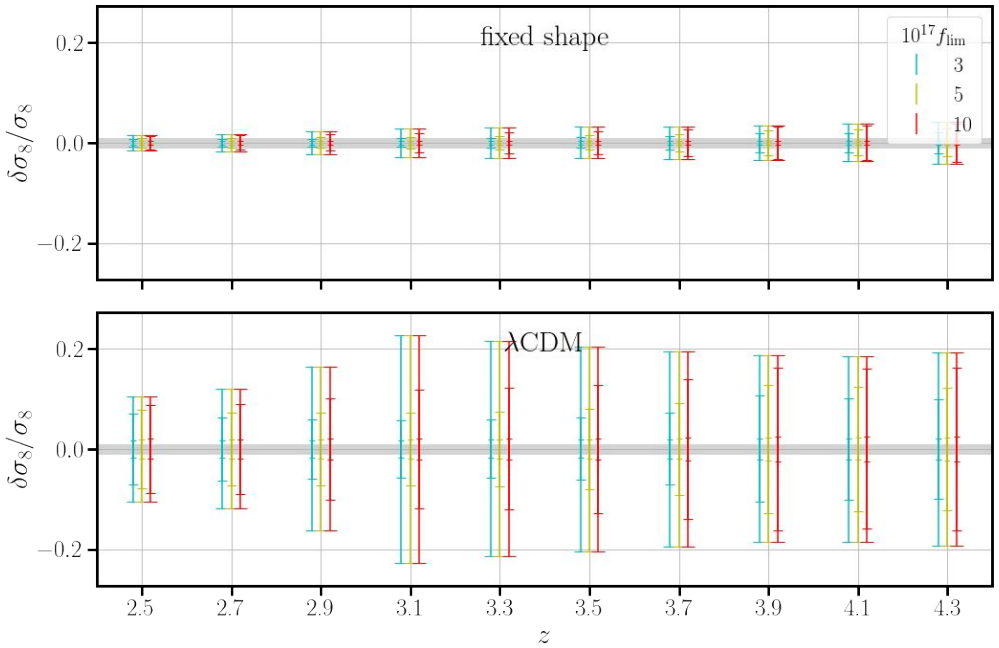
pocoMC

Haruki Ebina, 2nd year PhD student

Advisor: Martin White

Multi-tracer forecasting with LAE and LBG

- Performing Fisher information forecasting for multi-tracer surveys using FishLSS (LPT based EFTofLSS using velocileptors)
- Degeneracy breaking between parameters improve constraints



Justin Myles (postdoc)

- Especially interested in:
  - Testing cosmological models with galaxy clusters and galaxy weak lensing
  - The cluster galaxy population and its development over cosmic time
  - Galaxy SED-fitting and photo-zs
- Interested to learn more about and collaborate on:
  - Combining data from multiple surveys and optimizing science value of survey overlap
  - Machine learning
- Status:
  - Currently at the Aspen Center for Physics for sessions on studying Early Galaxies with JWST and on Galaxy Clusters
  - Starting a new position at Princeton on Oct. 1, but I hope to stay in touch

jmyles@berkeley.edu

Rongpu Zhou

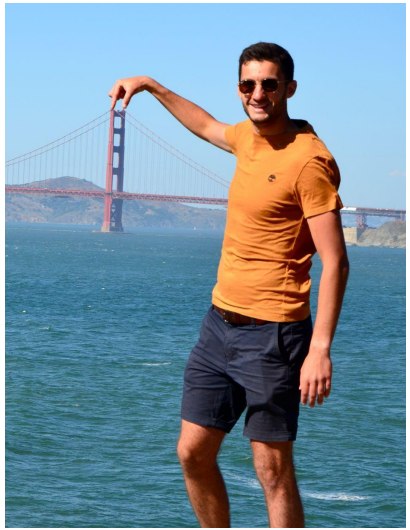
DESI postdoc at LBL

- DESI / DESI-2 imaging surveys, target selections and galaxy clustering
  - DESI cross-correlations with other observables, e.g., CMB lensing
- Forward modeling of imaging systematics in galaxy surveys
  - E.g., do we understand observational systematics well enough for fNL?
- DESI Y1 cosmology analysis: correcting for imaging and spectroscopic systematics in clustering measurements

Edmond Chaussidon (LBNL fellow)

DESI collaboration member since 2020.

Expect to arrive in early November 2023 from CEA Saclay (France).



memory from DESI meeting 2022

Previous work (PhD):

- Quasar target selection for DESI (KP1)
- Angular imaging systematic mitigation (KP3)
- Measurement of primordial non-gaussianity (PNG) via the scale-dependent bias (f_{NL}) with the DESI Y1 data (KP5)

Subject of interest:

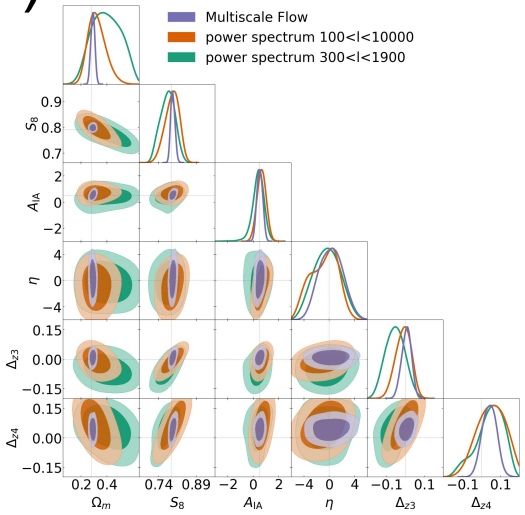
- Improve the PNG measurement using high-order correlations and cross-correlation with CMB lensing, in the specific context of DESI Y3 data.
- Plan DESI 2 and future Spec 5 experiments, in particular for multi-tracer analysis.

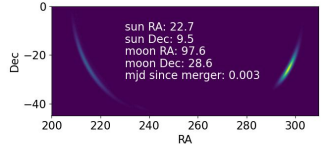
Very enthusiastic about coming to work at LBNL and looking forward to discovering new scientific subjects to which I can collaborate.

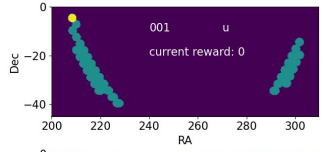
Biwei Dai (6th-year grad student)

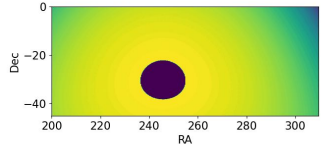
Cosmology X Machine Learning

- Current projects:
  - 80% of my time:
    - Generating mock weak lensing maps from ray-tracing simulations
    - Extracting cosmological information at the field level from WL maps
  - 20% of my time:
    - Kilonova follow-up observation with reinforcement learning
    - Learning representations of variable star light curves for novelty discovery
- Previous projects:
  - Fast particle-mesh simulations
  - Machine learning (normalizing flows)
  - Variational inference
  - Fast gravitational wave inference









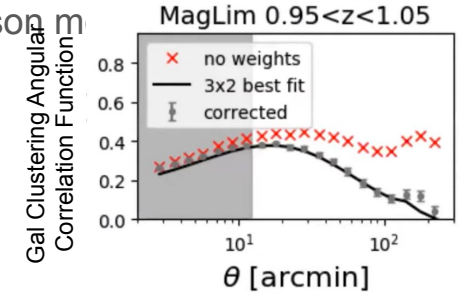
(an okay but not perfect policy…)

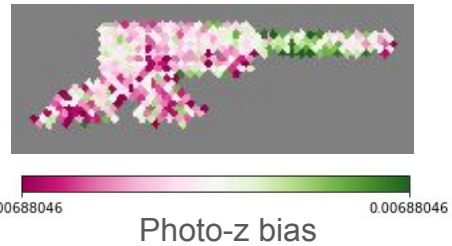
Noah J. Weaverdyck

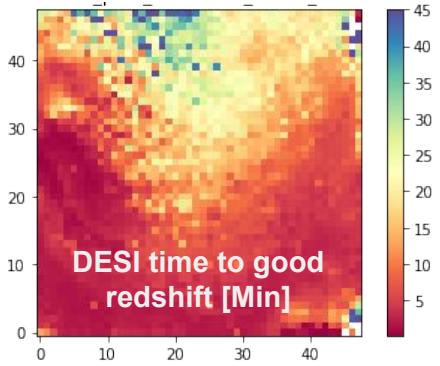
Chamberlain Fellow at LBNL

Research interests:

- Mitigating imaging systematics in LSS (primarily in DES)
- Synergies between photometric and spectroscopic surveys
- Leveraging DESI to characterize, improve photo-z's
- Bayesian stats, model validation and comparison m robust inference
- Primordial non-Gaussianity with LSS
- Cosmology in the era of climate change
- Member of Dark Energy Survey (DES), DESI, LSST







Other interests:

- Hiking, camping, live music

Interested in chatting?
NWeaverdyck@lbl.gov,
or swing by #5045 at LBL

Noah Sailer

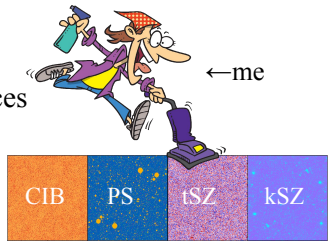
Advisors: Martin White & Simone Ferraro
5th year grad student @ UC Berkeley
nsailer@berkeley.edu

my cousin's cat (Charlotte)

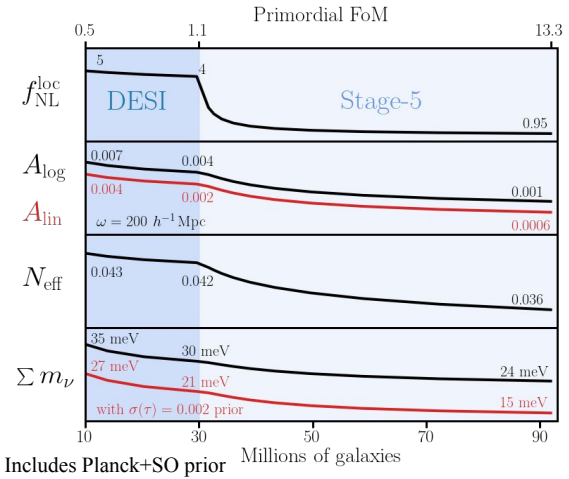
Interests: Large Scale Structure and CMB (lensing)

Past:

• *Foreground-immune CMB lensing reconstruction*
- (tSZ) profile-hardening
- "tailored" ILC weights
- hardening against polarized sources



• *Science potential for future high-z surveys*
- Stage-5 (MegaMapper), PUMA, …
- optical depth from (perturbative) 21 cm



Includes Planck+SO prior

Ongoing:

• *Cross-correlating DESI Luminous Red Galaxies w/ ACT κ map*

- Near term: measure $\sigma_8(z)$ across $0.4 < z < 1$
- Future plans: combine with year-1 LRG $P_{gg}(k,\mu)$ + BAO to constrain Σm_ν
- Spin off: "mask deconvolution" for CMB lensing estimators

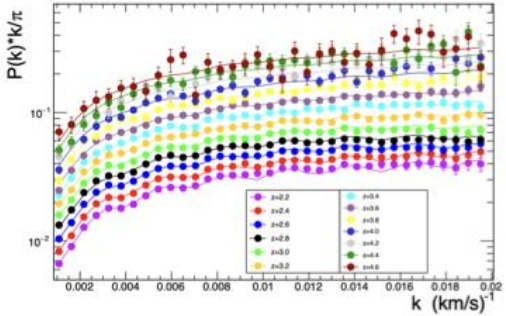
• *DESI-II*

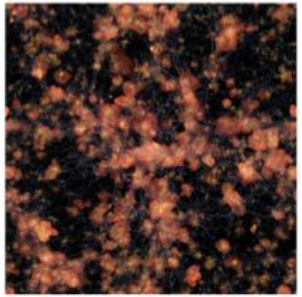
Solène Chabanier

LBL postdoc Data Division *(Zarija Lukic)*
schabanier@lbl.gov

Research Projects

- Cosmology with the Lya forest: DESI-Lya WG co-chair
  - Neutrino masses, dark matter models
  - 1D power spectrum data analysis (eBOSS and DESI)
  - Theoretical modeling with hydrodynamical simulations (Nyx, HACC, Ramses)
  - Statistical methods for inference process with hydro sims
  - Baryonic effects on cosmological probes





Pat McDonald

LBL

Working on DESI Key Projects

- KP3: catalogs & power/correlation estimate with covariance
- KP4: BAO distance estimate
- KP5: RSD+
- (KP6: LyaF)
- KP7: cosmological parameters
- Y1 Unblinding deadline late Nov
- Y1 Papers to be finished by Spring

DESI Dark Energy constraints
Projected Y1, BAO-only, no LyaF

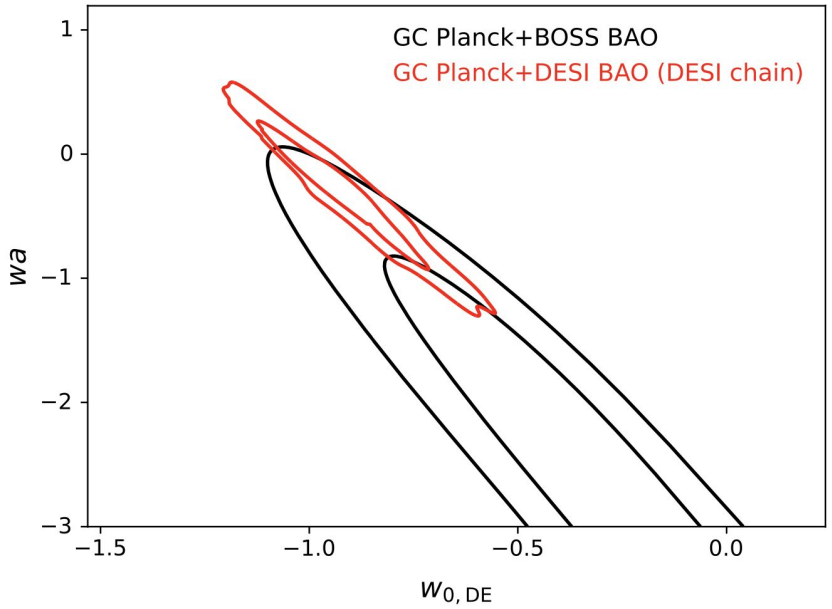
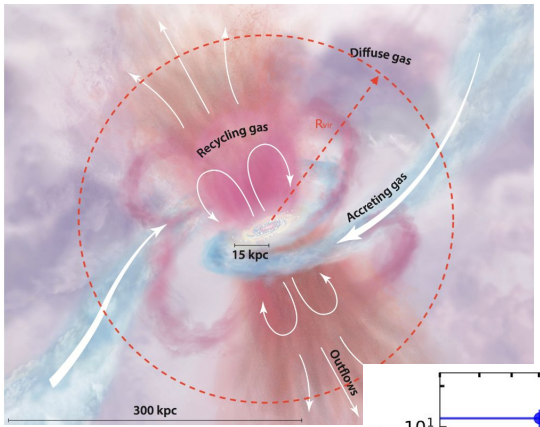


FIG. 10. Constraints on Dark Energy parameters in the FoM model, with free curvature.

The nature of multiphase circumgalactic gas in quasars and galaxies with quasar absorption lines

(Abhijeet Anand, Postdoc@LBL)

- Understanding the physical processes and gas nature of galactic halo (aka the circumgalactic medium, or CGM) is key to galaxy formation and evolution.
- The absorber - galaxy correlation can be a powerful way to study the gas flows in the CGM.
- Using ~25k MgII, CIV absorbers and millions of galaxies from SDSS, we study the nature of cool and warm CGM of galaxies and quasars.
- One of the first such large correlation study in 0.4<z<2 range
- The distribution of metal absorbers around galaxies and quasars are very different.
- Cool gas is more frequently detected in their haloes than warm gas.
- Possible indication that gas properties evolves with redshift and halo masses

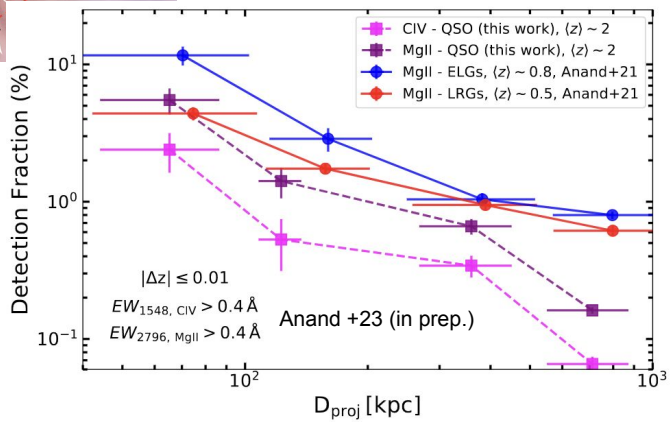


The gas flows in the CGM (Tumlinson et al. 2017)

Also using DESI EDR to perform a similar study

MgII (doublet: 2796 2803 A): tracer of 10^4 K gas

CIV (doublet: 1548, 1550 A): tracer of 10^5 K gas



Abhijeet Anand, LBL AbhijeetAnand@lbl.gov

Martin White (faculty; theory+data)

[Cosmological perturbation theory. Exploiting DESI data. CMB + LSS x-correlation. Preparing for nextGen surveys (what should we have done last time with 20/20 hindsight?). Blue-sky ideas for future surveys.]

Too many individual projects to try to list, so ...

Short term: Science with DESI … modeling P(k,μ), BAO reconstruction, x-correlation with CMB. [DESI]

Medium term: More DESI, prep for DESI-II. What can be learned by combining DESI+LSST+SO? What framework should we use to model and interpret these data? [DESI, LSST, SO, DESI-II, S4]

Long term: Cosmology “before noon”, i.e. large-scale structure above z~2ish. What can we learn from it, how do we map it and how do we analyze it. [DESI-II, StageV, SO/S4].

Elisa RUSSIER

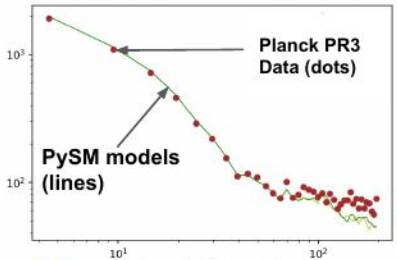
Contact: erussier@lbl.gov

PhD subject: Ground-based CMB data analysis in preparation for CMB-S4

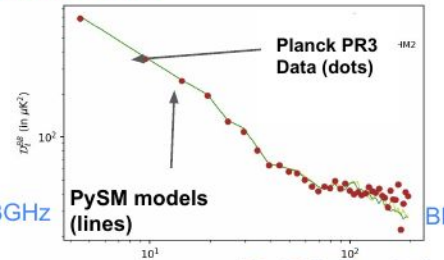
Scientific interests:

- Sky modelling
- Component separation

Validation of PySM latest dust models

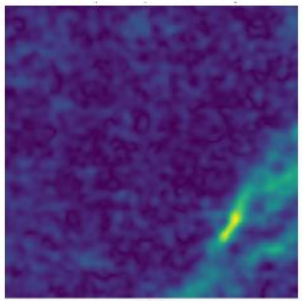


EE @353GHz

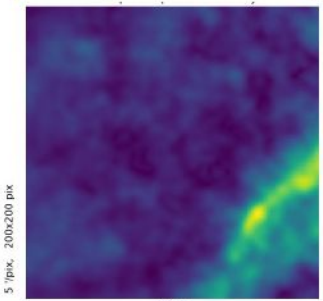


BB @353GHz

PR3 polarized intensity



PySM d9 polarized intensity



…But needs improvement at map level

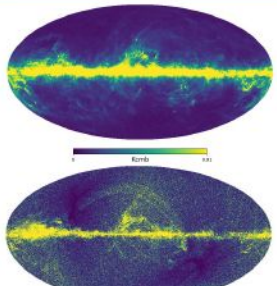
@NGP

Dust intensity maps with Planck npipe

GNILC method: signal to noise ratio for PCA, locally in space and angular scales

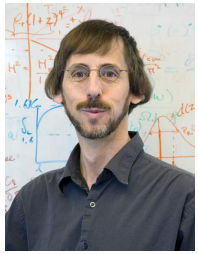
Modeling polarized dust emission

- Correlation between intensity and polarized dust
- Add cross-scale information to generate small scales



Dust intensity @353GHz

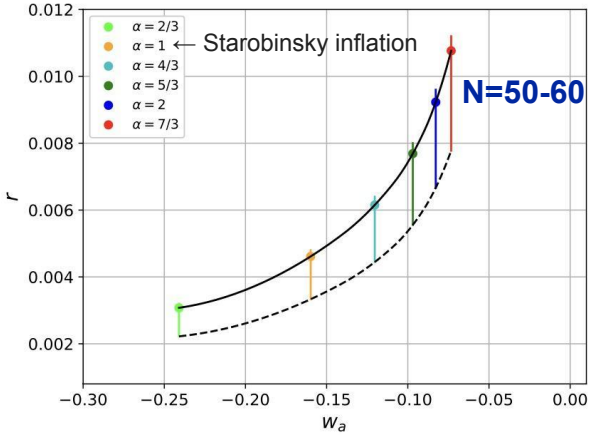
Polarized dust intensity @353GH



Eric Linder

evlinder@lbl.gov

Everything related to cosmic acceleration!



Probes: supernovae, redshift space distortions, strong lensing, CMB – and model independent cosmology analysis

Gravity beyond GR on cosmic scales

Connecting inflation and dark energy: new r-w_a relation.

Cosmic redshift drift – theory + method implemented to reduce systematics 10^3 x! (with Erskine)

CMB-S4 and Spec-S5

Acceleration and spacetime horizons:

- Pioneered “quantum pure” black hole (with Wilczek, Good)
- Leonardo da Vinci’s water pitcher (relativistic quantum version and charge radiation)

Coauthored 2 papers with undergrad, 2 papers with grad, 4 papers with postdoc in last 1.5 years

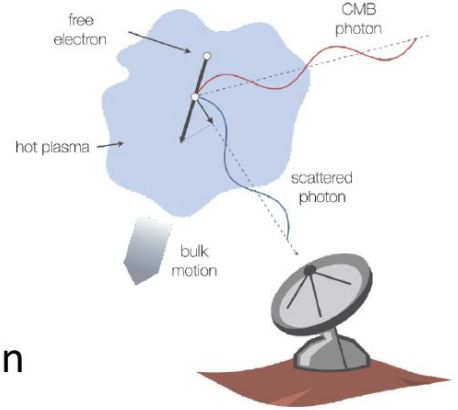
Henry Liu
刘瑞涵

3rd year grad student working with Simone Ferraro

r.henryliu@berkeley.edu

Current work:

- Cross-Correlation of DESI & ACT data for tSZ detection



Teaching:

- Physics 188/288: Bayesian Statistics in the Physical Sciences

Interests:

- DESI
- Cosmological data analysis
- ML applications in cosmology
- Bayesian Statistics/Astrostatistics

Other hobbies:

- Hiking/outdoors
- Photography/Astrophotography
- UAW 2865

Julien Guy
Staff scientist LBL
jguy@lbl.gov

DESI Spectroscopy:

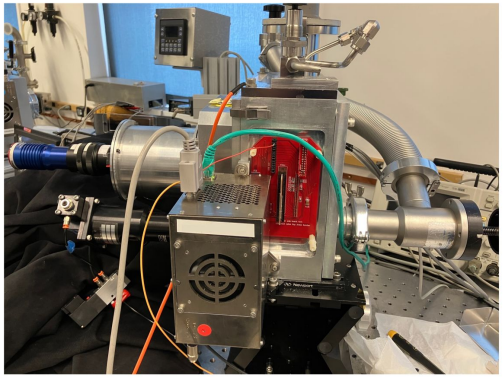
- CCD readout, calibration, validation
- Spectrograph focus, calibration
- Pipeline algorithms
- Opportunities for students!

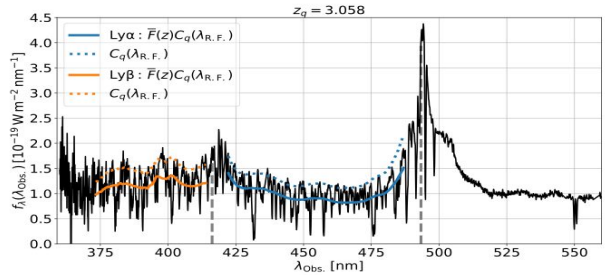
Instrumentation:

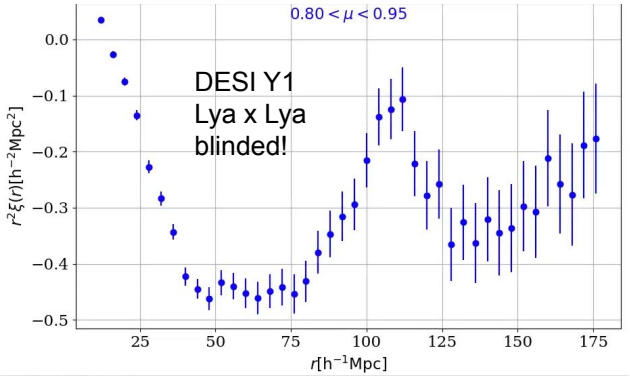
- Exciting R&D on low readnoise “MAS” CCDs
- Goal is to reach noise ~ 1 electron/pix
  (when reading a 4kx4k CCD in 1 min)
- Opportunities for students!

DESI Lyman-alpha analysis:

- BAO Year 1, co-lead of “KP6”
  (we start worrying about systematics on BAO >0.5%)
- Contaminants to the forests with Satya
- Cross-correlation Lya-CMB with Roger
- Helping on P1D
- Opportunities for students!







Hamza El Bouhargani

Postdoc in the Physics Division at LBNL

Working on CMB data analysis:

- ❏ Map-making and noise characterization
- ❏ Systematics assessment and mitigation
- ❏ Numerical techniques for large scale linear systems and their applications in CMB analysis context

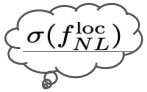
Projects:

- ❏ Involved in the development of the data reduction pipelines for CMB-S4 and Simons Observatory
- ❏ Reconstruction of the first full-sky polarization maps from *Planck* data at the submm frequencies (545 & 857 GHz)

Jamie Sullivan jmsullivan@berkeley.edu, jmsull.github.io

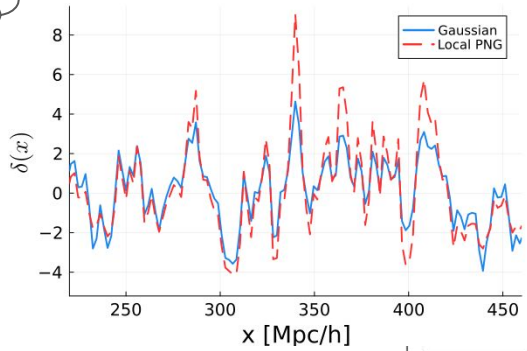
Desk 307D (open office)

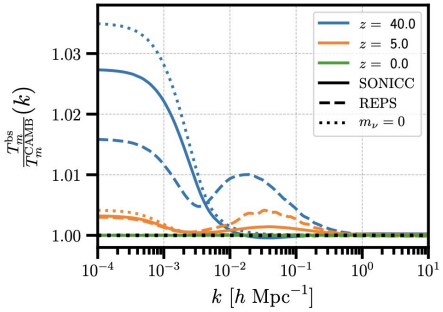
Final-year PhD student (w. Uroš)
Computational cosmology & LSS!



Local PNG w/ LSS

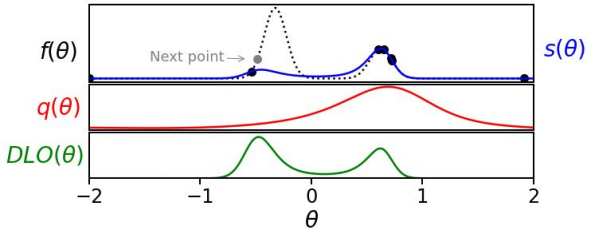
- multi-tracer
- galaxy bias
- data analysis

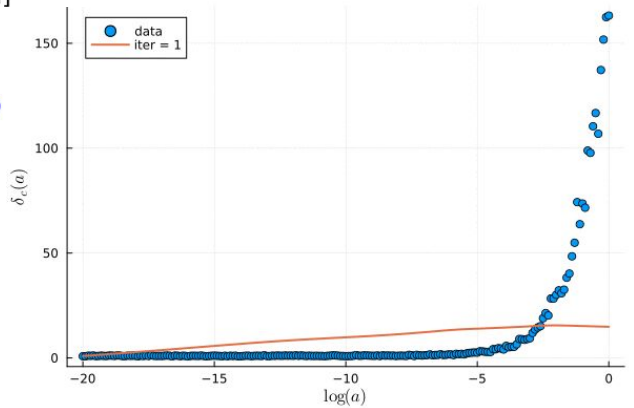




First differentiable Boltzmann code!

- non-parametric linear theory
- iterative methods





ML and active learning

- NF optimization (past)
- NN uncertainty (now)

Applying for postdocs - advice/wisdom please!

Liang Dai

Email: liangdai@berkeley.edu
Office: Campbell 367

Teach 110A, 110B, 139

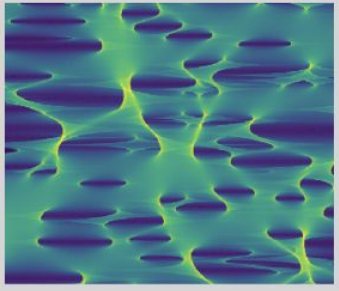
Work with physics/astronomy graduates, undergraduates, and postdocs.

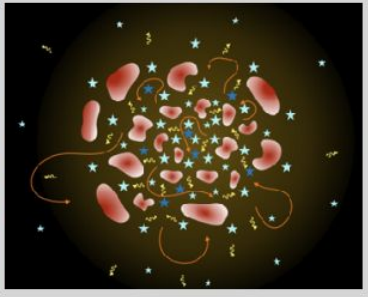
Current research scopes

Stars in the young Universe through gravitational lens

Extremely magnified massive stars (also as Dark Matter probes)

Nebular spectroscopy of Cosmic Noon star clusters





Radiation and gas dynamics in super star clusters

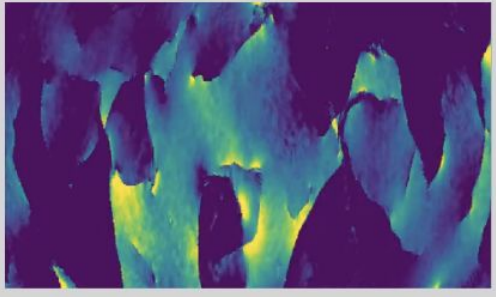
Physics of supermassive stars ?

Quest for new physics from cosmology

Probing cosmic birefringence from axion strings using:

[1] CMB polarization anisotropies

[2] Polarized radio emission x shape for galaxies



Fast radio bursts

Strong lensing of fast radio bursts

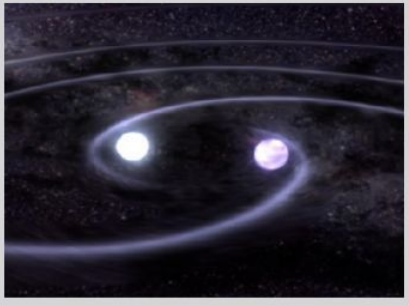
Multi-phase structure of circumgalactic medium

Gravitational waves

[1] Fast GW parameter inference

[2] EM/GW synergy for double white dwarf systems

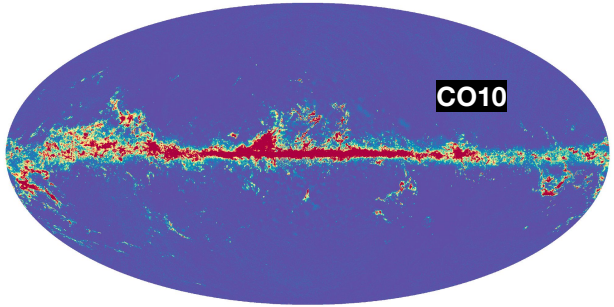
[3] Stochastic GW background from pulsar timing arrays

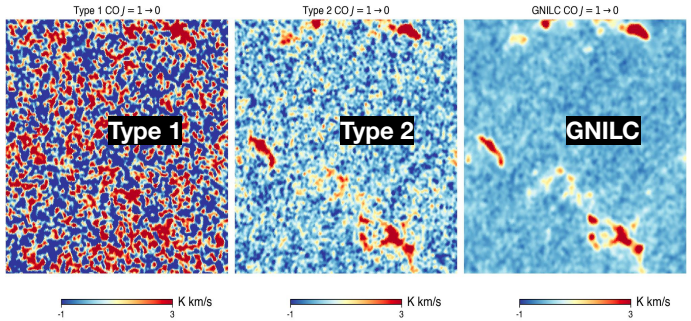


Shamik Ghosh

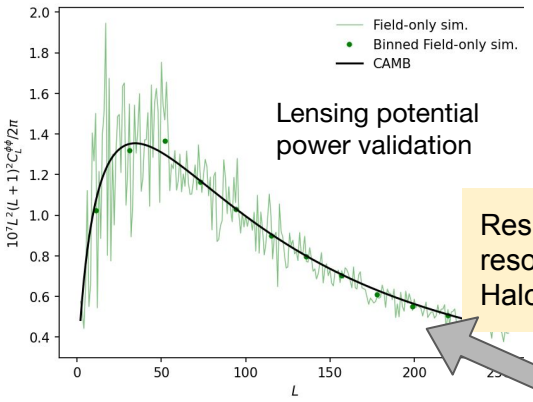
Postdoc at LBNL

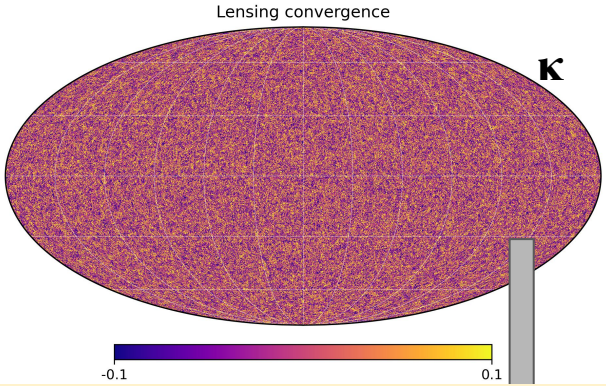
- Work on CMB simulation, component separation and parameter estimation.
- Recently work focused on obtaining better full sky galactic CO line emission maps from Planck data products.
- Ongoing project on simulations of the CMB, the LSS, galactic and extragalactic foregrounds.



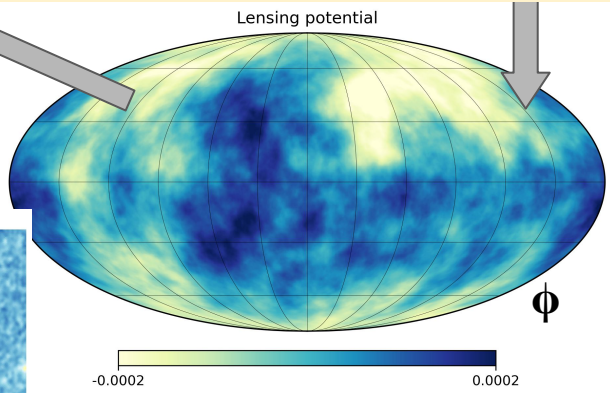


CO10 maps at (150, -45)





Results using from 7.7 Gpc box at 6144^3 resolution using LPT calculated on the lightcone. Halo component now in development.



Amélie Tamone

Postdoc at LBNL

Research interests:

- Galaxy clustering
- BAO and RSD measurements
- Multi-tracers analysis
- Voids

Currently at LBNL:

- CMB x DESI QSOs sigma8 measurement

Dylan Green

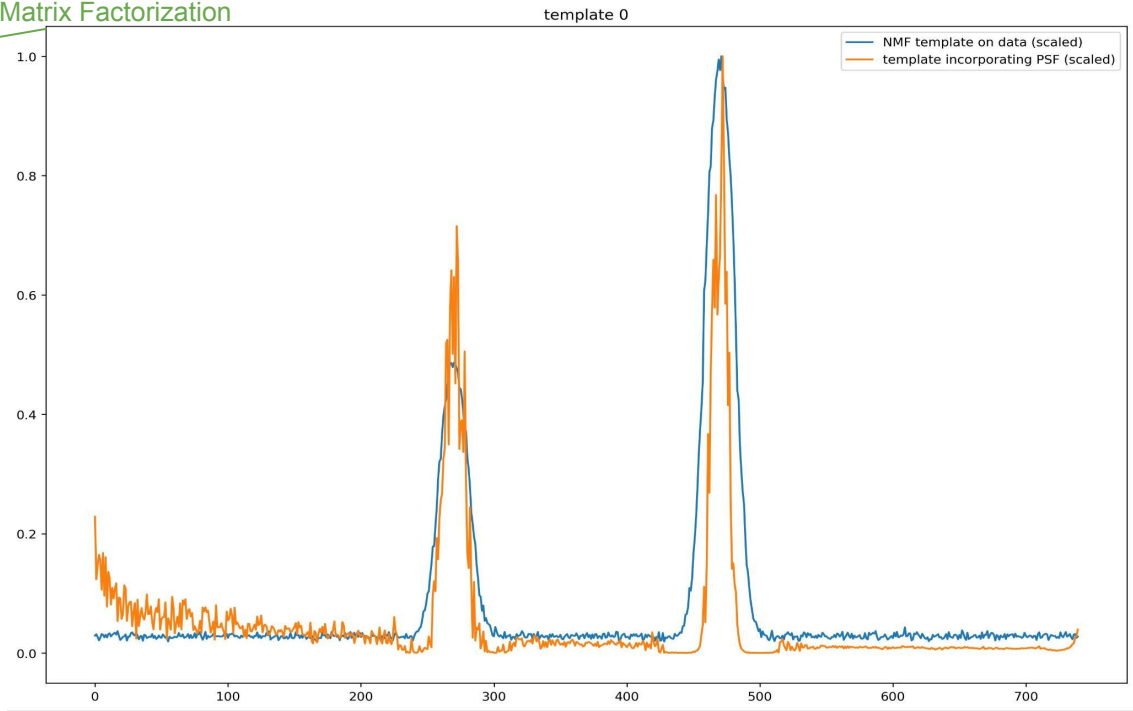
5th Year PhD Student | UCI/LBNL | David Kirkby | Stephen Bailey

While in Berkeley

Improving Redshift Estimation (using NMF?)

Nonnegative Matrix Factorization

- NMF might allow us to only admit physically possible solutions when redshift fitting
- Some “flavors” of NMF allow you to consider the PSF and generate templates from real data!



DARK ENERGY SPECTROSCOPIC INSTRUMENT

U.S. Department of Energy Office of Science

Slack: Dylan Green | dylanag@uci.edu | dylangreen@lbl.gov

UCI

Hello! My name is **Lingyuan Ji.**

Rising second year postdoc at BCCP

Gravitational Lensing

of gravitational waves and other transient sources

Critical Lensing

and highly-magnified stars

More numerical stuff…

NUFFT-based Hierarchy-less cosmological perturbation Solver

21cm line, Pulsar timing array

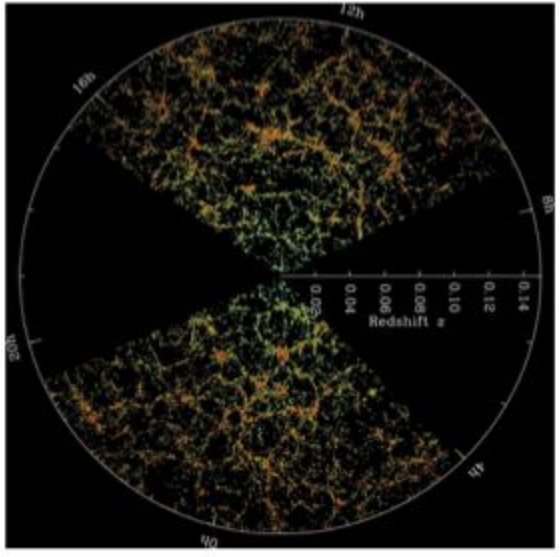
beyond intensity signal (linear/circular pol.)

More? Come to Campbell 341 and chat!

Mark Maus

mark.maus@Berkeley.edu
3nd year physics grad student

- Large scale structure with Martin White
- Cosmological constraints from galaxy clustering
- Template, ShapeFit, and Full-Modeling analyses of power spectra in redshift space
- DESI KP5 (fullshape analyses)
    - Comparison of EFT models and tests on Simulations



Antón Baleato Lizancos

BCCP postdoctoral fellow

BERKELEY LAB

- CMB lensing / delensing theory and systematics. Member of SO analysis team. Co-lead of delensing working group
- Interested in CMB lensing cross-correlations. From methods (e.g. model-agnostic variance reduction) to data applications
- Working on code to model impact of SZ/CIB/AGN on CMB lensing auto- and cross-correlations and delensing. How best to incorporate this into analyses?
- Impact of anisotropic dNdz's on galaxy clustering, shear, galaxy-galaxy lensing and cross-correlations

a.baleatolizancos@berkeley.edu Github: abaleato

Raul Monsalve

Associate Research Scientist and Senior Fellow
Space Sciences Laboratory, **UC Berkeley**

Research Interests and Activities

Learning about the **Dark Ages**, **Cosmic Dawn**, and **Epoch of Reionization** using 21-cm cosmology.

Designing and deploying **experiments** to measure the high-redshift 21-cm signal from the **ground and space**.

Participating in the **EDGES**, **MIST**, and **LuSEE-Night** global 21-cm experiments.

raul.monsalve@berkeley.edu

LBL 50-6053

Kyle Dawson: University of Utah

Focus #1: Completing first year DESI cosmology studies across galaxies, quasars, Lyman-alpha forest, and full cosmology interpretation

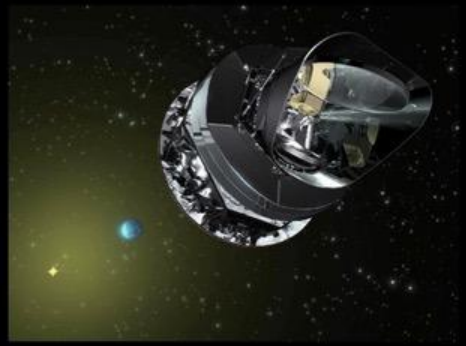
BAO covering 0<z<3.5; RSD covering 0<z<2

Focus #2: Completing proposal for six-year DESI-2 operations program

z>2 cosmology, Milky Way streams, and support of Rubin cosmology

Jacques Delabrouille

Centre Pierre Binétruy (CNRS)



Keywords:

CMB
CMB foregrounds
Planck space mission
Future CMB missions
Simulations
Data processing
CMB-S4