Current Position

September 1, 2020-

McWilliams Postdoctoral Fellow
The McWilliams Center for Cosmology
Department of Physics
Carnegie Mellon University
Pittsburgh, PA 15213, USA

E-mail: sukhdeep@cmu.edu

Research Interests

Cosmology: Large Scale Structure of the universe, Galaxy formation and evolution.
Weak Gravitational lensing: Galaxy and CMB lensing, Intrinsic Alignments of galaxies; Galaxy clustering, Redshift space distortions.

Educational Background

Ph.D in Physics August 2017
Carnegie Mellon University, Pittsburgh, PA USA
Advisor: Rachel Mandelbaum

M.S in Physics May, 2014
Carnegie Mellon University, Pittsburgh, PA USA
Advisor: Rachel Mandelbaum

Bachelor of Technology in Engineering Physics with Honors May, 2012
Indian Institute of Technology Bombay, Mumbai, India
Senior Thesis Advisor: Urjit A. Yajnik

Research Experience

BCCP Postdoctoral Fellow September 2017- August 2020
Berkeley center for cosmological physics, University of California, Berkeley, CA USA.

McWilliams Postdoctoral Fellow September 2020-
The McWilliams center for cosmology, Carnegie Mellon University, Pittsburgh, PA USA.

Honors & Awards

- BCCP Postdoctoral Fellowship, University of California Berkeley. 2017-2020.
- John Peoples Jr. Presidential Fellowship, Carnegie Mellon University. 2015-2016.
- Recipient of CBSE (Central Board for Secondary Education) Merit Scholarship for Professional Studies, 2008-2012. (awarded to top 1000 under graduate students in India)

- Selected for National Initiative in Undergraduate Science internship, NIUS-2009, India.

Research Highlights

- **Led the weak gravitational lensing analysis using data from SDSS, BOSS and Planck CMB surveys**
  - Developed and demonstrated the methodology to use cross correlations between CMB lensing, galaxy lensing and galaxy positions for cosmological analysis and systematics tests in lensing surveys. arXiv:1606.08841
  - Tests of gravity on cosmological scales. arXiv:1803.08915
  - Constraints on cosmological parameters using newer, faster methodology. arXiv:1811.06499
  - Optimal estimators for the measurements of two point functions and their covariance. arXiv:1611.00752
- **Performed the state of the art analysis of intrinsic alignments of galaxies.**
  - Performed best measurements to date and detailed study of dependence of IA on galaxy properties. arXiv:1411.1755
  - Studied impact of shape estimates on IA resulting in first detection of galaxy shape twisting in a statistically large sample. arXiv:1510.06752
  - Novel methodology to study the impact of galaxy clustering (density weighting) on IA measurements. Singh et al. *in prep*
- **Performed the detailed analysis of Fundamental plane (FP) of galaxies.**
  - Co-led the first detection of correlations of FP of galaxies with the density field. arXiv:1504.02662
  - Detailed study of FP and its correlations with galaxy environment and the effects of intrinsic alignments of galaxy shapes on FP. arXiv:2001.07700
  - Impact of size dependent selection function on galaxy clustering measurements and the constraints on rate of growth of structure in the universe. arXiv:2001.07700
- **Developing methodology for optimal 2-point joint analysis of large scale structure surveys to constrain cosmological models.** Singh et al. *in prep* github
  - Estimators for fast and optimal analysis, accounting for complicated survey geometry/selection functions in both Fourier space and configuration space.
  - Methodology for fast, unbiased and noiseless covariance matrices using only few hundred simulations.
  - Exploring synergies between different LSS surveys.
  - Impact of photometric redshifts on cosmological results from the joint analysis of next generation LSS surveys.

Collaborations

- Rubin Observatory Legacy Survey of Space and Time: Dark Energy Science Collaboration (LSST DESC).
- Sloan Digital Sky Survey (SDSS) III and IV.
- The Dark Energy Spectroscopic Instrument (DESI).
- Dark Energy Survey (DES).

Academic service

- Journal Referee: MNRAS, JCAP, APJ,APJL,A&A,PRD,PRL.
- Internal Referee for DESI and LSST collaborations.
- Chair of the organizing committee of workshop/conference on Weak gravitational lensing (January, 2019). http://bccp.berkeley.edu/2019-lensing
- Coordinator of LSST-DESC TJPCov group, responsible for delivering covariance matrices for joint probe cosmological analysis.
- Coordinator of Covariance efforts in the DESI cross correlations group, responsible for delivering covariance matrices for joint probe cosmological analysis.
- Member of the LSST-DESC meetings committee, responsible for organizing bi-annual collaboration meetings and hack weeks.
- Member of the local organizing committee of LSST-DESC winter meeting (February, 2019).
- Co-Founder and Co-organizer of AstroSnacks, the monthly Carnegie Mellon-University of Pittsburgh joint student astronomy seminars. Fall 2015-Summer 2017.
- Co-organizer Cosmology Journal Club at Carnegie Mellon university , Fall 2015-Summer 2017.
- Co-organizer Cosmology Journal Club at BCCP , Fall 2018-Summer 2020.

Teaching Experience

- Undergraduate student research
  - Hunter Martin (UC Berkeley): Studying impact of baryonic physics on intrinsic alignments of galaxy shapes. Summer 2018 and Summer 2019
  - Benjamin Lang (UC Berkeley, Co-Advisor): Cross correlations of galaxies with CMB observables. Fall 2019
- Mentoring graduate student projects
  - Byeonghee Yu (UC Berkeley): 1) Improved RSD analysis with SDSS BOSS galaxies. 2) Testing the efficacy of Jackknife Covariance matrices.
  - James Sullivan (UC Berkeley): Small scale modeling of galaxy-lensing cross correlations using HZPT model.

  - Tanveer Karim (Harvard University): 1) Observational systematics and cosmological analysis using DESI ELG sample and CMB lensing.

- Teaching Assistant, Introduction to Astronomy (Fall 2012), Physics I (Spring 2013).

References

- **Rachel Mandelbaum** E-mail: rmandelb@andrew.cmu.edu
  The McWilliams Center for Cosmology
  Department of Physics, Carnegie Mellon University
  Pittsburgh, PA, USA

- **Uroš Seljak** E-mail: useljak@berkeley.edu
  Berkeley Center for Cosmological Physics
  Department of Physics, University of California Berkeley
  Berkeley, CA, USA

- **Alexie Leauthaud** E-mail: alexie@ucsc.edu
  Department of Astronomy and Astrophysics
  University of California
  Santa Cruz, USA

- **Benjamin Joachimi** E-mail: b.joachimi@ucl.ac.uk
  Department of Physics and Astronomy
  University College London
  London, UK

Talks/Posters

  - **HEP Seminar**: University of Wisconsin, Madison. **Invited** *February 2020*
  - **Talk**: DESI Collaboration meeting, Berkeley. *July 2019*
  - **Talk**: LSST Dark Energy Science Collaboration meeting, Berkeley. *March 2019*
  - **Talk**: Accurate lensing in the era of precision Cosmology, Berkeley. *January 2019*
  - **Talk**: LSST Dark Energy Science Collaboration meeting, CMU. *July 2018*
  - **Cosmology Seminar**: University of California, Santa Cruz. **Invited** *February 2017*
  - **HEP Seminar**: Argonne National Lab, Chicago. **Invited** *January 2017*
  - **CCAPP Seminar**: Ohio state University, Columbus. **Invited** *January 2017*
  - **Dissertation Talk**: AAS winter meeting, Grapevine, Texas. *January 2017*

- **Cosmology Seminar**: University of California, Berkeley and LBNL. **Invited** *December 2016*
- **HSC/Cosmology Seminar**: Princeton University, Princeton. *December 2016*
- **Talk**: Cosmo-16, International cosmology conference, University of Michigan. *August 2016*
- **Talk**: LSST Dark Energy Science Collaboration meeting, SLAC, Stanford. *March 2016*
- **Talk**: International Conference on Gravitation and Cosmology, ISSER Mohali, India. *December 2015*
- **Poster**: Theoretical and Observational Progress on Large-scale Structure of the Universe, ESO, Munich. *July 2015*
- **Poster**: Accurate astrophysics. Correct cosmology. Royal Astronomical Society, London. *July 2015*
- **Talk**: LSST Dark Energy Science Collaboration meeting, SLAC, Stanford. *February 2015*
- **Talk**: Astrostatistics meeting, Carnegie Mellon University. *January 2015*
- **Talk**: SDSS-III meeting, University of Utah. *July 2014*
- **Poster**: AAS summer meeting, Boston. *June 2014*
- **Talk**: LSST Dark Energy Science Collaboration meeting, Pittsburgh. *December 2013*

Publications★ (Up to date list on ADS)

1. **S. Singh**, B. Yu, and U. Seljak. Fundamental Plane of BOSS galaxies: Correlations with galaxy properties, density field and impact on RSD measurements. *arXiv e-prints*, January 2020. *Accepted in MNRAS* ADS arXiv:2001.07700

2. J. Lange, A. Leauthaud, **S. Singh** et al. On the halo-mass and radial scale dependence of the lensing is low effect. *arXiv e-prints*, November 2020*Submitted to MNRAS* ADS arXiv:2011.02377

3. H. Huang, et al. including **S. Singh**. Dark Energy Survey Year 1 Results: Constraining Baryonic Physics in the Universe. *arXiv e-prints*, July 2020 ADS arXiv:2007.15026

4. Y Zhang, et al. including **S. Singh**. Testing General Relativity on cosmological scales at redshift $z \sim 1.5$ with quasar and CMB lensing. *arXiv e-prints*, July 2020 ADS arXiv:2007.12607

5. B. Dai, Y. Feng, U. Seljak, and **S. Singh**. High mass and halo resolution from fast low resolution simulations. *JCAP*, 2020(4):002, April 2020 ADS arXiv:1908.05276

6. B. Wibking, et al. including **S. Singh**. Cosmology with galaxy-galaxy lensing on non-perturbative scales: emulation method and application to BOSS LOWZ. MNRAS, 492(2):2872–2896, February 2020 ADS arXiv:1907.06293

7. C. Lin et al. including **S. Singh**. Non-Gaussianity in the weak lensing correlation function likelihood - implications for cosmological parameter biases. MNRAS, 499(2):2977–2993, October 2020 ADS arXiv:1905.03779

8. A. Leauthaud, **S. Singh et al.** Deep wide lensing surveys can measure the dark matter halos of dwarf galaxies. *Physics of the Dark Universe*, 30:100719, December 2020 ADS arXiv:1905.01433

9. J. Newman, LSST-DESC Collaboration et al. including **S. Singh**. Deep Multi-object Spectroscopy to Enhance Dark Energy Science from LSST. *arXiv e-prints*, Mar 2019 . *Astro2020 decadal survey.* ADS arXiv:1903.09325

10. R. Mandelbaum, LSST-DESC Collaboration et al. including **S. Singh**. Wide-field Multi-object Spectroscopy to Enhance Dark Energy Science from LSST. *arXiv e-prints*, Mar 2019 . *Astro2020 decadal survey* ADS arXiv:1903.09323

11. **S. Singh**, R. Mandelbaum, U. Seljak, S. Rodríguez-Torres, and A. Slosar. Cosmological constraints from galaxy-lensing cross-correlations using BOSS galaxies with SDSS and CMB lensing. MNRAS, 491(1):51–68, January 2020 ADS arXiv:1811.06499

12. Y. Li, **S. Singh**, B. Yu, Y. Feng, and U. Seljak. Disconnected covariance of 2-point functions in large-scale structure. *JCAP*, 2019:016, Jan 2019 ADS arXiv:1811.05714

13. N. Chisari, LSST-DESC Collaboration et al. including **S. Singh**. Core Cosmology Library: Precision Cosmological Predictions for LSST. *The Astrophysical Journal Supplement Series*, 242(1):2, May 2019 ADS arXiv:1812.05995

14. Y.-C. Chen et al. including **S. Singh**. Detecting Galaxy-Filament Alignments in the Sloan Digital Sky Survey III. MNRAS, 485:2492–2504, May 2019 ADS arXiv:1805.00159

15. **S. Singh**, S. Alam, R. Mandelbaum, U. Seljak, S. Rodriguez-Torres, and S. Ho. Probing gravity with a joint analysis of galaxy and CMB lensing and SDSS spectroscopy. MNRAS, October 2018 ADS arXiv:1803.08915

16. **S. Singh**, R. Mandelbaum, U. Seljak, A. Slosar, and J. Vazquez Gonzalez. Galaxy-galaxy lensing estimators and their covariance properties. MNRAS, 471:3827–3844, November 2017 ADS arXiv:1611.00752

17. **S. Singh**, R. Mandelbaum, and J. R. Brownstein. Cross-correlating Planck CMB lensing with SDSS: lensing-lensing and galaxy-lensing cross-correlations. MNRAS, 464:2120–2138, January 2017 ADS arXiv:1606.08841

18. **S. Singh** and R. Mandelbaum. Intrinsic alignments of BOSS LOWZ galaxies - II. Impact of shape measurement methods. MNRAS, 457:2301–2317, April 2016 ADS arXiv:1510.06752

19. B. Joachimi, **S. Singh**, and R. Mandelbaum. Detection of spatial correlations of Fundamental Plane residuals, and cosmological implications. MNRAS, 454:478–488, November 2015 ADS arXiv:1504.02662

20. **S. Singh**, R. Mandelbaum, and S. More. Intrinsic alignments of SDSS-III BOSS LOWZ sample galaxies. MNRAS, 450:2195–2216, June 2015 ADS arXiv:1411.1755

21. A. Tenneti, **S. Singh**, R. Mandelbaum, T. D. Matteo, Y. Feng, and N. Khandai. Intrinsic alignments of galaxies in the MassiveBlack-II simulation: analysis of two-point statistics. MNRAS, 448:3522–3544, April 2015 ADS arXiv:1409.7297