Nan Li
Curriculum Vitae

Postdoc at The University of Chicago &
Argonne National Laboratory
✆ *(312) 259 2961*
✉ *linan7788626@oddjob.uchicago.edu*
KICP Associate Fellow

Education

2009–2013 **Astrophysics, Ph.D., May 2013**, *National Astronomical Observatories,* Chinese Academy of Sciences, Beijing, China.
Thesis: "Gravitational Lensing and Cosmology"
Advisors: Prof. Liang Gao and Prof. Shude Mao

2006–2009 **Astrophysics, M.A., June 2009**, *National Astronomical Observatories,* Chinese Academy of Sciences, Beijing, China.
Thesis: "Cusp-core Problem and Strong Gravitational Lensing"
Advisor: Prof. Da-Ming Chen.

2001–2006 **Engineering Mechanics, B.S. June 2006**, *Beijing University of Aeronautics and Astronautics*, Beijing, China.
Thesis: "Structural Stability of the Connections between Stages of Segmented Objects"
Advisor: Yunfeng Xing

Research Experience

2013–present **The University of Chicago and Argonne National Lab**, Chicago IL, USA.
Collaborating with Prof. Mike Gladders, Dr. Salman Habib, and Dr. Katrin Heitmann to produce high fidelity image simulations of gravitational lensing for cosmological studies.

2009–2013 **National Astronomical Observatories, Chinese Academy of Sciences**, Beijing, China.
Worked with Prof. Liang Gao and Prof. Shude Mao on utilizing gravitational lensing to constrain the structure of galaxies and galaxy clusters.

2006–2009 **National Astronomical Observatories, Chinese Academy of Sciences**, Beijing, China.
Worked with Prof. Da-Ming Chen on accurately estimating the probability of strong gravitational lensing in the Universe.

2005–2006 **Beijing University of Aeronautics and Astronautics**, Beijing, China.
Worked with Prof. Yunfeng Xing on structural stability of the connections between stages of step objects.

Research Interests

1. **Simulations of Gravitational Lensing**.
   Currently, my research is concentrated on simulations of gravitational lensing over a range of lens masses, and includes lensing in the both the strong and weak regimes. At present my focus is primarily on producing high fidelity image simulations, in order to predict the lensing cross-sections of massive halos in current (e.g., SPT/DES) and future (e.g., LSST) imaging surveys. I am now transitioning some effort to focus on galaxy-scale simulations of galaxy-scale strong lensing systems, including gravitational lens time delays, to test the reliability and the accuracy of lens modeling pipelines.

2. **Automated Strong-lens Finding**.
   In next-generation imaging surveys, such as LSST, Euclid, and WFIRST, there will be billions of objects and thousands or tens of thousands of strong lenses. Therefore an automated approach is necessary for finding strong lenses in these enormous datasets. I am working to apply machine learning techniques to improve automated strong-lens finding algorithms.

3. **Automated Gravitational Lens Modeling**.
   Lens modeling is a technique to reconstruct the mass distribution of lenses. In coming surveys, it is predicted that tens of thousands of lensing systems will be detected. Potentially, machine learning algorithms could improve the accuracy and efficiency of lens modeling pipelines, and thus we can model a large number of the observed lensing systems.

4. **Crowdsourcing Lens Finding and Lens Modeling**.
   To deal with the *big data* problem in astrophysics and cosmology, crowdsourcing is another approach complementary to machine learning. I am working on developing a web-based app for crowdsourcing lens modeling. Furthermore, I am trying to construct an end-to-end pipeline for citizen scientists to seek and model lensing systems by clicking and dragging.

5. **Applications of Machine Learning in Cosmology**.
   With the capability of next-generation telescopes, astrophysics and cosmology are stepping into the *big data* era. The application of machine learning on lens finding and lens modeling is an attempt to take on the challenge of *big data*. I am also thinking about extending machine learning approaches to other applications in astrophysics and cosmology.

Presentations

Selected Presentations

11/2016   **The Tuesday Chalk Talk at the University of Chicago**, *Chicago*, IL, USA.
(**Invited**) Machine learning and Gravitational Lensing

11/2016   **Atroseminar at the University of Pittsburgh**, *Pittsburgh*, PA, USA.
(**Invited**) Applications of Strong Lensing Simulations in Cosmology

05/2016   **Fermilab Astroseminar**, *Batavia*, IL, USA.
(**Invited**) Applications of Simulations of Strong Lensing

04/2016   **NAOC Cosmology Division Lunch Seminar**, *Beijing*, China.
(**Invited**) Simulations of Gravitational Lensing

02/2016   **KICP Postdoc Symposium for 2016 Spring**, *Chicago*, IL, USA.
(**Invited**) PICS: A Simulation Pipeline for Strong Lensing in Galaxy Clusters

07/2015   **Santa Fe Cosmology Workshops for 2015**, *Santa Fe*, NM, USA.
(**Review**) Simulations of Gravitational Lensing

02/2014   **KICP Postdoc Symposium for 2014 Spring**, *Chicago*, IL, USA.
(**Invited**) Simulations of Strong Gravitational Lensing

Collaboration Meetings

08/2016   **DES Collaboration Meeting at ANL**, *Chicago*, IL, USA.
Crowdsourcing Lens Modeling for Galaxy-galaxy Strong Lensing

06/2016   **SPT Face2Face Conference**, *Chicago*, IL, USA.
Strong Lensing Simulation for SPT Clusters

03/2016   **LSST DESC Collaboration Meeting at SLAC**, *Menlo Park*, CA, USA.
Galaxy-galaxy Strong Lensing for the Twinkles Simulation

10/2015   **LSST DESC Collaboration Meeting at ANL**, *Chicago*, IL, USA.
Lensing Simulations Using CatSim, GalSim, and PhoSim.

06/2015   **SPT Cluster Collaboration Meeting**, *Chicago*, IL, USA.
Simulations of Strong Lensing in the SPT Cluster Catalog.

03/2015   **LSST DESC Collaboration Meeting at SLAC**, *Menlo Park*, CA, USA.
Mocking Realistic Strongly-lensed Arcs.

Public Outreach

10/2015-now **A Volunteer at the Space Visualization Lab at Adler Planetarium**.
I have been a volunteer at the Space Visualization Laboratory at the Adler Planetarium in Chicago since 10/2015. The aim of this work is to introduce upcoming exciting scientific discoveries to the museum visitors by using videos and interactive games. My work is focused on visualizing and demonstrating galactic dynamics, gravitational lensing, and cosmological simulations.

9/2016 **Translation of "Dark Matter and the Dinosaurs" to Chinese**.
I contributed to the translation to Chinese of the book "DARK MATTER AND THE DINOSAURS", which is written by Prof. Lisa Randall. We wish to bring Chinese readers an overview of the relation between the ecology of the earth and the cosmological environment of our solar system. The translated book will be published by Zhejiang People's Publishing House in November 2016, in China.

05/2016 **STEMCON Outreach at DuPage College**.
STEMCON is devoted to introducing a broad range of fields of Science and Technology to people of all ages, where STEM is an acronym that stands for Science + Technology + Engineering + Math. During this event, my colleagues and I presented basic knowledge of physics phenomenon observed by the Dark Energy Survey, such as supernovae and gravitational lensing.

10/2015 **DES Outreach: Adler After Dark at Chicago.**.
"Adler After Dark at Chicago" is an event held at the Alder Planetarium in 10/2015. Volunteers from Fermilab, Argonne and the University of Chicago used entertaining games to introduce people to interesting topics in cosmology: for example, Tug-of-War: the battle between gravity and dark energy, Lens-yourself: involving gravitational lensing effects of your photos.

06/2015 **Translation of "The Science of Interstellar" to Chinese**.
My Chinese colleagues and I translated the book THE SCIENCE OF INTERSTELLAR, which is written by Prof. Kip Thorne, to Chinese. Our goal is to allow Chinese readers to enjoy the journey through the otherworldly science behind Christopher Nolan's film INTERSTELLAR. The translated book was published by Zhejiang People's Publishing House June 2015, in China.

03/2015 **An Application to Demonstrate Gravitational Lensing**.
BENDING LIGHT is an application to demonstrate gravitationally lensed images and time delays. It is designed as an advanced tool, suitable for use in a classroom setting, or even in a research setting to allow the rapid exploration of basic models for visualization purposes. Please go to `http://linan7788626.github.io/bending_light_cython` for more details.

Nan Li's Publications

Astrophysics & Cosmology:

1. **PICS: Simulations of Strong Gravitational Lensing in Galaxy Clusters**.
   Li, Nan; Gladders, Michael D.; Rangel, Esteban M.; Florian, Michael K.; Bleem, Lindsey E.; Heitmann, Katrin; Habib, Salman; Fasel, Patricia, The Astrophysical Journal, Volume 828, Issue 1, article id. 54, 19 pp. (2016).

2. **The Gini Coefficient as a Morphological Measurement of Strongly Lensed Galaxies in the Image Plane**.
   Florian, Michael K.; **Li, Nan**; Gladders, Michael D., The Astrophysical Journal, doi:10.3847/0004-637X/832/2/168

3. **The Gini Coefficient as a Tool for Image Family Identification in Strong Lensing Systems with Multiple Images**.
   Florian, Michael K.; Gladders, Michael D.; **Li, Nan**; Sharon, Keren, The Astrophysical Journal Letters, Volume 816, Issue 2, article id. L23, 4 pp. (2016).

4. **Galaxy-galaxy Weak Lensing Measurement from SDSS: (I) Image Processing**.
   Luo, Wentao; Yang, Xiaohu; Zhang, Jun; Tweed, Dylan; Fu, Liping; Mo, H.J.; van den Bosch, Frank C.; Shu, Chenggang; Li, Ran; **Li, Nan**; Liu, Xiangkun; Pan, Chuzhong; Wang, Yiran; Radovich, Mario, accepted by ApJ, arXiv: astro-ph/1607.05406

5. **Measuring the Mass-to-light Ratio of Galaxies with Weak Lensing**.
   Li, Nan; Li, Ran; Er, Xinzhong, 2013, RAA, Vol. 13, No. 9, 1041–1051

6. **Effects of Supermassive Binary Blackholes on Gravitational Lenses**.
   Li, Nan; Mao, Shude; Gao, Liang; Loeb, Abraham and di Stefano, R., 2012, MNRAS, Vol. 419, 2424–2432

7. **Cusp-Core Problem and Strong Gravitational Lensing**.
   Li, Nan; Da-Ming Chen, 2009, RAA, Vol. 9, No. 11, 1173–1184

8. **The Importance of Secondary Halos for Strong Lensing in the SPT Cluster Catalog**.
   Li, Nan; Gladders, Michael D.; Rangel, Esteban M.; Child, Hillary; Florian, Michael K.; Bleem, Lindsey E.; Heitmann, Katrin; Habib, Salman, in preparation

9. **MACHLLENSFINDER I: A Automated Strong Lensing Identification Pipeline Based Machine Learning**.
   Avestruz, Camille; **Li, Nan**; Lightman, Matthew;Collett, Thomas; Habib, Salman; Heitmann, Katrin; Gladders, Michael D.; Luo, Wentao, in preparation

10. **Towards Automated Lens Modeling: Involving Machine Learning to Reconstruct Galaxy-galaxy Strong Lenses**.
    Li, Nan; Sun, Siqi; Avestruz, Camille; Lightman, Matthew; Habib, Salman; Heitmann, Katrin; Gladders, Michael D., in preparation

11. **A Robust Mass Scale for Dark Matter Subhalo Perturbations in Strong Gravitational Lenses**.
    Minor, Quinn E.; Kaplinghat, Manoj; **Li, Nan**, in preparation

12. **Large-Scale Simulations of Sky Surveys**.
    Heitmann, K.; Habib, S.; Finkel, H.; Frontiere, N.; Pope, A.; Morozov, V.; Rangel, S.; Kovacs, E.; Kwan, J.; **Li, N.**; Rizzi, S.; Insley, J.; Vishwanath, V.; Peterka, T.; Daniel, D.; Fasel, P.; Zagaris, G., Computing in Science & Eng., vol. 16, no. 5, pp.14–23 2014

Computational Science:

1. **Parallel DTFE Surface Density Field Reconstruction**.
   Rangel, Esteban; **Li, Nan**; Habib, Salman; Peterka, Tom; Agrawal, Ankit; Liao, Wei-keng; Choudhary, Alok, 30th IEEE International Parallel & Distributed Processing Symposium, **Awarded the best paper of the Conference**

2. **Self-adaptive Density Estimation of Particle Data**.
   Peterak, Tom; Croubois, Hadrien; **Li, Nan**; Rangel, Esteban; Cappello Franck, SIAM Journal on Scientific Computing 2015, 11214

Published Books:

1. **Dark Matter and the Dinosaurs (Chinese)**.
   Author: Prof. Lisa Randall. Translators: Gou, Lijun; **Li, Nan**; Er, Xinzhong; Wang, Lan; Zheng, Zheng; Xie, Lizhi. November 2016, Zhejiang People's Publishing House, China

2. **The Science of Interstellar (Chinese)**.
   Author: Prof. Kip Thorne. Translators: Gou, Lijun; Wang, Lan; Li, Ran; Er, Xinzhong; Wang, Qiao; Xie, Lizhi; **Li, Nan**. June 2015, Zhejiang People's Publishing House, China

Computer Skills

Advanced	PYTHON, CYTHON, C/C++, OPENMP, MPI4PY, BASH SHELL
Intermediate	JAVASCRIPT/CSS3/HTML5, MPI, IDL, FORTRAN, OPENCL
Basic	MARKDOWN, ANGULARJS, JQUERY, MATLAB, SWIFT, CUDA
Skillful	Linux, Mac OSX, Latex, Latex-beamer, GSL, FFTW, CFITSIO

Languages

Mothertongue	**Chinese**	
Intermediate	**English**	*Conversationally fluent*
Basic	**Korean**	*Basic words and phrases only*

Awards

2016	**The Best Paper Award for IEEE Cluster Conference**	*2nd Author*
2015	**Chinese *Wenjin* Book Award**	*Co-authors*
2012	**Merit Student, UCSA, China**	

References

Available upon request.