

Ailong Ke

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Education

University of California, Berkeley, 2002-05
Post-doc, Department of Molecular & Cellular Biology. Advisor: Dr. Jennifer Doudna.

Johns Hopkins University School of Medicine, 2002
Ph.D., Dept. of Biophysics and Biophysical Chemistry. Advisor: Dr. Cynthia Wolberger.

University of Science and Technology of China, P.R. China,
1995 B.S., Department of Biology.

Professional Positions

- Full Professor, Department of Molecular Biology and Genetics, Cornell University, appointed July 1, 2017.
- Associate Professor, Department of Molecular Biology and Genetics, Cornell University, appointed January 1, 2012.
- Assistant Professor, Department of Molecular Biology and Genetics, Cornell University, appointed August 1, 2005.
- Post-doctoral researcher, University of California at Berkeley, 2002-2005.
- Postdoctoral, Johns Hopkins University School of Medicine, Apr. 2002-May 2002.
- Graduate research assistant, Johns Hopkins University School of Medicine, 1996-2002.
- Teaching assistant, Miami University, 1995-1996.
- Undergraduate researcher, University of Science and Technology of China, 1994-1995.

Honors and Fellowships

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| 2017 | Chinese-American Chemistry and Chemical Biology Professors Association (CAPA) Distinguished Faculty Award. |
| 2016 | NIH MIRA Award. |
| 2016 | HHMI 2016 Faculty Scholars Competition, Semi-Finalists. |
| 2013 | Keynote Speaker, RNA Upstate NY: Finger Lakes RNA Conference Meeting, Canandaigua, NY. |
| 2012 | Santander Visiting Professor to Tsinghua University, China. Supported by the Santander Bank, Spain. |
| 1992-93 | Undergraduate academic scholarship, Univ. of Sci. and Tech. of China. |
| 1991 | Admission with an exemption from entrance exams, University of Sci. and Tech. of China. |

Professional Societies:

Member, American Crystallography Association.
Member, RNA Society.
Member, American Society for Biochemistry and Molecular Biology (ASBMB).
Member, Chinese-American Chemistry & Chemical Biology Professors Association.

Advisory Panels and Committees:

Ad-hoc grant reviews for: NIH Small Business: Cell and Molecular Biology 2017.
Ad-hoc grant reviews for: NIH Macromolecular Structure and Functions C (MSFC) study section 2017.
Ad-hoc grant reviews for: NIH Prokaryotic Cell and Molecular Biology (PCMB) study section 2016.
Ad-hoc grant reviews for: NIH Prokaryotic Cell and Molecular Biology (PCMB) study section 2015.
Ad-hoc grant reviews for: NIH Small Business: Cell and Molecular Biology 2016.
Ad-hoc grant review for: NSF's CAREER Solicitation NSF 15-555 review section 2015
Ad-hoc grant reviews for: NIH Early Independence Award Review 2015.
Ad-hoc grant reviews for: Research Grants Council (Hong Kong) 2005.
MACCHESS Express Mode Proposal Reviews committee 2006-present.
APS Proposal Review Committee 2008 – present.
ALS Proposal Review Committee 2016 – present.

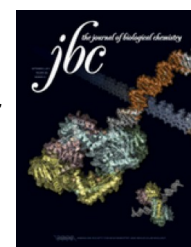
Publications Since Appointment. (* Corresponding authors)

1. Cheulhee Jung, John Hawkins, Stephen K. Jones Jr, Yibei Xiao, Jim R. Rybarski, Kaylee Dillard, Mashelfatema A Saifuddin, Cagri Savran, Andrew Ellington, **Ailong Ke**, William H. Press, and Ilya J. Finkelstein*. Massively parallel biophysical analysis of a CRISPR-Cas protein complex on repurposed next generation sequencing chips. *Cell*. 2017 (Accepted).
2. Lew KM, **Ailong Ke***. Building the Class 2 CRISPR-Cas Arsenal. *Molecular Cell*. 2017 Feb 2;65(3):377-379.
3. Ballaglia RA, Price IR, **Ke A***. Structural basis for guanidine sensing by the ykkC family of riboswitches. *RNA*. 2017 Apr;23(4):578-585.
4. Xiao Y, **Ke A***. PIWI Takes a Gait Step. *Cell*. 2016 Oct 6; 167(2):310-312.
5. Hayes RP, Xiao Y, Ding F, van Erp PB, Rajashankar K, Bailey S, Wiedenheft B, **Ke A***. Structural basis for promiscuous PAM recognition in type I-E Cascade from *E. coli*. *Nature*. 2016 Feb 25;530(7591):499-503.
6. Nam KH, DeLisa MP*, **Ke A***. Characterizing metal-dependent nucleases of CRISPR-Cas prokaryotic adaptive immunity systems. *Methods in Molecular*

- Biology: CRISPR, Methods and Protocols.** 2015;1311:265-76.
7. Grigg JC, **Ke A***. Structure of Large RNAs and RNA-Proteins Complexes: Toward Structure Determination of Riboswitches. **Method Enzymol.** 2015;558:213-32
 8. Mizrachi D, Chen Y, Liu J, Peng HM, **Ke A**, Pollack L, Turner RJ, Auchus RJ, DeLisa MP. Making water-soluble integral membrane proteins in vivo using an amphipathic protein fusion strategy. **Nature Commun.** 2015 Apr 8;6:6826.
 9. Price IR, **Ke A***. Mn²⁺ Sensing Mechanisms of yybP-ykoY Orphan Riboswitches. **Molecular Cell** 2015 MAR 19; 57(6): 1110-1123
<http://stke.sciencemag.org/content/8/371/ec84.abstract> **EDITORS' CHOICE**
<http://www.nature.com/nrmicro/journal/v13/n5/full/nrmicro3478.html> **RESEARCH HIGHLIGHT**
 10. Hayes RP, **Ke A***. One more Piece Down to Solve the III-A CRISPR puzzle. **J Mol Biol** 2015 Jan 30;427(2):228-30
 11. Price IR, Grigg JC, **Ke A***. Common themes and differences in SAM recognition among SAM riboswitches. **Biochim Biophys Acta** 2014 Oct;1839(10):931-938
 12. Huo Y, Nam KH, Ding F, Lee H, Wu L, Xiao Y, Farchione MD Jr, Zhou S, Rajashankar K, Kurinov I, Zhang R, **Ke A***. Structure of CRISPR Cas3 offer mechanistic insights into Cascade-activated DNA unwinding and degradation. **Nature Structure Molecular Biology** 2014 Sept;21(9):771-7-102.
 13. Johnson CM, Chen Y, Lee H, **Ke A**, Weaver KE, Dunny GM*. Identification of a conserved branched RNA structure that functions as a factor-independent terminator. **Proc Natl Acad Sci U S A.** 2014 Mar 4;111(9):3573-8.
 14. Liu JJ, Bratkowski MA, Liu X, Niu CY, **Ke A***, Wang HW*. Visualization of distinct substrate-recruitment pathways in the yeast exosome by EM. **Nature Structure Molecular Biology** 2014 Jan;21(1):95-102.
 15. Grigg JC, **Ke A***. Sequence, structure and stacking: specifics of tRNA anchoring to the T box riboswitch. **RNA Biol.** 2013 Dec 1;10(12):1761-4.
 16. Grigg JC, **Ke A***. Structural determinants for geometry and information decoding of tRNA by T box leader RNA. **Structure.** 2013 Nov 5;21(11):2025-32.
 17. Grigg JC, **Ke A***. One platform, five brands: how nature cuts the cost on riboswitches. **Journal of Molecular Biology.** 2013 May 27;425(10):1593-5.
 18. Grigg JC, Chen Y, Grundy FJ, Henkin TM, Pollack L, **Ke A***. T box RNA decodes both the information content and geometry of tRNA to affect gene expression. **Proc Natl Acad Sci U S A.** 2013 Apr 30;110(18):7240-5.
 19. Chen Y, Nam KH, **Ke A**, Pollack L*. A SAXS Study of the CRISPR Associated Gene (Cas) Csn2 in the Presence and Absence of Calcium Ions. **Biophysical**

Journal. 2013 January 29;104(2); 252a-253a.

20. Nam KH, Huang Q, **Ke A***. Nucleic Acid Binding Surface and Dimer Interface Revealed by CRISPR-associated CasB Protein Structures. **FEBS Letters.** 2012 Nov 16;586(22):3956-61.
21. Nam KH, Ding F, Haitjema C, Huang Q, Delisa MP, **Ke A***. Double-stranded Endonuclease Activity in *B. halodurans* Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)-associated Cas2 Protein. **Journal of Biological Chemistry.** 2012 Oct 10; 287: 35943-35952. [Featured on the Cover of JBC]
22. Nam KH, Haitjema C, Liu X, Ding F, Wang H, DeLisa MP*, **Ke A***. Cas5d protein processes pre-crRNA and assembles into a Cascade-like interference complex in Subtype I-C/Dvulg CRISPR-Cas system. **Structure.** Jun. 2012 Sep 5; 20(9):1574-1564. [Cover art, Preview commentary in the same issue.]
23. Zhao W, Saha M, **Ke A**, Morais MC, Jardine PJ, Grimes S*. Three-helix junction is the interface between two functional domains of prohead RNA in λ 29 DNA packaging. **Journal of Virology.** 2012 Feb 10;416(1):94-107.
24. Gwangrog Lee, Matthew Bratkowski, Fang Ding, **Ailong Ke**, Taekjip Ha*. Single molecule analysis of yeast Rrp44 exonuclease reveals a spring-loaded mechanism of RNA unwinding. **Science.** 2012 Jun 29;336(6089):1726-9.
25. Karlsson AJ, Lim HK, Xu H, Rocco MA, Bratkowski MA, **Ke A**, DeLisa MP*. Engineering antibody fitness and function using membrane-anchored display of correctly folded proteins. **Journal of Molecular Biology.** 2012 Feb 10;416(1):94-107.
26. Nam KH, Kurinov I, and **Ke A***. Crystal structure of clustered regularly interspaced short palindromic repeats (CRISPR)-associated Csn2 protein revealed Ca^{2+} -dependent double-stranded DNA binding activity. **Journal of Biological Chemistry.** 2011 Sep 2; 286: 30759- 30768. [Featured on the Cover of JBC] [Selected as a "Paper of the Week" by JBC.] [Selected as a "JBC Best of 2011" (12/4000)]
27. Lu C, Smith AM, Ding F, Chowdhury A, Henkin TM, **Ke A***. Variable sequences outside the SAM-binding core critically influence the conformational dynamics of the SAM-III/SMK box riboswitch. **Journal of Molecular Biology.** 2011 Jun 24;409(5):786-99.
28. Ding F, Lu R, Zhao W, Rajashankar K, Anderson DL, Jardine PJ, Grimes S, **Ke A*** (2010). Structure and Assembly of the Essential RNA Ring Component of a Viral DNA Packaging Motor. **Proc Natl Acad Sci U S A** 2011 May 3;108(18):7357-62.



29. Ataide SF, Schmitz N, Shen K, **Ke A**, Shan SO, Doudna JA*, Ban N* (2010). The Crystal Structure of the Signal Recognition Particle in Complex with its Receptor. **Science**, 2011 Feb 18;331(6019):881-6.
30. Perez-Rodriguez R, Huang Q, Wu X, Ding F, Bernardis S, **Ke A***, and DeLisa MP* (2010). Envelope stress is a trigger of CRISPR-mediated gene silencing in prokaryotes. **Molecular Microbiology**. 2011 Feb;79(3):584-99. (Commented in the same issue).
31. Lu C, Chowdhury A, Ding F, Pradhan V, Tomsic J, Holmes WM, Henkin TM, **Ke A***. (2010). SAM Recognition and Conformational Switching Mechanism in the *Bacillus subtilis* *yitJ* SAM-I/S box riboswitch. **Journal of Molecular Biology**. 2010 Dec 17;404(5):803-18.
32. Lu C, Ding F, **Ke A***. Crystal structure of the *S. solfataricus* archaeal exosome reveals conformational flexibility in the RNA-binding ring. **PLOS One**. 2010 Jan 15;5(1):e8739. (PMC2806925)
33. Lu C, Smith AM, Fuchs RT, Ding F, Rajashankar K, Henkin TM, **Ke A***. Crystal structures of the SAM-III/S(MK) riboswitch reveal the SAM-dependent translation inhibition mechanism. **Nature Structural & Molecular Biology**. 2008 Oct;15(10):1076-83.
34. Wang HW*, Wang J, Ding F, Callahan K, Bratkowski MA, Butler JS, Nogales E, **Ke A***. Architecture of the yeast Rrp44 exosome complex suggests routes of RNA recruitment for 3' end processing. **Proc Natl Acad Sci U S A**. 2007 Oct 23;104:16844-16849. co-corresponding authors. (PMC2040474)
35. **Ke A**, Ding F, Batchelor JD, Doudna JA*. Monovalent cation binding sites in the HDV ribozyme. **Structure (Camb)**. 2007 Mar;15(3):281-7.
36. Wu S, **Ke A**, Doudna JA*. A fast and efficient procedure to produce scFvs specific for large macromolecular complexes. **J. Immunology Methods**. 2007 Jan 10;318(1-2):95-101.
37. Spangord RJ, Siu F, **Ke A**, Doudna JA. RNA-mediated interaction between the peptide-binding and GTPase domains of the signal recognition particle. **Nature Structural & Molecular Biology**. 2005 Dec;12(12):1116-22

Extramural Research Support

NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES

Title: Mechanistic investigation of RNA-Mediated Gene Regulation and Immunity

Type: R35GM116632

Period: 07/01/2016 – 03/31/2021, 5 years.

Role: P.I.

Invited Talks

1. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Biophysics, Johns Hopkins University. (01/2017).
2. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Molecular Biophysics and Biochemistry, Yale University. (12/2016)
3. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Molecular Biosciences, University of Texas at Austin. (12/2016)
4. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Biochemistry and Molecular Biology, Chicago University. (12/2016)
5. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Chemistry, Indiana University. (11/2016)
6. “RNA-mediated gene regulation and immunity.” Invited Seminar, Department of Biology, University of Science and Technology of China. (7/2016)
7. “RNA-mediated gene regulation and immunity.” Invited Seminar, Donghua University, Shanghai China. (07/2016)
8. “RNA-mediated gene regulation and immunity.” Invited Meeting Speaker and Section Chair, RNA society meeting 2016, Japan. (06/2016)
9. “Directional R-loop formation mechanism in Type I-E Cascade and its implications in Cas3 recruitment and activation.” Invited Meeting Speaker, CRISPR meeting 2016, Israel. (05/2016)
10. “T-box and yybP-ykoY orphan riboswitches – versatility of bacterial riboregulators in sensing macromolecules and metal ions.” Invited Meeting Speaker, Zing Regulating with RNA in Bacteria and Archaea Conference. Cancun Mexico. (12/06/2015)
11. “RNA-mediated gene regulation and immunity.” Invited Meeting Speaker, 14th Upstate New York NMR Conference and Structural Biology Symposium. (10/21/2015)
12. “PAM recognition mechanism in the Type I CRISPR-Cas system.” Invited Meeting Speaker, Section Chair, CRISPR meeting 2015, Rockefeller University, New York. (06/22/2015).
13. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Meeting Speaker, 4th Zing Nucleic Acids Conference 2014, Cancun Mexico. (12/06/2014).
14. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Seminar Speaker, Donghua University, Shanghai China. (08/2014).
15. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA

- interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Seminar Speaker, Wadsworth Center. Albany, NY. (04/17/2014).
16. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Seminar, Department of Biophysics and Biophysical Chemistry, Johns Hopkins University School of Medicine, Baltimore, MD. (11/13/2013).
 17. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Keynote Speaker, RNA Upstate NY: Finger Lakes RNA Conference Meeting, Canandaigua, NY. (10/2013).
 18. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Seminar Speaker. Department of Biochemistry and Biophysics, Washington University, St. Louis, MO. (10/2013).
 19. “RNA-Based Bacterial Immunity and Gene Regulatory Networks: i) CRISPR RNA interface, and ii) tRNA Sensing by T-box Riboswitch.” Invited Speaker, American Crystallography Meeting, Waikiki, Hawaii. (7/2013).
 20. “CRISPR Interference in Type I-C/Dvulg organisms.” Invited Speaker, CRISPR: Evolution, Mechanisms, and Infection, University of St Andrews, UK. (6/18/2013).
 21. “T box riboswitch decodes both the information content and geometry of tRNA to affect gene expression.” Invited Speaker, RNA Society Meeting, Davos, Switzerland. (6/14/2013).
 22. “Conformation dynamics on Sam-III translational riboswitch and RNA interference in Type I-C CRISPR-cas system.” Seminar talk and Outreach talk, Towson University, Maryland. (12/2012).
 23. “Conformation dynamics on Sam-III translational riboswitch and RNA interference in Type I-C CRISPR-cas system.” Invited Speaker, Zing Nucleic Acid Conference at Mexico. (11/2012).
 24. “Conformation dynamics on Sam-III translational riboswitch and RNA interference in Type I-C CRISPR-cas system.” Seminar Speaker, Department of Microbiology, Cornell University. (10/2012).
 25. “Conformation dynamics on Sam-III translational riboswitch and RNA interference in Type I-C CRISPR-cas system.” Invited Speaker, Riboregulation Meeting, Shanghai, China. (9/2012).
 26. “Conformation dynamics on Sam-III translational riboswitch and RNA interference in Type I-C CRISPR-cas system.” Seminar Speaker, Scripps Institute at Florida. (5/2012).
 27. “Conformational dynamics in Sam-III riboswitch and quaternary RNA self-assembly in ø29 prohead RNA.” Invited Speaker, International RNA Symposium, Goethe

- University, Frankfurt am Main, Germany. (4/23/2012).
28. "Ligand-sensing and oligomerization mechanisms in RNA." Seminar Speaker, Department of Chemistry and Biochemistry, University of Maryland, College Park. (3/2011)
 29. "Ligand-sensing and oligomerization mechanisms in RNA." *Department Seminar*, Department of Molecular Biology and Genetics, Cornell University. (06/03/2011).
 30. "Ligand-sensing and conformational dynamics in SAM-binding riboswitches." *Invited Seminar*, Department of Biology, University of Science and Technology of China. (10/2010).
 31. "Ligand-sensing and conformational dynamics in SAM-binding riboswitches." *Invited Seminar*, Department of Animal Physiology, Nanjing Agriculture University, China. (10/2010).
 32. "Eukaryotic and prokaryotic RNA interference." *Invited Seminar*, Department of Animal Physiology, Nanjing Agriculture University, China. (10/2010).
 33. "A new trick by RNA: Quaternary self-assembly in prohead RNA of bacteriophage ϕ 29." *Invited Speaker*, RNA Society Meeting. (6/25/2010).
 34. "Mechanism of ligand-sensing and multimerization in RNA." *Invited Seminar*, Department of Biological Sciences, SUNY, Albany. (12/4/2009).
 35. "Mechanism of ligand-sensing and multimerization in RNA." *Invited Seminar*, Department of Chemistry, Penn State University. (11/7/2009).
 36. "Mechanism of RNA multimerization in bacteriophage ϕ 29." *Invited Speaker*, RNA Session at Pittsburgh Diffraction Conference. (10/23/2009).
 37. "Mechanism of RNA multimerization in bacteriophage ϕ 29." *Invited Speaker*, Symposium on RNA Biology VIII: RNA, Tool and Target. (10/17/2009).
 38. "Structural studies of RNA switches and RNA 'terminators'." *Invited Seminar*, Institute of Biophysics, China. (7/12/2009).
 39. "Structural studies of RNA switches and RNA 'terminators'." *Invited Seminar*, Tsinghua University, China. (7/6/2009).
 40. "Structural studies of RNA switches and RNA 'terminators'." *Invited Speaker*, Section of Molecular Structures, NIDDK, NIH. (11/5/2008).
 41. "Structural studies of RNA switches and RNA 'terminators'." *Invited Seminar*, Department of Biological Sciences, University of Pittsburgh. (9/20/2008).
 42. "Architecture of the Yeast Rrp44-Exosome Complex Suggests Routes of RNA Recruitment for 3'-end Processing". *Invited Speaker*, mRNA Quality Control Meeting, Granada, Spain (6/8/2008).

43. "Structural studies of RNA switches and RNA 'terminators'." *Invited Seminar*, Department of Chemistry and biochemistry, University of Maryland at College Park. (4/1/2008).
44. "Structure and function of an RNA terminator" *Invited Seminar*, Cornell Chemistry Department (11/2007).
45. "Architecture of the Yeast Rrp44-Exosome Complex Suggests Routes of RNA Recruitment for 3'-end Processing". *Invited Speaker*, Chinese Biological Investigator Society 2007 meeting at Beijing, China (7/24/2007).
46. "Chemical repertoire of RNA and protein ribonucleases." *Invited Seminar*, BTI, Cornell, NY (2/13/2007).
47. "Chemical repertoire of RNA in HDV ribozyme and signal recognition particle." *Invited Seminar*, CHESS journal club seminar, NY (12/16/2005).
48. "Chemical repertoire of RNA in HDV ribozyme and signal recognition particle." *Invited Seminar*, Cornell Biophysics Colloquia, Cornell University, NY (11/9/2005).
49. "The amazing RNA world." *Invited Seminar*, Department of Biology, University of Science and Technology of China. (10/2005).

Teaching Responsibilities

BioMG 4380, The RNA World; TU, TH, 11:45-12:50; 3 Credits; Fall Semester.

This course is intended for upper-level undergraduates and graduate students. It consists of 2x75 min sessions on Tuesday and Thursday; 4 lectures were devoted to presentation and discussions. Part of the excitement about "the RNA world" stems from the recognition that RNA is ancient and that the evolution of life as we know it depended upon RNA evolving both informational and catalytic capabilities. This course explores these ideas, but more generally provides a comprehensive introduction to RNA biology. Many interesting topics in the RNA biology, such as the mechanism of RNA interference and its wide spread applications in research and medicine are covered in detail. Other topics require consideration of essential RNA-protein complexes such as ribosome, spliceosome, telomerase, and signal recognition particles. Classical experiments as well as up-to-date research are covered in this class.