

PROMOTION RECOMMENDATION

The University of Michigan
College of Engineering

Yaoyun Shi, assistant professor of electrical engineering and computer science, Department of Electrical Engineering and Computer Science, is recommended for promotion to associate professor of electrical engineering and computer science, with tenure, Department of Electrical Engineering and Computer Science.

Academic Degrees:

Ph.D. 2001 Princeton University, Computer Science, Princeton, New Jersey
M.A. 1999 Princeton University, Computer Science, Princeton, New Jersey
B.S. 1996 Beijing University, Computer Science, Beijing, China

Professional Record:

2002-present Assistant Professor, Department of Electrical Engineering and Computer Science,
University of Michigan
2001-2002 Postdoctoral Scholar, Institute for Quantum Information, California
Institute of Technology, Pasadena, California.

Summary of Evaluation:

Teaching: Professor Shi has taught courses at all levels of the program, from introductory undergraduate courses on discrete mathematics to small seminars on emerging topics such as quantum computing. Letters from undergraduate students indicate that Professor Shi is a dedicated teacher and takes his teaching duties seriously. One student speaks of his “passion for teaching” and his flexibility in adapting the course schedule to the students’ progress. The letters from graduate students, and in particular from the Ph.D. students he is supervising, indicate a great level of respect for the knowledge and guidance Professor Shi has imparted to them. He has graduated one Ph.D. student and has another in the pipeline. He is committed to teaching mathematically challenging courses, graduate and undergraduate, which are indispensable to several CSE degree programs. Finally, Professor Shi is a devoted teacher, who strives to share some of the excitement of scientific discovery with his students.

Research: Professor Shi has become one of the leading researchers in the field of quantum computing, an exciting new multi-disciplinary field spanning computer science, electrical engineering and physics. He has strengthened and raised the visibility of the theoretical computer science group (a priority area for the Computer Science and Engineering Division) at the University of Michigan. Together with researchers in EECS and the Physics Department he has helped make Michigan a focal point for quantum computing research. Professor Shi has demonstrated an impressive breadth in his research not often found in a junior faculty member. He has proven fundamental lower bounds in quantum computing for sorting and the element distinctness problem, two of the most important problems in computer science. He has significant results on the design of quantum circuits, which may have far-reaching consequences in the fabrication of quantum computers. He has investigated several other fundamental problems such as classical simulation of quantum computation and efficient simulation of a quantum many-body system. He has several significant papers on the nonlocality of quantum operations involving not only fundamental questions in computer science, but also of quantum physics. He has worked with his students on the question of whether quantum communication protocols can be dramatically more efficient than classical communication protocols. He has published his work in highly prestigious journals and rigorously refereed conferences in theoretical computer science. He has been very successful in attracting

funding (at the level expected of theorists) in a very competitive field. Professor Shi is PI on three NSF grants, including the very prestigious NSF Career Award. He has also worked and published in areas not related to quantum computing, including the PageRank algorithm used by Google to prioritize related web pages, and on auction games.

Recent and Significant Publications:

- L. Duan, Y. Shi and Guifré Vidal, "Classical Simulation of quantum many-body systems with a tree tensor network," *Physical Review A*, 74, 022320, 2006.
- W. Huang, Y. Shi, S. Zhang, and Y. Zhu, "The communication complexity of the Hamming Distance Problem," *Information Processing Letters*, 99(4) pp. 149–153, 2006.
- Y. Shi, "Quantum and classical tradeoffs," *Theoretical Computer Science*, 344(2–3) pp. 335–345, 2005.
- Y. Shi, "Tensor norms and the classical communication complexity of nonlocal quantum measurements," *Proceedings of the 37th ACM Symposium on Theory of Computation (STOC 2005)*, pp. 460–467, 2005.
- S. Aaronson and Y. Shi, "Quantum lower bounds for the collision and element distinctness problems," *Journal of the ACM*, 51(4):595-605, 2004.
- A. Ambainis and Y. Shi, "Distributed construction of quantum fingerprints," *Quantum Information and Computation*, 4(2), pp. 146-151, 2004.
- Y. Shi, "Both Toffoli and Controlled-NOT need little help to do universal quantum computation," *Quantum Information and Computation*, 3(1), pp. 84-92, 2003.
- P. Hoyer, J. Neerbek and Y. Shi, "Quantum complexities of ordered searching, sorting, and element distinctness," *Algorithmica*, 34(4), pp. 429–448, 2002.
- A. Chakrabarti, S. Khot and Y. Shi, "Evasiveness of subgraph containment and related properties," *SIAM Journal on Computing*, 31(3), pp. 866–875, 2002.
- Y. Shi, "Entropy lower bounds of quantum decision tree complexity," *Information Processing Letters*, 81(1), pp. 23–27, 2002.
- Y. Shi, "Quantum lower bounds for the collision and element distinctness problems," *Proceedings of the Forty-Third Annual Symposium on the Foundations of Computer Science (FOCS 2002)*, pp. 513–519, 2002.

Service: Professor Shi has made significant contributions to the University and his profession through his service, much more than expected of a junior faculty member. He has served on the Graduate Committee for Computer Science and Engineering; the Hiring Committee of the UM-SJTU Joint Institute, an engineering institute located in Shanghai sponsored jointly by UM and Shanghai Jiao Tong University; the Curriculum Committee; and coordinated the Distinguished Lecture Series in CSE. He has contributed to diversity and outreach through participation in the Michigan Road Scholars program. In external service he served on five conference program committees, the editorial board of *Theoretical Computer Science*, a leading journal in his field, and as an NSF reviewer and panelist. Worth special note, Professor Shi served on the Program Committee for the Annual Symposium on Foundations of Computer Science (FOCS) in 2007 – one of two top theory conferences. An invitation to serve on this committee is an indication of his stature in the theoretical computer science community.

External Reviewers:

Reviewer A: "The range of topics that he has addressed (all within theoretical quantum computation) is impressive and evidence of a very considerable creative ability."

Reviewer B: "I judge the quality of his work to be among the very best in the field."

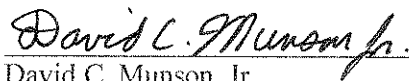
Reviewer C: "His papers cover a remarkably large part of the domain, and some of them actually opened up new subfields in the area. He is clearly a leading researcher in quantum complexity theory."

Reviewer D: “He will be one of the leading figures in the quantum information science community (he already is within his [cohort]).”

Reviewer E: “Prof. Shi's research is both excellent and highly regarded in the field of quantum computation and information processing, particularly the difficult area of quantum algorithms, where it has been influential with other researchers.”

Reviewer F: “He has been involved in several subareas, including quantum lower bounds, quantum communication complexity and the classical simulation of both quantum circuits and quantum systems. He has, in my opinion, addressed important problems in all these areas.”

Summary of Recommendation: Through his research, multiple collaborations, productive work with graduate students and active involvement in the quantum-computing community, Professor Shi is bringing prominence to Michigan’s theoretical computer science group. He is a dedicated instructor who conveys a passion for teaching both inside and outside of the classroom. Through his service, he has made significant contributions to the University and his profession. Granting promotion and tenure to Professor Shi will strengthen the University’s position in an exciting, energetic area of research, thereby strengthening the College of Engineering. It is with the support of the College of Engineering Executive Committee that I recommend Yaoyun Shi to for promotion to associate professor of electrical engineering and computer science, with tenure, Department of Electrical Engineering and Computer Science, College of Engineering.



David C. Munson, Jr.
Robert J. Vlasic Dean of Engineering
College of Engineering

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