



ACCS Briefing Paper #3

Data on China's PhD Completions Related to Cyber Security

Lu Wenzhe

November 2017



UNSW
A U S T R A L I A

Australian Centre for
Cyber Security

UNSW Canberra

Data on China's PhD Completions Related to Cyber Security

ACCS Briefing Paper No. 3

Lu Wenze

Australian Centre for Cyber Security
University of New South Wales Canberra
23 November 2017

Contents

Introduction	2
Part One Cyber Security/Information Security	3
1. The number of Ph.D. dissertations completed in each year from 1999- 2016.....	3
2. The number of Ph.D. dissertations sponsored by the top 40 funds.....	4
3. The number of Ph.D. dissertations from different research levels.....	7
4. The number of Ph.D. dissertations from Top 20 specialties	9
5. The number of Ph.D. dissertations from Top 15 Universities	11
Part Two Quantum Computing/Quantum Communication	13
1. The number of Ph.D. dissertations completed in each year from 1999- 2016.....	13
2. The number of Ph.D. dissertations sponsored by the top 25 funds.....	14
3. The number of Ph.D. dissertations from different research levels.....	16
4. The number of Ph.D. dissertations from Top 20 specialties	18
5. The number of Ph.D. dissertations from Top 13 Universities	20
Part Three Artificial Intelligence.....	22
1. The number of Ph.D. dissertations completed in each year from 1999 to 2016.....	22
2. The number of Ph.D. dissertations sponsored by the top 40 funds.....	23
3. The number of Ph.D. dissertations from different research levels.....	26
4. The number of Ph.D. dissertations from Top 20 specialties	27
5. The number of Ph.D. dissertations from Top 15 Universities	30
Part Four Comparison	32

Introduction

This ACCS briefing paper analyses available public data on the main subjects of completed PhD dissertations in China to determine trends in completions on the separate subjects of cyber security, information security, quantum communications/quantum computing, and artificial intelligence. It has been prepared in support of a research project led by Professor Greg Austin on cyber security education at the Australian Centre for Cyber Security (ACCS) in the University of New South Wales Canberra. The briefing paper is also related to a book on “Cyber Security in China” in publication with Springer and authored by Professor Greg Austin. This paper provides raw data only which is still being analysed. It is being published informally to provoke discussion about the possible causes of the main trend that it identifies: that between 2011 and 2017 there has been a marked downturn in Ph D completions in China on key subjects relating to cyber security.

The data comes from the China Doctoral Dissertations Full-text Database (CDFD) of the China National Knowledge Infrastructure (CNKI).¹ CNKI is a database to offer full-text articles from Chinese journals and other academic sources. The CDFD does not include all of China’s PhD completions since authors can make a choice to include their dissertation, and since staff in some institutions, like Beijing University and Tsinghua, reportedly discourage their students from submitting their dissertations to CNKI. Nevertheless, it is reasonable to assume that the year on year trends in PhD topics from dissertations in the CDFD speaks to broader trends in topics of choice for graduate research degrees in China. Many specialists in China regard the CDFD as relatively comprehensive, and most PhD graduates regard it as a useful and practical route for a shortened publication cycle.² The analysis does not seek to summarise data on all topics “related to” cyber security, but simply those identified in the “subject” category by the signature terms mentioned.

The paper adopts the way of “subject searching” to obtain the data From CNKI’s China Doctoral Dissertations Full-text Database. Subject searching, in CNKI, means searching a term in article titles, keywords, and abstracts. The paper has four parts: the first part is about data on cyber

¹ In Chinese, 中国知网.

² CNKI. China Doctoral Dissertations Full-text Database. Available at: <http://oversea.cnki.net/kns55/brief/result.aspx?dbPrefix=CDFD> [Accessed: Nov 20 2017]

security/information security; the second artificial intelligence; the third quantum computing/quantum communication; the last part is the conclusion.

Part One Cyber Security/Information Security

The paper searched for “subject: “信息安全” (Information security) OR “网络安全” (Cyber security)” and obtained 1855 Ph.D. dissertations. The time span is from 1999 to 2016.

To test if the method double counts dissertations that contain both terms, the paper also employs another two searching ways. The paper searched for "subject: “‘信息安全’ not ‘网络安全’” and got 986 dissertations. Then, it searched for “subject ‘网络安全’ not ‘信息安全’” and got 690. Finally, the paper searched for “subject ‘信息安全’ and ‘网络安全’ and obtained 179 dissertations. Therefore, the total number of the dissertations on “‘信息安全’ OR ‘网络安全’” can be obtained by adding the above numbers together. Moreover, the paper searched for “subject: ‘信息安全’” and obtained 1165 dissertations. Then, it searched for “subject: ‘网络安全’ and got 869. Still, the total number of the dissertations on “‘信息安全’ OR ‘网络安全’” is 1855 (1166+869-179).

1. The number of Ph.D. dissertations completed in each year from 1999- 2016

Year	Quantity	Year	Quantity
1999	1	2008	171
2000	3	2009	177
2001	17	2010	165
2002	40	2011	180
2003	44	2012	166
2004	52	2013	145
2005	73	2014	138
2006	121	2015	129
2007	136	2016	74

Table 1 The number of Ph.D. dissertations completed in each year from 1999-2016

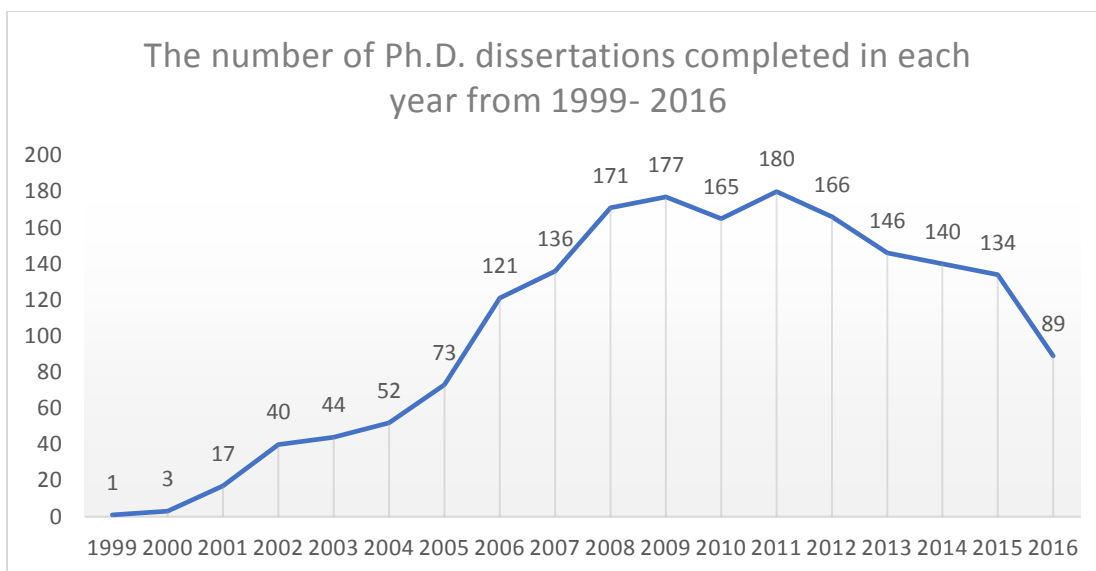


Figure 1 The number of Ph.D. dissertations completed in each year from 1999-2016

2. The number of Ph.D. dissertations sponsored by the top 40 funds

Name of the fund	Quantity
National Natural Science Foundation of China	299
National High Technology Research and Development Program - 863 Program	149
State Key Basic Research and Development Program - 973 Program	43
Special scientific research fund of doctoral degree of higher education	31
China Scholarship Council Fund	12
Ministry of Education Science and Technology Research Project	12
National Science and Technology Support Program	11
Natural Science Foundation of Guangdong Province	10
Natural Science Foundation of Beijing	9
Natural Science Foundation of Hubei Province	8
Cross - century Talent Training Program	7
National Social Science Fund	6
Natural Science Foundation of Shaanxi Province	6
Natural Science Foundation of Shandong Province	6
Natural Science Foundation of Hebei Province	6
National Defense Science and Technology Advance Research Fund	6
Natural Science Foundation of Jiangsu Province	5
Basic research on major projects	4
Applied Basic Research Fund of Sichuan Province	4
Natural Science Foundation of Hunan Province	4
Sichuan Youth Science and Technology Fund	4

The general university natural science research plan of Jiangsu Province	3
Cheung Kong Scholars Program	3
International Science and Technology Cooperation Program	3
Zhejiang Science and Technology Department Fund	3
Science and Technology Fund of Liaoning Province	3
Natural Science Foundation of Gansu Province	3
Science and Technology Project of Hubei Province	2
Science and Technology Project of Heilongjiang Province	2
China Postdoctoral Science Foundation	2
Science and Technology Project of Shaanxi Province	2
Youth Science and Technology Research Fund of Shanxi Province	2
Fund Support Program for Key Teachers in Colleges and Universities	2
Natural Science Foundation of Shanxi Province	2
Outstanding young college teachers teaching and research awards	2
Science and Technology Development Fund of Beijing Education Commission	2
Science and Technology Development Plan Fund of Jilin Province	2
Aviation Science Fund	2
Electronic Information Industry Development Fund	2
Hong Kong Research Grants Council funded projects	2

Table 2 The number of Ph.D. dissertations sponsored by the top 40 funds

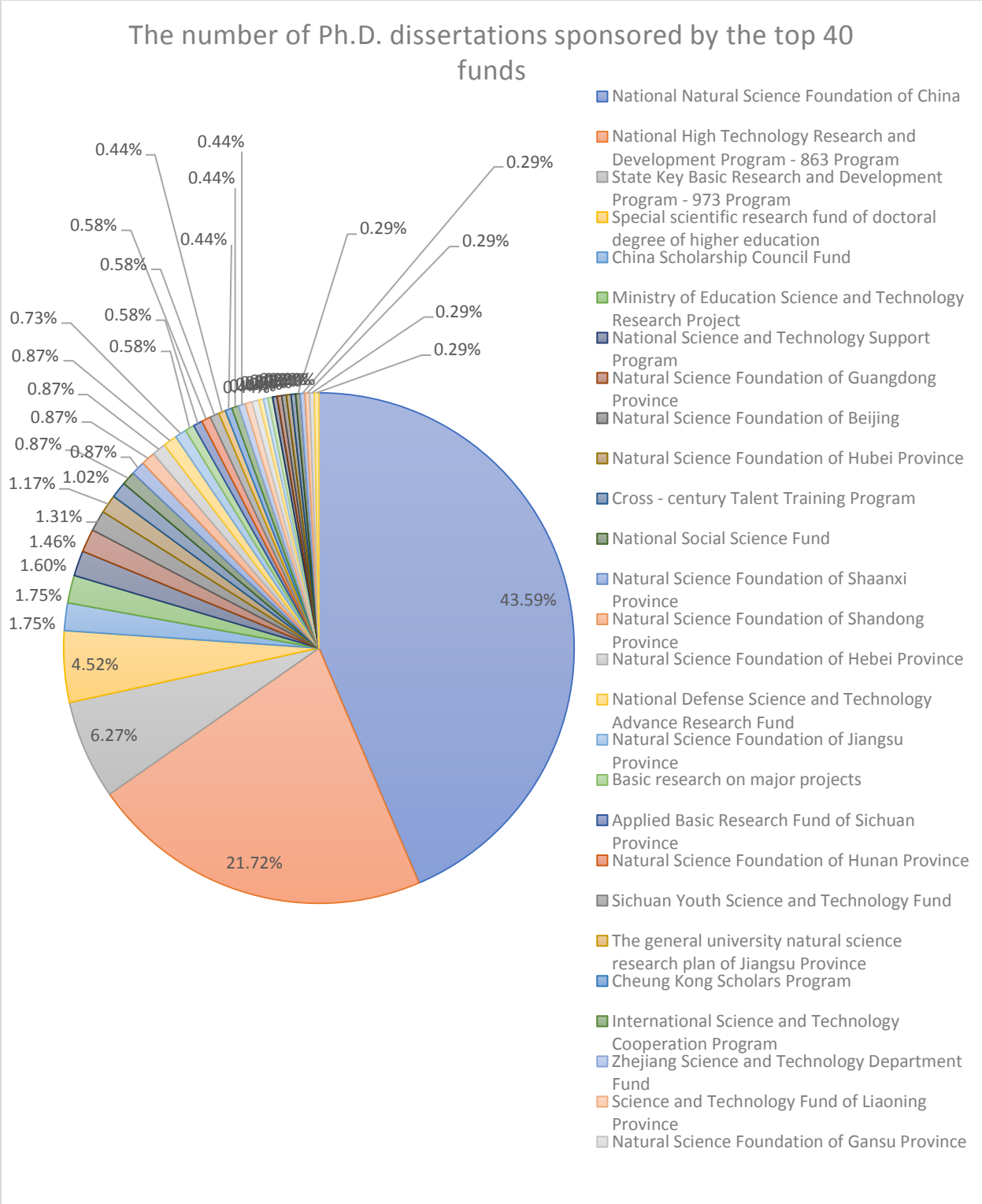


Figure 2 The number of Ph.D. dissertations sponsored by the top 40 funds and ratios they have

3. The number of Ph.D. dissertations from different research levels

Research Level	Quantity
Engineering Technology (Natural Sciences)	1251
Fundamental and Applied Basic Research (Natural Sciences)	430
Basic Research (Social Sciences)	109
Policy Research (Social Sciences)	29
Industry Guidance (Social Sciences)	26
Industry Technical Guidance (Natural Sciences)	4
Career Guidance (Social Sciences)	4
Basic education and secondary vocational education	1

Table 3 The number of Ph.D. dissertations from different research levels

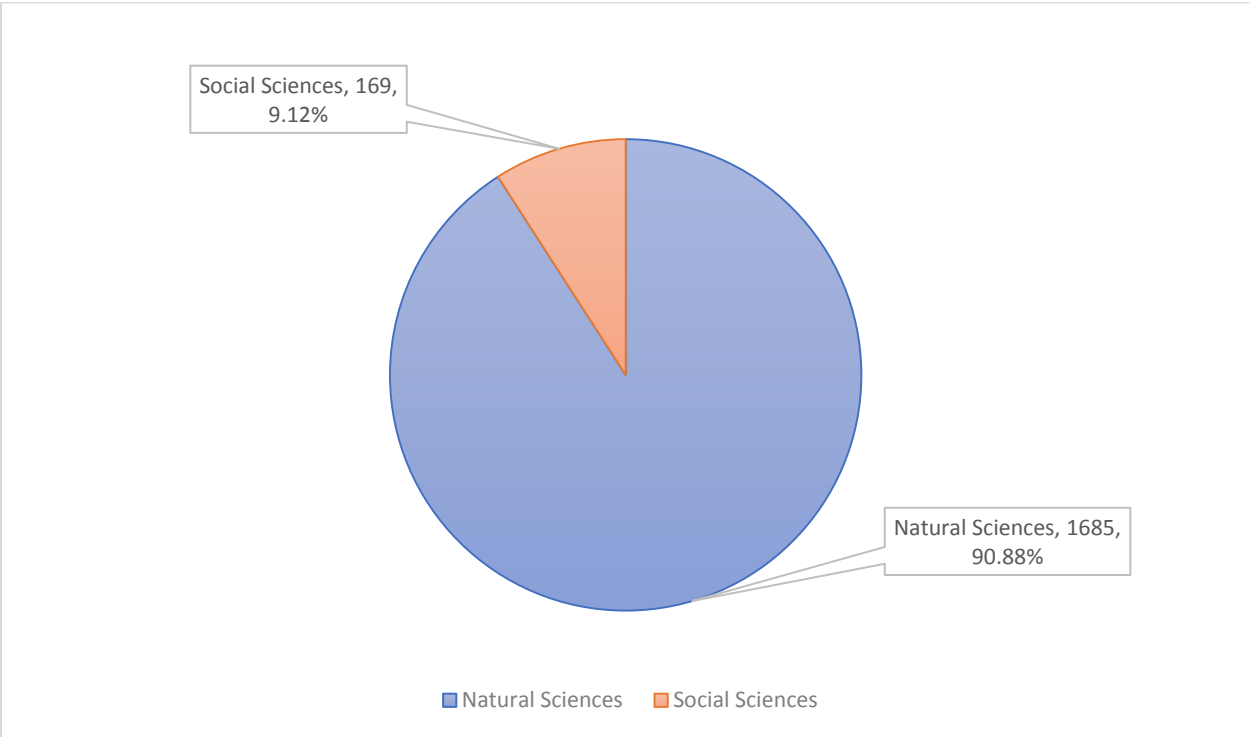
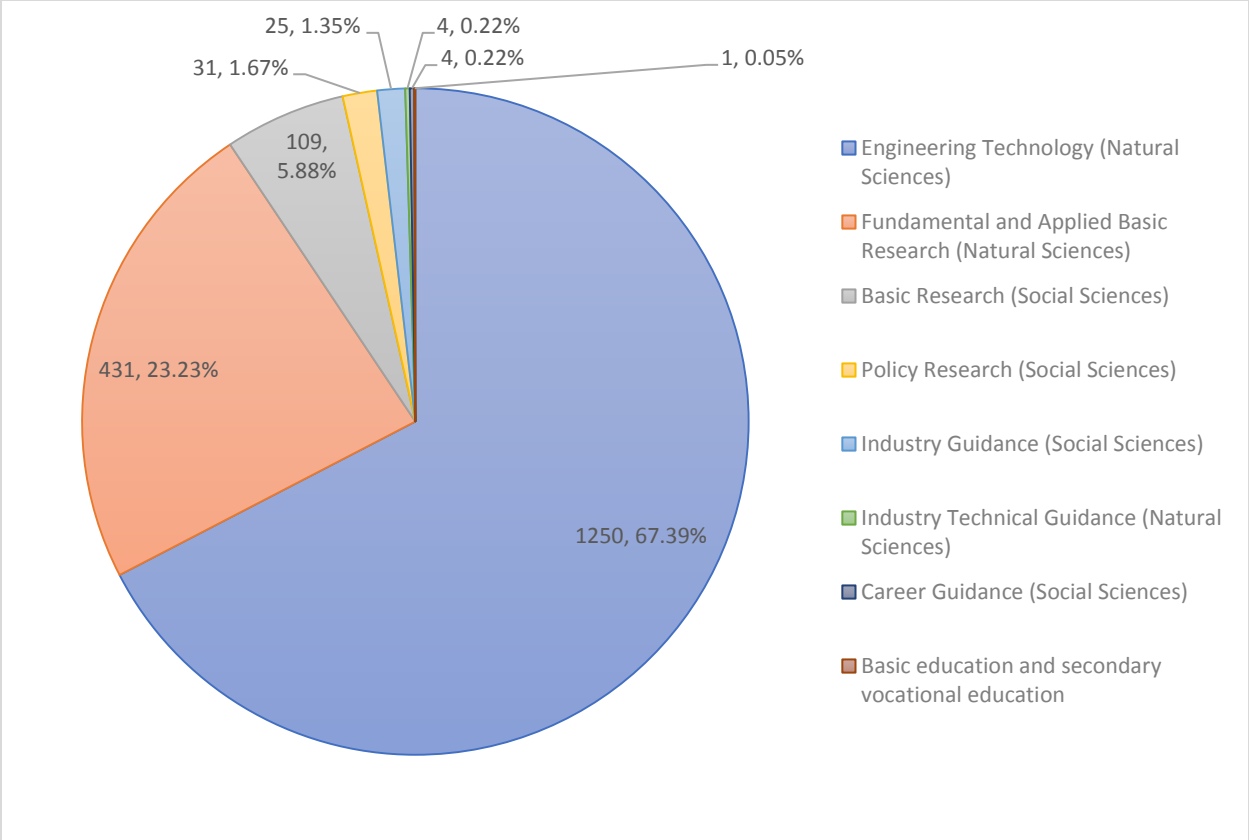


Figure 3 The number of Ph.D. dissertations from different research areas and ratios they have

4. The number of Ph.D. dissertations from Top 20 specialties

Specialty name	Quantity	Rate
Computer Application Technology	398	21.46%
Communication and Information System	234	12.62%
Computer Software and Theory	132	7.12%
Computer Architecture	126	6.80%
Computer science and Technology	110	5.93%
Cryptography	91	4.91%
Signal and information processing	73	3.94%
Management Science and Engineering	68	3.67%
Control theory and control engineering	60	3.24%
Circuits and Systems	36	1.94%
applied mathematics	35	1.89%
Information and Communication Engineering	28	1.51%
Power System and Automation	22	1.19%
Traffic Information Engineering and Control	19	1.02%
Optics	17	0.92%
Microelectronics and Solid-State Electronics	16	0.86%
Mechatronic Engineering	13	0.70%
Mechanical design and theory	12	0.65%
Physical electronics	12	0.65%
Pattern recognition and intelligent system	11	0.59%

Table 4 The number of Ph.D. dissertations from Top 20 specialties

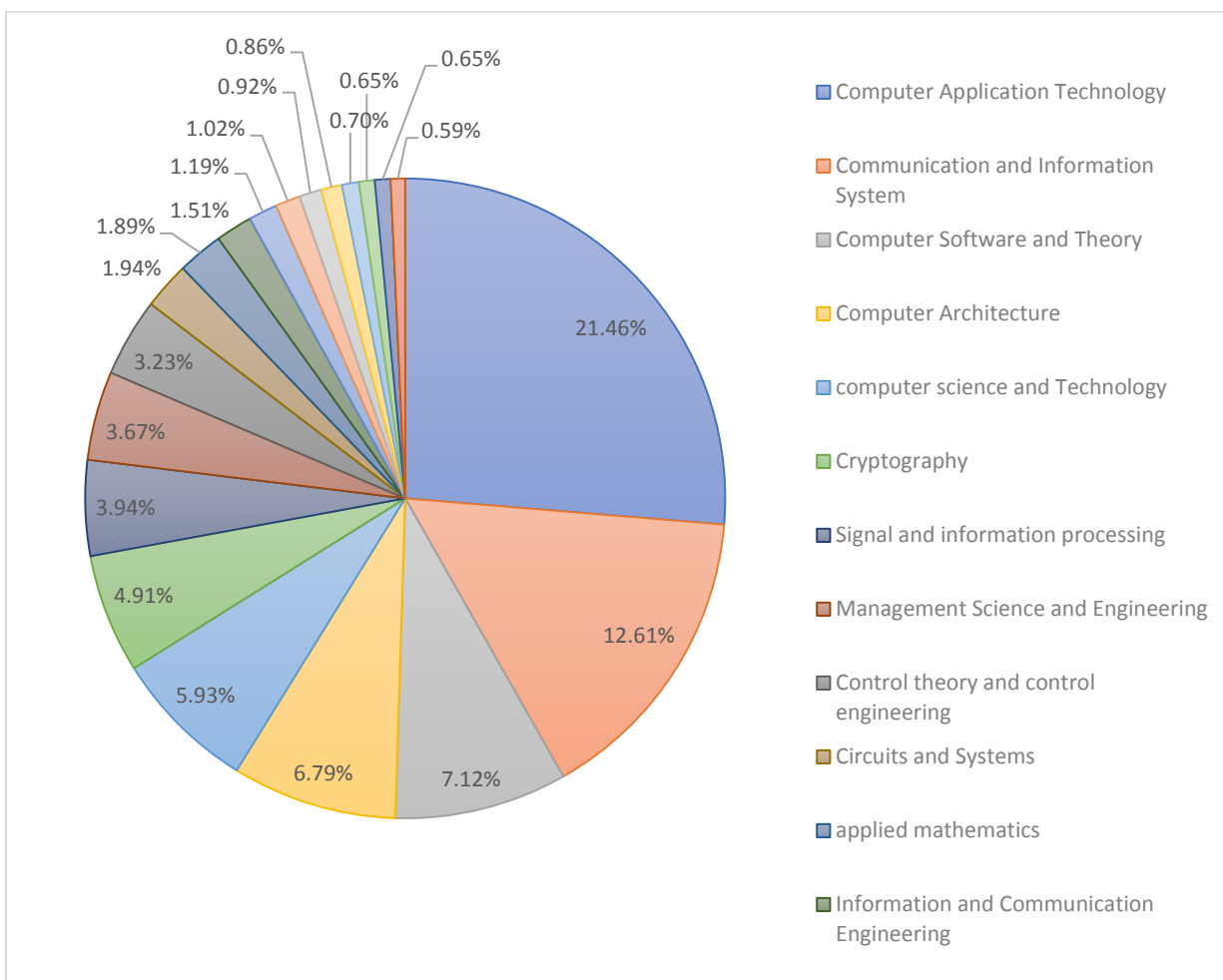
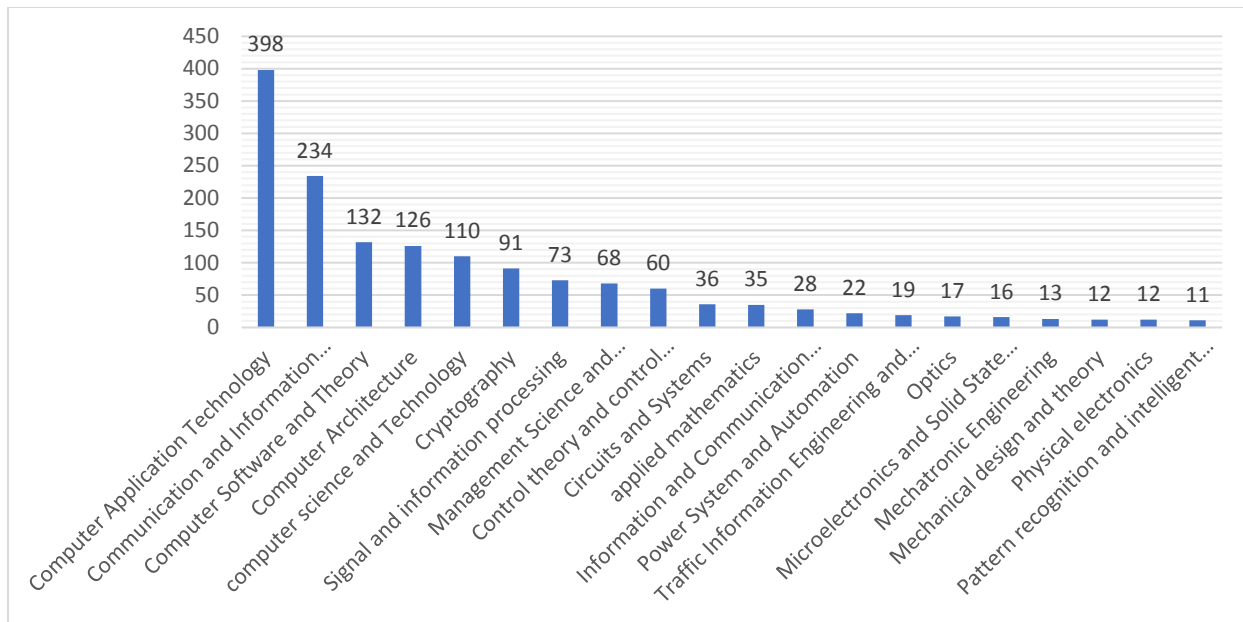
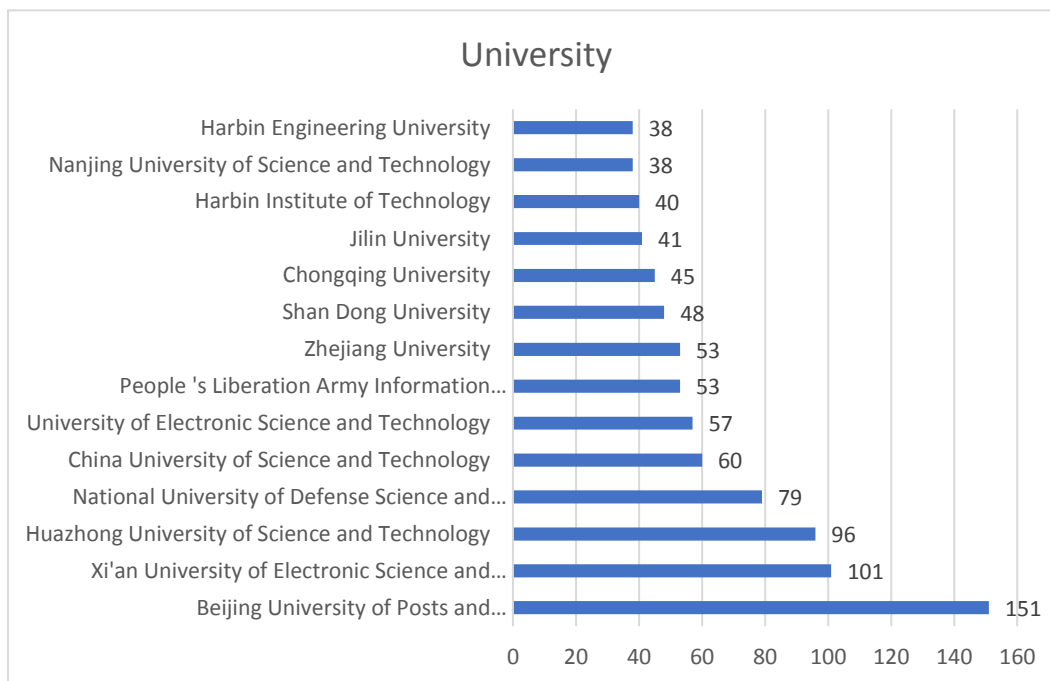


Figure 4 The number of Ph.D. dissertations from Top 20 specialties and ratios they have

5. The number of Ph.D. dissertations from Top 15 Universities

University	Quantity	Rate
Beijing University of Posts and Telecommunications	151	8.14%
Xi'an University of Electronic Science and Technology	101	5.44%
Huazhong University of Science and Technology	96	5.18%
National University of Defense Science and Technology	79	4.26%
China University of Science and Technology	60	3.23%
University of Electronic Science and Technology	57	3.07%
People 's Liberation Army Information Engineering University	53	2.86%
Zhejiang University	53	2.86%
Shan Dong University	48	2.59%
Chongqing University	45	2.43%
Jilin University	41	2.21%
Harbin Institute of Technology	40	2.16%
Nanjing University of Science and Technology	38	2.05%
Harbin Engineering University	38	2.05%

Table 5 The number of Ph.D. dissertations from Top 15 Universities



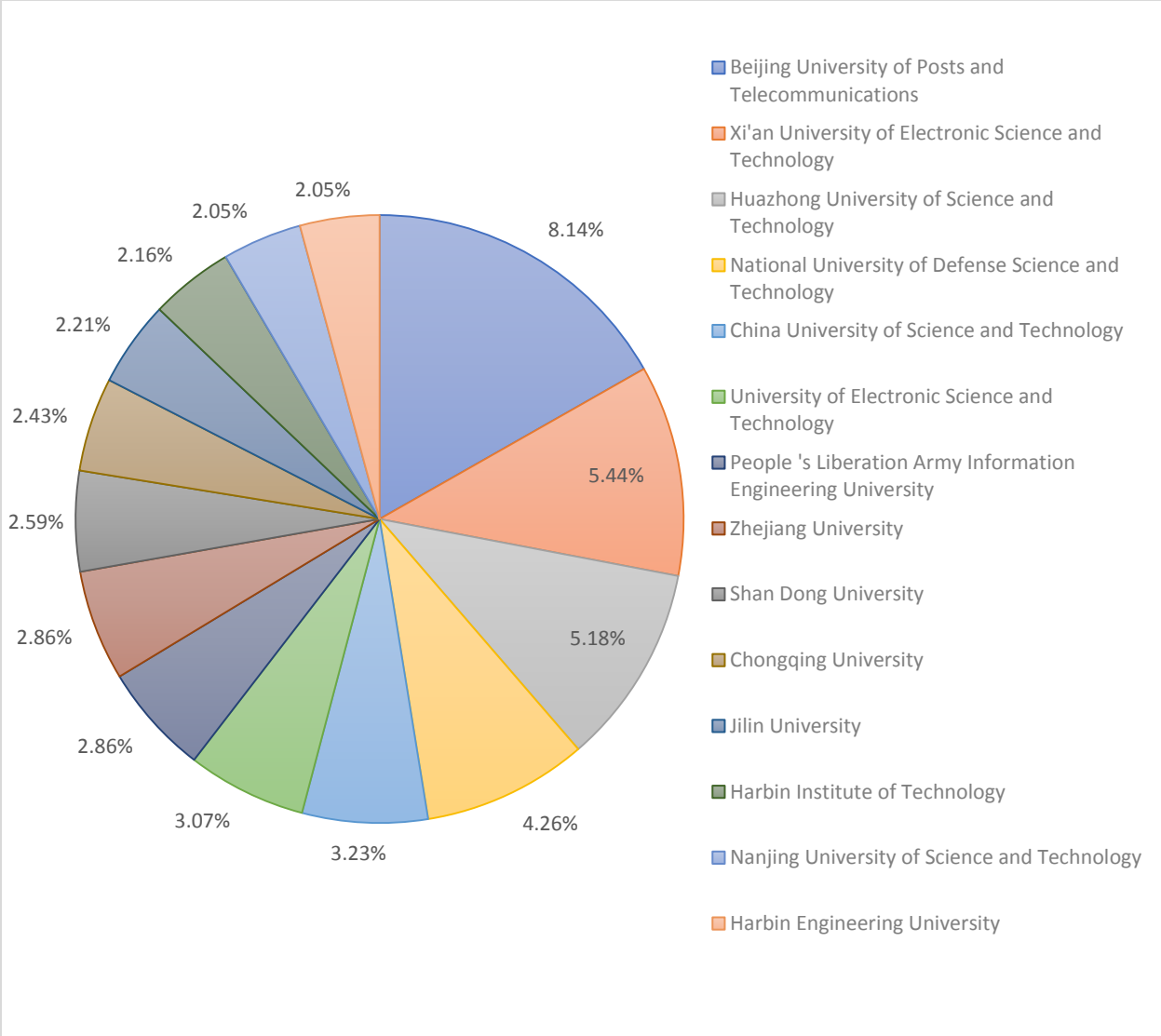


Figure 5 The number of Ph.D. dissertations from Top 15 Universities and ratios they have

Part Two Quantum Computing/Quantum Communication

The paper adopts the way of subject searching to obtain the data from CNKI's China Doctoral Dissertations Full-text Database. Subject searching, in CNKI, means searching a term in article titles, keywords, and abstracts. The paper searched for “subject: “量子计算” (quantum computing) OR “量子通信” (quantum communication)” and obtained 770 Ph.D. dissertations. The time span is from 1999 – 2016.

1. The number of Ph.D. dissertations completed in each year from 1999- 2016

Year	Quantity	Year	Quantity
1999	4	2008	55
2000	1	2009	68
2001	2	2010	57
2002	1	2011	58
2003	7	2012	79
2004	7	2013	77
2005	12	2014	92
2006	20	2015	100
2007	52	2016	78

Table 6 The number of Ph.D. dissertations completed in each year from 1999-2016

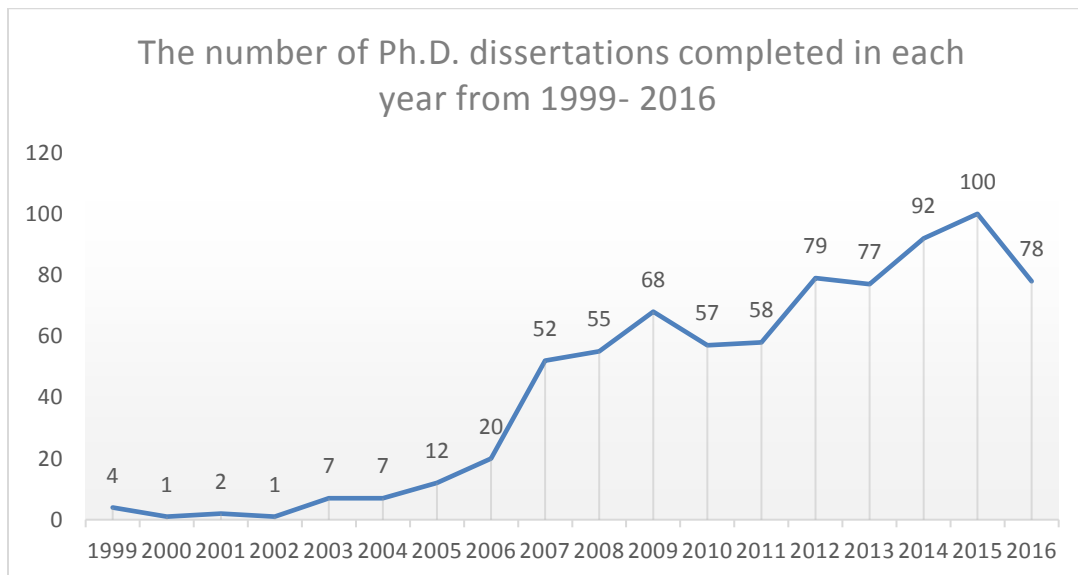


Figure 6 The number of Ph.D. dissertations completed in each year from 1999-2016

2. The number of Ph.D. dissertations sponsored by the top 25 funds

Name of the fund	Quantity
National Natural Science Foundation of China	67
State Key Basic Research & Development 973 Program	9
National High Technology Research& Development 863 Program	8
Special scientific research fund of doctoral degree	7
China Scholarship Council Fund	6
Knowledge innovation project of Chinese Academy of Sciences	4
Cheung Kong Scholars Program	3
Hong Kong Research Grants Council funded projects	2
Natural Science Foundation of Hebei Province	2
Science and Technology Project of Heilongjiang Province	1
National Defense Science & Technology Advanced Research Fund	1
National key laboratory construction project plan	1
Natural Science Foundation of Anhui Province	1
Natural Science Foundation of Beijing	1
Shanghai education commission dawn project	1
Natural Science Foundation of Jiangsu Province	1
Fok Ying Tung education foundation	1
Science and Technology Development Plan Fund Jilin Province	1
Natural Science Foundation of Hunan Province	1
Natural Science Foundation of Shandong Province	1
Natural Science Foundation of Hubei Province	1
Natural Science Foundation of Shanghai	1
Cross - century Talent Training Program	1
National science and technology breakthrough plan	1
National Science and Technology Support Program	1

Table 7 The number of Ph.D. dissertations sponsored by the top 25 funds

The number of Ph.D. dissertations sponsored by the top 25 funds

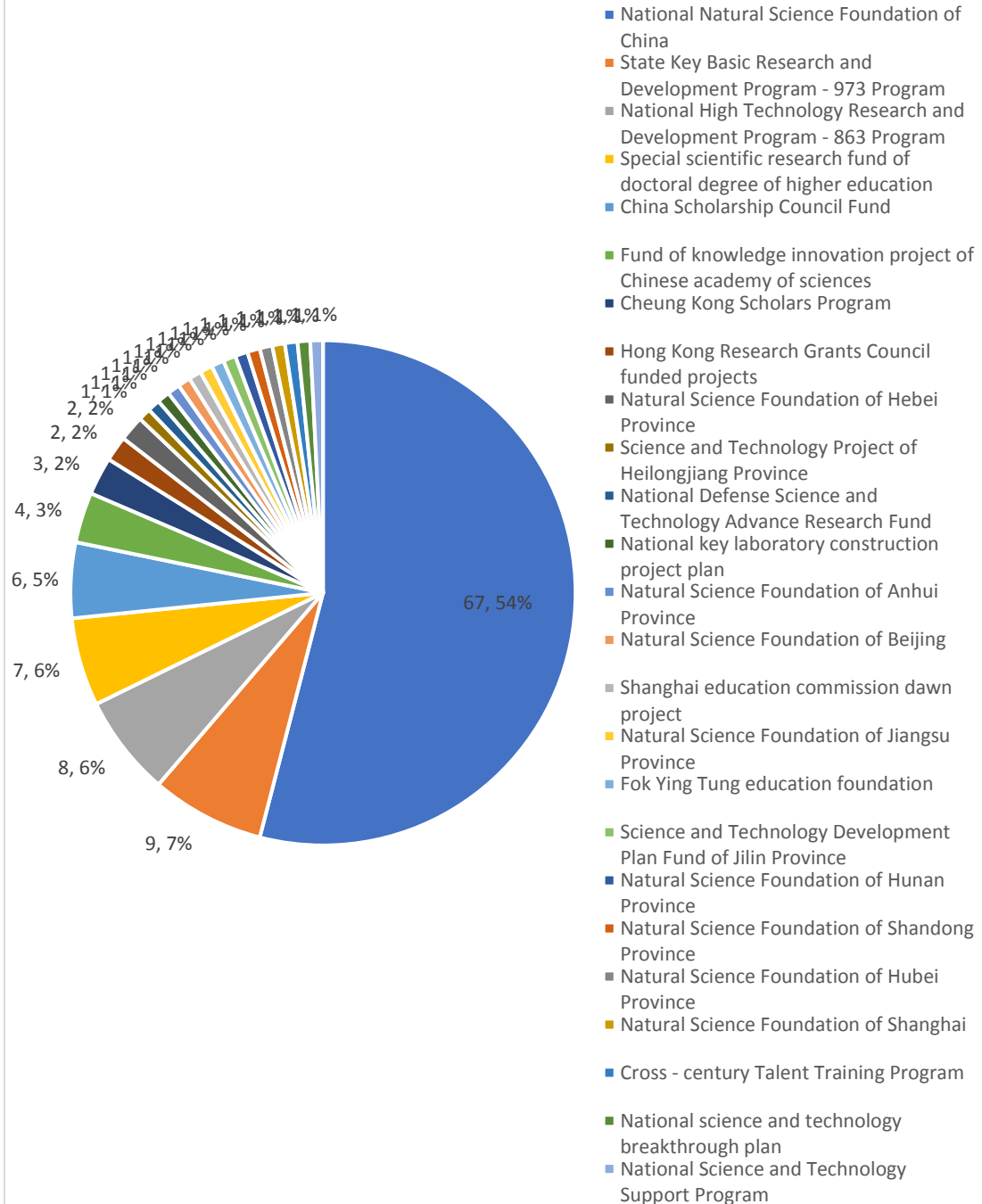
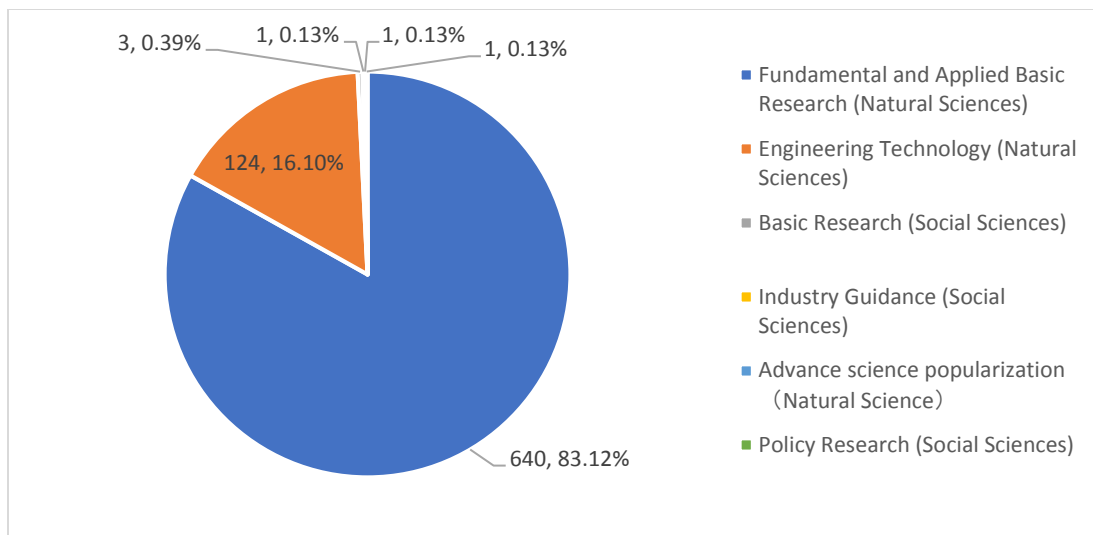


Figure 7 The number of Ph.D. dissertations sponsored by the top 25 funds and ratios they have

3. The number of Ph.D. dissertations from different research levels

Research Level	Quantity
Fundamental and Applied Basic Research (Natural Sciences)	640
Engineering Technology (Natural Sciences)	124
Basic Research (Social Sciences)	3
Industry Guidance (Social Sciences)	1
Advance science popularization (Natural Science)	1
Policy Research (Social Sciences)	1

Table 8 The number of Ph.D. dissertations from different research levels



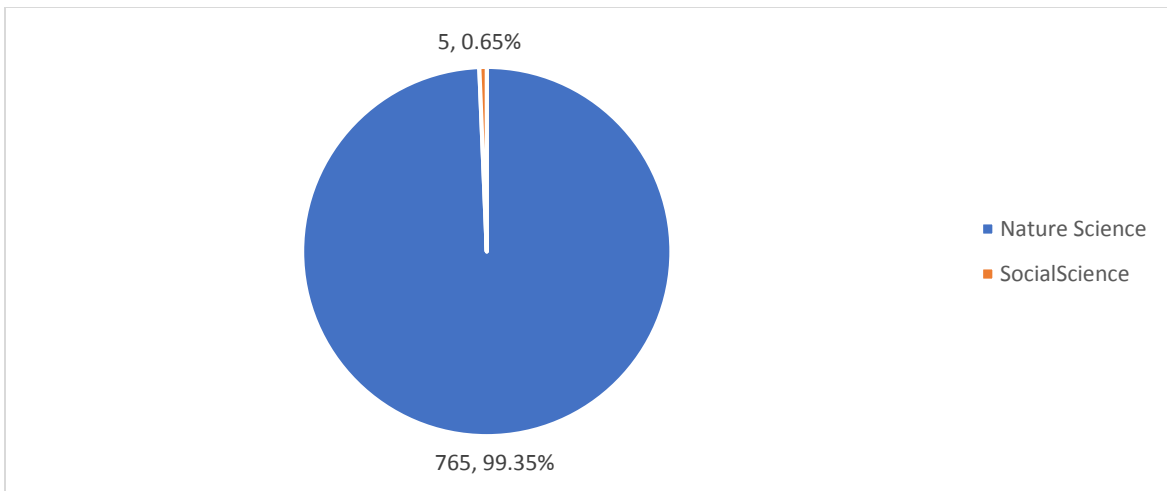
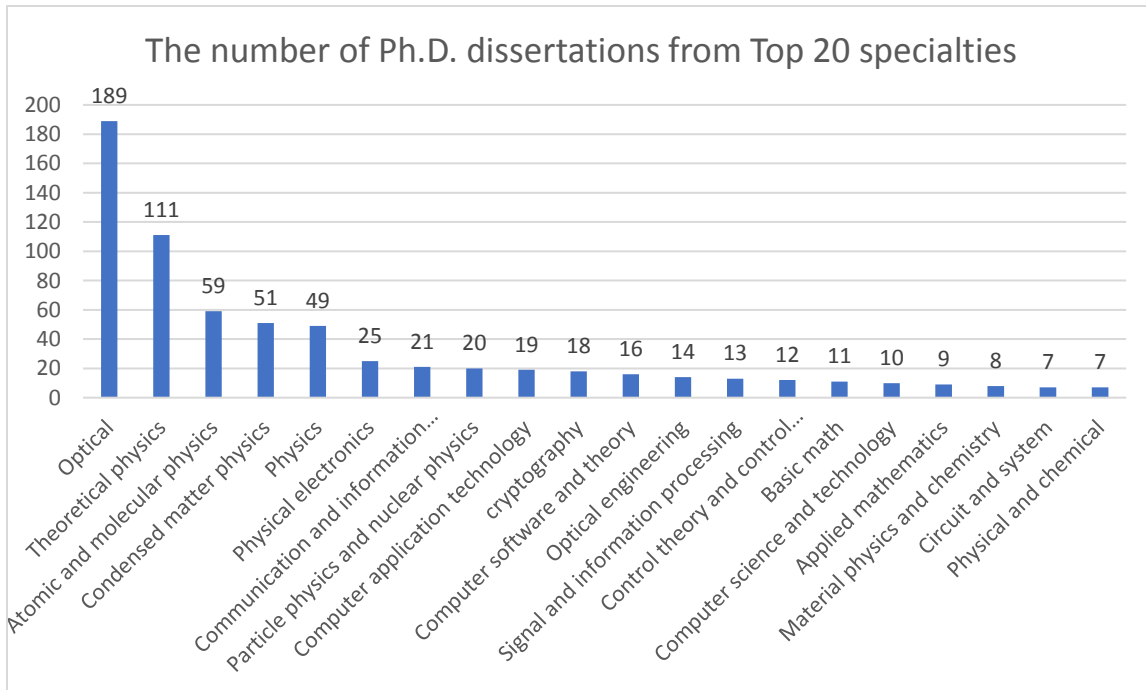


Figure 8 The number of Ph.D. dissertations from different research levels and ratios they have

4. The number of Ph.D. dissertations from Top 20 specialties

Specialty name	Quantity	Rate
Optical	189	24.55%
Theoretical physics	111	14.42%
Atomic and molecular physics	59	7.66%
Condensed matter physics	51	6.62%
Physics	49	6.36%
Physical electronics	25	3.25%
Communication and information systems	21	2.73%
Particle physics and nuclear physics	20	2.60%
Computer application technology	19	2.47%
cryptography	18	2.34%
Computer software and theory	16	2.08%
Optical engineering	14	1.82%
Signal and information processing	13	1.69%
Control theory and control engineering	12	1.56%
Basic math	11	1.43%
Computer science and technology	10	1.30%
Applied mathematics	9	1.17%
Material physics and chemistry	8	1.04%
Circuit and system	7	0.91%
Physical and chemical	7	0.91%

Table 9 The number of Ph.D. dissertations from Top 20 specialties



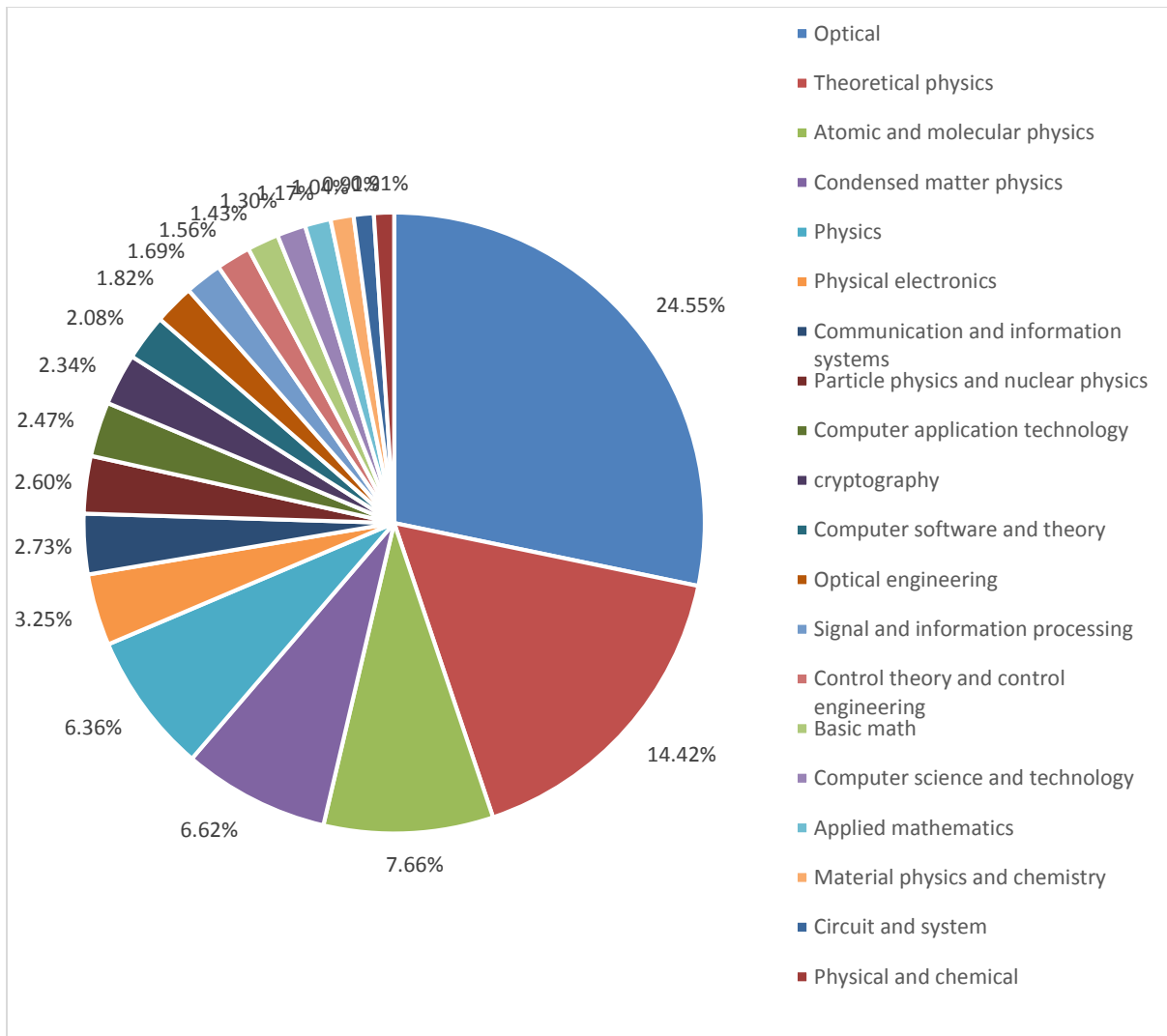
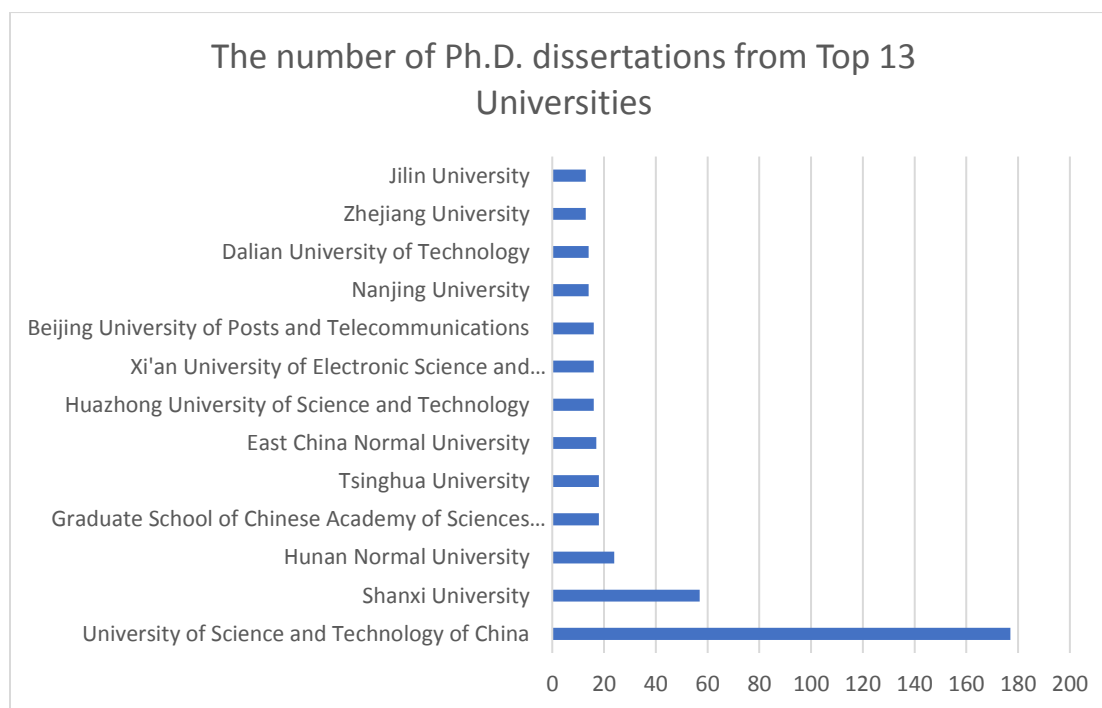


Figure 9 The number of Ph.D. dissertations from Top 20 specialties and ratios they have

5. The number of Ph.D. dissertations from Top 13 Universities

University	Quantity	Rate
University of Science and Technology of China	177	22.99%
Shanxi University	57	7.40%
Hunan Normal University	24	3.12%
Graduate School of Chinese Academy of Sciences Wuhan Institute of Physics and Mathematics	18	2.34%
Tsinghua University	18	2.34%
East China Normal University	17	2.21%
Huazhong University of Science and Technology	16	2.08%
Xi'an University of Electronic Science and Technology	16	2.08%
Beijing University of Posts and Telecommunications	16	2.08%
Nanjing University	14	1.82%
Dalian University of Technology	14	1.82%
Zhejiang University	13	1.69%
Jilin University	13	1.69%

Table 10 The number of Ph.D. dissertations from Top 13 Universities



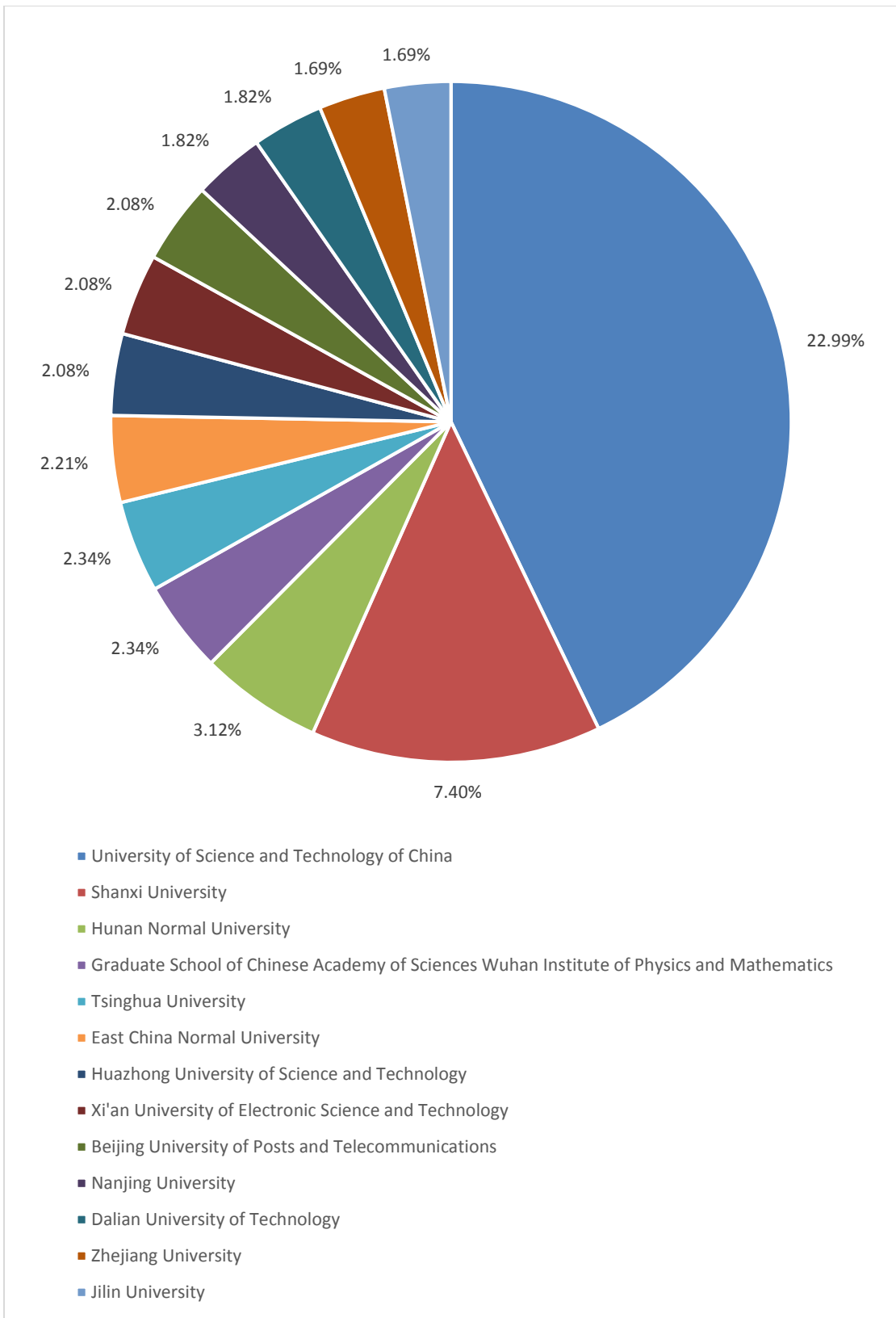


Figure 10 The number of Ph.D. dissertations from Top 13 Universities and ratios they have

Part Three Artificial Intelligence

The paper adopts the way of subject searching to obtain the data from CNKI's China Doctoral Dissertations Full-text Database. Subject searching, in CNKI, means searching a term in article titles, keywords, and abstracts. The paper searched for “subject: ‘人工智能’ (artificial intelligence),” and obtained 1977 Ph.D. dissertations. The time span is from 1999 to 2016.

1. The number of Ph.D. dissertations completed in each year from 1999 to 2016

Year	Quantity	Year	Quantity
1999	9	2008	147
2000	17	2009	154
2001	30	2010	172
2002	62	2011	162
2003	69	2012	161
2004	109	2013	141
2005	122	2014	116
2006	153	2015	109
2007	149	2016	95

Table 11 The number of Ph.D. dissertations completed in each year from 1999-2016

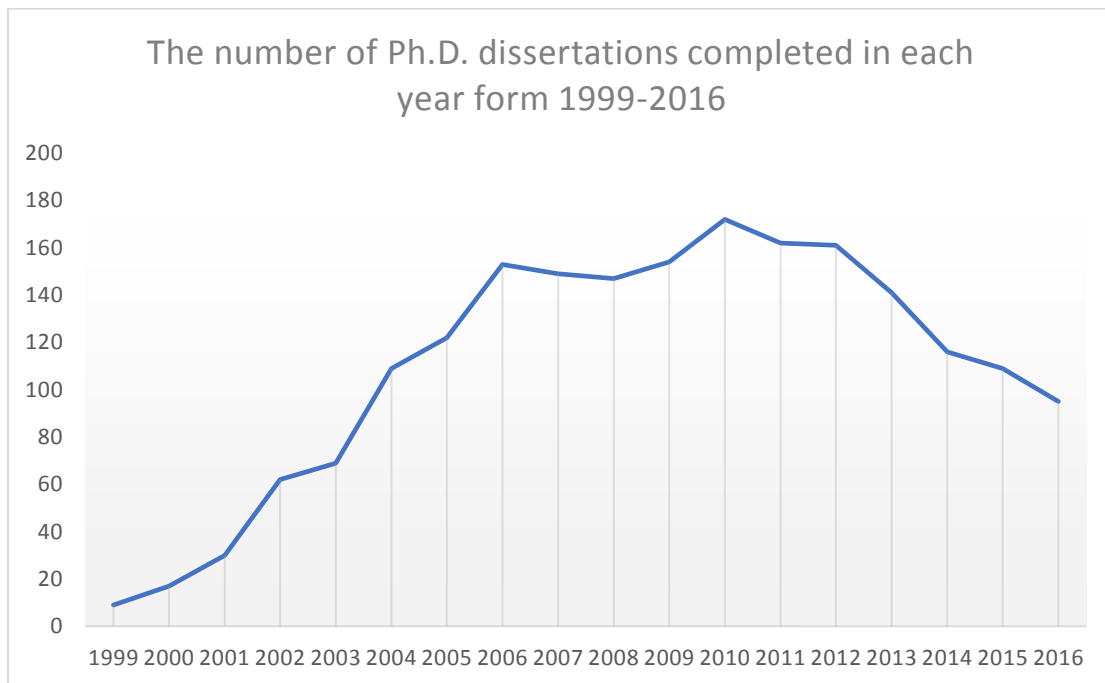


Figure 11 The number of Ph.D. dissertations completed in each year from 1999-2016

2. The number of Ph.D. dissertations sponsored by the top 40 funds

Name of the fund	Quantity
National Natural Science Foundation of China	313
National High Technology Research and Development Program - 863 Program	93
State Key Basic Research and Development Program - 973 Program	52
Special scientific research fund of doctoral degree of higher education	45
National Science and Technology Support Program	21
National science and technology breakthrough plan	13
China Scholarship Council Fund	11
Natural Science Foundation of Guangdong Province	8
Natural Science Foundation of Zhejiang Province	7
Cross - century Talent Training Program	7
Science and Technology Project of Hubei Province	7
Ministry of Education Science and Technology Research Project	6
Natural Science Foundation of Hebei Province	6
Natural Science Foundation of Chongqing	6
Shanghai science and technology development fund	5
Science and Technology Fund of Liaoning Province	5
Natural Science Foundation of Beijing	5
Natural Science Foundation of Shanxi Province	4
National technology innovation fund for small and medium enterprises	4
Natural Science Foundation of Hubei Province	4
Science and technology R&D project of the ministry of railway	4
Natural Science Foundation of Shandong Province	3
Chongqing science and technology breakthrough plan	3
Natural Science Foundation of Jiangsu Province	3
International science and technology cooperation key project plan	3
Shanghai science and technology breakthrough plan	3
Guangxi science fund	3
National Defense Science and Technology Advance Research Fund	3
China Postdoctoral Science Foundation	3
Zhejiang education commission research fund	3
Funding plan for university backbone teachers	3
Guangdong Province science and technology breakthrough plan	2
Cheung Kong Scholars Program	2
Shanxi Province scientific research fund for returned Chinese scholars	2
Science and Technology Development Plan Fund of Jilin Province	2
National soft science research program	2

Special plans for the basic work of science and technology	2
Pre-research fund for weapons and equipment	2
National defense fundamental research program	2
Hong Kong Research Grants Council funded projects	2

Table 12 The number of Ph.D. dissertations sponsored by the top 40 funds

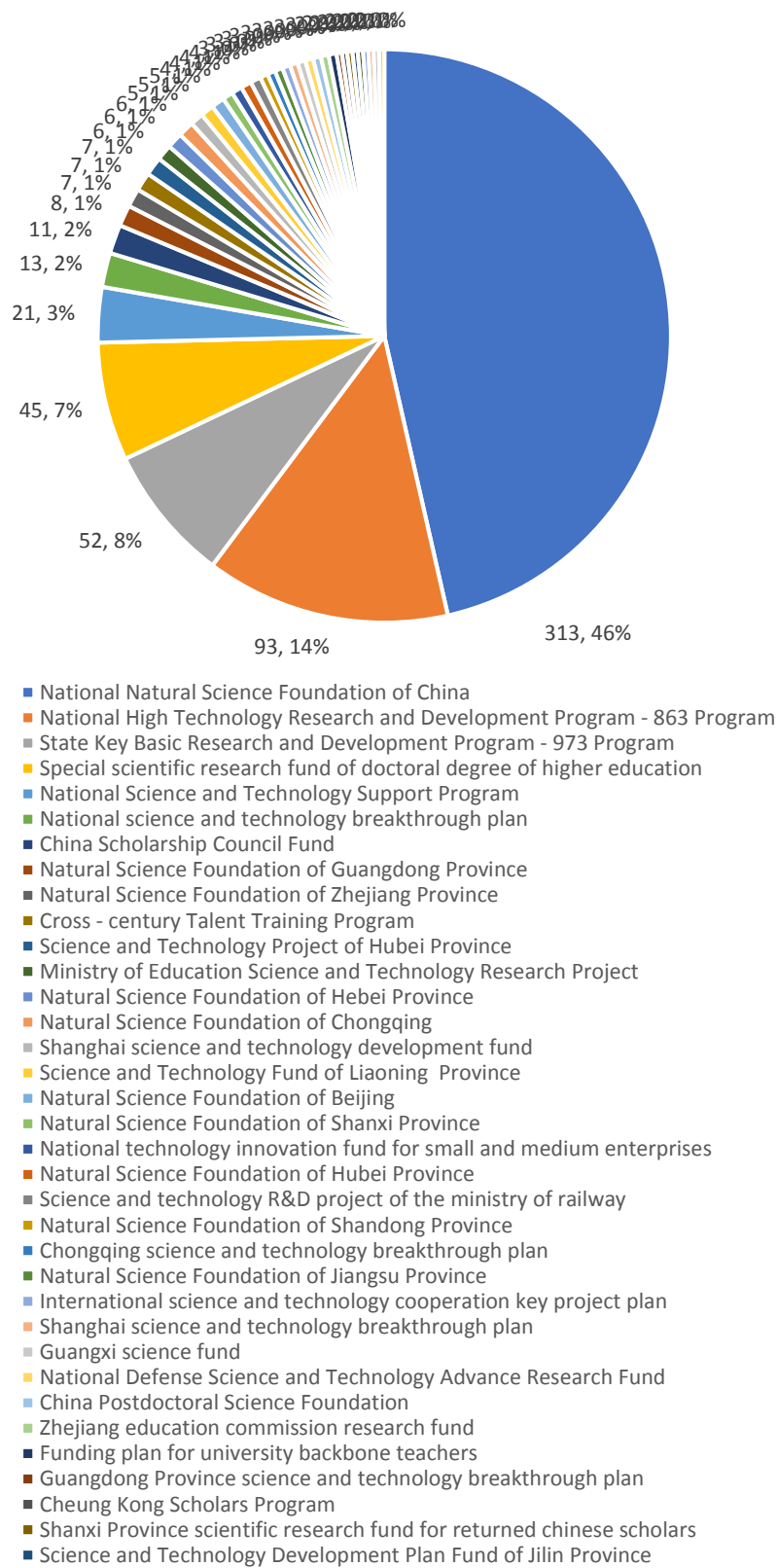


Figure 12 The number of Ph.D. dissertations sponsored by the top 40 funds and ratios they have

3. The number of Ph.D. dissertations from different research levels

Research Level	Quantity
Engineering Technology (Natural Sciences)	1018
Fundamental and Applied Basic Research (Natural Sciences)	714
Basic Research (Social Sciences)	207
Industry Guidance (Social Sciences)	15
Industry Technical Guidance (Natural Sciences)	9
Policy Research (Social Sciences)	8
Career Guidance (Social Sciences)	4
Practical techniques (Natural Sciences)	2

Table 13 The number of Ph.D. dissertations from different research levels

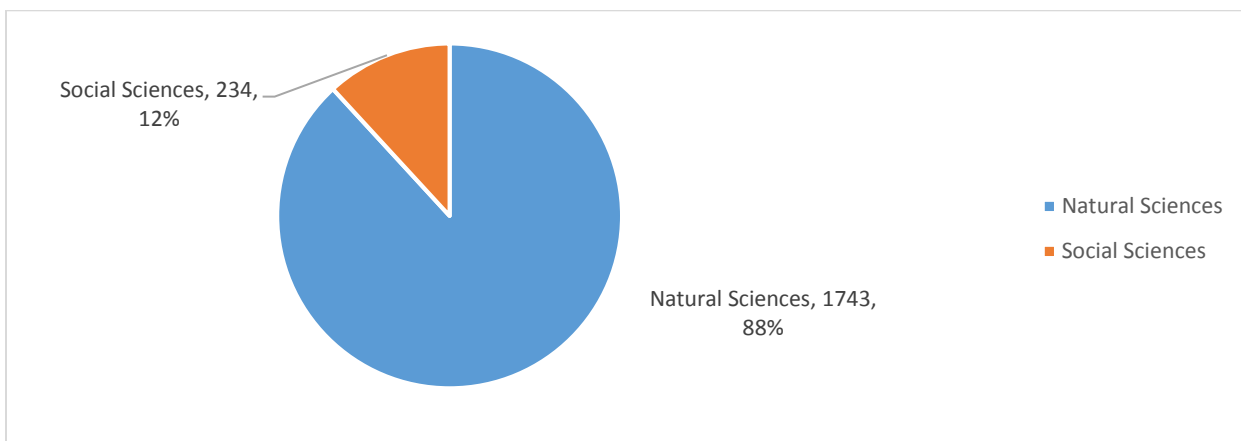
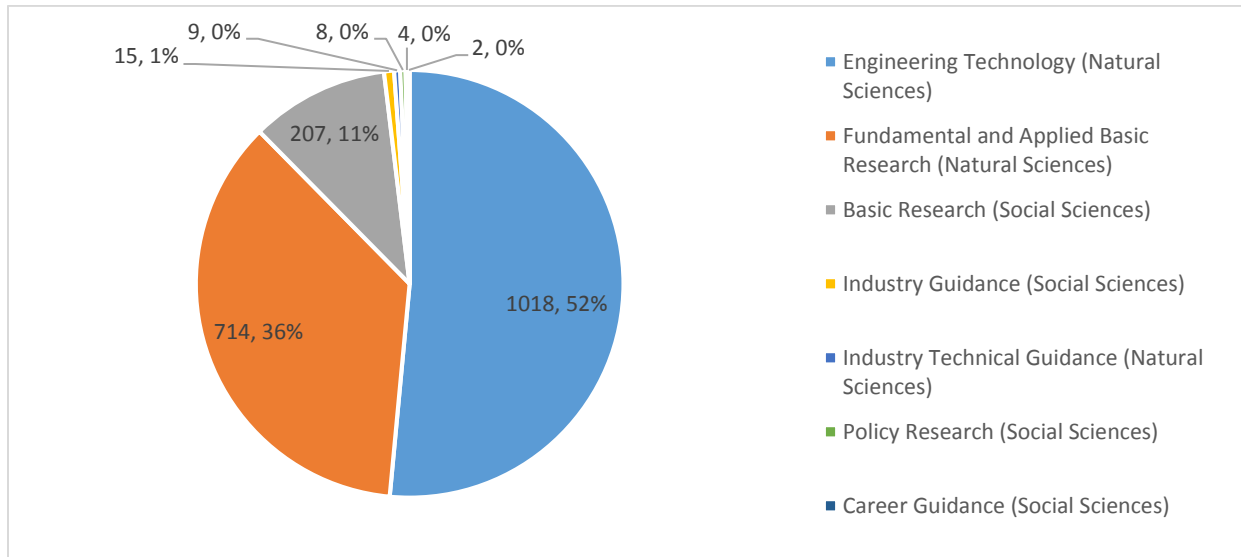
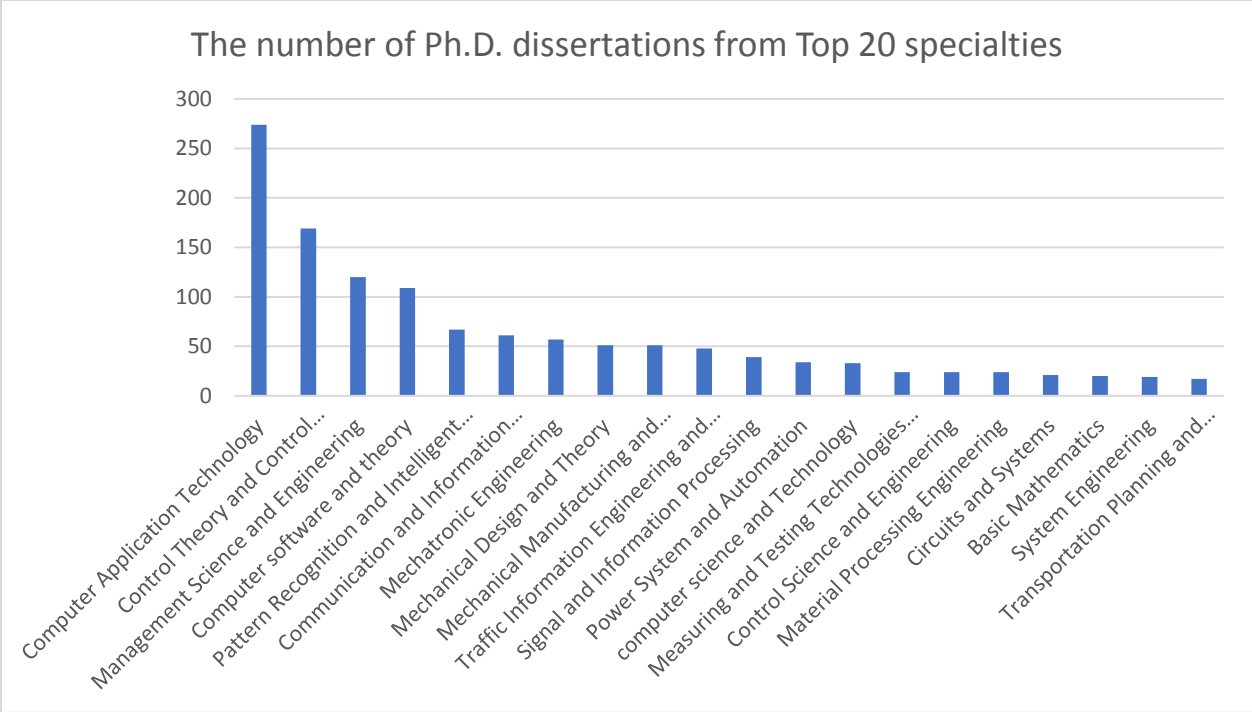


Figure 13 The number of Ph.D. dissertations from different research levels

4. The number of Ph.D. dissertations from Top 20 specialties

Specialty name	Quantity	Rate
Computer Application Technology	274	13.86%
Control Theory and Control Engineering	169	8.55%
Management Science and Engineering	120	6.07%
Computer software and theory	109	5.51%
Pattern Recognition and Intelligent Systems	67	3.39%
Communication and Information System	61	3.09%
Mechatronic Engineering	57	2.88%
Mechanical Design and Theory	51	2.58%
Mechanical Manufacturing and Automation	51	2.58%
Traffic Information Engineering and Control	48	2.43%
Signal and Information Processing	39	1.97%
Power System and Automation	34	1.72%
computer science and Technology	33	1.67%
Measuring and Testing Technologies and Instruments	24	1.21%
Control Science and Engineering	24	1.21%
Material Processing Engineering	24	1.21%
Circuits and Systems	21	1.06%
Basic Mathematics	20	1.01%
System Engineering	19	0.96%
Transportation Planning and Management	17	0.86%

Table 14 The number of Ph.D. dissertations from Top 20 specialties



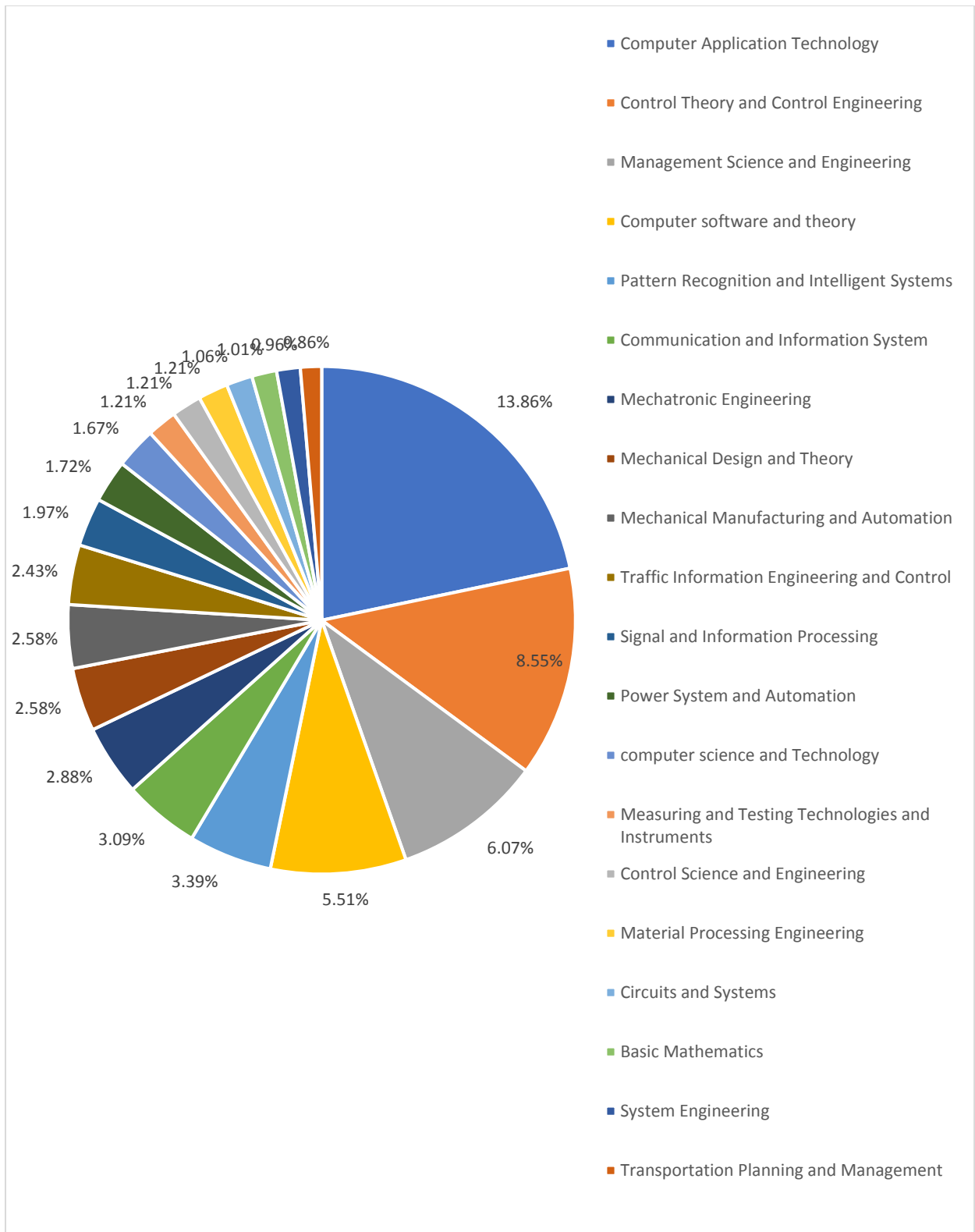
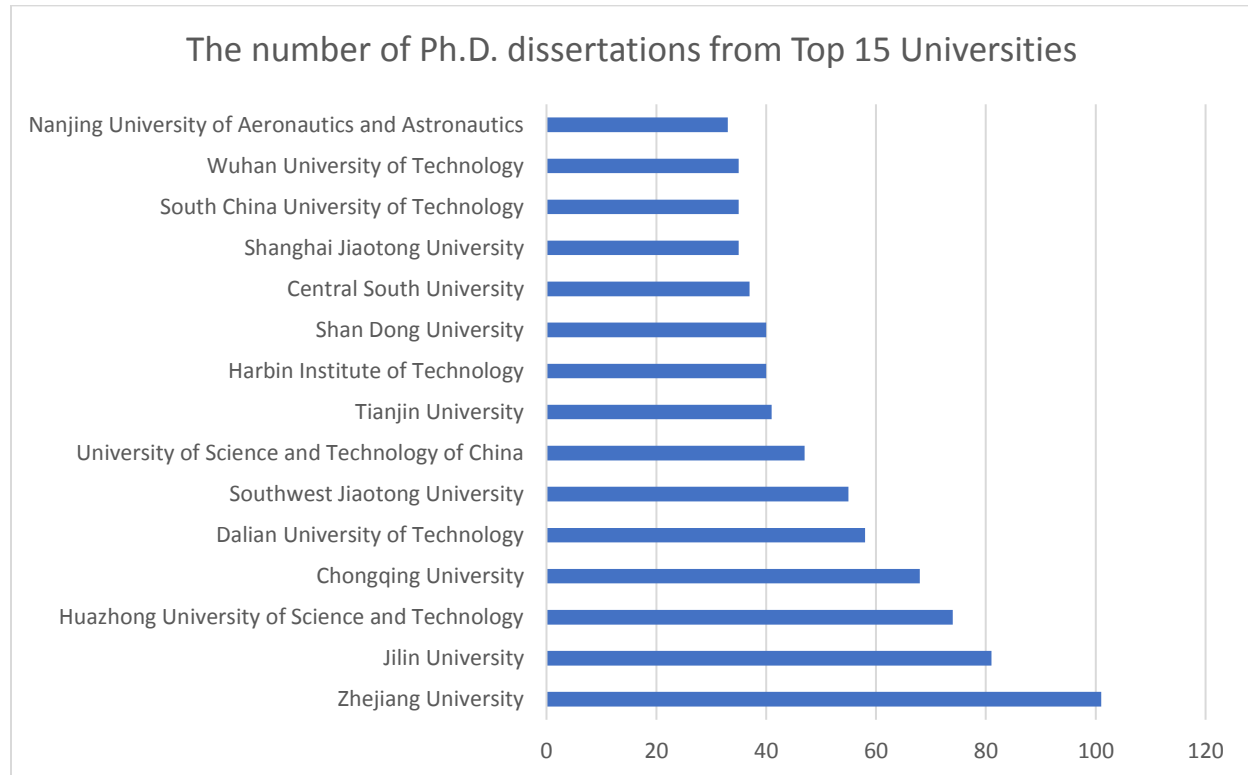


Figure 14 The number of Ph.D. dissertations from Top 20 specialties and ratios they have

5. The number of Ph.D. dissertations from Top 15 Universities

University	Quantity	Rate
Zhejiang University	101	5.11%
Jilin University	81	4.10%
Huazhong University of Science and Technology	74	3.74%
Chongqing University	68	3.44%
Dalian University of Technology	58	2.93%
Southwest Jiaotong University	55	2.78%
University of Science and Technology of China	47	2.38%
Tianjin University	41	2.07%
Harbin Institute of Technology	40	2.02%
Shan Dong University	40	2.02%
Central South University	37	1.87%
Shanghai Jiaotong University	35	1.77%
South China University of Technology	35	1.77%
Wuhan University of Technology	35	1.77%
Nanjing University of Aeronautics and Astronautics	33	1.67%

Table 15 The number of Ph.D. dissertations from Top 15 Universities



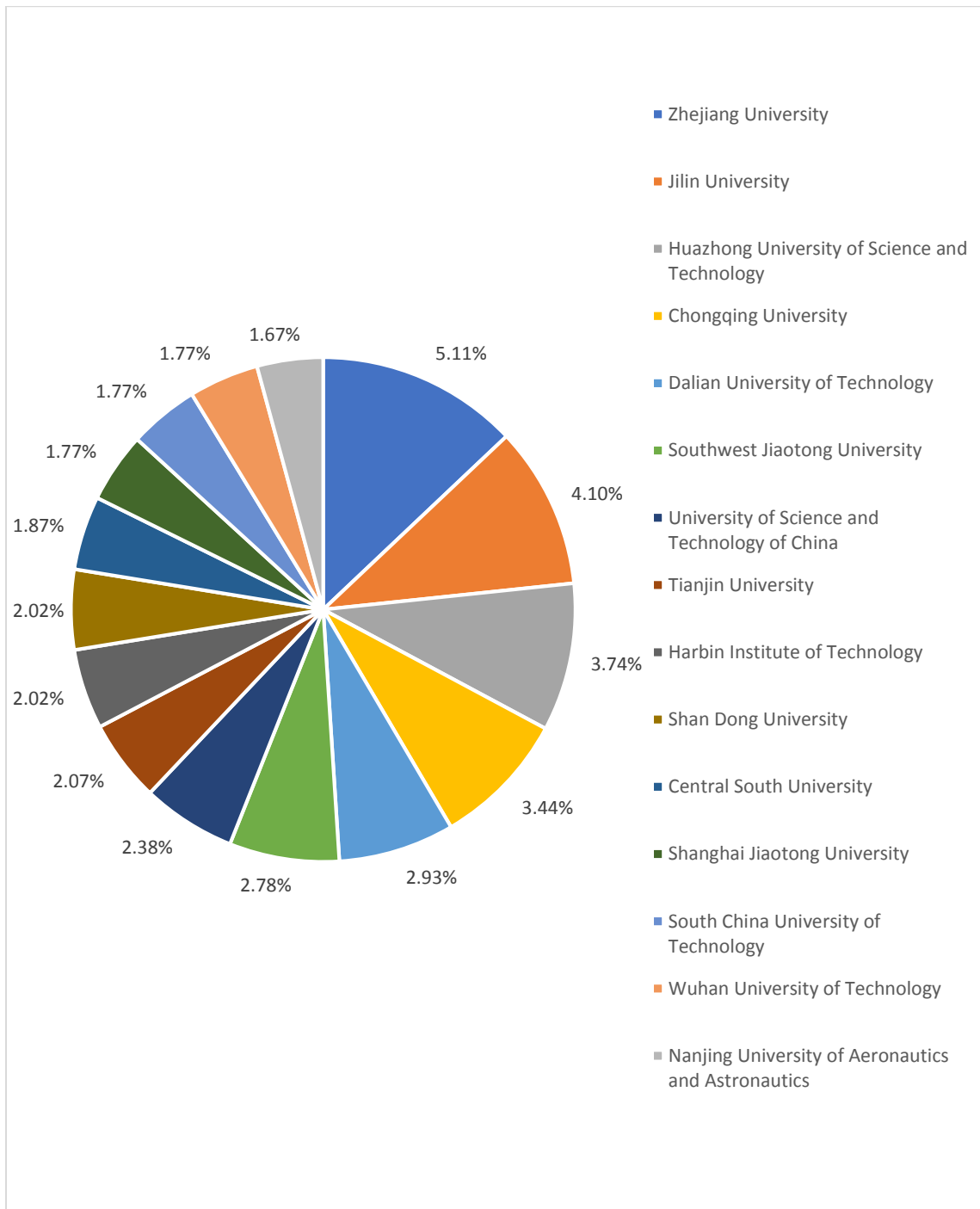


Figure 15 The number of Ph.D. dissertations from Top 15 Universities and ratios they have

Part Four Comparison

Year	Cyber security or Information security	Quantum Computing or Quantum Communication	Artificial Intelligence
1999	1	4	9
2000	3	1	17
2001	17	2	30
2002	40	1	62
2003	44	7	69
2004	52	7	109
2005	73	12	122
2006	121	20	153
2007	136	52	149
2008	171	55	147
2009	177	68	154
2010	165	57	172
2011	180	58	162
2012	166	79	161
2013	146	77	141
2014	140	92	116
2015	134	100	109
2016	89	78	95

Table 16 Comparison of the number of Ph.D. dissertations from three topics

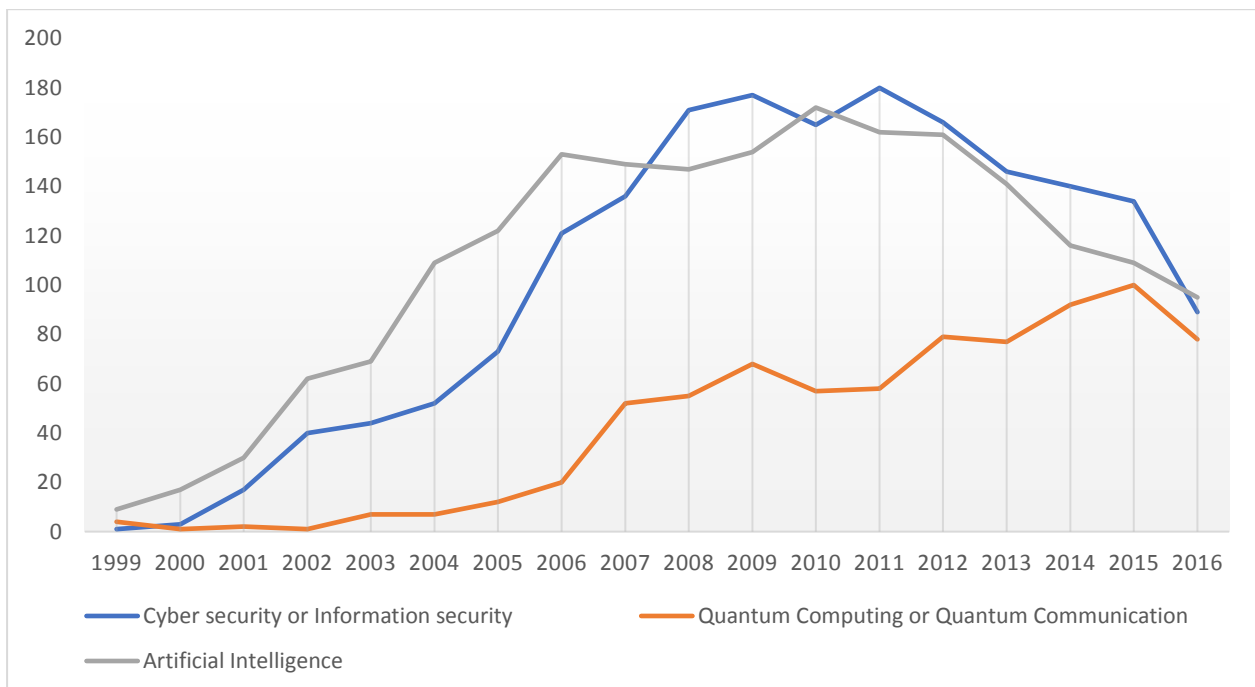


Figure 16 Comparison of the number of Ph.D. dissertations from three topics

ABOUT ACCS

The Australian Centre for Cyber Security (ACCS) at the University of New South Wales Canberra is two things. First, it is a focal point for 60 scholars from various faculties across UNSW who conduct research work on different aspects of cyber security. Second, it is a unit based in Canberra at the Defence Force Academy that provides both advanced research as well as undergraduate and graduate education on cyber security. ACCS serves as hub for the biggest concentration of research and tertiary education for the study of cyber security in any single university in the Southern hemisphere. A number of ACCS scholars, in areas ranging from information technology and engineering to law and politics, have significant international reputations for their work.

<https://www.unsw.adfa.edu.au/australian-centre-for-cyber-security/>

ACCS Briefing Papers are a short-form and informal publishing vehicle to stimulate new thinking about research directions, specific research questions and or public policy.

Lu Wenze is a Ph.D. Candidate in the School of Humanities & Social Sciences, UNSW Canberra at the Australian Defence Force Academy. He received his Bachelor's and Master's degrees from Northeastern University (NEU) in China and the Australian National University (ANU). He has Master's degrees in Financial Management, in Business, and in Control Theory and Control Engineering (by research). He currently serves as a research assistant at the Australian Centre for Cyber Security. He has held posts in China's Ministry of Industry and Information Technology (MIIT) and its Academy of Telecommunications Research.

