External Review of

Department of Physics,
Institute for Physics of Intelligence,
Research Center for the Early Universe,
and
Universal Biology Institute

February 13 and 14, 2020

This Review

- Purposes of the Review

【Promotion of self-enlightenment】 By summarizing the present status of activities in education, academic research, collaboration with societies, and internationalization, and by confirming their future directions, the self-assessment and external review, which should be on its own judgment of each unit in the university, are expected to enhance such activities further and/or keep their high levels.

【Accountability fulfillment】 By opening the results of self-assessment and external review to the public, the self-assessment and external review are useful to show the roles of the university as the center of excellence, and also helpful to make each unit in the university sincerely consider the evaluation and criticisms from outside to meet requirements dictated by the society.

- Previous Reviews

The First Review: January 1993 (FY 1992)

The Second Review: January 2005 (FY 2004)

The Third Review: January 2013 (FY 2012)

Focusing Points

(1) Is the level of our research activity high enough in view of the international standard?

(2) Are our undergraduate and graduate course programs on a sufficiently high level in view of the international standard?

(3) Are our efforts for social relation and cooperation with private companies relevant?

(4) Are our efforts for diversity of staff and students (globalization, gender, etc.) relevant?

(5) Is there any concern on management of our department including budget and recruit of staff?

Time Table

Feb. 13		Feb.14	
9:00	Closed Meeting	9:00	Research Presentation
9:30	Overview Dept. of Physics		
10:30	Reserch Presentation		
12:00		12:00	RESCEU & UBI
14:00	Research Presentation	14:00	Interview of Undergrad.
		15:00	
16:00			Closed Meeting
16:30	Interview of Grad. Students		
17:30			
18:00	Banquet		

Activity Report of Department of Physics from FY2013 to FY2019

Satoshi Yamamoto
Department of Physics, The University of Tokyo

Department of Physics

Condensed Matter Physics
Fukuyama, Ogata, Tsuneyuki, Murao, Hasegawa, Takagi, Todo, Okamoto, Nakatsuji, Katsura, Hayashi, Kitagawa

Nuclear Physics
Sakurai, Fukushima

Astrophysics
Suto, Yamamoto, Yoshida, Bamba, Kusaka, Ando, Yokoyama

Biophysics
Higuchi, Okada

Elementary Particle Physics
Aihara, Moroi, Asai, Matsuo, Hamaguchi, Yokoyama

Fundamental Physics
Takeuchi

Quantum Optics
Ueda, Yumoto

Frontier Science
Takase, Nose

Institute for Photon Science and Technology
Sakai

Universal Biology Institute
Furusawa

Cryogenic Research Center
Shimano

Institute for Physics of Intelligence
Kobayashi

38 Faculty Members and about 140 Undergraduate Students

Graduate Course of Physics

Department of Physics

Institute for Solid State Physics

Institute for Cosmic Ray Physics

Kavli IPMU

International Center for Elementary Particle Physics

The Institute of Space and Astronautical Science

Institute for Physics of Intelligence

Universal Biology Institute

Department of Arts and Science

Research Center for the Early Universe

School of Engineering

Department of Complexity Science and Engineering

Institute for Photon Science and Technology

Cryogenic Research Center

140 Faculty Members and 500 Graduate Students

Principal Goals of Education and Research Activities of Our Department

(1) To lead, develop, and deepen all the areas of physics including fundamental, frontier, and interdisciplinary ones.

(2) To make active contributions from a viewpoint of physics to various issues which our modern society is facing.

(3) To grow up young generations having strong mind of physics who will play active roles in academia and various other fields.

Physics is diverging!

- In Relation to Biology
- In Relation to Machine Learning, Deep Learning, and AI
- In Relation to Quantum Information and Quantum Material
- In Relation to Advanced Industrial Technology

Physics can play a vital role in many fields!

Highlights from 2013 to 2019

- Research Highlights

  -> Individual Presentations
- Extension of Research Fields

  Launch of *Institute for Photon Science and Technology (2013)*

  Launch of *Universal Biology Institute (2016)*

  Launch of *Institute for Physics of Intelligence (2019)*

  Launch of *Trans-Scale Quantum Science Institute (2020)*
- Reformation of Graduate Course

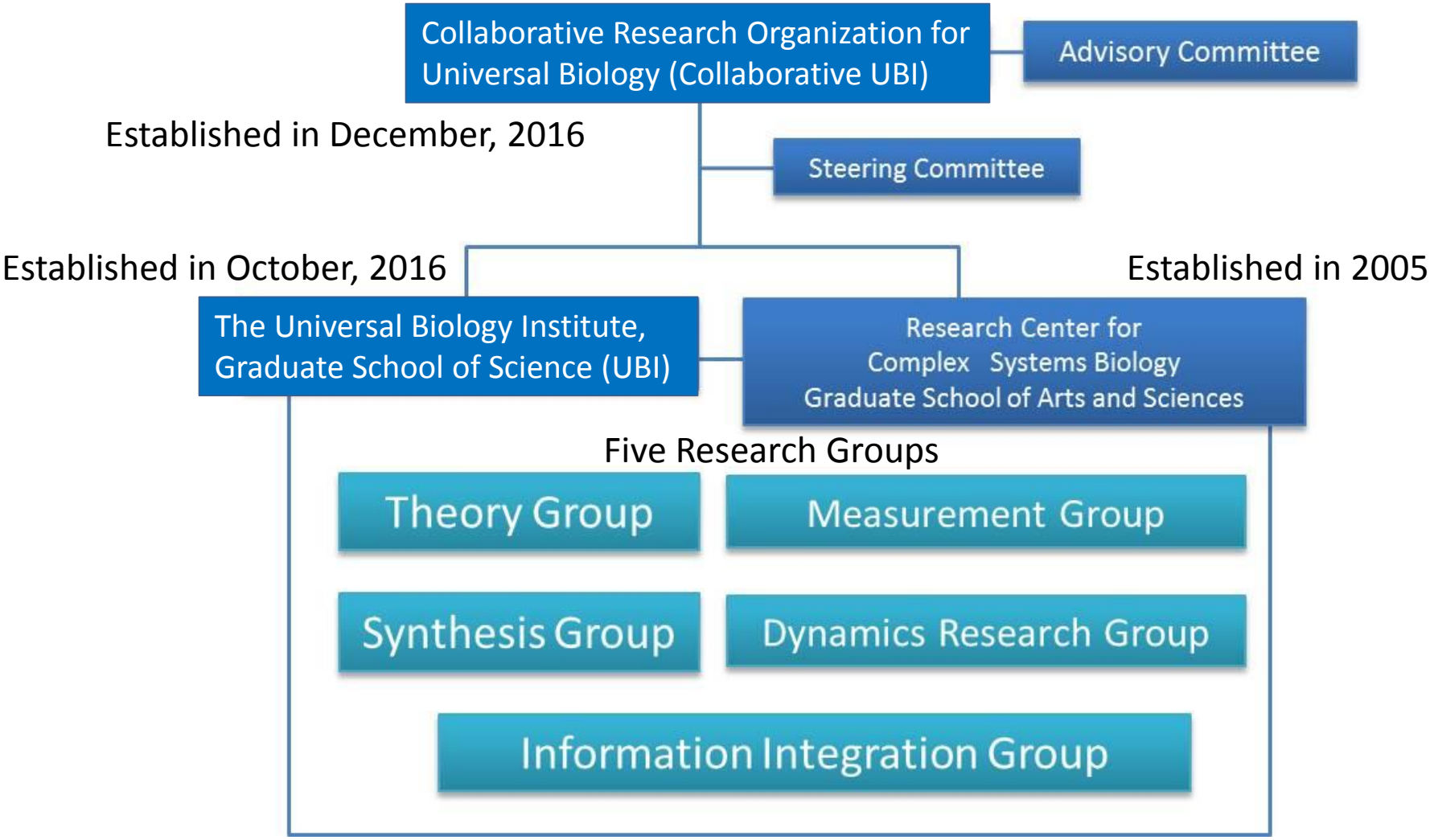
  Success of *ALPS* (2011-2017) and *XPS* (2018)

  MEXT WISE Program: *FoPM* (2019-)

  （World-leading Innovative & Smart Education）
- Social Relation

  Cooperative Agreement with the Company (2020-)

Universal Biology Institute (UBI) and Collaborative UBI



Affiliations of members

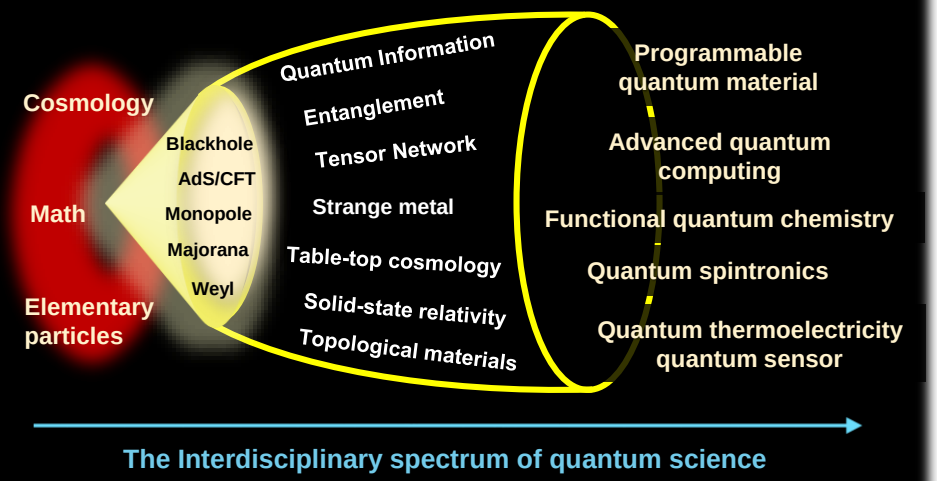
Graduate School of Science (Physics, Chemistry, Biological Science), Art and Science, Pharmaceutical Sciences, Medicine, Engineering and Frontier Sciences, and Institute of Industrial Science

Trans-scale Quantum Science Institute

The School of Science・ISSP・IPMU・Cryogenic Research Center

We bring together the world-class research infrastructures of the University of Tokyo, promoting educational exchanges and collaborative research with leading universities and institutions abroad.

Our mission is to advance the conceptual framework of fundamental quantum science, to create quantum-technology innovations, and to train future quantum-science experts that may significantly contribute to our society over the next 20 years.



Vision

Action 1 −① Establish a global network of collaborative research

- Gather talents and advanced research facilities of quantum science through international collaborations

Action 2 −② Enrich academic experience with international way of thinking

- Conduct international education and research exchange programs with the partner universities and institutions overseas

Action 4−③ Ensure diversity and inclusion in membership

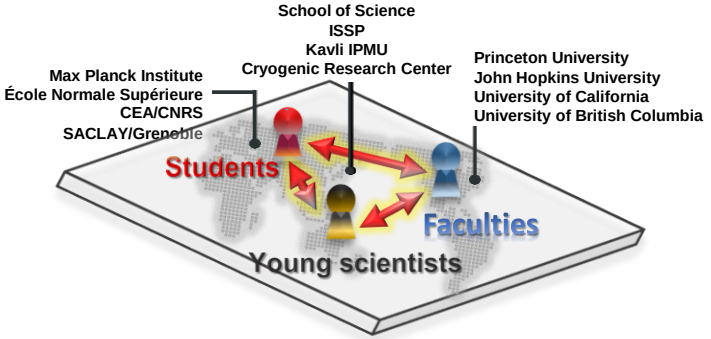
- Build an effective talent pool for quantum research in the next 20 years

Action 3 −① Bringing long-term benefits to society

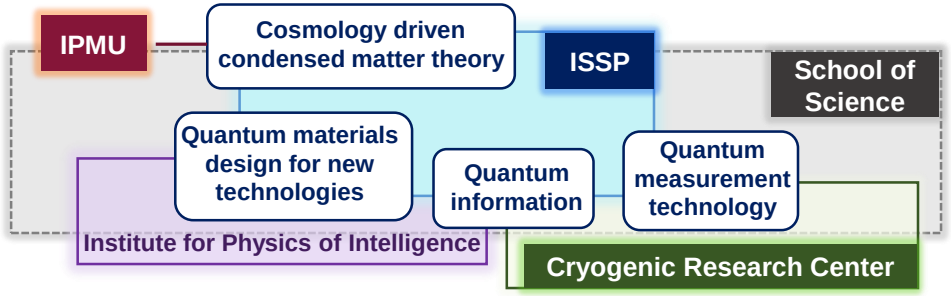
- Foster worldwide interdisciplinary research and education that spans the entire spectrum of quantum science

➢ Building the Research Platform

- Promote cross-appointments of UTokyo faculties and support mobility of young researchers and students
- Open calls for strategic research themes
- Internationalize research training through global collaborative projects



➢ Exploring the Full Spectrum of Quantum Science



➢ Developing Strategic Plans for Research Training

Awards

- Hiroyoshi Sakurai: Nishina Memorial Prize (2015)
  For discovery of anomalies in magic numbers of neutron-rich nuclei
- Ryo Shimano: Inoue Prize for Science (2016)
  For discovery of Higgs mode in superconductors and pioneering contribution to the terahertz condensed matter spectroscopy
- Naoki Yoshida: JSPS Prize, Japan Academy Medal (2016)
  For large-scale computer simulations of formation of stars and blackholes in the early universe
- And many… See page 51.

Awards (Students)

- UT President Prize (Soucho-sho)

  Xing Fan (2016); Yoko Oya (2017); Yuto Ashida (2018); Kohei Kawabata (2018);

- JSPS Ikushi Prize

  Kento Masuda (2016); Yuto Ashida (2018); Gong Zongping (2019)

- Inoue Research Award for Young Scientists

  Tomoka Fujii (2015); Yoko Oya (2018)

- BBC 100 Women 2018

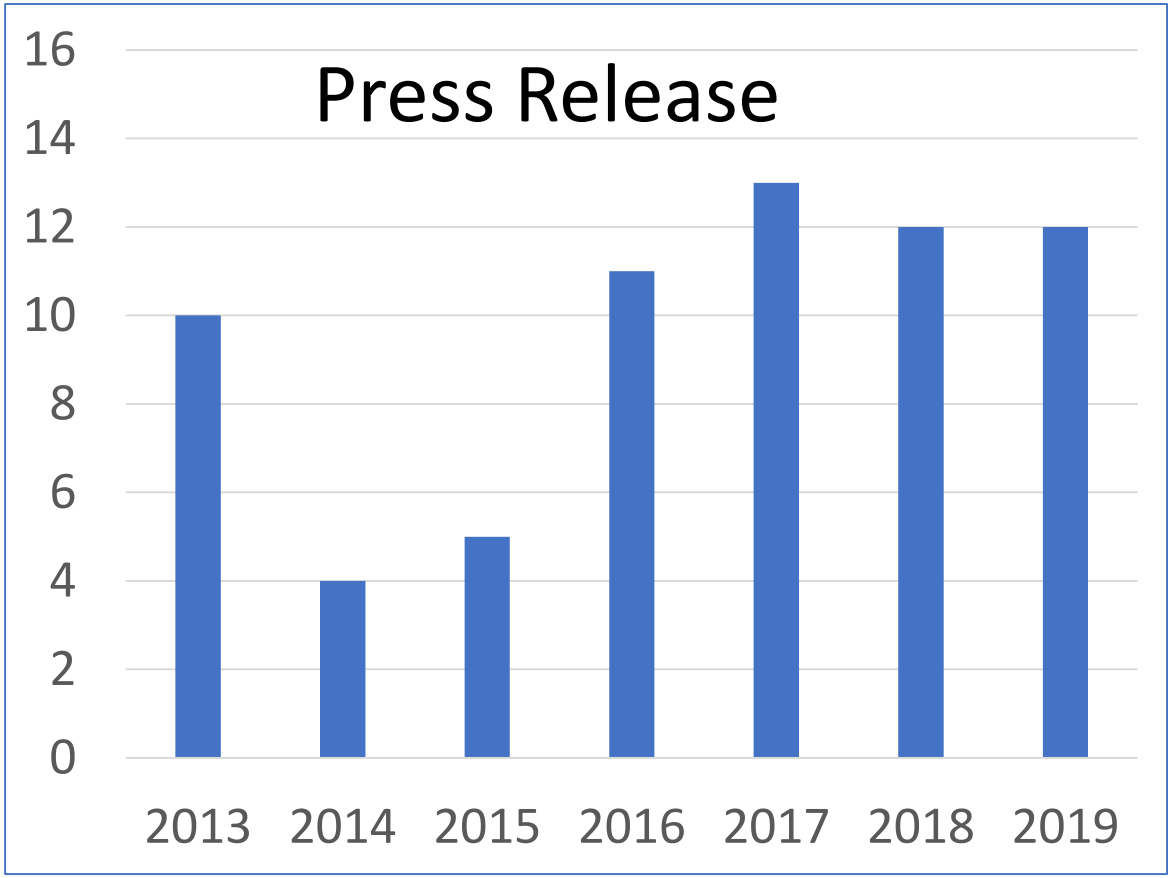
  Yuki Okoda (2018)

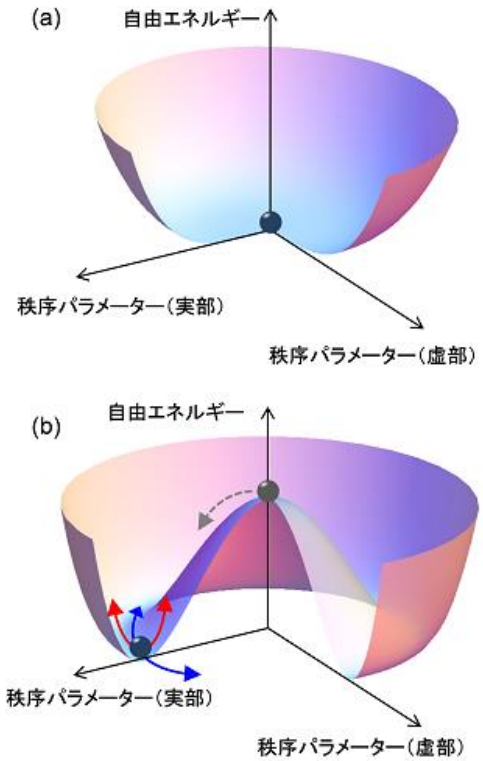
- And many… See page 71.

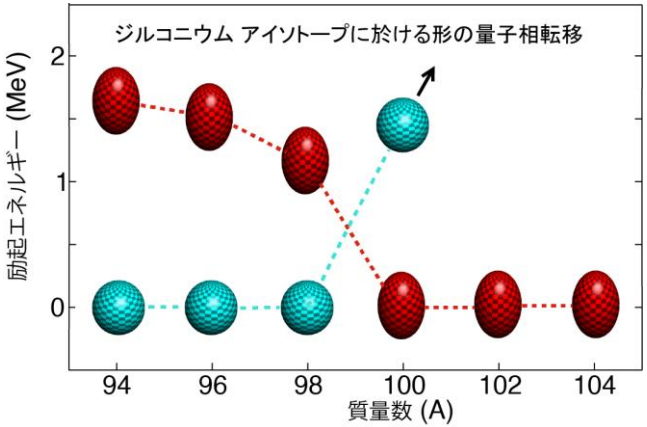
Y. Ashida

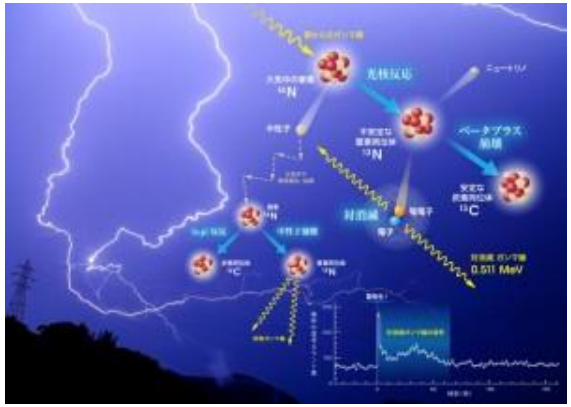
Y. Oya

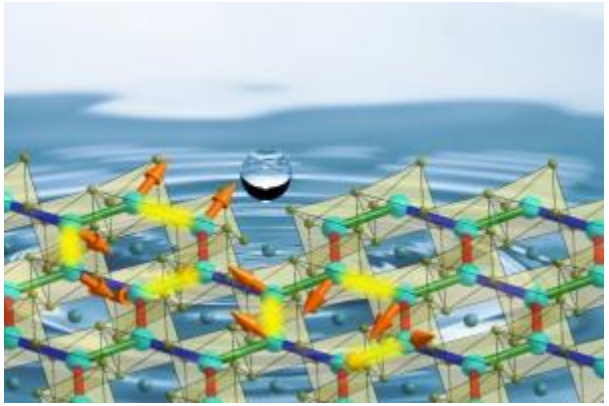
Y. Okoda


Press Release
16
14
12
10
8
6
4
2
0
2013
2014
2015
2016
2017
2018
2019


(a)
自由エネルギー
秩序パラメーター（実部）
秩序パラメーター（虚部）
(b)
自由エネルギー
秩序パラメーター（実部）
秩序パラメーター（虚部）


ジルコニウム アイソトープに於ける形の量子相転移
励起エネルギー (MeV)
2
1
0
94
96
98
100
102
104
質量数 (A)





Recruiting New Faculty Members

- From FY2013 to FY2019, we appointed 14 new PIs.

  1 Lecturer

  8 Associate Professors

  5 (+5) Professors (internal promotion)

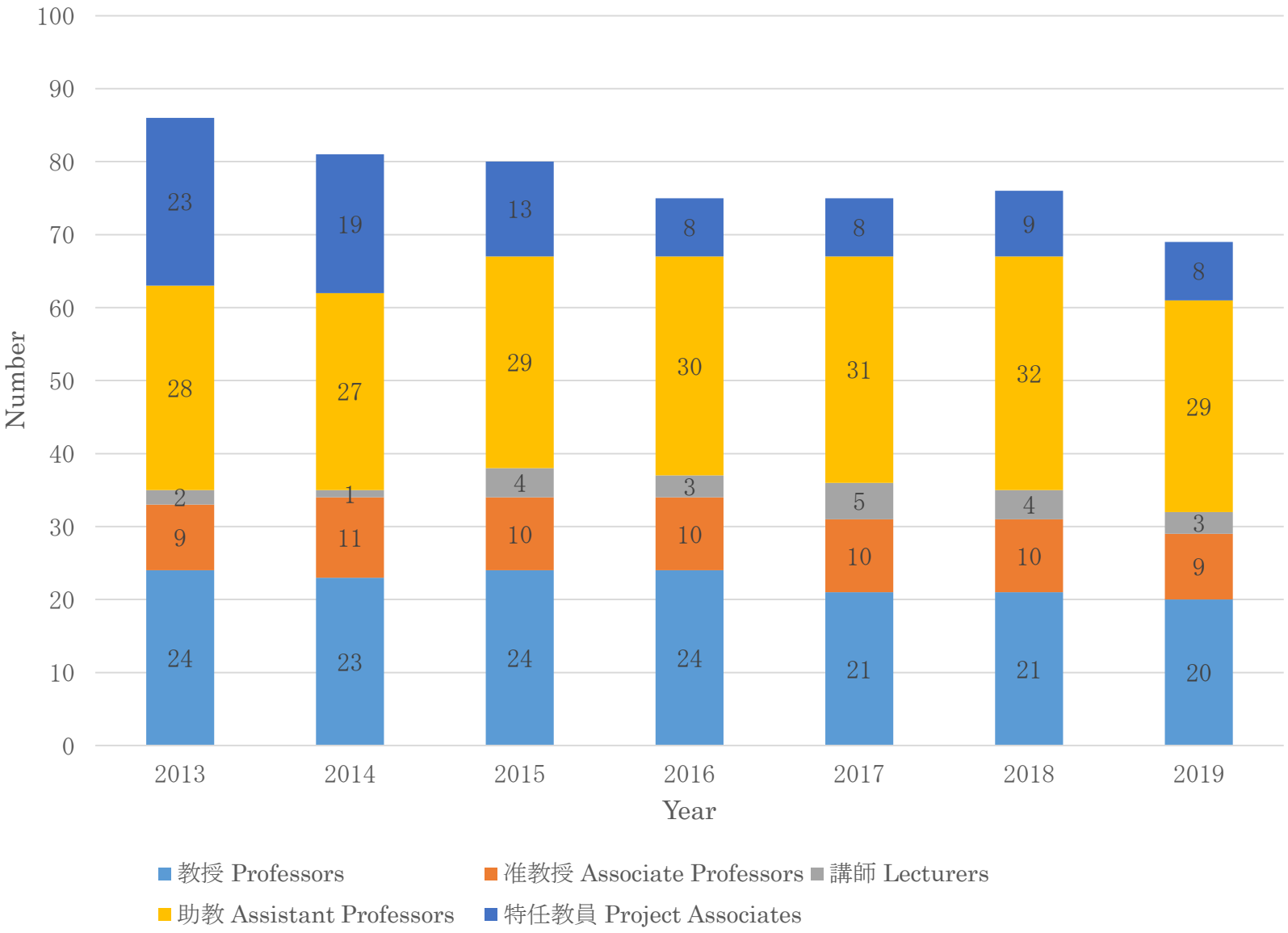
- Toward Increasing Diversity

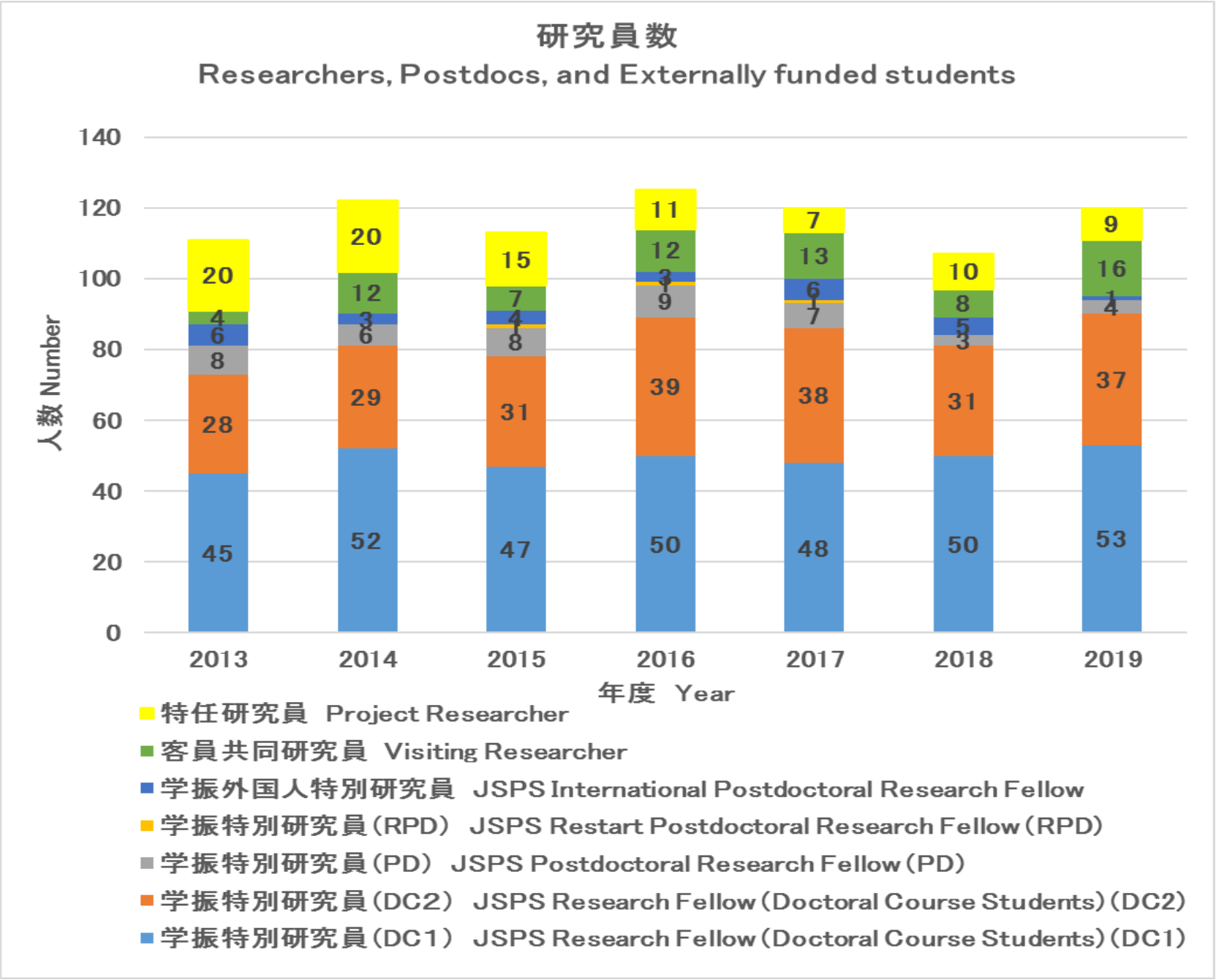
  Lecturer: Kathrin Wimmer (2014-2019)

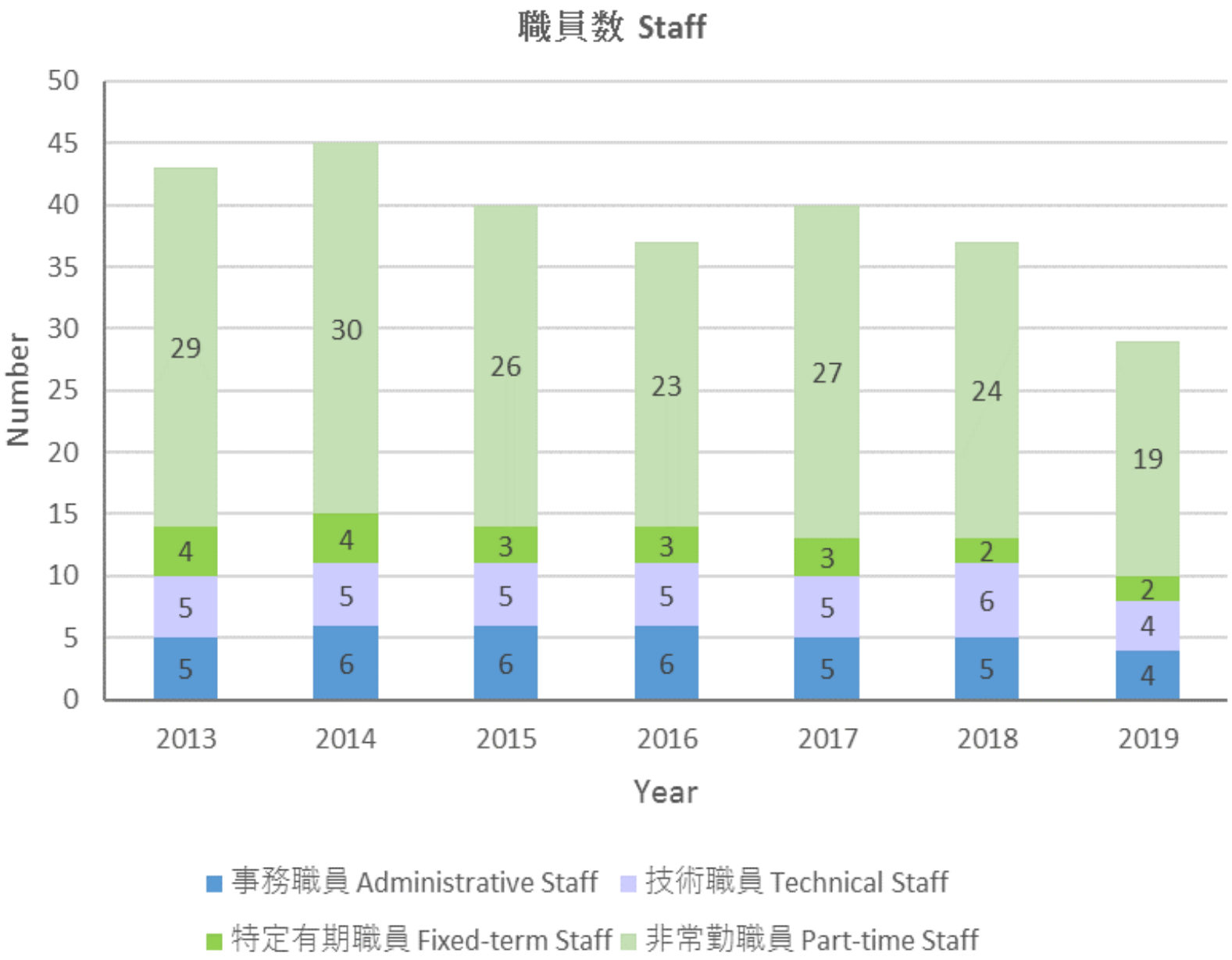
  Associate Professor: Aya Bamba (2016-)

  Associate Professor: Non-Japanese (FY2020-)

Teaching Staff




研究員数
Researchers, Postdocs, and Externally funded students
140
120
100
80
60
40
20
0
人数 Number
2013
2014
2015
2016
2017
2018
2019
年度 Year
20
4
6
8
28
45
20
12
3
6
29
52
15
7
4
1
8
31
47
11
12
3
1
9
39
50
7
13
6
1
7
38
48
10
8
5
3
31
50
9
16
1
4
37
53
特任研究員 Project Researcher
客員共同研究員 Visiting Researcher
学振外国人特別研究員 JSPS International Postdoctoral Research Fellow
学振特別研究員(RPD) JSPS Restart Postdoctoral Research Fellow (RPD)
学振特別研究員(PD) JSPS Postdoctoral Research Fellow (PD)
学振特別研究員(DC2) JSPS Research Fellow (Doctoral Course Students) (DC2)
学振特別研究員(DC1) JSPS Research Fellow (Doctoral Course Students) (DC1)


職員数 Staff
Number
50
45
40
35
30
25
20
15
10
5
0
29
30
26
23
27
24
19
4
4
3
3
3
2
2
5
5
5
5
5
6
4
5
6
6
6
5
5
4
2013
2014
2015
2016
2017
2018
2019
Year
事務職員 Administrative Staff
技術職員 Technical Staff
特定有期職員 Fixed-term Staff
非常勤職員 Part-time Staff

Funding Situation

- Fundamental Funds

  Mostly used for management, utility, and education.

  Almost constant over 7 years, thanks to the efforts by the Faculty of Science

  Decrease in FY2018 is caused by the end of the ALPS program.

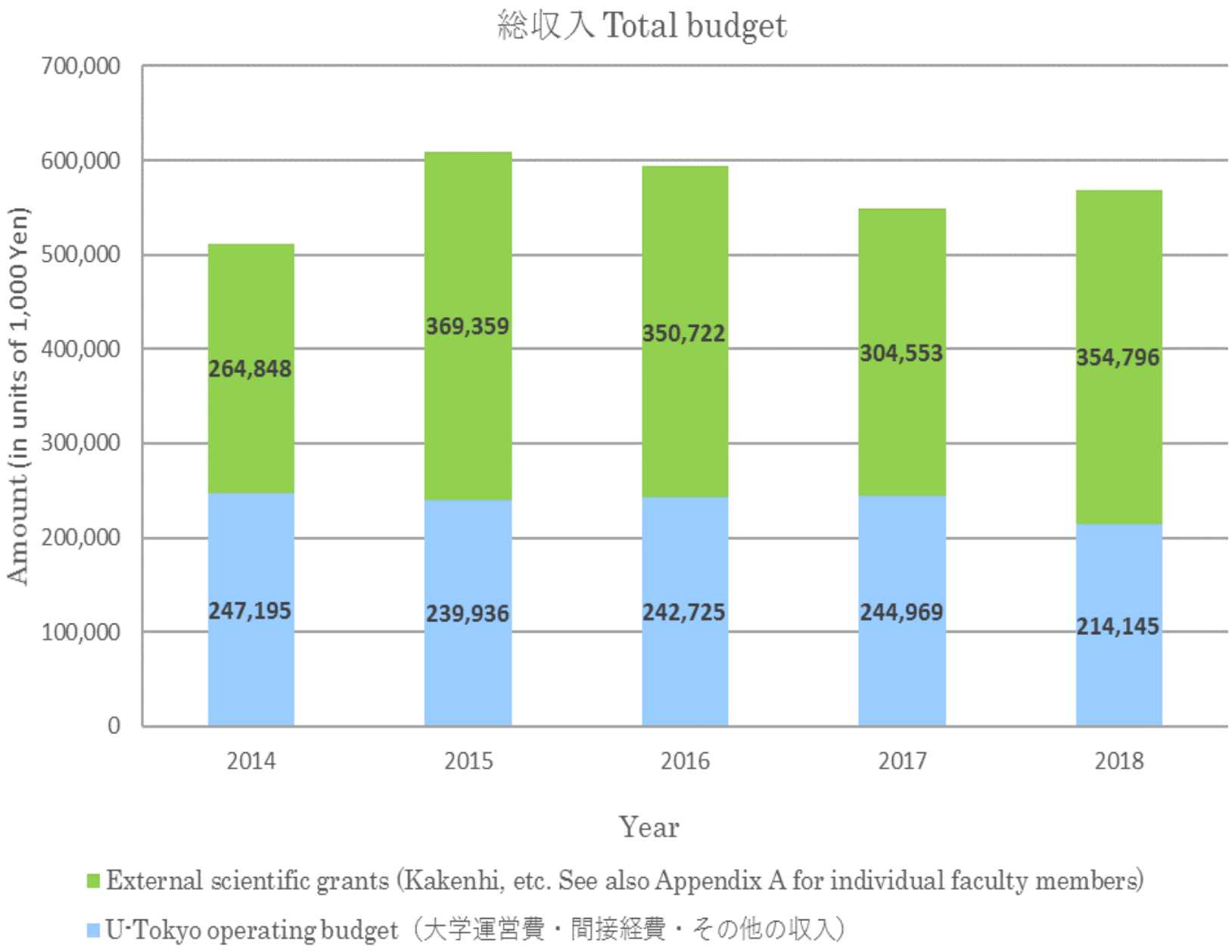
- External Funds

  For research activities

  JSPS Kakenhi (Page 18)

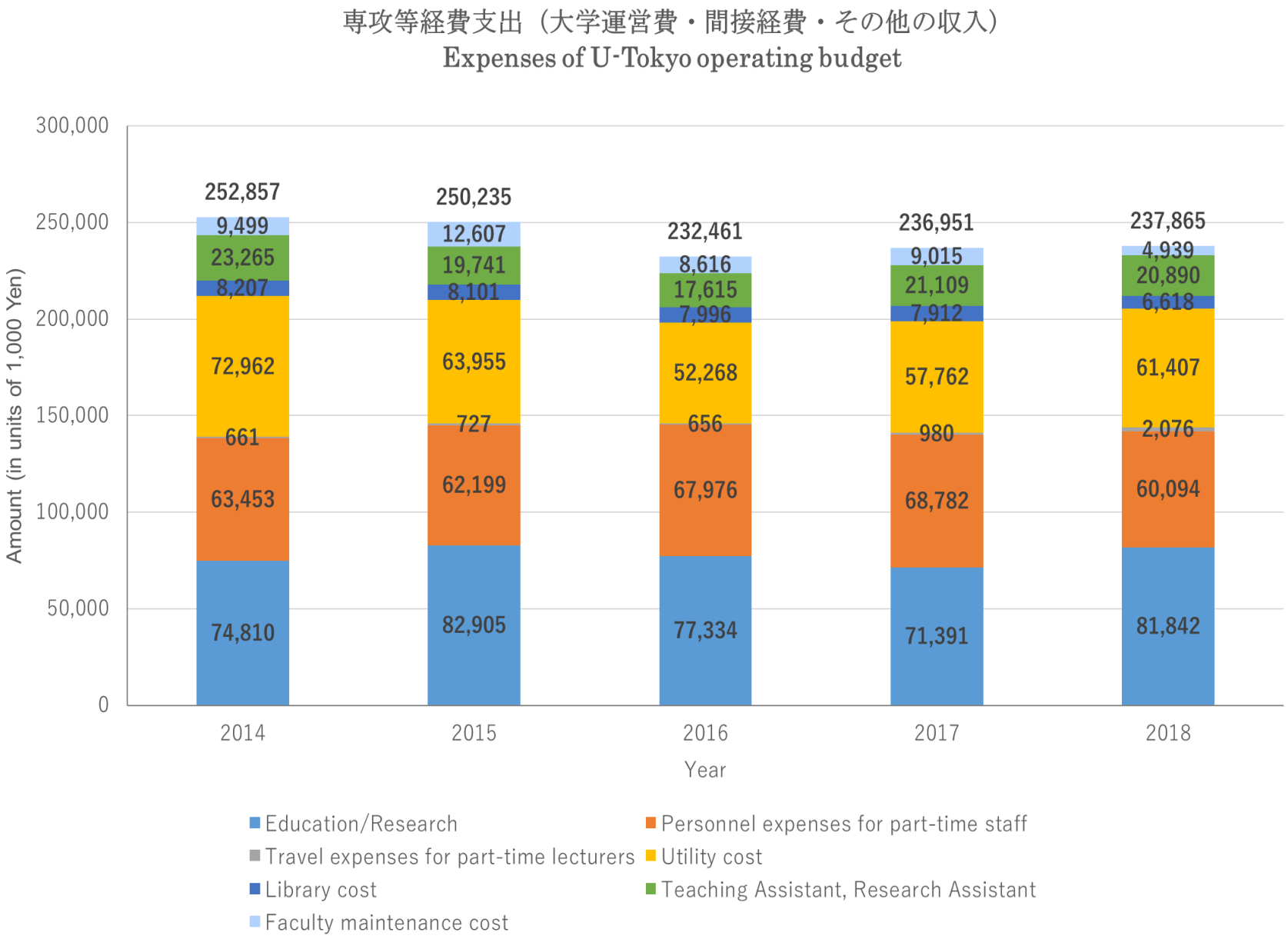
  JST and others (Page 68-70)

  Only small funds from private companies


総収入 Total budget
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Amount (in units of 1,000 Yen)
264,848
369,359
350,722
304,553
354,796
247,195
239,936
242,725
244,969
214,145
2014
2015
2016
2017
2018
Year
External scientific grants (Kakenhi, etc. See also Appendix A for individual faculty members)
U-Tokyo operating budget（大学運営費・間接経費・その他の収入）

専攻等経費支出（大学運営費・間接経費・その他収入）　Expenses of U-Tokyo operating budget　in units of 1,000 Yen

	2014	2015	2016	2017	2018
教育研究経費 Education/Research	74,810	82,905	77,334	71,391	81,842
非常勤職員経費 Personnel expenses for part-time staff	63,453	62,199	67,976	68,782	60,094
非常勤講師旅費 Travel expenses for part-time lecturers	661	727	656	980	2,076
図書館維持費 Library cost	8,207	8,101	7,996	7,912	6,618
光熱水料 Utility cost	72,962	63,955	52,268	57,762	61,407
TA・RA経費 Teaching Assistant, Research Assistant	23,265	19,741	17,615	21,109	20,890
建物維持管理経費 Faculty maintenance cost	9,499	12,607	8,616	9,015	4,939
計 Total	252,857	250,235	232,461	236,951	237,865


専攻等経費支出（大学運営費・間接経費・その他の収入）
Expenses of U-Tokyo operating budget
Amount (in units of 1,000 Yen)
300,000
250,000
200,000
150,000
100,000
50,000
0
252,857
9,499
23,265
8,207
72,962
661
63,453
74,810
250,235
12,607
19,741
8,101
63,955
727
62,199
82,905
232,461
8,616
17,615
7,996
52,268
656
67,976
77,334
236,951
9,015
21,109
7,912
57,762
980
68,782
71,391
237,865
4,939
20,890
6,618
61,407
2,076
60,094
81,842
2014
2015
2016
2017
2018
Year
Education/Research
Personnel expenses for part-time staff
Travel expenses for part-time lecturers
Utility cost
Library cost
Teaching Assistant, Research Assistant
Faculty maintenance cost

外部資金　External funds ((　); Breakdowns of Kakenhi)

in units of : 1,000 Yen

	平成26年度(2014年度)		平成27年度(2015年度)		平成28年度(2016年度)		平成29年度(2017年度)		平成30年度(2018年度)	
	件数	金額	件数	金額	件数	金額	件数	金額	件数	金額
科学研究費助成事業	36	199,800	44	310,300	43	276,500	46	266,800	45	217,350
新学術領域研究	(10)	(15600)	(9)	(143000)	(8)	(65100)	(7)	(60500)	(6)	(61400)
基盤研究S	(2)	(40600)	(1)	(21200)	(1)	(18700)	0	0	(1)	(24800)
基盤研究A	(11)	(102100)	(14)	(89600)	(10)	(111400)	(11)	(74500)	(12)	(52000)
基盤研究B　※1	(6)	(20900)	(9)	(31800)	(12)	(52700)	(12)	(42700)	(12)	(46300)
基盤研究C　※1	(3)	(4200)	(3)	(3200)	(3)	(2800)	(2)	(2300)	(5)	(4700)
挑戦的萌芽研究　※1 ※2	(2)	(2900)	(4)	(4500)	(4)	(4100)	(4)	(3900)	(1)	(700)
挑戦的研究(萌芽) ※1							(0)	0	0	0
挑戦的研究(開拓)							(4)	(13700)	(5)	(7900)
若手研究A　※1 ※3	(1)	(12800)	(1)	(4700)	(1)	(1000)	(1)	(13300)	(1)	(6500)
若手研究B　※1 ※3	(1)	(700)	(2)	(1400)	(2)	(1700)	(2)	(1700)	0	0
若手研究　※4									0	0
国際共同研究加速基金(国際活動支援班)	0	0	(1)	(10900)	(2)	(19000)	(2)	(19100)	(1)	(8100)
国際共同研究加速基金(帰国発展研究)	0	0	0	0	0	0	(1)	(35100)	(1)	(4950)
受託研究費	4	53,360	3	47,109	3	39,157	4	31,543	8	102,897
共同研究費	3	0	6	6,150	9	3,495	8	2,500	8	14,799
寄附金	7	11,688	5	5,800	4	31,570	2	3,710	11	19,750
計	50	264,848	58	369,359	59	350,722	60	304,553	72	354,796

※1は一部基金化種目または基金研究種目であるため、当該年度の当初計画に対する配分額を計上

※2は平成29年度より新規募集なし

※3は平成30年度より新規募集なし

※4は平成30年度から新規募集開始

Floor Space

- Total Floor Space for Our Department

  9836 m^2 in Faculty of Science Bldg. 1 & 4

  c.f. 14,648 m^2 (Official area which should be allocated by Faculty of Science)

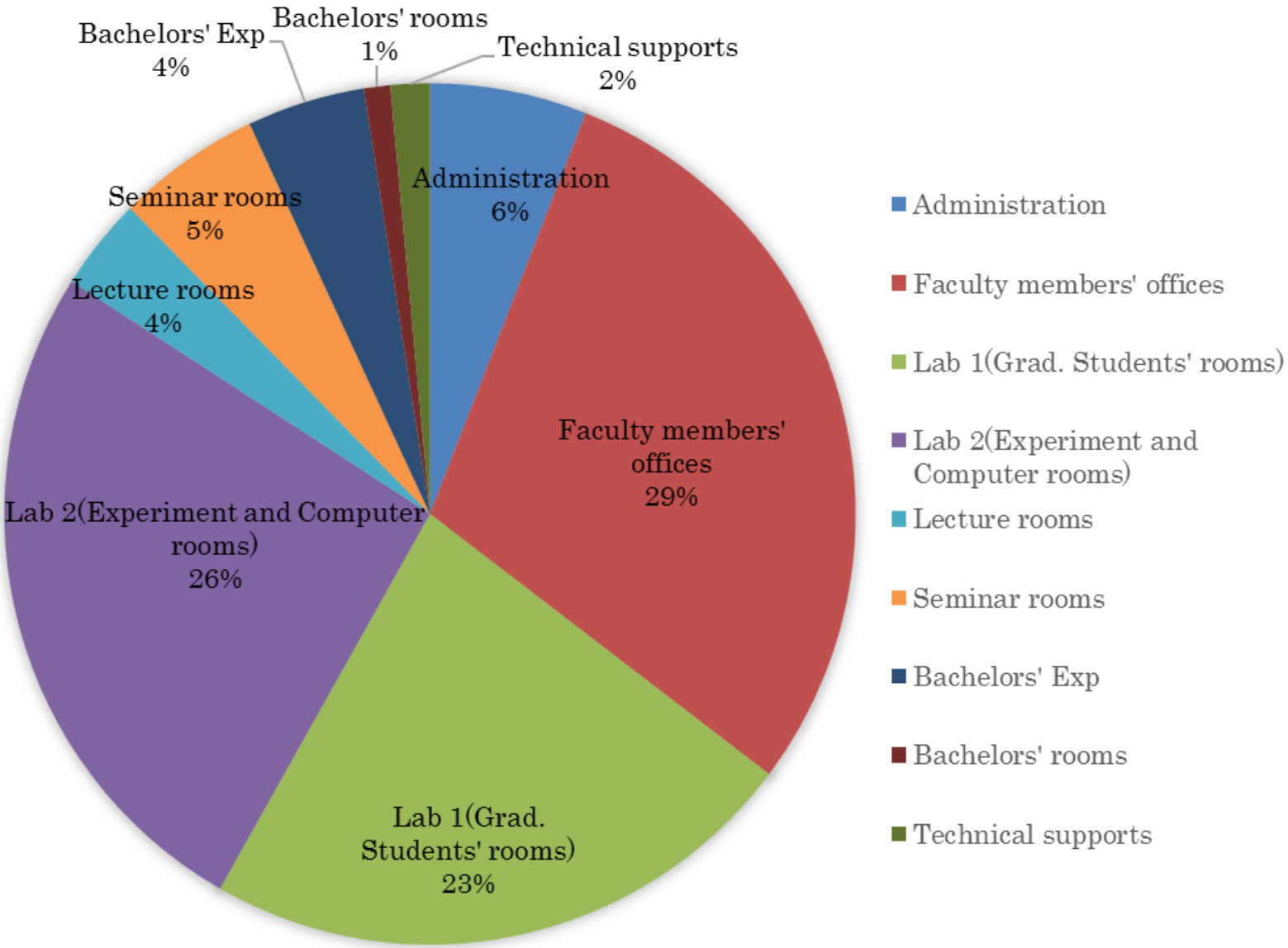
  22,455 m^2 (Official area which was originally recommended by MEXT)

- Actual allocation for each group

  200 m^2 each for experiment groups

  80 m^2 each for theory groups

- Shortage of space would affect the safety!


Bachelors' Exp
4%
Bachelors' rooms
1%
Technical supports
2%
Administration
6%
Seminar rooms
5%
Lecture rooms
4%
Faculty members' offices
29%
Lab 2(Experiment and Computer rooms)
26%
Lab 1(Grad. Students' rooms)
23%
Administration
Faculty members' offices
Lab 1(Grad. Students' rooms)
Lab 2(Experiment and Computer rooms)
Lecture rooms
Seminar rooms
Bachelors' Exp
Bachelors' rooms
Technical supports

Undergraduate Education

(Course Timetable: Page 23-25)

- A semester of the 2nd grade and the 3rd grade

  Fundamental Physics Courses

  (Physical Mathematics, Classical Mechanics, Quantum Mechanics, Electromagnetism, Statistical Mechanics, Solid State Physics)

  Exercises and Laboratory Works (Related to Lectures)

  Seminar Works (split seminar)

- The 4th Grade

  Advanced/Specific Physics Courses (Some are on a graduate level.)

  English in Physics

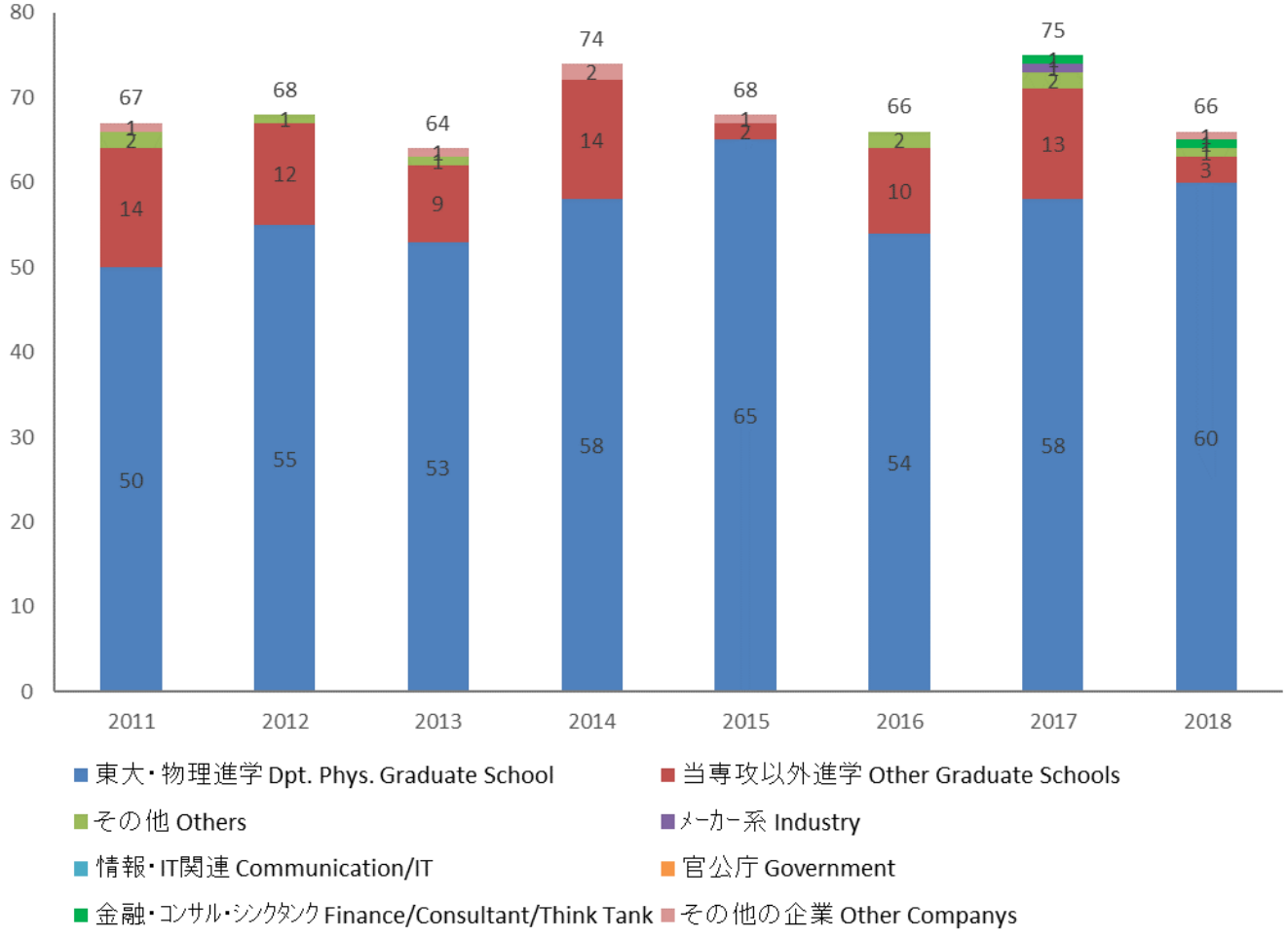
  Senior Projects in Experimental/Theoretical Physics

  (Different labs for S and A semesters. One should be Experimental one.)

  Students are recommended to participate in Department Colloquium.

- Evaluation by Students: See Pages 46-49.

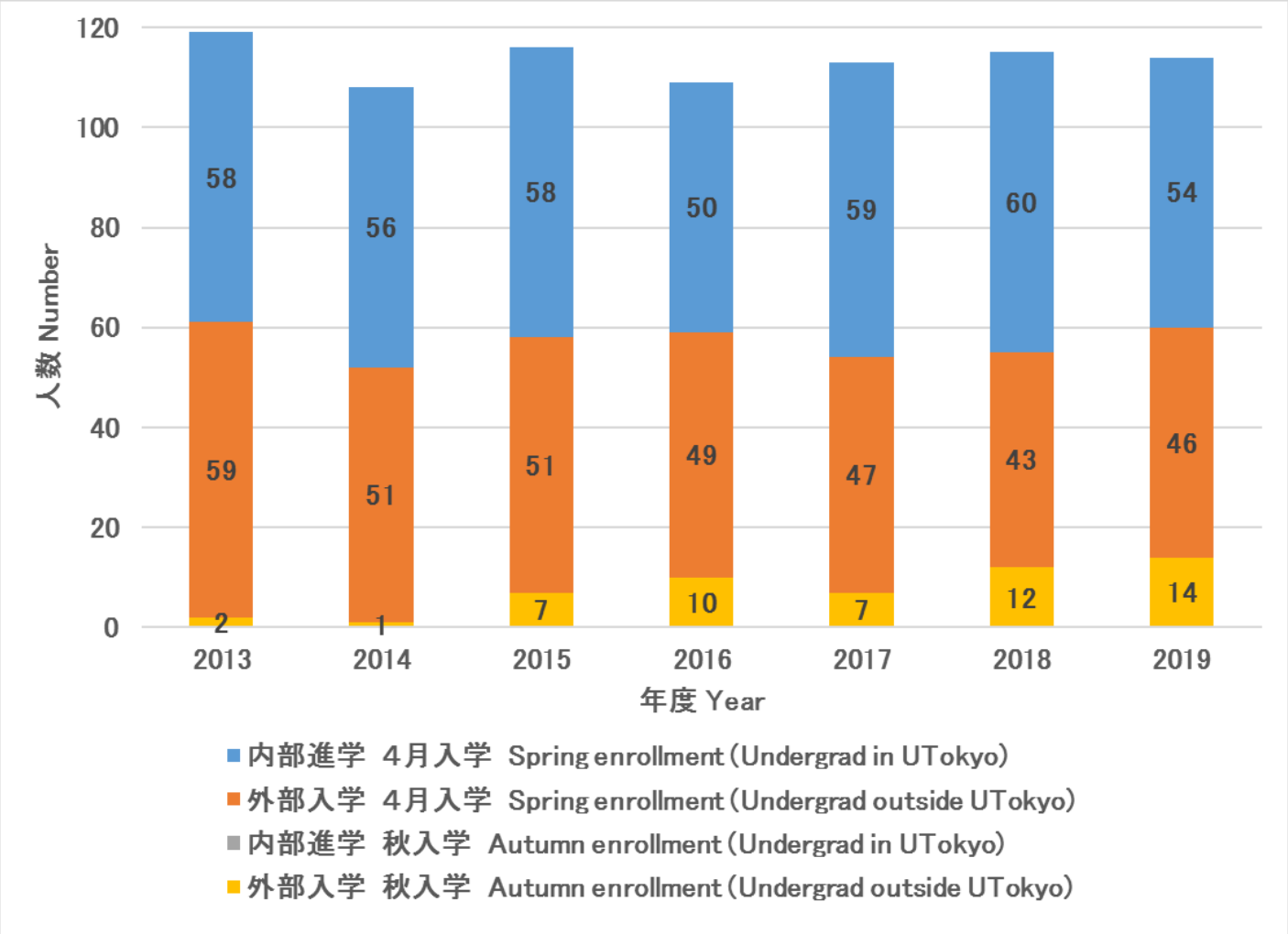
学部卒業者（学士）の進路 After Undergraduate Course

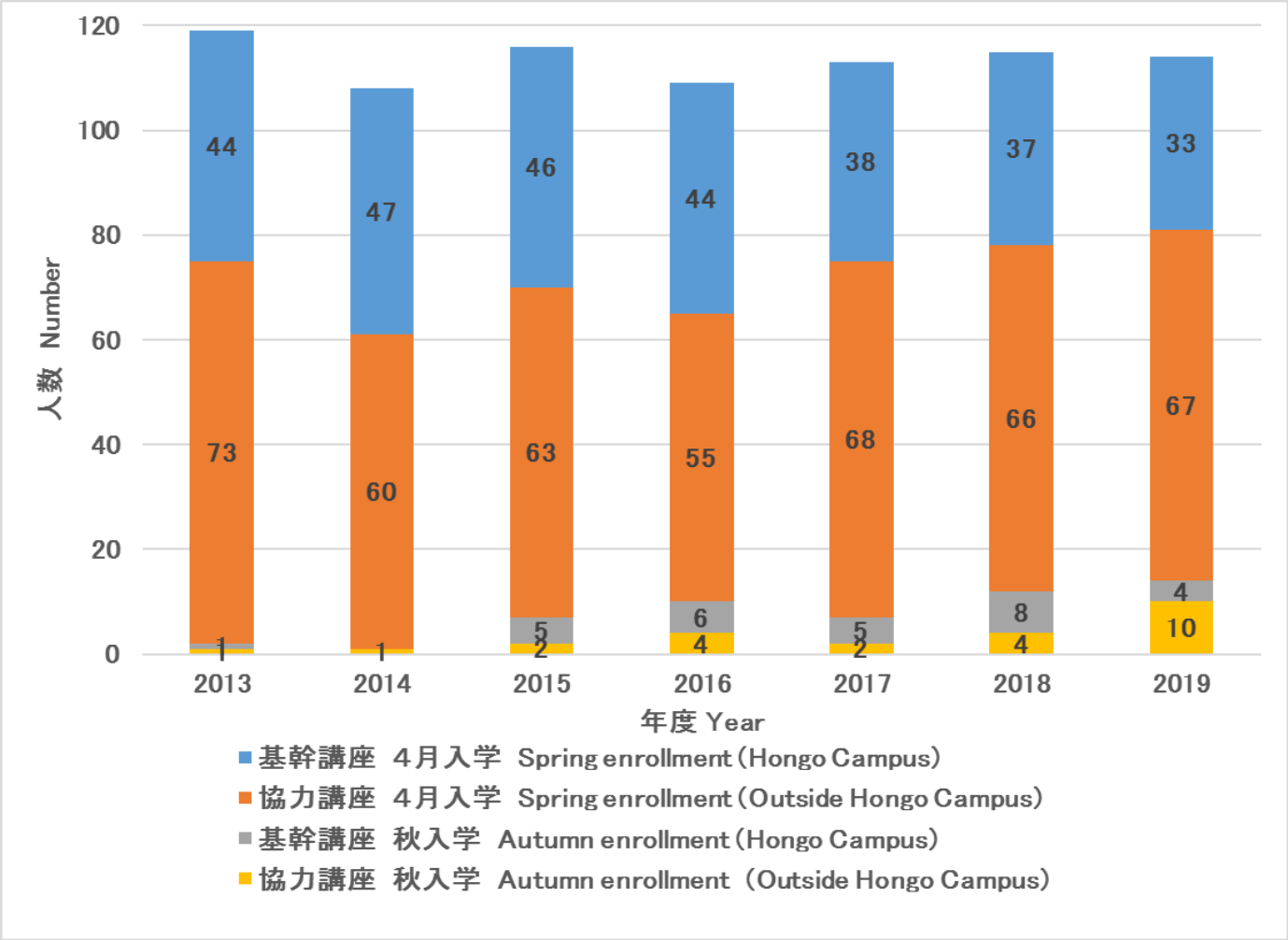


Graduate Course

(Master Course)

110 – 120 New Students per Year




120
100
80
60
40
20
0
人数 Number
44
73
1
47
60
1
46
63
5
2
44
55
6
4
38
68
5
2
37
66
8
4
33
67
4
10
2013
2014
2015
2016
2017
2018
2019
年度 Year
基幹講座 4月入学 Spring enrollment (Hongo Campus)
協力講座 4月入学 Spring enrollment (Outside Hongo Campus)
基幹講座 秋入学 Autumn enrollment (Hongo Campus)
協力講座 秋入学 Autumn enrollment (Outside Hongo Campus)

Graduate Education

- Course Works

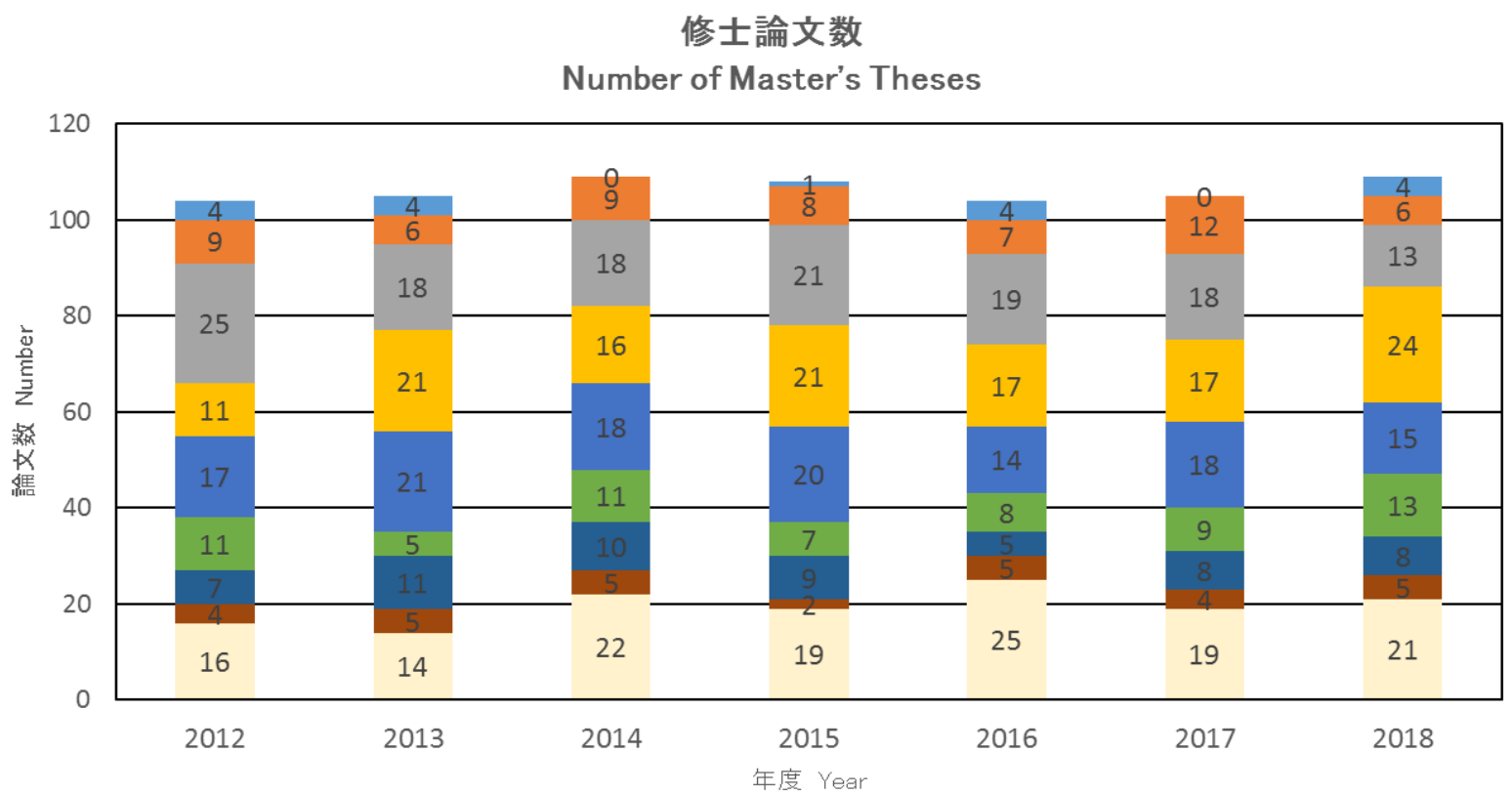
  We offer different levels of course works.

  Continuation of the undergraduate course is also considered.

  Lectures are provided in English, if there is one or more students who cannot understand Japanese.

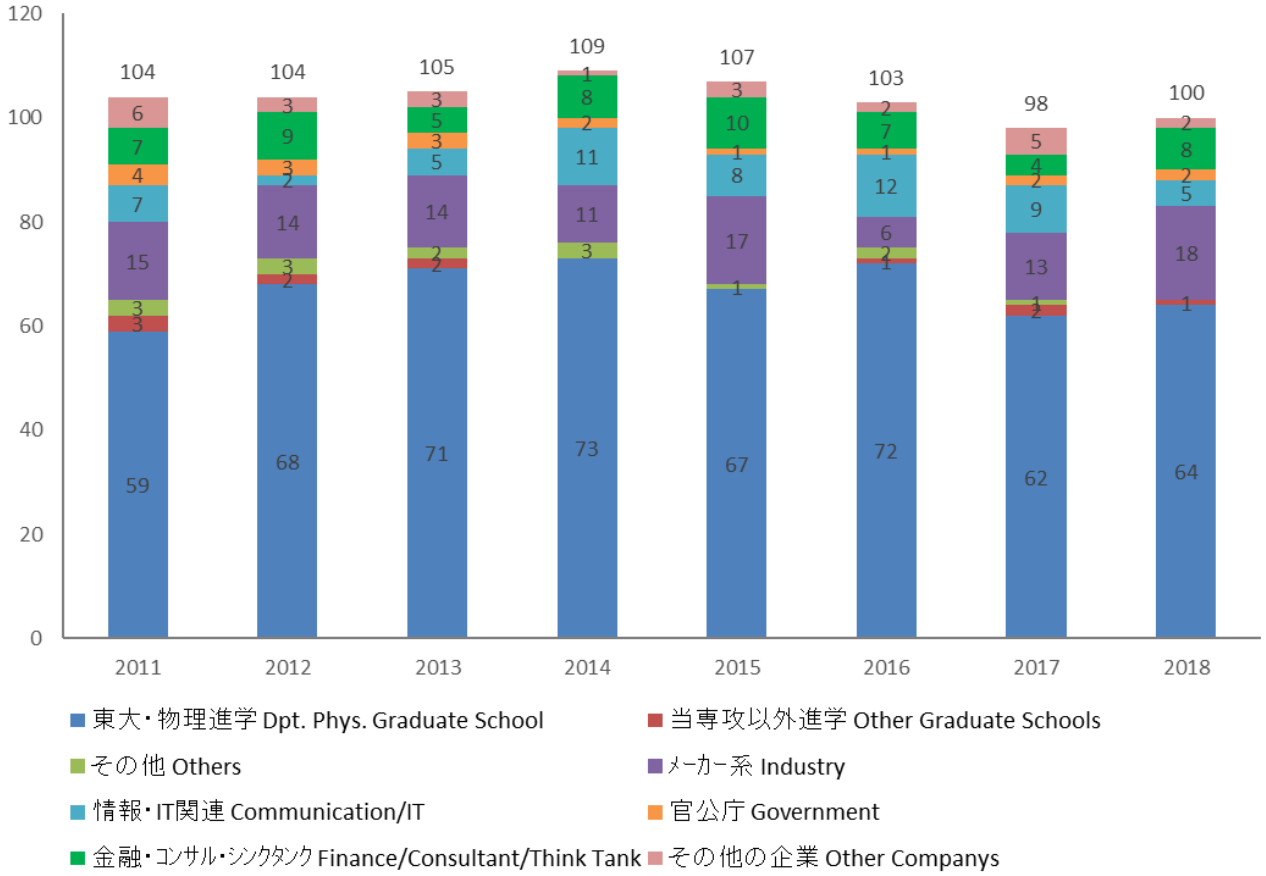
- Research Works

  Done in individual research groups under the guidance of the advisor.



- A0 : 原子核理論 Nuclear Phys. (Theory)
- A1 : 素粒子理論 Elementary Particle Phys. (Theory)
- A2 : 素粒子実験・原子核実験・加速器 High-energy/Nuclear Phys. (Experiment)
- A3 : 物性理論 Cond. Matter Phys. (Theory)
- A4 : 物性実験 Cond. Matter Phys. (Experiment)
- A5 : 一般物理学理論 General Phys. (Theory)
- A6 : 一般物理学実験 General Phys. (Experiment)
- A7 : 生物物理 Biophysics
- A8 : 宇宙物理実験・宇宙素粒子実験 Astrophysics/Astroparticle Phys. (Experiment)

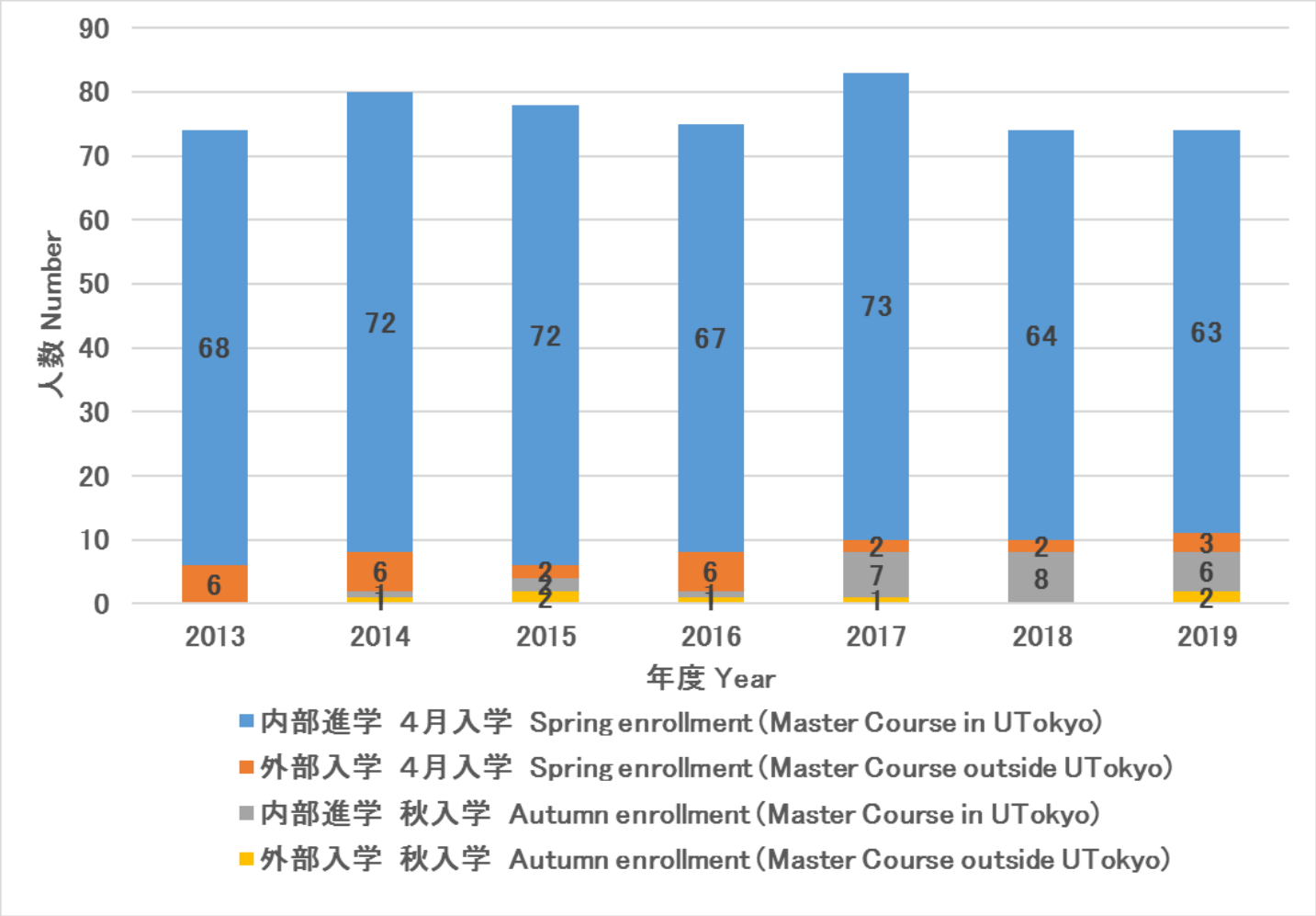
修士課程修了者の進路 After Master Course

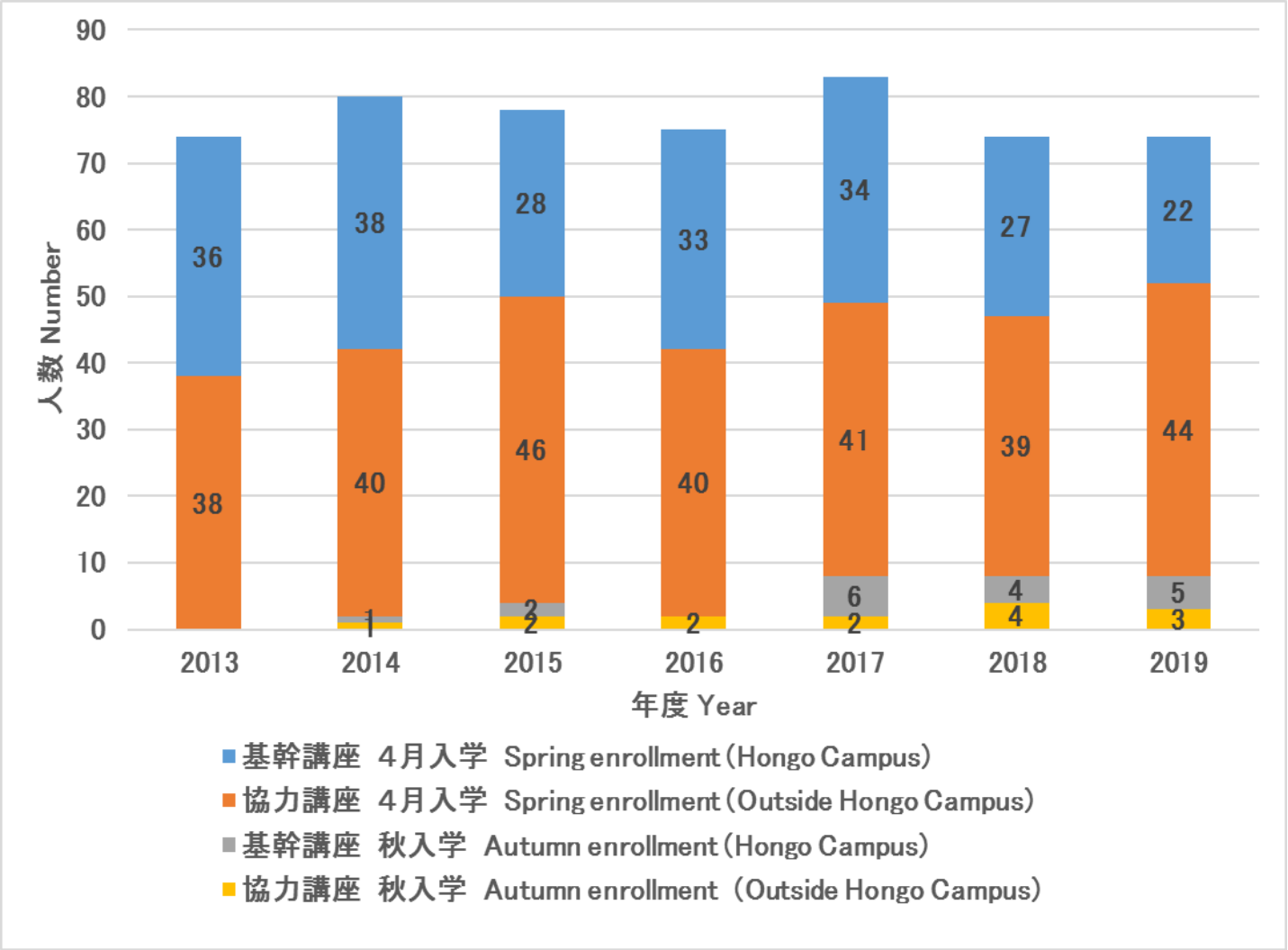


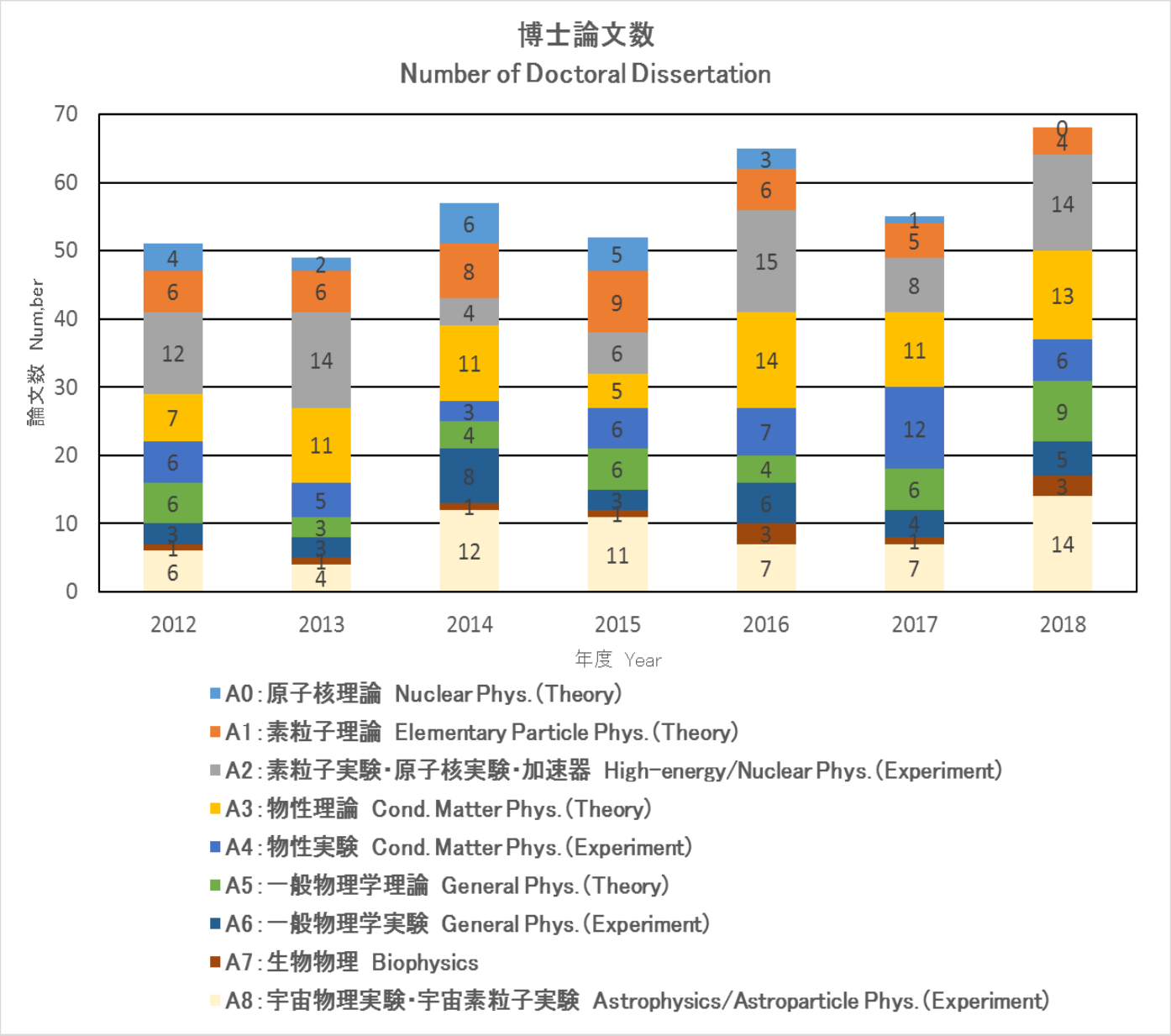
Graduate Course

(PhD Course)

70 – 80 New Students per Year




90
80
70
60
50
40
30
20
10
0
人数 Number
36
38
38
40
1
28
46
2
2
33
40
2
34
41
6
2
27
39
4
4
22
44
5
3
2013
2014
2015
2016
2017
2018
2019
年度 Year
基幹講座 4月入学 Spring enrollment (Hongo Campus)
協力講座 4月入学 Spring enrollment (Outside Hongo Campus)
基幹講座 秋入学 Autumn enrollment (Hongo Campus)
協力講座 秋入学 Autumn enrollment (Outside Hongo Campus)


博士論文数
Number of Doctoral Dissertation
論文数 Num,ber
年度 Year
2012
2013
2014
2015
2016
2017
2018
A0 : 原子核理論 Nuclear Phys. (Theory)
A1 : 素粒子理論 Elementary Particle Phys. (Theory)
A2 : 素粒子実験・原子核実験・加速器 High-energy/Nuclear Phys. (Experiment)
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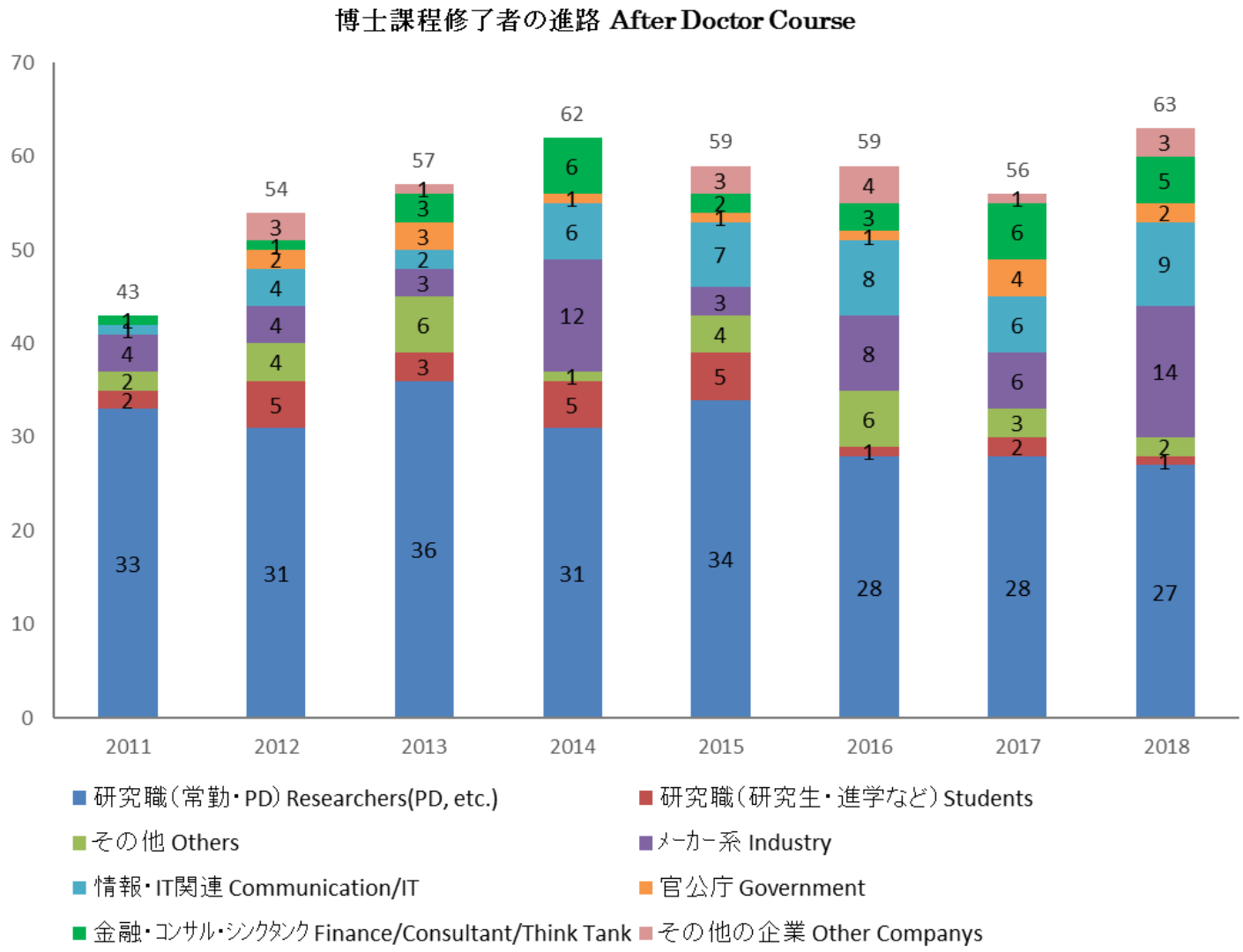
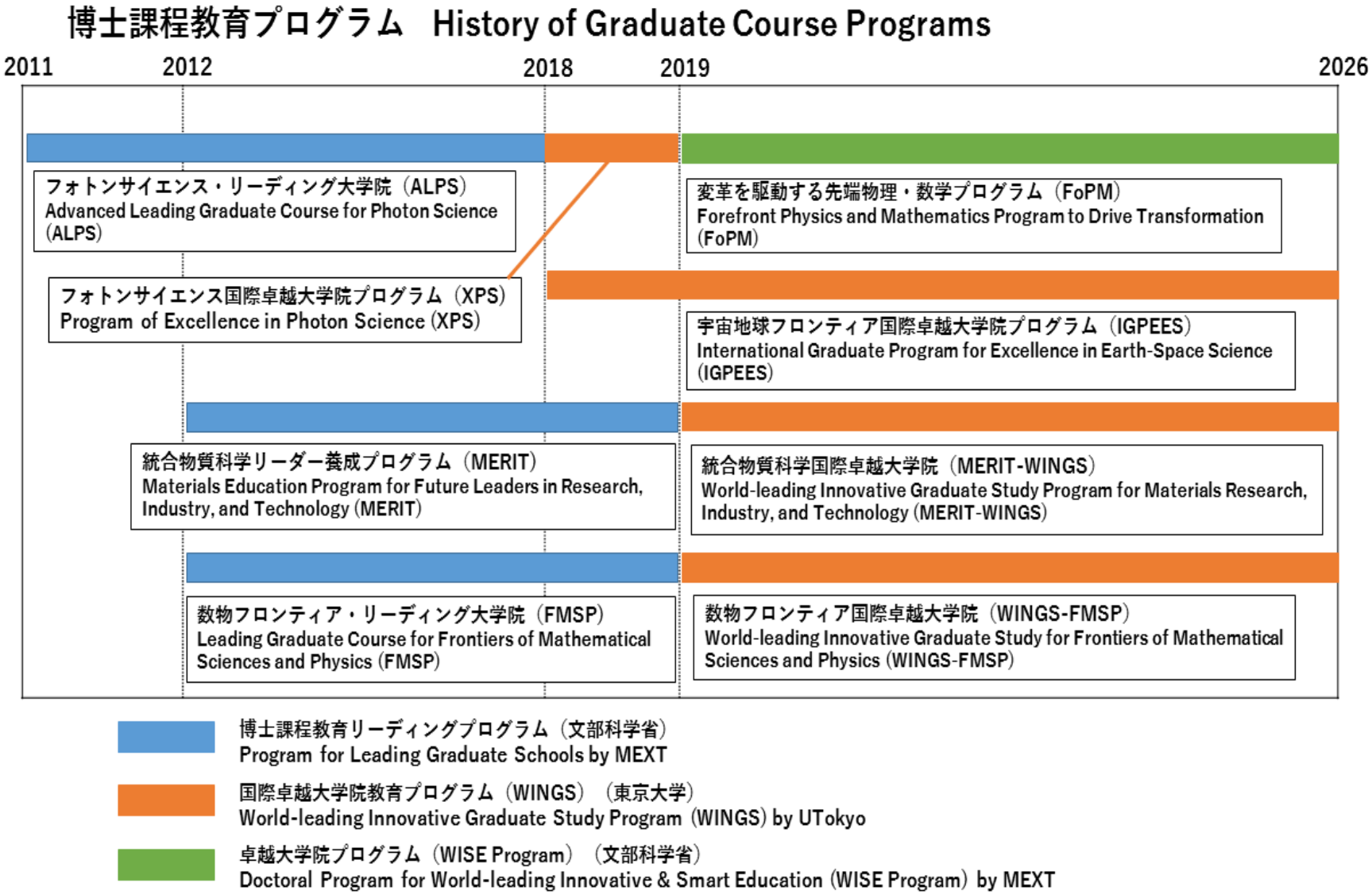

博士課程修了者の進路 After Doctor Course
70
60
50
40
30
20
10
0
2011
2012
2013
2014
2015
2016
2017
2018
43
54
57
62
59
59
56
63
33
31
36
31
34
28
28
27
研究職（常勤・PD）Researchers(PD, etc.)
研究職（研究生・進学など）Students
その他 Others
メーカー系 Industry
情報・IT関連 Communication/IT
官公庁 Government
金融・コンサル・シンクタンク Finance/Consultant/Think Tank
その他の企業 Other Companys

Graduate Course Program

- Reformation of the Graduate Course
  - Broader scope of science
    Challenging spirit to new fields
    Realizing social relations
  - Broader scope of carrier path
    Academia, Private Company, Government
  - Broader supporting system
    Vice supervisor system, QE system
- Financial support
  - Recruiting high-level students to the PhD course

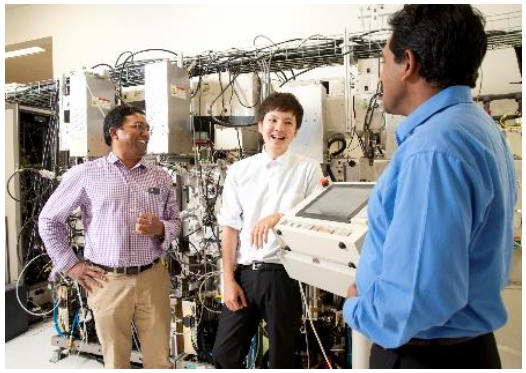
Graduate Student Program



Advanced Leading Graduate Course for Photon Science (ALPS)

Features of the ALPS Program

Course work	Course work classes are provided to train ability to harness a commanding perception and knowledge across multiple disciplines based on photon science fusion theory.
Off-campus activities	Hands-on practical experience outside of the university campus, such as placement in overseas universities, research institutes, industry internships, collaborative research with other universities, etc., planned by our course students are proactively encouraged.
Multi-tutor supervision	Throughout the course, in addition to main supervisors, secondary supervisors are assigned to each student for promoting access to new research ideas through academic networking and dialog with multiple researchers and their graduate schools, departments and laboratories.
Financial support	A financial grant of 200,000 yen per month is given to students beginning in the latter half of their first year in the Master's program to allow them to devote themselves to their studies in peace of mind until completing their PhD program.



Reformation of the Graduate Course by ALPS

- Breaking down the three “walls”

  between science and engineering

  between different disciplines

  between master and doctor courses
- Student support from the master course stage

  -> Increase of doctor course students
- Broader carrier path

  Academia : Others -> 50 % : 50 %

THE UNIVERSITY OF TOKYO

FoPM

Forefront Physics and Mathematics Program to Drive Transformation

Selected for the MEXT Doctoral Program for World-leading Innovative & Smart Education (WISE Program) 2019

Advancing social innovation through basic science

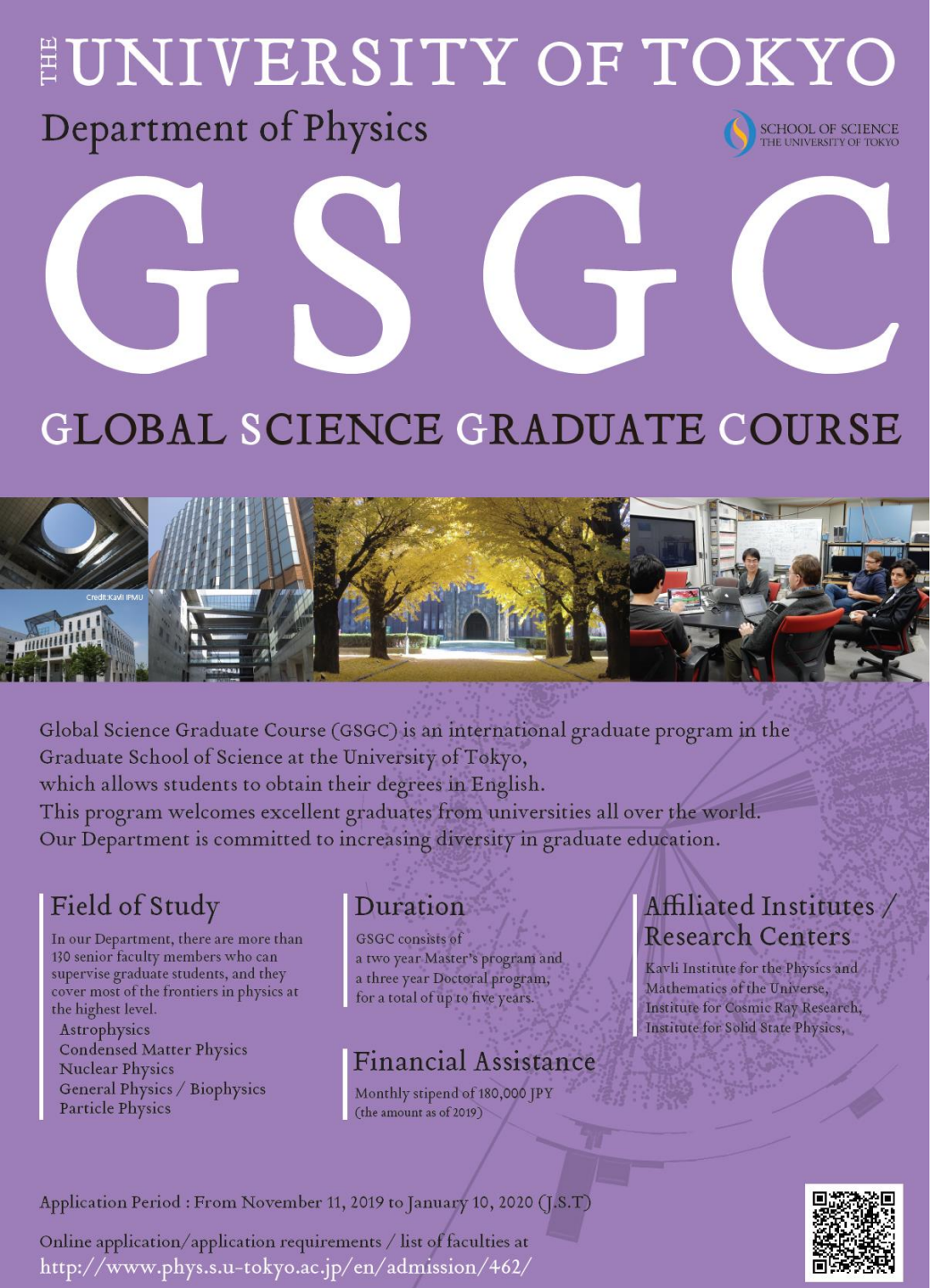
- **English Curriculum**
  Complete all coursework entirely in English
- **Integrated Program**
  Graduate in 5 years with a Masters and a Doctorate
- **Financial Assistance**
  Receive a monthly stipend of JPY170,000–JPY180,000
- **International Experience**
  Collaborate with world-class researchers outside Japan (support available)

Welcome to FoPM! We use state-of-the-art physics and mathematics to train basic science specialists who can also find solutions to real-world problems. Join us to work with world leaders in mathematics and the physical sciences and push through scientific frontiers to transform science and society!

Prof. Hitoshi Murayama, Program Coordinator

https://www.s.u-tokyo.ac.jp/en/FoPM/

Contact: WINGS Desk, Graduate School Office of the Graduate School of Science, The University of Tokyo
E-mail: wings.s@gs.mail.u-tokyo.ac.jp

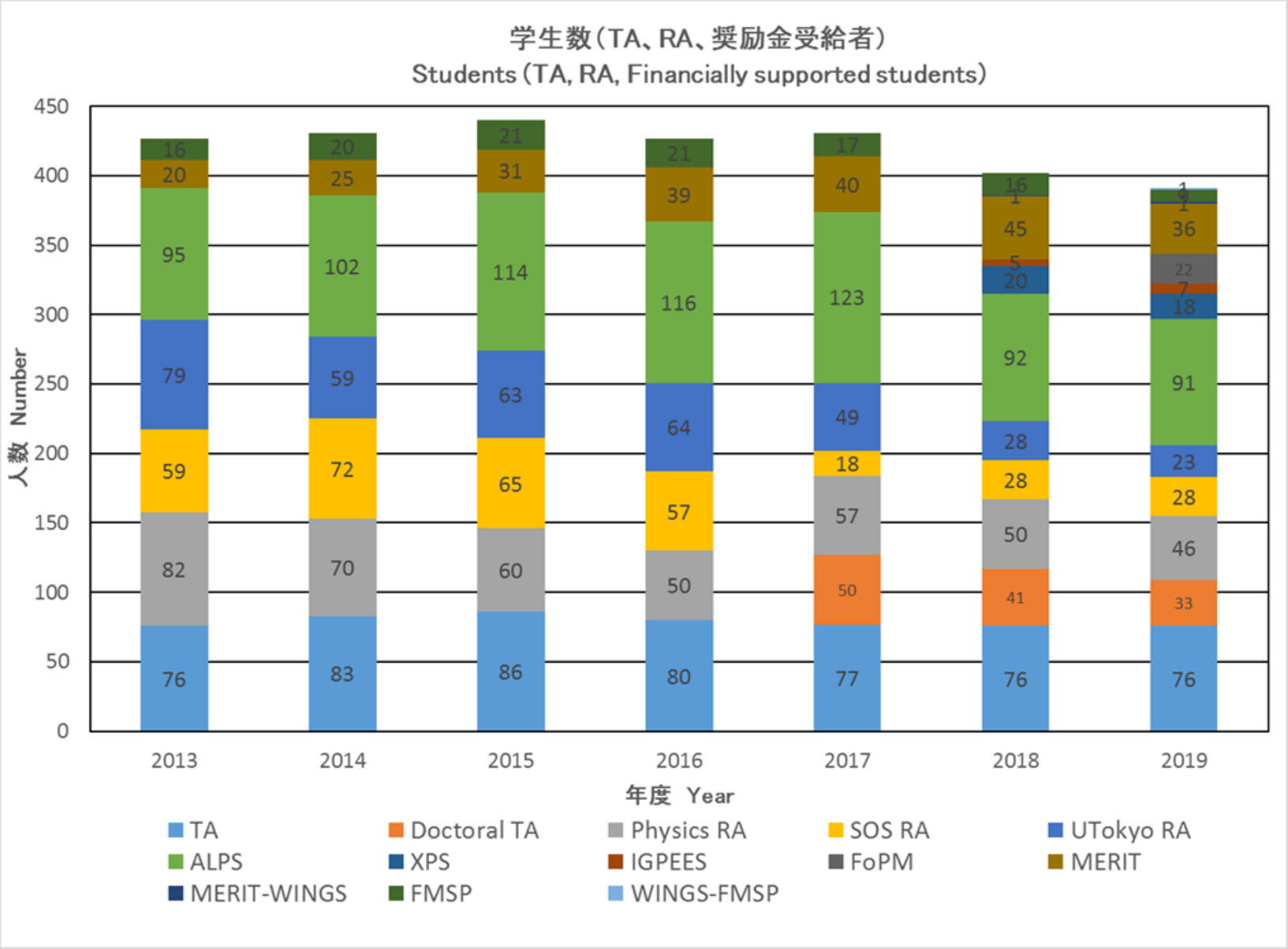


Started in 2016

GSGC Students / Year

Department of Physics	3
Kavli IPMU	1
ICRR	1
ISSR	1

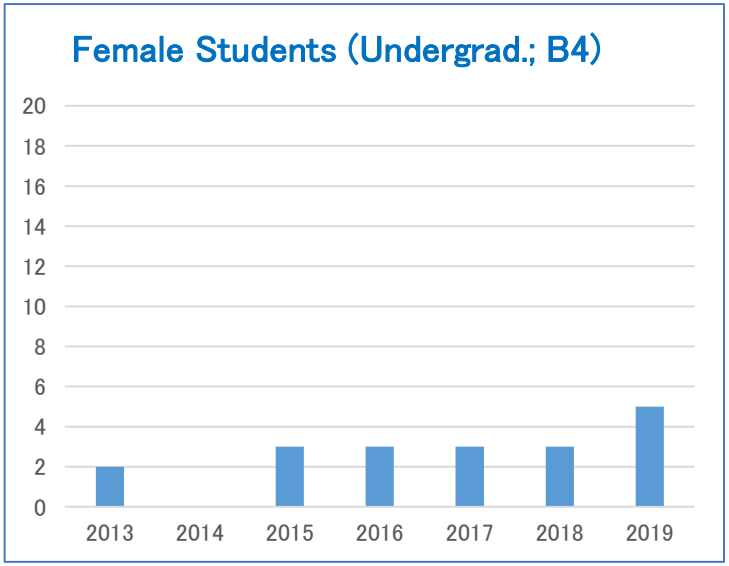
- Application by GRE and GPA
- 5 Year PhD Course
- Financial Support
  180,000JPY/month

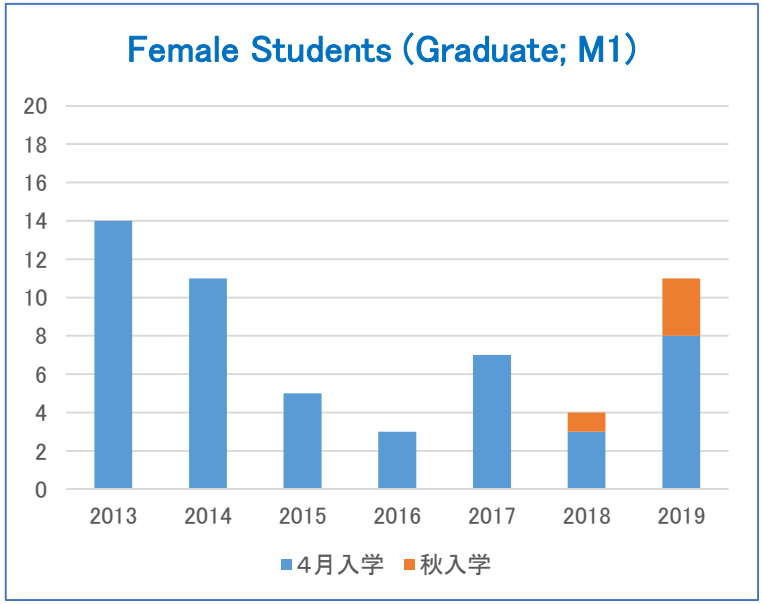

学生数（TA、RA、奨励金受給者）
Students (TA, RA, Financially supported students)
人数 Number
年度 Year
2013
2014
2015
2016
2017
2018
2019
TA
Doctoral TA
Physics RA
SOS RA
UTokyo RA
ALPS
XPS
IGPEES
FoPM
MERIT
MERIT-WINGS
FMSP
WINGS-FMSP

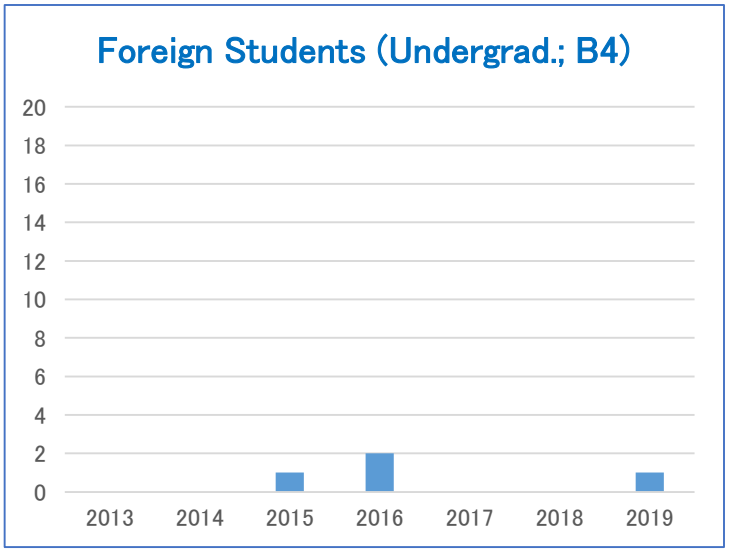
Future Directions and Actions

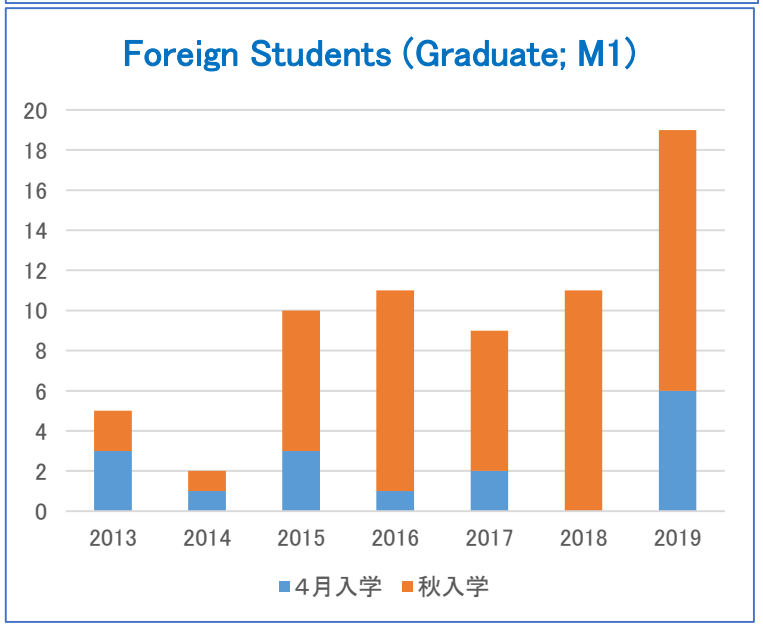
- Timely Actions to Expanding Physics
  - Cooperation with Related Institutes
    e.g., Institute for Trans-Scale Quantum Science
    ISSR, IPMU, CRC
    Universal Biology Institute
  - Extension of *Institute for Physics of Intelligence*
    e.g., Recruitment of young experts
- More Internationalization
  - Diversity of Students
    e.g., Recruitment international students
    GSGC, FoPM
  - Diversity of Staff
  - Curriculum in English

Diversity of Students

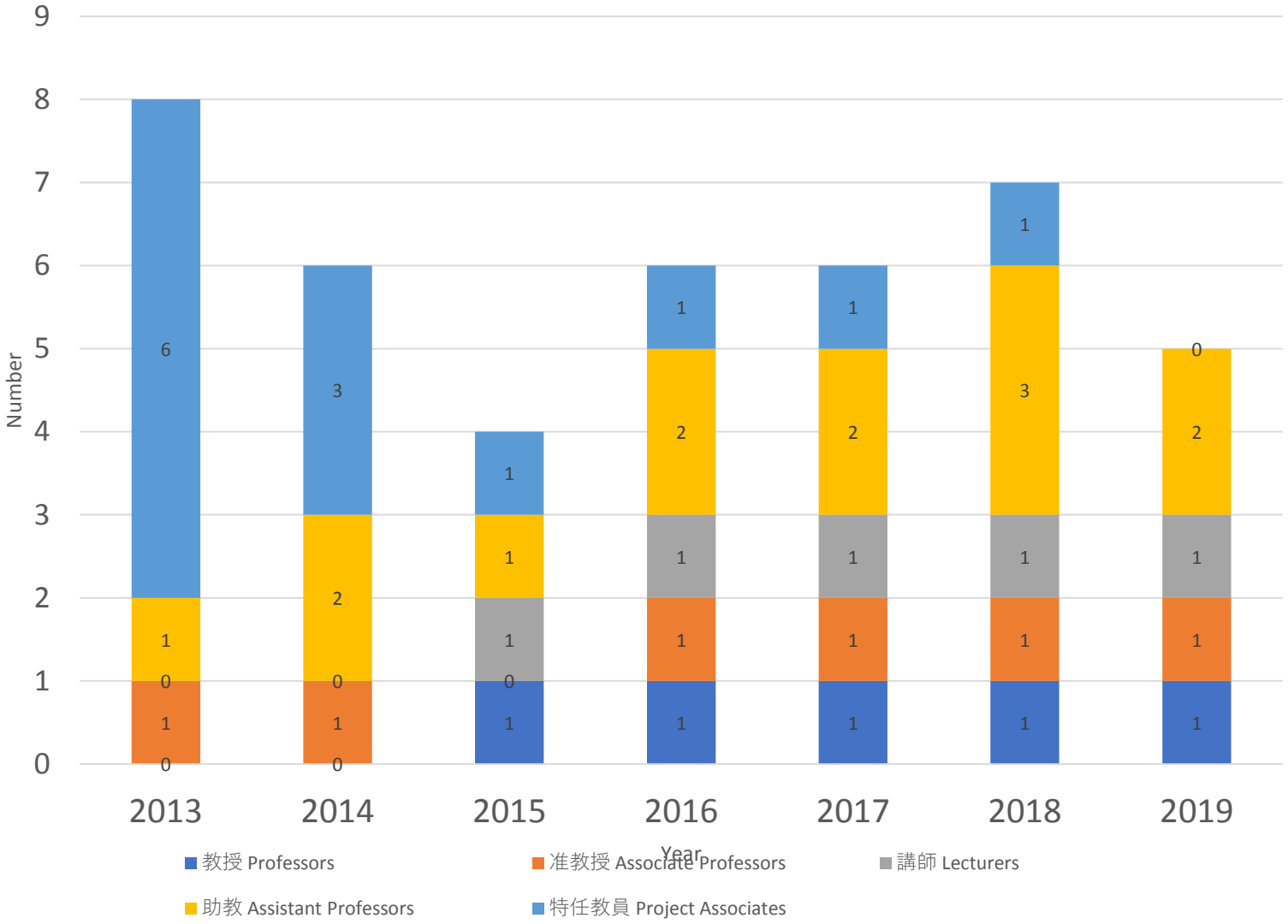








Female Staff



Future Directions and Actions (2)

- Enhancing Research Capability
  - Start of Sabbatical System
    Once per 7 years for AP: per 10 years for P
  - Decrease of non-research time
  - Hiring high-level support staff (URA etc.)
- Strengthening Financial Base
  - Diversity of Funding
    Department based cooperation with companies
- Launching New Institutes
  - Institute for Physics of Intelligence
  - Trans-scale Quantum Science Institute

知の物理学研究センター
Institute for Physics of Intelligence

Institute for Physics of Intelligence (IPI)

launched in Dec. 2019
Aim: To explore research frontiers through integration of physics and artificial intelligence

overseas researchers (Nobel Prize Winners)

知の物理学研究センター
Institute for Physics of Intelligence

Organization & Staff members

Director
Prof. Masahito Ueda

数理情報部門
Mathematical Informatics Team

Prof. Kenji Fukushima

Prof. Masahito Ueda

Associate Prof. Hosho Katsura

知能・学習部門
Intelligence Learning Team

Prof. Shinji Tsuneyuki

Full professor is going to join IPI from Apr. '20

We are planning to hire an associate professor

非線形非平衡部門
Nonlinear Non-equilibrium Team

Prof. Kensuke Kobayashi

Prof. Naoki Yoshida

Associate Prof. Kazumasa Takeuchi

Assistant Prof. Tilman Hartwig

客員部門
Visiting Researches Team

Well–known overseas researchers e.g. Nobel Prize Winners stay regularly

BUDGETS & PERSONNEL

Budget Request（概算要求）

- For educational and research budgets for FY 2020 and allocated, amount to be announced
- For hiring an associate professor, allocated, a candidate under recruiting
- Applying for reallocation of budgets for FY 2021 for hiring assistant professor

Corporate Sponsored Research Program to be launched in May. 2020（**寄付講座**）

- "Research on Physics of Intelligence" by DAIKIN INDUSTRIES, Ltd
- Total amount : 160,000,000 JPY for 5 years
- Aim : Exploration of research frontiers through integration of physics and artificial intelligence

The University of Tokyo Foundation via Support Fund for Institute for Physics of Intelligence since Feb. 2019（**大学基金**）

- Total donated amount : 557,600 JPY as of Feb. 7th
- Aim : Support of graduate students and young researchers
  Scholarship and research expenses
  Dispatch of students and researchers to overseas institutions
  Support of overseas presentation
  Acceleration of research and hiring of postdoctoral fellows

Thank you!