変革を駆動する
先端物理・数学プログラム

Forefront Physics and Mathematics Program to Drive Transformation

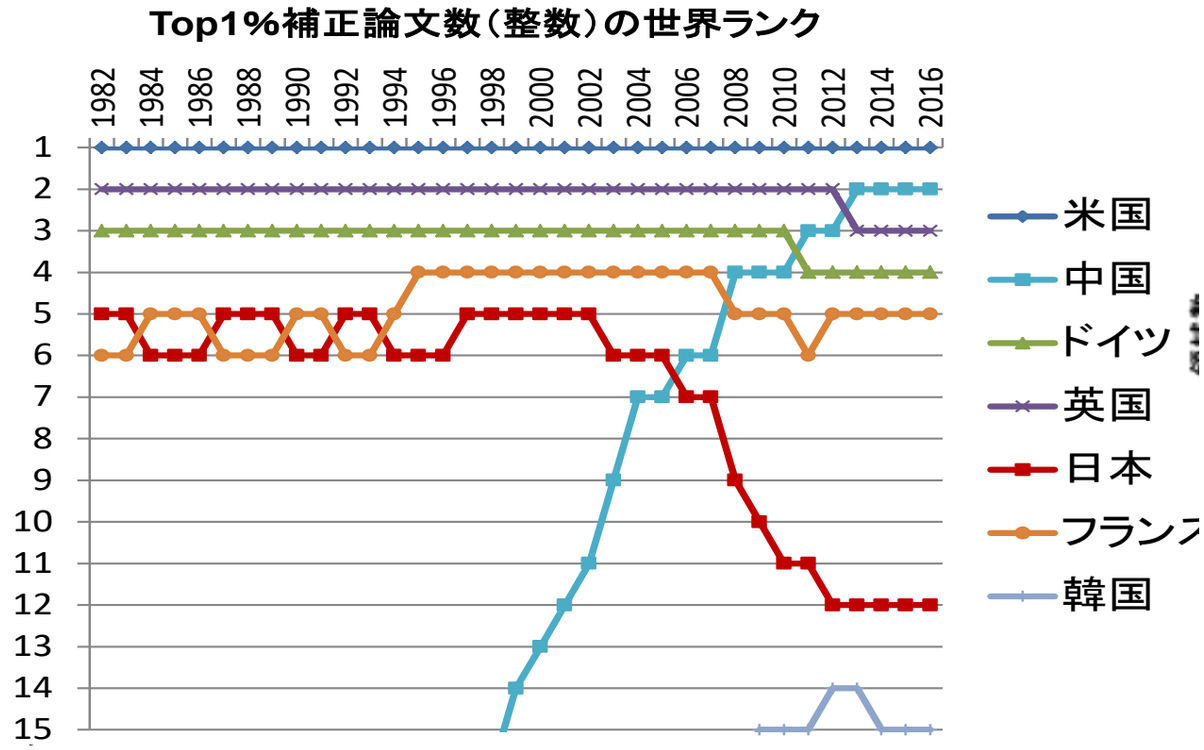
Hitoshi Murayama, Coordinator
(Berkeley, Kavli Institute for the Physics and Mathematics of the Universe)

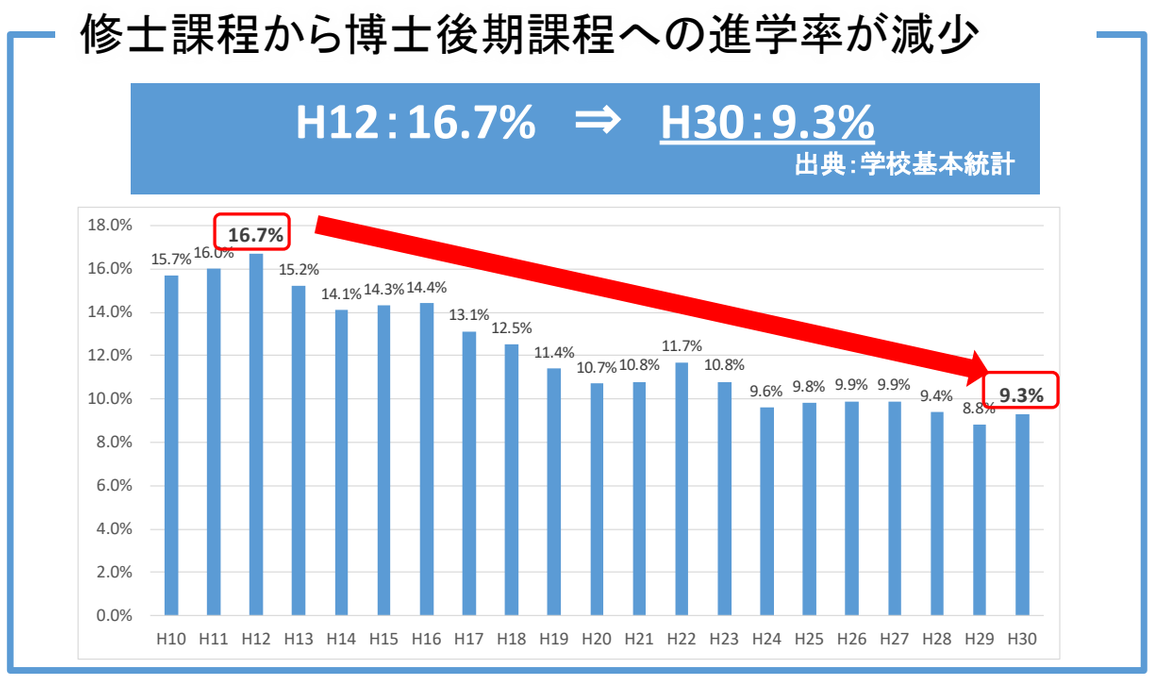
東京大学
THE UNIVERSITY OF TOKYO

KAVLI IPMU INSTITUTE FOR THE PHYSICS AND MATHEMATICS OF THE UNIVERSE

facts

- scientific leadership of Japan is sliding
- graduate school is attracting less students
- graduate students are normally not supported in Japan
- Yet technical knowledge is evermore important for future of human society
- how can Japanese universities change for the better future?





government initiative

WISE Program (Doctoral Program for World-leading Innovative & Smart Education)

The WISE Program is a program to encourage universities to systematically collaborate with other domestic and foreign universities, research institutes and private companies, etc. while taking advantage of its own strengths and achievements of graduate school reforms so far, and develop a five-year integrated doctoral degree program aggregating the world's top level educational and research capabilities, thereby fostering excellent doctoral talents who can lead each sector and creating outstanding bases where human resources development and exchange and new joint research are advanced sustainably.

Policy

Policy Index

Budget

National Councils

Education

Forefront Physics and Mathematics Program to Drive Transformation

- University of Tokyo asked me to put together a proposal
- my guiding principles
- get back to basics: education is about maximizing the potential of each student
  - students are worried about their career opportunities
  - don’t limit to Japanese academia: overseas, industry
- education in Japan is excellent
  - yet two areas for improvement for students
    - communication skills
    - skill to find new game-changing problems

FoPM approved 11 out of 44
launched in fall 2019

Forefront Physics and Mathematics Program to Drive Transformation

final aim: maximize potential of graduate students

- **Graduate education in Japan is *excellent***
  - very high level of basic education, trains students of excellent problem-solving skills within the existing fields
  - However, **is not realizing maximum potential of students**, loss to society
  - **can't *sell* excellent results**
  - **weak environment to discover new game-changing problems**

- Need **Diversity of people & disciplines** & **Interaction**
- lack of diversity among students
  - math：women 3%　international 12%
  - physics：women 6%　international 9%
  - **maximize *entrance* of students**

RT formula **revolutionalized QI theory**
overlapped in grad school, no contacts
both postdocs at UCSB by chance
discovered new problem during lunch, solved soon

Watanabe-Murayama theorem
extends Nobel Prize by Nambu
2016 Yukawa Prize
grad student in Berkeley
material science & cosmology

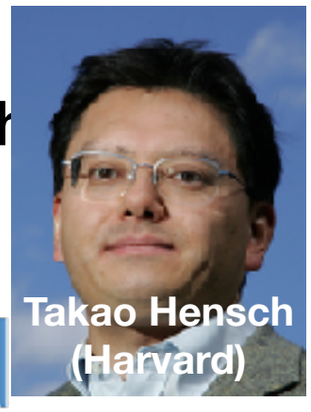
path to QI & AI

- Both QI & AI came from physics and math
  - **Maximize Exits of students** using the skills
- worldwide competition in **QI**
  - Companies (i.e.g Microsoft) hires scientis trained in basic physics to reshuffle discplines
  - Even work on black hole information paradox
  - e.g. Ryu-Takayanagi formula
- physics, astronomy, neuroscience are awash with **Big Data**
  - **Learn to use AI naturally during research**
  - **Bring bio, physics, math together**
    - ➡understand development of neural net
    - ➡human intelligence
    - ➡develop **Next Gen AI**based on the principle
  - Lead the world with **Explainable AI**

AI has to study 10M pictures of cats

Next Gen AI

Human babies do not need big data to identify cats



IRCN

知の物理学 創発センター
Institute for Physics of Intelligence

Forefront Physics and Mathematics Program to Drive Transformation

final aim: maximize potential of graduate students

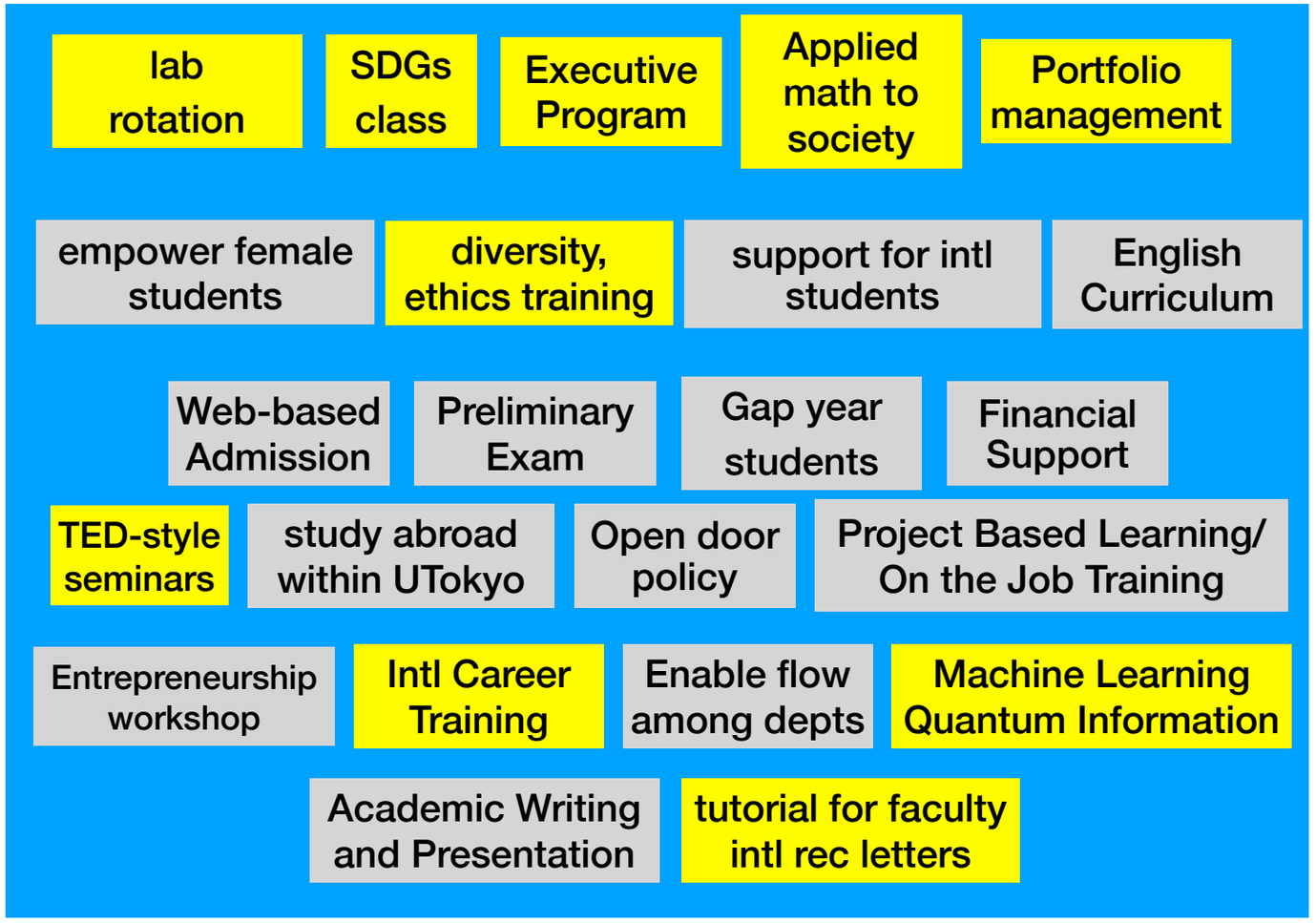
Diversity & Interaction

Diversity of disciplines

Diversity of Entrance

Interaction

Diversity of Exits



Reform mindset of faculty & students

Examples Pilot Program

Diversity: 13⇒16 female, 11⇒16 international

among 87⇒95 faculty members

授業科目名等	単位数	履修方法	備　考
Academic Writing and Presentation	2	必修	
機械学習(A)演習	2	選択必修	2科目のうち2単位以上
量子コンピューティング演習	2		
SDGs 特論	2		
エグゼクティブ・プログラム	2		
社会数理先端科学	2	選択必修	5科目のうち2単位以上
社会課題実践演習	2		
数物スタートアップ演習	2		
Introductory Course: Quantum Information Science I	1		
Introductory Course: Quantum Information Science II	2		
Introductory Course: Neurointelligence I	1		
Introductory Course: Neurointelligence II	2		
Contemporary Mathematics for Physicists I	1		
Contemporary Mathematics for Physicists II	2		
Contemporary Physics for Mathematicians I	1		
Contemporary Physics for Mathematicians II	2		
Contemporary Biology for Mathematicians and Physicists I	1	選択必修	18科目のうち2単位以上
Contemporary Biology for Mathematicians and Physicists II	2		
Contemporary Photon Science I	1		
Contemporary Photon Science II	2		
Astroinformatics I	1		
Astroinformatics II	2		
Applied Quantum Beams I	1		
Applied Quantum Beams II	2		
Math for Industry I	1		
Math for Industry II	2		

上記授業科目の履修のほか、国際キャリア研修、国外連携機関長期研修、ダイバーシティ・倫理教育への参加を修了要件とする。

- **Required: Diversity Ethics Training**
- **Requied: Academic Writing and Presentation**

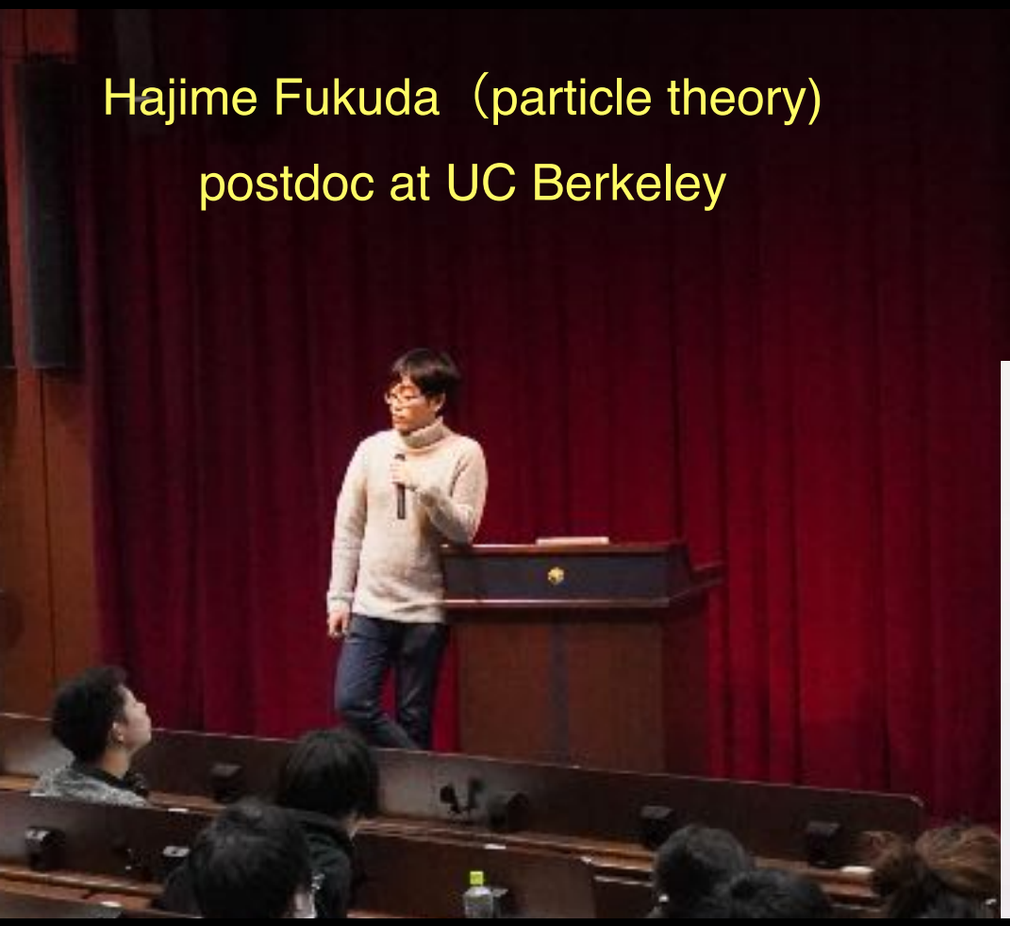
Charles Yokoyanma (IRCN)
senior scientific editor

since 1995

Kate Harris 理学系 URA
senior physical sciences editor

- **Required: Travel Abroad**
- **Required: (2 units)**
  - **data mining**
  - **quantum computing**
- **Required: (4 units)**
  - **entrepreneurship workshop**
  - **SDGs: proactive environmental science**
  - **Executive Program (omnibus)**
  - **Introduction Course Neurointelligence (IRCN)**
  - **Contemporary Math for Physicists**
  - **Contemporary biology**
  - **Practical Research in Applying Mathematics to Society**

Career workshop　Dec 19, 2019



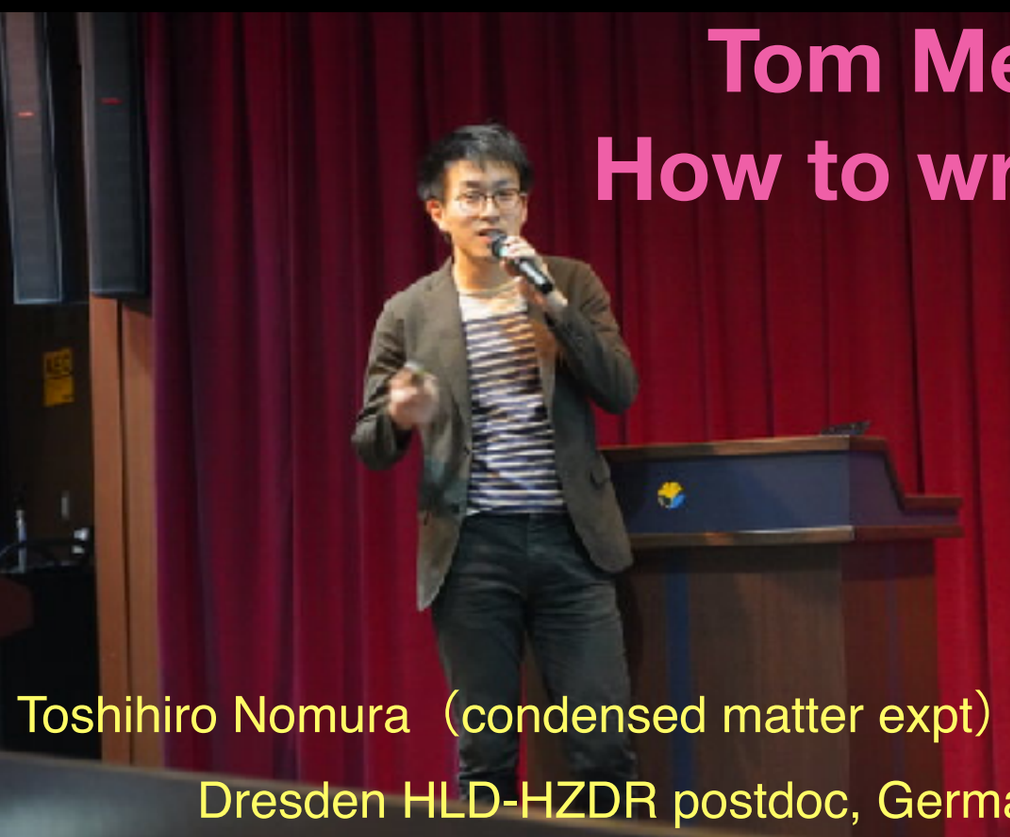
Hajime Fukuda（particle theory)

postdoc at UC Berkeley

Yuji Chinone（CMB expt）Project Assist Prof

LBL Associate Specialist till 2018

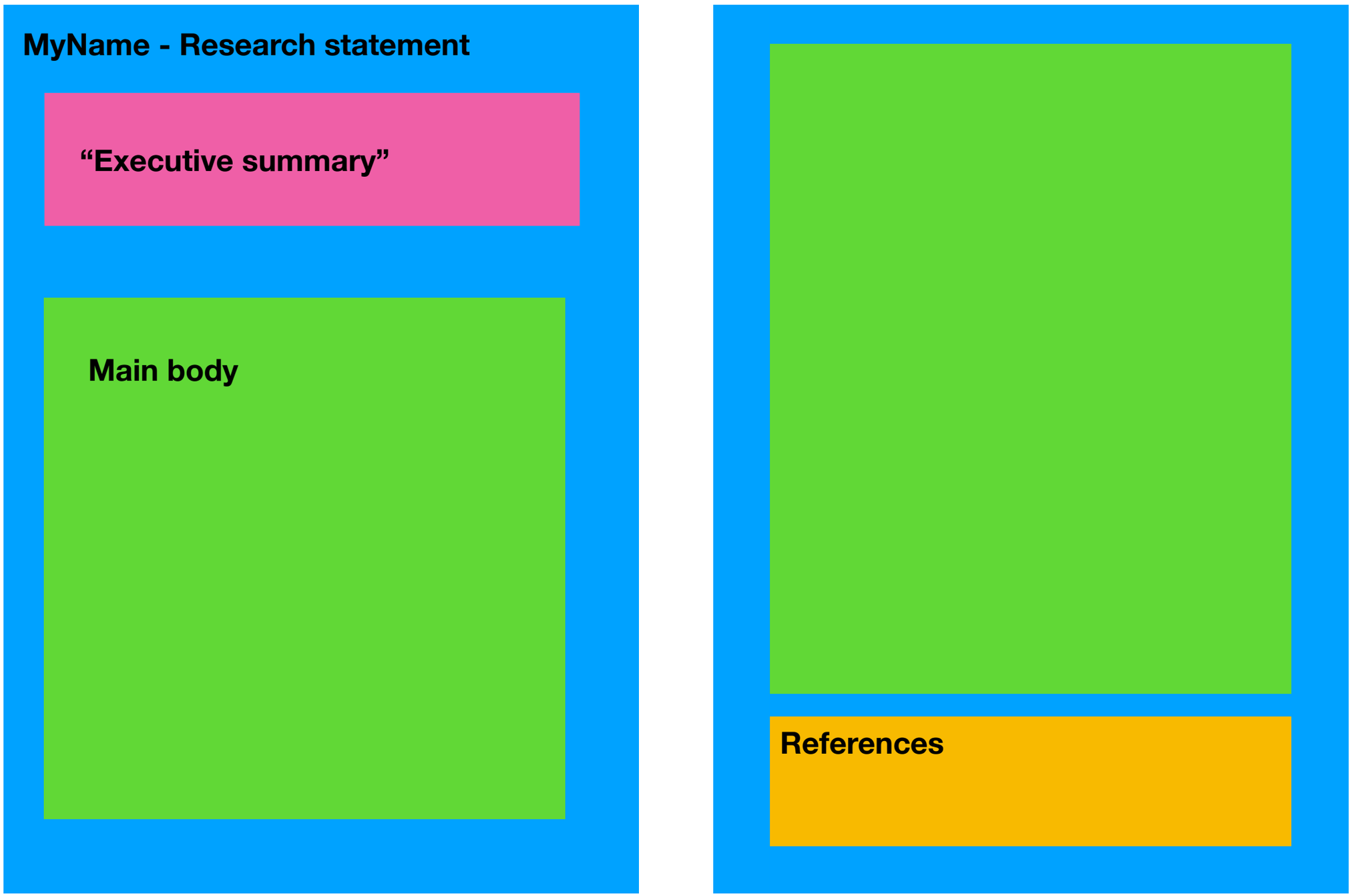
Tom Melia IPMU Assist Prof
How to write postdoc application



Toshihiro Nomura（condensed matter expt）Assist Prof

Dresden HLD-HZDR postdoc, Germany

Here’s an idea for layout



This sounds unique, unusual — I want to know more!

Highlights a key achievement- "if you have it, flaunt it!"

Good summary sentences:

"My research lies at the relatively unexplored interface between ocean science and high energy particle physics. I developed the use of cosmic ray muons in the study of the feeding patterns of yellow-fin tuna."

"I propose to focus my research around the following questions:

1. How do yellow-fin tuna migration routes correlate with their feeding patterns?

2. Are there correlations between the solar cycle and the frequency with which the tuna feed?"

Questions are a good technique for engaging a reader.

These are specific, generating interest, but notice that they still convey the same information as

This is generic (they already know you are an ocean scientist, and there are 50 applications all studying feeding patterns of yellowfin tuna)

Bad (i.e. just ok) first sentences:

"I am an ocean scientist interested in studying the feeding patterns of yellow-fin tuna."

"Because yellowfin tunas undergo such an amazing transformation in size (from being nearly microscopic to being one of the largest open ocean predators), they eat a wide variety of prey, throughout their lifetimes. At a young age, they eat tiny zooplankton, and their prey increases in size as they do. As adults, they eat fairly large bony fishes and squids." <— I took this from oceana.org

Starting with general background feels logical, but is actually weak. Your first sentences should be about YOU!

Reference letters

Your supervisor will likely be your first choice of reference writer — good!

It *really* helps to have another senior scientist as a reference writer.

It *really* helps to have one or more reference writers outside your institution, and

It *really* helps if one of these is from outside Japan

Reference letters

This means that you need to interact with senior scientists beyond your direct supervisor.

But this is important beyond simply obtaining reference letters. You will learn new science from then, and they can learn from you! The latter is important in disseminating your scientific work and insights to the broad community

Reaching out

Golden opportunities will arise when you go to (international) **conferences** and **workshops**

1) **Look up** who is there (participant list on the website)

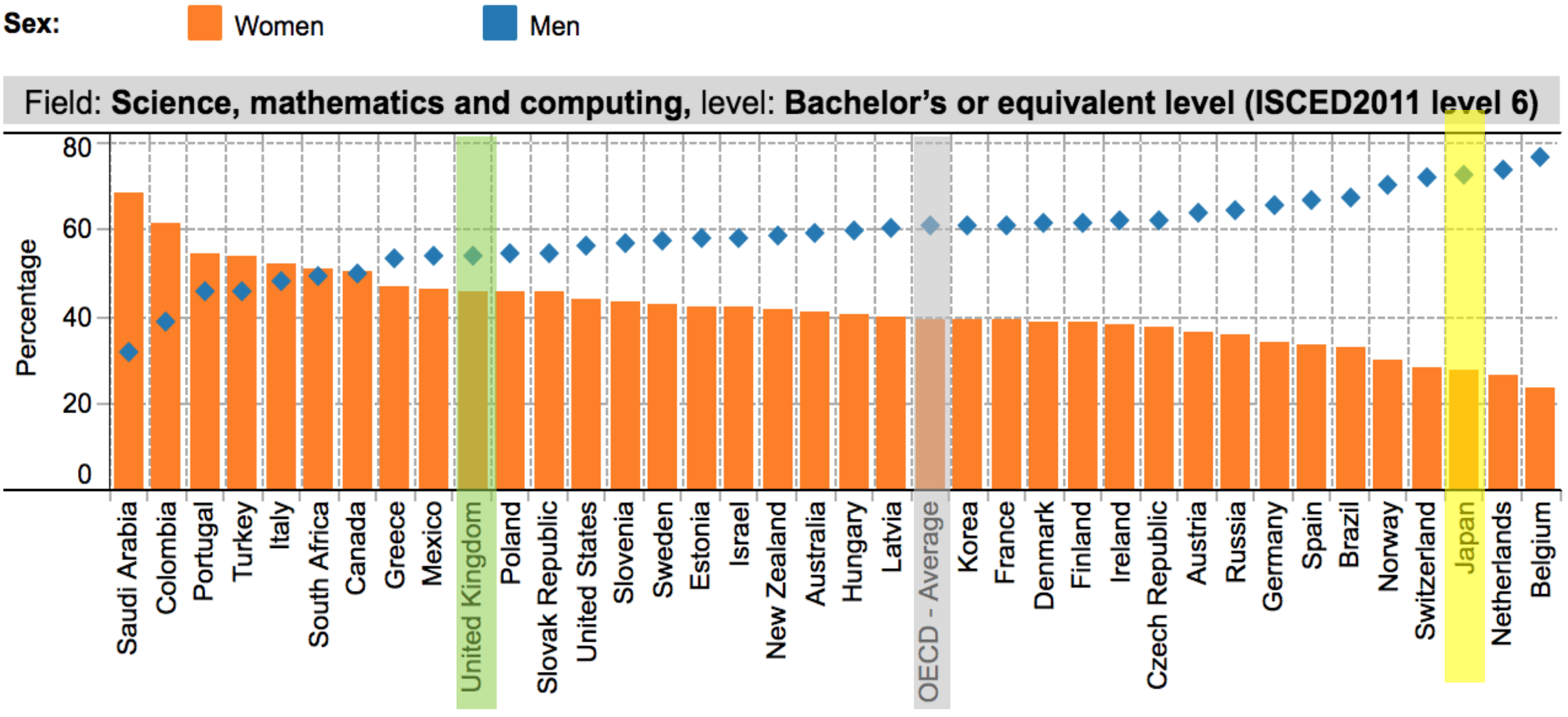
2) You are allowed to '**prepare**'! Read up on the latest papers of scientists whom you are interested in talking to. And have ready a 2 minute explanation of your recent work. And have ready a 10 minute blackboard version.

3) You have to **Go For It!**

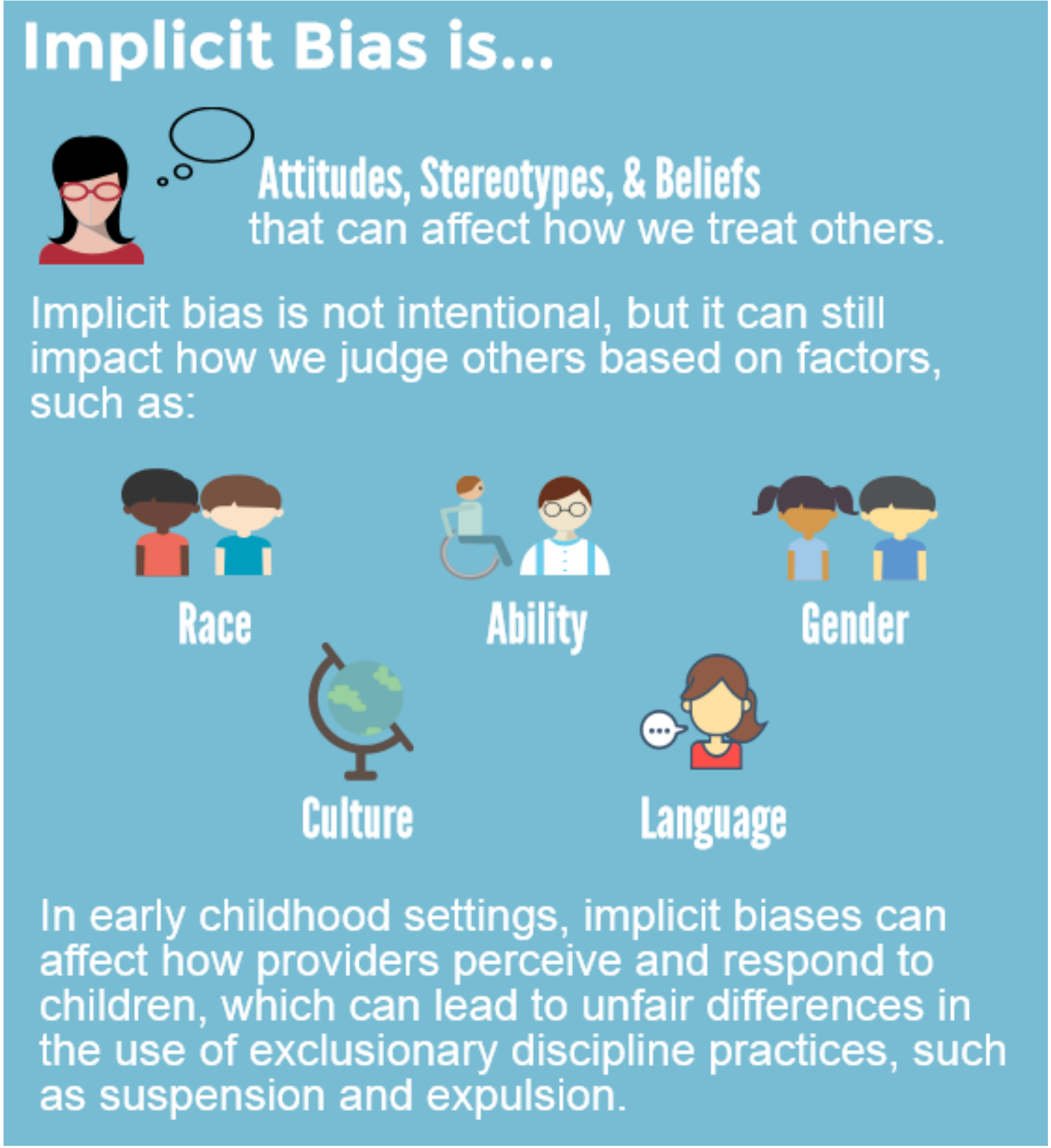
Tenure review

- In many countries, you go from fixed-term assistant professors to tenured associate and full professors
    - You get reviewed!
    - You suggest ~5 people who can write evaluation letters
    - Department chooses ~5 more people you do not suggest
    - You need to be known internationally
        - Networking is crucial

OECD data


Sex:
Women
Men
Field: Science, mathematics and computing, level: Bachelor's or equivalent level (ISCED2011 level 6)
Percentage
80
60
40
20
0
Saudi Arabia
Colombia
Portugal
Turkey
Italy
South Africa
Canada
Greece
Mexico
United Kingdom
Poland
Slovak Republic
United States
Slovenia
Sweden
Estonia
Israel
New Zealand
Australia
Hungary
Latvia
OECD - Average
Korea
France
Denmark
Finland
Ireland
Czech Republic
Austria
Russia
Germany
Spain
Brazil
Norway
Switzerland
Japan
Netherlands
Belgium

Unconscious bias



https://www.docspeaks.com/uncovering-implicit-bias-recognizing-unconscious-bias-master-class

Gender-based Systematics in HST Proposal Selection

I.Neill Reid, Space Telescope Science Institute

6. Summary

We have reviewed eleven cycles of the HST Telescope Allocation Process for trends in the proposal acceptance fraction with respect to the gender of the Principal Investigator. The results show that male PIs have a higher success rate than female PIs. The offset might be attributed to sampling statistics for a single cycle, but the consistent results for every cycle indicate that this is a systematic bias. Closer inspection of data from recent cycles shows that the gender disparity is lower among proposals submitted by more recent graduates. There is little evidence for significant variations with regard to geographical origin, and while some science categories give more balanced results than others within the dataset examined, the same panel of reviewers can produce results with significantly different gender ratios for different categories.

Looking forward, we will continue to brief incoming members of the HST TAC on the potential for unconscious bias. Those TAC members are charged with identifying what they consider the "best science" among the proposals submitted to their panel. They will be asked to give careful consideration to the criteria they use in ranking those proposals – the most effective means of countering unconscious bias is recognizing that it may be present. In addition, starting in Cycle 22, we are revising the proposal format: the Principal Investigator is no longer listed on the front page; all investigators are listed together in the proposal, with the PI identified, but giving initials rather than first names. The goal is to provide a broader view of the team who will carry out the

IAT (Implicit Association Test)

Project Implicit®

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Skin-tone IAT	***Skin-tone*** **('Light Skin - Dark Skin' IAT).** This IAT requires the ability to recognize light and dark-skinned faces. It often reveals an automatic preference for light-skin relative to dark-skin.
Age IAT	***Age*** **('Young - Old' IAT).** This IAT requires the ability to distinguish old from young faces. This test often indicates that Americans have automatic preference for young over old.
Disability IAT	***Disability*** **('Disabled - Abled' IAT).** This IAT requires the ability to recognize symbols representing abled and disabled individuals.
Race IAT	***Race*** **('Black - White' IAT).** This IAT requires the ability to distinguish faces of European and African origin. It indicates that most Americans have an automatic preference for white over black.
Weight IAT	***Weight*** **('Fat - Thin' IAT).** This IAT requires the ability to distinguish faces of people who are obese and people who are thin. It often reveals an automatic preference for thin people relative to fat people.
Gender-Science IAT	***Gender - Science.*** This IAT often reveals a relative link between liberal arts and females and between science and males.
Religion IAT	***Religion*** **('Religions' IAT).** This IAT requires some familiarity with religious terms from various world religions.

necessary for US faculty applications

Statement on Advancing Diversity, Equity, and Inclusion

[redacted]

Introduction

I firmly believe that *diversity* plays a key role in advancing science. The variety of world views and ways of thinking, arising from our personal experiences and the culture we grew up in, is a tremendous resource of new ideas, viewpoints, critical questioning of existing paradigms, and stimulating discussions. In comparison with the world at large, the average conference room in high energy particle physics is sadly quite uniform, both in the audience and the selection of speakers. I am dedicated to changing this as best I can. This is, of course, a challenging task with no simple magical solutions. We need to proactively ensure *equity*, the fair treatment and access to support for those who have had structural issues and barriers placed in their career paths. The current worldwide COVID-19 crisis is tremendously increasing those barriers for some, with many children cut off from the education and programs provided by their schools. It will be an additional challenge in the upcoming years to reach out to and support these young people. Finally, I strive to achieve a high level of *inclusion* in scientific environments by providing a welcoming and respectful atmosphere. Research thrives on asking critical questions and recognizing mistakes, so I believe it is crucial to value all contributions to a discussion, encourage questions, and openly admit errors. I also believe it is important (and often neglected) to provide feedback, both critical and positive, to students and colleagues.

Advancing diversity, equity and inclusion is a complex and multi-dimensional task. In this statement I will focus mainly on aspects of geographic, socioeconomic and gender diversity, but other aspects such as race, ethnicity, religion, language, abilities/disabilities, sexual orientation are by no means less important. Some aspects which I discuss here can be extended into these other directions, but the complexity necessitates a multitude of carefully tailored steps to address them all.

Track record

As an undergraduate, I spent a semester in Singapore and travelling the neighbouring countries of Southeast Asia, curious to explore the world beyond the boundaries of Europe. I learned some science there, too, but mostly I was impressed by cultural differences, some of them rather entertaining but others leading me to seriously question my views of the world. I was deeply impressed by the hospitality and the open-mindedness of people who in my 'western' eyes were bitterly poor and had very little education. After finding myself stranded in the countryside of Laos during a motorcycle tour, a schoolteacher in a remote village brought me into his home. The next day when I met his students, I was struck by their tremendous enthusiasm for science; at the same time it was sadly clear that these kids had little chance of any higher education. I felt there was little I could do, beyond setting up their only computer, answering some questions, and helping them to practice English. Later on in my career, I have tried to create opportunities for students and young researchers from countries which are not traditionally strong in natural sciences. I have given talks and visited research institutes in Vietnam and India, and recently, during the COVID-19 crisis, I gave a public lecture to undergraduate students in Bangladesh. Last year, I was a co-organizer of a workshop on gravitational waves at ICTP, Trieste, with a special budget and strategy to attract participants from developing countries.

I also strive to improve the gender balance in natural sciences. As a postdoc in Paris, I was

Prepared for Pitt-PACC University of Pittsburgh 9/9/2020

Statement on Contributions to Advancing Diversity, Equity, and Inclusion

[redacted]

The lack of diversity in physics as a whole and in theoretical particle physics in particular is a serious problem. I believe that there is a lot that I can do as a professor to try to increase the number of women and members of underrepresented minorities in the field. Below I outline some of the strategies that I have implemented towards this end since starting at the University of Michigan and transitioning to LBNL. I have been actively approaching this problem from two different perspectives. First, I work to encourage women and members of underrepresented minorities to consider careers in theoretical physics. Second, I work to promote researchers from underrepresented groups already in the field.

In my first semester at Michigan it became clear to me that while there are many white women and members of underrepresented minorities in the department, these undergraduate and graduate students were not approaching me about research opportunities. After talking with colleagues, I started to suspect that many of these students were simply more intimidated about approaching the faculty, especially in the particle theory group. To counter this issue I decided to approach Zhiquan Sun, an extremely strong undergraduate student in my advanced physics class, to see if she would be interested in working in my research group. She was enthusiastic and told me that she was hoping to work with someone in the theory group on a research project but felt too intimidated to approach anyone directly. My work with Zhiquan has been extremely successful, and we have authored three papers together. I encouraged her to present some of her work at the APS conference in Denver in 2019, where she made valuable connections with successful female faculty members in the field (who I asked in advance to chat with Zhiquan). I also encouraged her to apply for the FUTURE of Physics workshop at Caltech for aspiring young women in physics in the fall of 2019. I nominated her for the program and her application was successful. She said that the program made her excited about graduate school and helped her ease her sense of impostor syndrome. I helped Zhiquan prepare her graduate school applications, and she was accepted to an impressive number of top programs in theoretical physics, including MIT, Princeton, Stanford, and Caltech; she is now pursuing a PhD in theoretical physics at MIT.

Last year I tried applying the same hiring approach to graduate students. I was frustrated that our incoming class of graduate students interested in high-energy phenomenology was almost exclusively male, so I searched through the applications of the incoming class and found that one of the graduate students (Yujin Park) who was accepted for cosmology theory indicated on her application that one of her main interests is dark matter. I contacted her over the summer of 2019 to see if she would be interested in discussing research prospects with me, and I started having conversations with her. I quickly discovered that she was is fact most interested in working on exactly the type of physics done in my group but that she felt intimidated by the high-energy theory group and so was planning to approach faculty members in cosmology instead. Yujin and I have been working together now for around a year, and I have found her to be a very strong physicist. We are currently finishing our first paper together. One point that I have taken away from these experiences is that there may be barriers that make it less likely for students from underrepresented groups to contact faculty directly about research opportunities. One way to help work around this is to contact promising students from these groups directly, which is an approach that I plan to continue in the future.

In 2019/2020 I served on the Michigan graduate admissions committee, and I was specifically in charge of phenomenology and cosmology theory applications. I am proud to have helped recruit one of the most diverse groups of incoming students, starting in fall 2020, in these subfields in recent years at Michigan. I believe that part of this success was due to an aggressive recruiting strategy that I adopted, where I spent extra time encouraging women and members of underrepresented minorities to attend Michigan. In the future I would like to continue exploring ways to increase the diversity of incoming graduate students in high-energy theory, phenomenology, and cosmology.

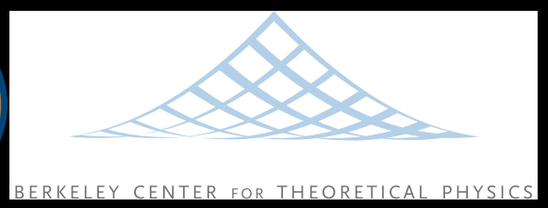
In addition to encouraging white women and members of underrepresented minorities to consider careers in theoretical physics, I believe that serious effort needs to be done to make sure that these aspiring researchers stay in the field. In my own group I try to foster an inclusive atmosphere, where everyone feels comfortable and respects professional boundaries. At the same time I try to make sure that my group feels like a community, for example we all have lunch together almost every day (since going virtual due to COVID-19 we all have a daily virtual coffee time), as I believe that having a sense of belonging is especially helpful for members of underrepresented groups in maintaining confidence with their career choices.

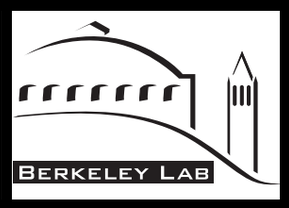
At the professional level I make an effort when organizing seminars, conferences, and workshops to include a diverse array of participants and speakers. I have organized multiple conferences and workshops, and this is always one of my

How to give an effective talk

Hitoshi Murayama (Berkeley, Kavli IPMU)

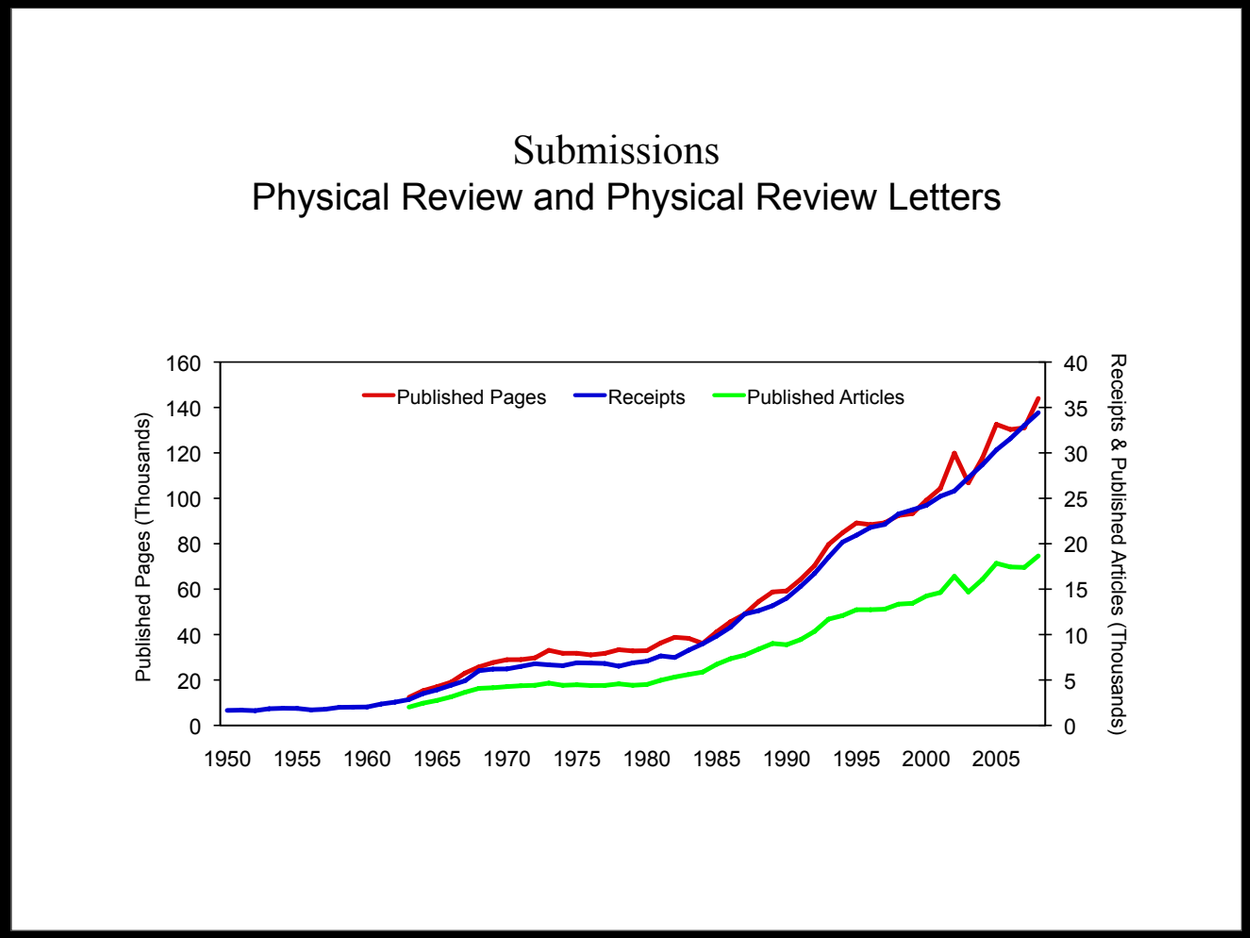
FoPM Career Workshop, Dec 20, 2022





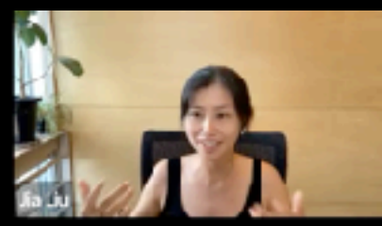
Why do you care?

- Giving good talks is the *best way* to find good jobs
    - At any conferences/workshops, senior people are watching who give good talks to see whom to hire
- No longer “good old days”
    - Nobody reads every paper!
    - People read your papers when they know you or your name
    - Chicken & egg problem!
    - Good presentations break the barrier



Basic Idea

1. Know your audience
    - Find a common denominator between you and them
2. Give a clear message
    - You can’t give a good talk if you don’t know what you are saying
3. Keep it simple
    - Slides should be simple, clean, visual
4. Entertain the audience
    - Make sure the audience is engaged
5. Practice, practice, practice!
    - Nobody likes it when you go over time



Don’t be afraid of asking questions in class (and in life)

“I’m the only one who doesn’t know this.”
Everyone else probably thinks the same…you’re doing them a favor.

(slide inspired by: Jae Woo Lee)

Put it to a practice!

- Approach invited speakers
  - “Exposure”: become known by senior scientists
  - Go to lunch with them
- Give accessible talks
  - Your chance to shine!
  - If you give good talks, you receive questions
- Ask questions
  - This is what coffee breaks are for

indico.ipmu.jp

VPN News Physics Finance Japan travel church Home Schools computer admin TV COVID-19 dictionaries Music E&O

Overview
Timetable
Contribution List
Speaker List
Venue layout
Poster

Contact
wings.s@gs.mail.u-toky...

Timetable

Mon 06/02 | Tue 07/02 | Wed 08/02 | All days

Print | PDF | Full screen | Detailed view | Filter
Session legend

Coffee Break | Coffee Break | Group Photo | Lunch

see more...

09:00

Welcome — *Masahiro Hoshino*
Main auditorium, Ito Hall — 09:30 - 09:35

Logistics — *Kate Harris*
Main auditorium, Ito Hall — 09:35 - 09:40

FoPM — *Hitoshi Murayama*
Main auditorium, Ito Hall — 09:40 - 10:00

10:00

Diversity is more than counting, and more than women: Looking at diversity from a broad perspective
Ronni Alexander

Stopping the light into quantum memories: A path to a future quantum internet — *Julien Laurat*
Main auditorium, Ito Hall — 10:30 - 11:00

11:00

Coffee Break
Main auditorium, Ito Hall — 11:00 - 11:30

Public slides

- You can post your slides on the web page
  - Let the world see your work! Your pride.
- But in some fields, people worry about making the research public before publications
  - Somebody may steal your work: “scooping”
- Please check with your advisor. If OK, send me the slides. I’ll post them on the web.

Have fun!