

# Accelerator research assessment in different countries:

## Situation in Japan

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# SUBJECTS TO BE PRESENTED

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- Accelerator Activity in Japan
  - MEXT : Funding Agency
  - Brief History of Accelerators in Japan
  - Education
    - Inter-University Research Institute Corporation
    - SOKENDAI
  - Societies and Publication system
    - Domestic Societies
    - Journal PTEP
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# ACCELERATOR ACTIVITY IN JAPAN

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- Activity Centers
  - Big 3 Laboratories
  - Universities and Laboratories
  - Medical Accelerators
- Accelerator Statistics in Japan



# BIG 3 LABORATORIES

## KEK

- 40 B/JY /FY2014  
mainly accelerators
- Proton Synchrotrons  
~~KEK-PS, KEK-PSB~~  
J-PARC
- Light Sources  
PF, PF-AR
- Colliders  
~~TRISTAN~~  
~~KEKB~~  
SuperKEKB
- Test Machines  
~~ATF, ATFII~~, STF, c-ERL

## RIKEN

- 80 B/JY /FY2014  
partly accelerators
- Light Sources  
Spring-8  
SACLA
- Nuclear Physics  
RIBF

## JAEA

- 180 B/JY /FY2014  
hardly accelerators
- J-PARC
- ITER  
IFMIF test machine



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# UNIVERSITIES AND LABORATORIES

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- Cyclotrons  
Nuclear physics
  - Tandem Electro-Static Accelerators  
Nuclear physics  
AMS (Accelerator Mass Spectrometry)
  - Light Sources
  - Accelerators for Test and Development  
Beam Cooling, FFAG, etc.
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# MEDICAL ACCELERATORS

## HOSPITAL, UNIVERSITY, LABORATORY, INDUSTRY

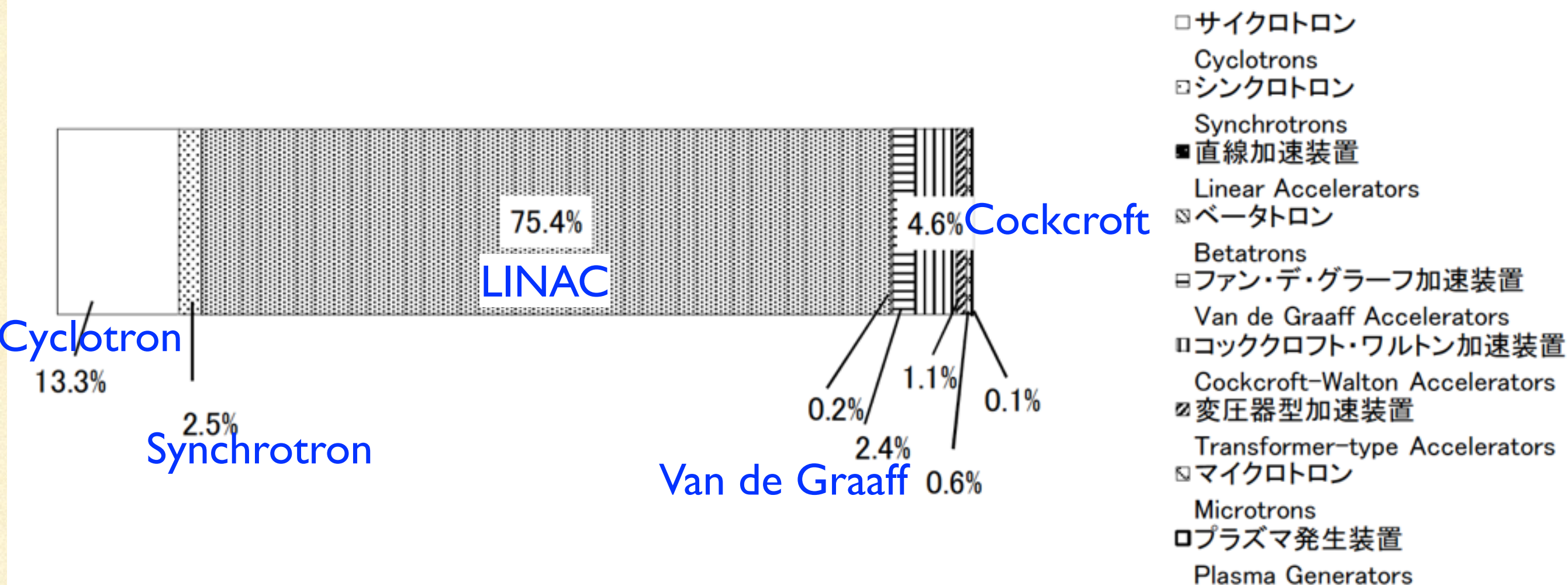
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- NIRS(National Institute of Radiological Science, 1957-)  
Radiation Safety, Radiotherapy, etc.
  - Cancer Therapy Machines
    - X-ray, Electron beams
    - Proton beams
    - Carbon beams
    - Neutron beams for BNCT(Boron Neutron Capture Therapy)
  - Production of Medical RI
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# ACCELERATOR STATISTICS IN JAPAN

## Ratio of Accelerator Kinds in Use (as of March 31, 2013)



Number of Radiation Generators in Use (as of March 31,2013)

発生装置 Radiation Generators	機関 Category	総数 Total 構成比 Ratio(%)	医療機関 Hospitals &Clinics	教育機関 Educational Institutions	研究機関 Research Institutions	民間企業 Private Companies	その他の機関 Other Organizations
総数 Total 構成比 Ratio %		1,595 100%	1,180 74.0	66 4.1	165 10.3	147 9.2	37 2.3
サイクロトロン Cyclotrons		212 13.3	143	4	23	39	3
シンクロトロン Synchrotrons		40 2.5	9	3	23	4	1
シンクロサイクロトロン Synchrocyclotrons		— —	—	—	—	—	—
直線加速装置 Linear Accelerators		1,202 75.4	1,024	25	55	65	33
ベータトロン Betatrons		3 0.2	—	1	2	—	—
ファン・デ・グラーフ加速装置 Van de Graaff Accelerators		38 2.4	—	14	23	1	—
コッククロフト・ワルトン加速装置 Cockcroft-Walton Accelerators		73 4.6	—	16	27	30	—
変圧器型加速装置 Transformer-type Accelerators		17 1.1	—	—	9	8	—
マイクロトロン Microtrons		9 0.6	4	3	2	—	—
プラズマ発生装置 Plasma Generators		1 0.1	—	—	1	—	—



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# MEXT : FUNDING AGENCY

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- MEXT

  - Ministry of Education, Culture, Sports, Science and Technology

- Born at 2001 by merging Mombusho and STA

  - Mombusho(Ministry of Education, **Science** and Culture, 1871-2001)

    - :Traditional ministry named after the name of middle age government agency

  - STA(**Science** and Technology Agency, 1956-2001)

    - : New born agency to introduce peaceful usage of atomic energy

- A word “**Science**” was shared between Mombusho and STA

  - Science à la Mombusho → To be Academic

  - Science à la STA → To be Practical together with Technology

  - 科学・技術 vs. 科学技術

- The above is a key to understand the unseen mechanism of MEXT

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# BRIEF HISTORY OF ACCELERATORS IN JAPAN

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- Before WWII

Cyclotrons almost ranked among the world front : RIKEN, Osaka University, Kyoto University

- After WWII

Following the destruction of cyclotrons, Black Age (Research Inhibited) continued Until Early 50's.

Research started again synchronizing with introduction of Peaceful Usage of Atomic Power initiated by US. STA was founded to serve PUAP.

Two fields of research (Accelerator, Nuclear & Particle physics vs. PUAP) took different ways (Science à la Mombusho and Science à la STA).

- KEK history of 3 phases

Nearly the Japanese history of Accelerators after WWII.

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# KEK HISTORY : FIRST PHASE

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1955 **INS** (**Institute of Nuclear Study**) established @Tokyo University

1957 **FF cyclotron**, 1958 **FM cyclotron**, 1961 **Electron Synchrotron** 0.75 -> 1.3GeV('66)

1964 Working group for a future laboratory

Long Period needed for discussion and Struggle

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# KEK HISTORY : 2ND PHASE

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1971 **KEK** established as **National Laboratory for High Energy Physics**

1976 **Proton Synchrotron** reached 12 GeV      Order of magnitude behind the world energy front

1978 **Booster Synchrotron** Utilization Facility (BSF) and **Photon Factory (PF)** were founded  
Policy to expand research field for wide supports

1981 **TRISTAN e<sup>+</sup>e<sup>-</sup> Collider** construction began.

1982 PF succeeded in storing 2.5 GeV electron beams

1986 Electron and positron beams of 25.5 GeV collided at TRISTAN  
World highest energy e<sup>+</sup>e<sup>-</sup> collider in those days

1988 TRISTAN energy upgrade to 32 GeV by installing Superconducting RF cavities

1989 **SOKENDAI** founded with Accelerator department and Synchrotron Radiation Science  
Able to make PHD independently  
department at KEK

1994 **KEKB** construction started

1995 **TRISTAN experiments** completed      Without finding Top quark

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# KEK HISTORY : 3RD PHASE

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1997 By merging INS, formal name changed to **High Energy Accelerator Research Organization** (still called as KEK)

1998 First beam storage at KEKB

1999 SOKENDAI at KEK added Particle and Nuclear Science department

**K2K experiment** (long-baseline neutrino oscillation) began

**Belle experiment** started at KEKB

2001 **J-PARC** construction started

2004 KEK joined **Inter-University Research Institute Corporation**

**School of High Energy Accelerator Science** of SOKENDAI was founded at KEK

(departments: Accelerator Science, Materials Structure Science, Particle and Nuclear Physics)

**More freedom of Education**

2008 Physics Nobel Prize for M. Kobayashi, former director of IPNS

2009 J-PARC construction completed

**Show the reason of KEK existence**

2010 **SuperKEKB** construction started

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# INTER-UNIVERSITY RESEARCH INSTITUTE CORPORATION

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- Triggered by the establishment of KEK in 1971, many national institutes and university institutes funded by Mombusho followed the same. They were reorganized in 2004 as the Inter-University Research Institute Corporation as in the followings.
  - National Institutes for the Humanities(NIHU)  
including 6 Institutes
  - National Institutes of Natural Sciences(NINS)  
including 5 Institutes and 2 Research Centers
  - High Energy Accelerator Research Organization(KEK)  
including 2 Institutes and 2 Laboratories
  - Research Organization of Information and Systems(ROIS)  
including 4 Institutes and 2 Research Centers
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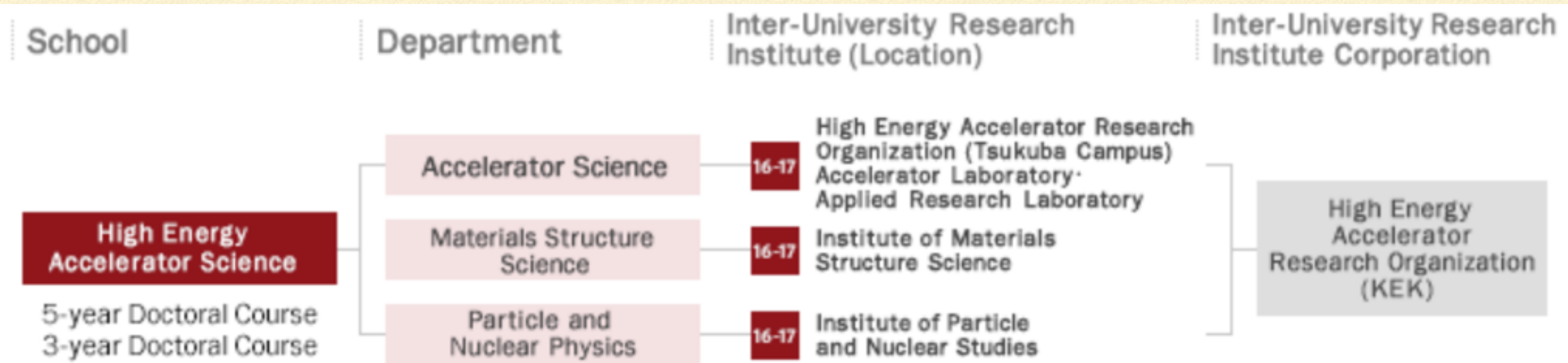
# SOKENDAI

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- In 1989, SOKENDAI was established to enable postgraduate education based on the Inter-University Research Institutes.
  - In 2004, reorganized as 6 Schools and 21 Departments.
    - Advanced Sciences (1 Department)
    - Culture and Social Studies (6 Departments)
    - Multidisciplinary Sciences (3 Departments)
    - Life Science (3 Departments)
    - Physical Science (5 Departments)
    - Hight Energy Accelerator Science (3 Departments)
  - Relationship between SOKENDAI Schools and Inter-University Research Institutes is rather complicated except for KEK.
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# SCHOOL OF HIGH ENERGY ACCELERATOR SCIENCE



- Compact relationship between the School and the Inter-University Research Corporation



# Number of Students in the School of High Energy Accelerator Science

(As of May 1, 2014)

School & Department	Quota		Grade					Total
	3 - year	5 - year	1st	2nd	3rd *3	4th *4	5th *5	
School of High Energy Accelerator Science								
Dept. Accelerator Science	- 4*6	2			3	1	5	9
Female *1	-						1	1
International Student *2	-					1	2	3
Dept. Materials Structure Science	- 4*6	3			2	1	3	6
Female *1	-				1	1	1	3
International Student *2	-						2	2
Dept. Particle and Nuclear Physics	- 4*6	4	5	4	10	9	10	38
Female *1	-		2					2
International Student *2	-		1	1	1	1	1	5
Subtotal	- 4*6	9	5	4	15	11	18	53
Female *1	-	-	2		1	1	2	6
International Student *2	-	-	1	1	1	2	5	10

## Degrees Awarded

(As of April 1, 2014)

School	Quota	Field	for the period of 1991-2008	'09	'10	'11	'12	'13	Total
School of High Energy Accelerator Science	*(9)	Philosophy	22[0](8)	0	0	0	1[1]	0(1)	23[1](9)
		Science	101[3](10)	8(1)	6(1)	12	12(1)	5	144[3](13)
		Engineering	36[0](19)	2	1(1)	1(1)	3	1	44[0](21)



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# ACCELERATOR RELATED DOMESTIC SOCIETIES

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- Physics Society of Japan (JPS)
  - Since 1877-
  - Membership 18,000
  - Journals  
PTEP, JPSJ
- Particle Accelerator Society of Japan (PASJ)
  - Since 2004-
  - Membership 800
  - Industries explicitly included
- Japanese Beam Physics Club
  - Since 1996-
  - Membership 500
  - Management of beam physics region of JPS
  - Education of young researchers encouraged
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# Progress of Theoretical and Experimental Physics

- [Oxford Journals](#)
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## Subject Index

- A General and Mathematical Physics
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- C Experimental Particle Physics
- D Nuclear Physics
- E Theoretical Astrophysics and Cosmology
- F Experimental Astrophysics
- G Beam Physics
  - G0 Accelerators
  - G1 Physics of beams
  - G2 Application of beams
- H Instrumentations and Technologies for Physics
- I Condensed Matter Physics
- J Cross-Disciplinary Physics



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“Thanks for Your Attention”

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