

WHITE PAPER ON MUON SCIENCE RESEARCH

AT
MUON SCIENCE LABORATORY
INSTITUTE OF MATERIAL STRUCTURE SCIENCE
HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION
(2006 ~ 2009)

EDITED BY
R. KADONO

DOCUMENT FOR EXTERNAL EVALUATION COMMITTEE
Muon Science Laboratory IMSS-KEK
MARCH 2010

Issued in February, 2010

Muon Science Laboratory

Institute of Materials Structure Science

High Energy Accelerator Research Organization

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**The Requirement for the Muon Science Laboratory Review Committee,
for Institute of Materials Structure Science, Inter-University Research Institute Corporation
High Energy Accelerator Research Organization**

February 22, 2010

By the order of the Director General

(Purpose)

Article 1 The Requirement for reviewing the Muon Science Laboratory, Institute of Materials Structure Science at Inter-University Research Institute Corporation High Energy Accelerator Research Organization are as specified in the requirement for reviewing on researches in Inter-University Research Institute Corporation High Energy Accelerator Research Organization, hereinafter called “the Review Requirement”, and in addition as specified here.

(Establishment of the committee)

Article 2 The Muon Science Advisory Committee, hereinafter called “the Committee”, will be established according to the Article 2 of the Review Requirement.

(Charge)

Article 3 The Committee will review the research activities of the Muon Science Laboratory.

(Members)

Article 4 The members of the Committee will be formed by the specialists on muon science and other learned people of less than 10.

(Chairperson)

Article 5 The Chairperson will chair the Committee.

2 When the Chairperson could not chair the Committee for some reason, a member of the Committee named by the Chairperson shall chair the Committee.

(Call)

Article 6 The Committee meeting will be called by the Chairperson as required.

(Quorum)

Article 7 If the number of attendants fall short of the quorum, which is two thirds of the members, the Committee shall not make a decision.

(Secretarial work)

Article 8 The Secretarial works for the Committee will be done by the Research Cooperation Division of the General Management Department.

(Others)

Article 9 In addition to the requirement specified here, the Committee will decide the way to proceed the review as necessary.

Effective date

This Requirement will be effective starting February 22, 2010.

**The Requirement for the Reviewing of the Muon Science Laboratory,
for Institute of Materials Structure Science, Inter-University Research Institute Corporation
High Energy Accelerator Research Organization**

February 22, 2010
Decision of the Committee

(Purpose)

Article 1 This Requirement will specify the terms necessary for the Committee to review the Muon Science Laboratory, Institute of Materials Structure Science of Inter-University Research Institute Corporation High Energy Accelerator Research Organization.

(Charge)

Article 2 Objectives of the review are: research activity and achievements of the Muon Science Laboratory, Institute of Materials Structure Science, including those conducted at the MUSE (Muon Science Establishment) Facility located in the MLF (Materials and Life Science Experiment) Facility in J-PARC (Japan Proton Accelerator Research Complex) and other scientific activities related with muon science.

(Review Process)

Article 3 Reviewing will be done by interviews.

- 2 The subjects to reviewed are facility operation, research achievements, value of the achievements in view of international standards, and status of upgrading the MUSE Facility at J-PARC.

(Publicizing the review result)

Article 4 The result of the review will be published and made open to public on KEK web site via Internet in both English and Japanese. However, sections considered to be dealing with the matter such as personal information, intellectual property and that considered to be inappropriate by the Committee may be omitted,

Effective date

This Requirement will be effective starting February 22, 2010.

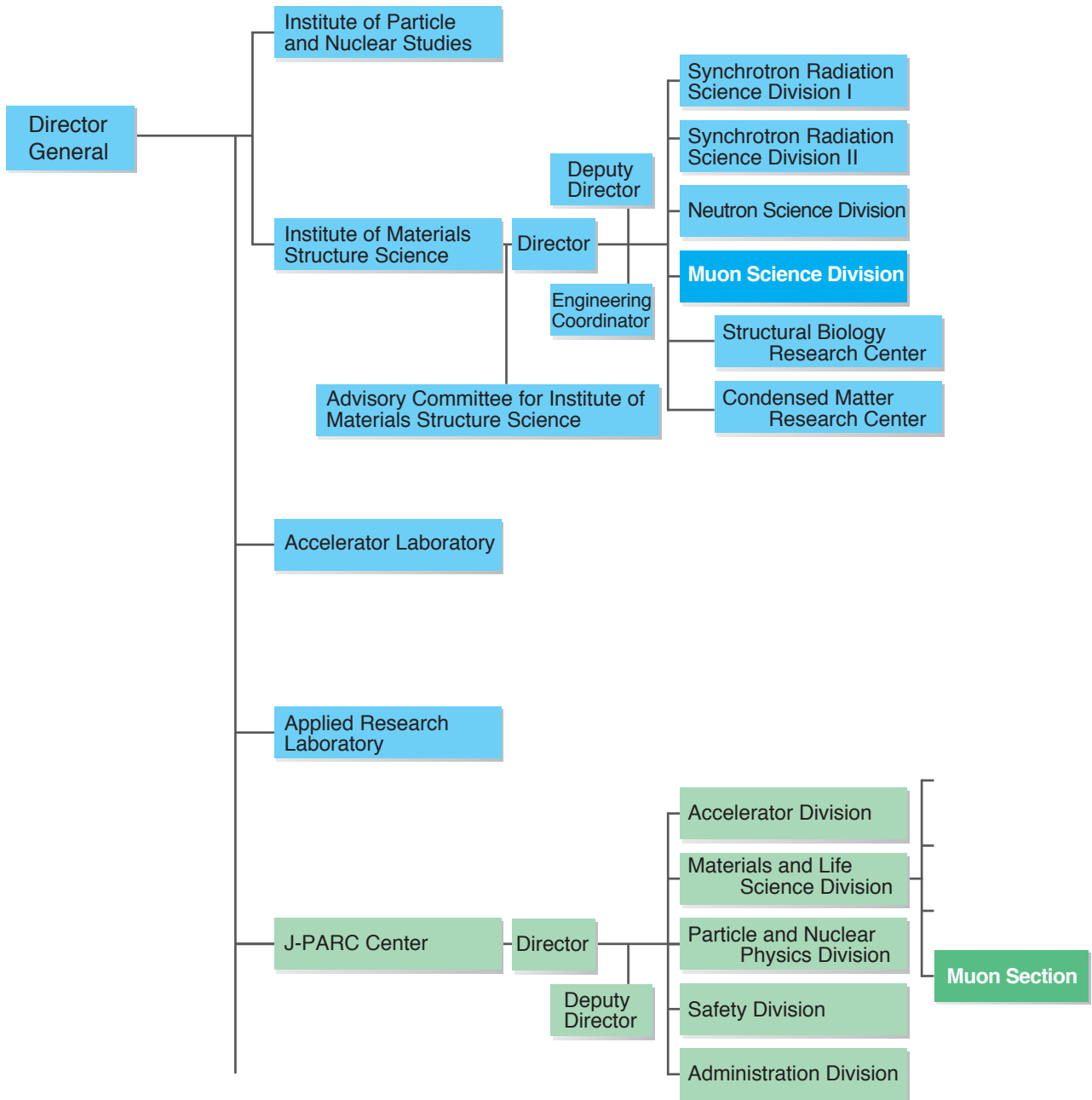
White Paper on Muon Science Research at MSL-IMSS-KEK (2006 – 2009)

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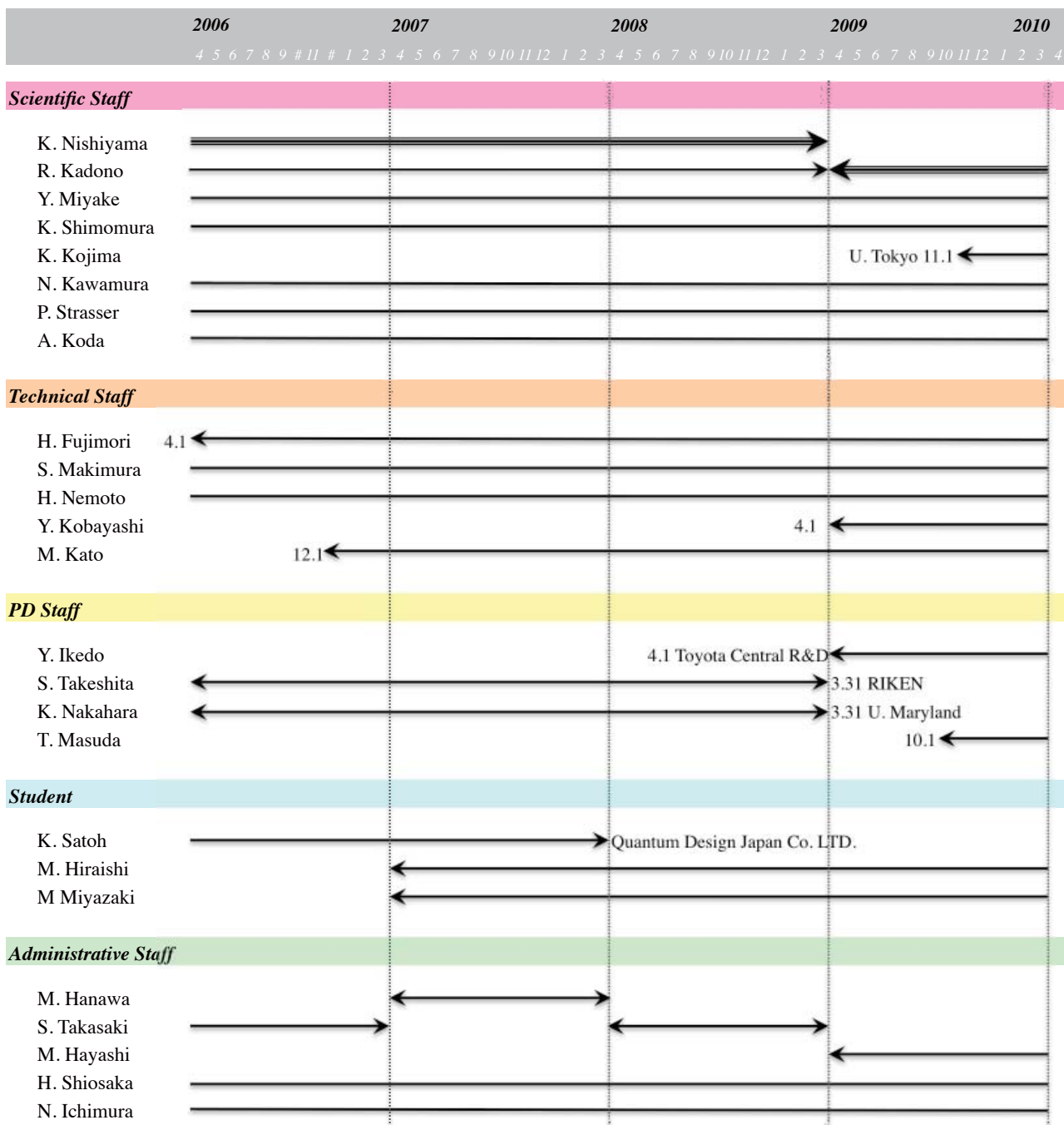
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1. KEK-MSL Organization and Comittee Members

Organization Chart (2009 April)



KEK-MSL Members



Program Advisory Committee of Muon Science Laboratory (April 2005 – March 2009)

H. Amitsuka	Condensed Matter, Experiment	Professor, Hokkaido University
K. Fukutani	Condensed Matter, Experiment	Professor, The University of Tokyo
S. Ikeda	Condensed Matter, Experiment	Professor & Associate Director, KEK-KENS
M. Iwasaki	Nuclear Physics, Experiment	Chief Scientist, RIKEN
R. Kadono *	Condensed Matter, Experiment	Professor, KEK-MSL
S. Kambe	Condensed Matter, Experiment	Principle Scientist, JAEA
T. Kamiyama	Condensed Matter, Experiment	Professor, KEK-KENS
Y. Koike	Condensed Matter, Experiment	Professor, Tohoku University
Y. Kuno	Particle Physics, Experiment	Professor, Osaka University
T. Matsushita	Condensed Matter, Experiment	Professor, KEK-IMSS
K. Nasu	Condensed Matter, Theory	Professor, KEK-PF
K. Nishiyama	Muon Science	Professor & Head, KEK-MSL
H. Nojiri	Condensed Matter, Experiment	Professor, Tohoku University
M. Nomura	Condensed Matter, Experiment	Professor & Head, KEK-PF
M. Ogata	Condensed Matter, Theory	Professor, The University of Tokyo
K. Sato	Accelerator Physics	Professor, KEK-Accelerator
A. Shinohara	Chemistry	Professor, Osaka University
M. Takigawa	Condensed Matter, Experiment	Professor, The University of Tokyo
S. Tsuneyuki	Condensed Matter, Theory	Professor, The University of Tokyo
I. Watanabe	Condensed Matter, Experiment	Senior Research Scientist, RIKEN

* Chairman

Program Advisory Committee of Muon Science Laboratory (April 2009 – March 2011)

H. Amitsuka	Condensed Matter, Experiment	Professor, Hokkaido University
K. Fukutani	Condensed Matter, Experiment	Professor, University of Tokyo
S. Ikeda	Condensed Matter, Experiment	Professor & Associate Director, KEK-KENS
H. Ikezoe	Condensed Matter, Experiment	Vice Director, JAEA
K. Itoh	Condensed Matter, Experiment	Professor & Head, KEK-PF
M. Iwasaki	Condensed Matter, Experiment	Chief Scientist, RIKEN
R. Kadono*	Condensed Matter, Experiment	Professor & Head, KEK-MSL
T. Kamiyama	Condensed Matter, Experiment	Professor, KEK-KENS
S. Kambe	Condensed Matter, Experiment	Principal Scientist, JAEA
H. Kobayashi	Accelerator Physics	Professor & Head, KEK-Accelerator
Y. Koike	Condensed Matter, Experiment	Professor, Tohoku University
Y. Kuno	Particle Physics, Experiment	Professor, Osaka University
Y. Miyake	Condensed Matter, Experiment	Professor, KEK-MSL
K. Nasu	Condensed Matter, Theory	Professor, KEK-PF
H. Nojiri	Condensed Matter, Experiment	Professor, Tohoku University
M. Ogata	Condensed Matter, Experiment	Professor, Tokyo University
K. Ono	Condensed Matter, Experiment	Associate Professor, KEK-PF
H. Seto	Condensed Matter, Experiment	Professor & Head, KEK-KENS
A. Shinohara	Radiation Chemistry	Professor, Osaka University
K. Suzuya	Condensed Matter, Experiment	Chief Scientist, JAEA
M. Takigawa	Condensed Matter, Experiment	Professor, University of Tokyo
S. Tsuneyuki	Condensed Matter, Theory	Professor, University of Tokyo
I. Watanabe	Condensed Matter, Experiment	Senior Research Scientist, RIKEN

* Chairman

2. Budget and Financial Support

Budget Profile (2006 – 2008)

	2006	2007	2008
Administrative Expenditure	1.1	1.7	1.4
KEK Special Fund	2.2	5.0	
J-PARC Facility Construction (M2) (Beam Line)	118.6 14.6		234.6
J-PARC Equipments	380.6	387.3	
J-PARC Muon Exp Cost			4.6
Inter-Univ. Res. Prog. for Oversea Muon Facilities (goods)	7.4	6.1	2.6
Inter-Univ. Res. Prog. for Oversea Muon Facilities (travel expenditure)	12.6	13.3	11.0
Total	537.1	413.4	254.2

(M Yen)

External Support for KEK-MSL Experiment

Grants-in-Aid for Scientific Research (KAKENHI, JSPS)

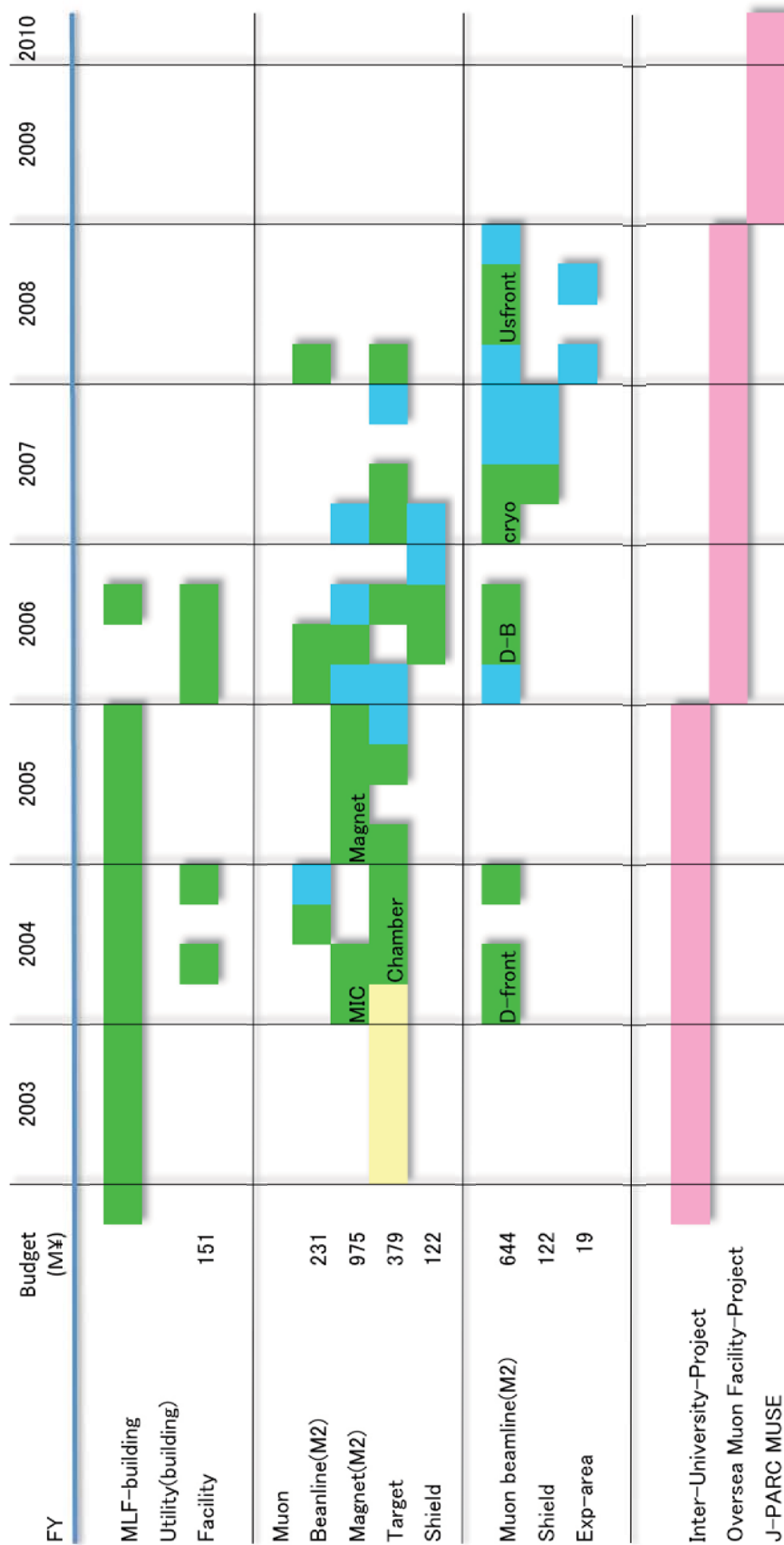
Category	Title
Scientific Research on Priority Areas	Physics of exotic superconductors
Scientific Research(A)	Development of axial-focusing solenoid system for low-emittance & high-intensity ultraslow muons
Scientific Research(B)	Development of functional materials for spintronics using muonium spin exchange reaction
Scientific Research(B)	Isotope shift of X-rays from muonic Sm atoms embedded in thin solid deuterium layers
Scientific Research(B)	Correlation between anisotropic superconductivity and magnetism in oxide-based strongly correlated electron systems

Budget Profile (KAKENHI, JSPS)

Research leader	Contributor	Years	Total (S Yen)	2004	2005	2006	2007	2008	2009
H. Takigawa	R. Kadono	2004-2008	143,200	46,800	35,800	20,200	20,200	20,200	
Y. Miyake		2007-2009	48,100				14,690	30,550	2,860
E. Torikai	K. Shimomura	2007-2009	19,370				17,810	780	780
P. Strasser		2008-2009	17,030					11,050	5,980
K. Ishida	A. Koda	2006-2007	16,720			11,000	5,720		

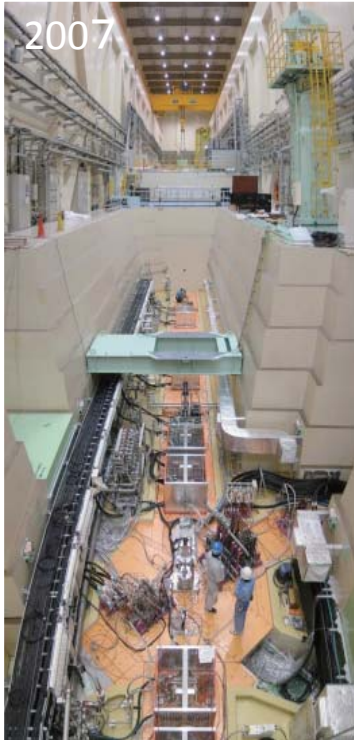
3. Facilities

Project at KEK-MSL (2003 – 2010)

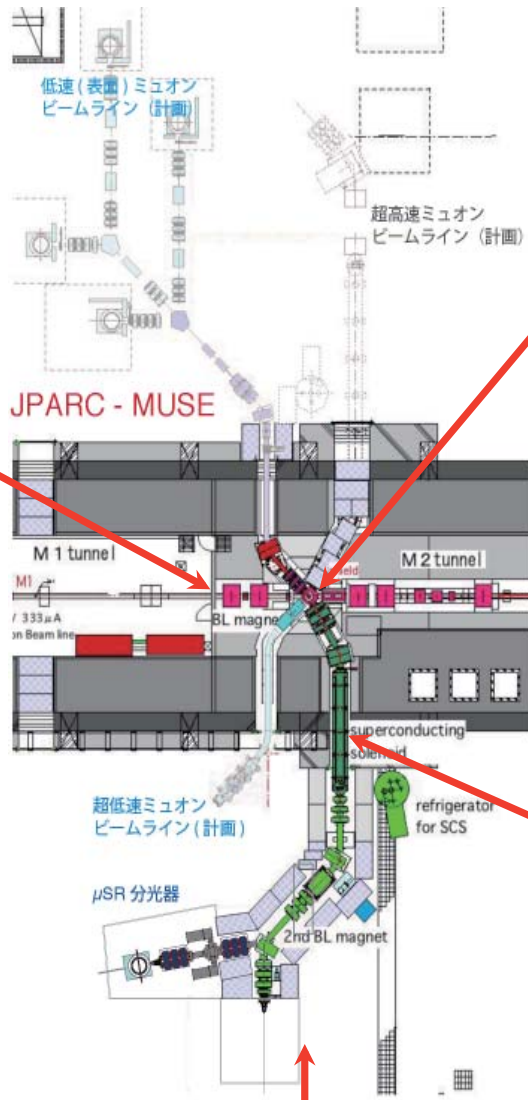


Major Equipments

J-PARC Muon Facility (MUSE, ~2008)



2007
Proton Beamline (M2 Tunnel)



Graphite Target

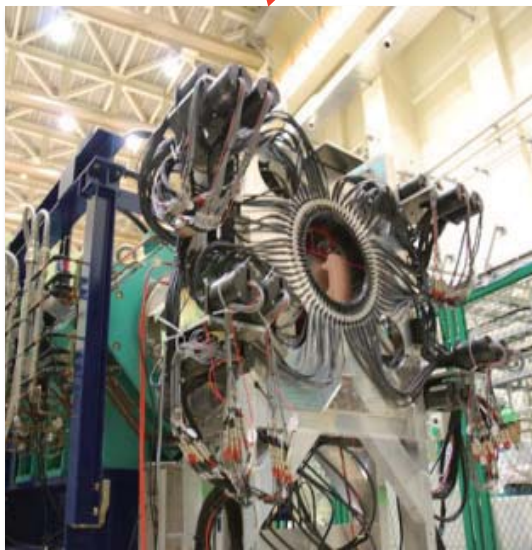
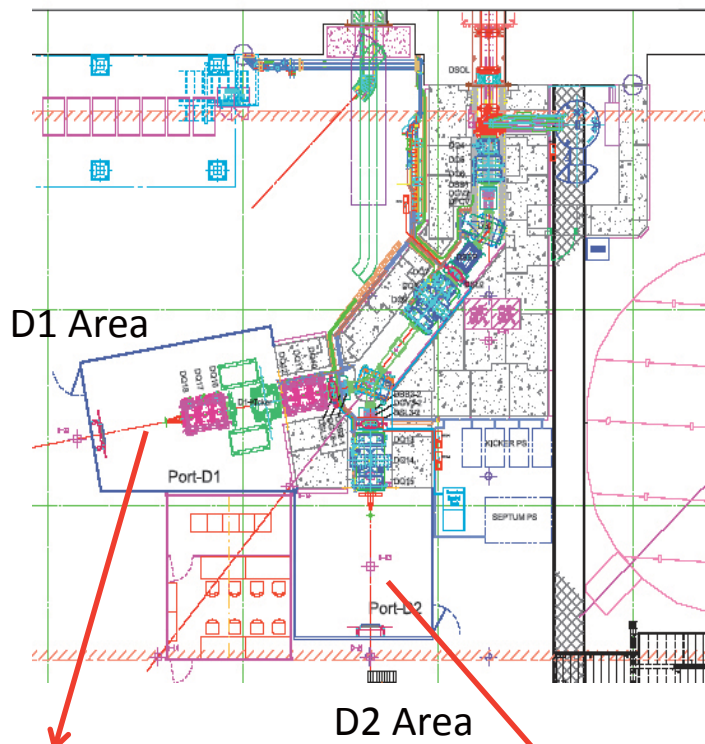


Supercond. Solenoid



2008
Slow/Fast Muon Beamline

J-PARC Muon Facility (since 2008)



μSR Spectrometer
(128 detectors, ZF,
WTF, LF[0.15 T])



Open Area
(Test & Development)

4. Experimental Proposals

List of Proposal in FY2006

Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2006M-01	K. Sato	Saitama U	μ SR study of unconventional organic superconductor κ -(BEDT-TTF) ₄ Hg _{2.89} Br ₈	TRIUMF
2006M-02	W. Higemoto	JAEA	Static and dynamic properties of multipoles in <i>f</i> -electron system	TRIUMF
2006M-03	S. Ohira	RIKEN	Impurity-induced effect in a spin-Peierls compound TiOBr	RIKEN-RAL
2006M-04	J. Sugiyama	Toyota Central R&D Labs. Inc.	Full phase diagram of Na _x CoO ₂	TRIUMF
2006M-05	K. Ishida	Kyoto U	Magnetic correlations and superconductivity in La _{2-x} Sr _x CuO ₄	TRIUMF
2006M-06	K. Shimomura	KEK-MSL	Precise determination of the electric structure of shallow muonium in wide gap semiconductors	PSI
2006M-07	Y. Ikedo	Toyota Central R&D Labs. Inc.	μ SR study on superprotonic ionic conductors	RIKEN-RAL
2006M-08	Y. Miyake	KEK-MSL	μ SR studies in a thin Nd _{0.5} Sr _{0.5} MnO ₃ film	RIKEN-RAL
2006M-09	N. Nishida	Tokyo Tech	Studies of vortex core in parity-violated superconductor with strong spin-orbit interaction by muon spin rotation and relaxation	RIKEN-RAL
2006M-10	P. Strasser	KEK-MSL	Muon transfer studies in solid D ₂ with implanted alkali and alkaline-earth ions	RIKEN-RAL
2006M-11	T. Enoki	Tokyo Tech	Gas adsorption-effect on magnetism of edge state spins in nanographite	RIKEN-RAL
2006M-12	S. Takeshita	KEK-MSL	Electronic ground state of quasi-1D conducting β -vanadium bronzes	TRIUMF
2006M-13	R. Kadono	KEK-MSL	Magnetism and flux line lattice structure of oxychloride superconductors	TRIUMF
2006M-14	R. Kadono	KEK-MSL	Development of new TDC and data acquisition system for the next generation μ SR	RIKEN-RAL
2006M-15	T. Goto	Sophia U	Anomalous magnetic instability around the quantum critical point in quantum spin system IPS-Cu(Cl _{1-x} Br _x) ₃	RIKEN-RAL
2006M-16	K. Nagamine	KEK-MSL	Probing hemoglobin magnetism with muon spin relaxation	TRIUMF
2006M-17	J. Sugiyama	Toyota Central R&D Labs. Inc.	One-dimensional cobalt oxides under high-pressure	PSI
2006M-18	R.H. Heffner	JAEA	Superconductivity and magnetism in $T_nM_mX_{3n+2m}$, $T = Ce$ and Pu, $M = Ir, Rh, Co$, $X = In$ and Ga	TRIUMF
2006M-19	T. Goko	Tokyo U Science	μ SR study of magnetic order in high- T_c superconductor under high pressure	TRIUMF
2006M-20	T. Goko	Tokyo U Science	Crossover from itinerant ferromagnet to correlated paramagnet : high-pressure μ SR study in MnSi	TRIUMF

List of Proposal in FY2007 (2007-1)

Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2007M-01	J. Akimitsu	Aoyama Gakuin U	Correlation between Superconducting Transition Temperature and Superconducting Carrier Density / Gap Structure in Novel Superconductors	TRIUMF
2007M-03	H. Kageyama	Kyoto U	Competition between Magnetically Ordered State and Disordered State in a Frustrated Square Lattice Antiferromagnets (CuX)LaM ₂ O ₇ (X = Cl, Br; M = Nb, Ta)	TRIUMF
2007M-04	R. Kadono	KEK-MSL	Magnetism and Superconductivity of Bi ₂ Sr ₂ CuO _{6+δ}	TRIUMF
2007M-05	R. Kadono	KEK-MSL	The Vortex Structure and Magnetism of Electron-doped Cuprate Superconductors	TRIUMF
2007M-06	K. Satoh	Saitama U	Study of Strongly Correlated Electron Systems by μ SR under High Pressure	TRIUMF
2007M-07	J. Sugiyama	Toyota Central R&DLabs. Inc.	Full Phase Diagram of Na _x CoO ₂	TRIUMF
2007M-08	S. Takeshita	KEK-MSL	Electronic Ground State of Quasi-1D Conducting β -vanadium Bronzes	TRIUMF
2007M-09	W. Higemoto	JAEA	Static and Dynamic Properties of Multipoles in <i>f</i> -electron Systems (E1083).	TRIUMF
2007M-10	W. Higemoto	JAEA	Novel Property of Superconductor without Inversion Symmetry	TRIUMF
2007M-11	T. Adachi	Tohoku U	μ SR Study of The Impurity-induced Magnetic Order in the Hole-doped High- <i>T_c</i> Superconductor La _{2-x} Sr _x CuO ₄	PSI
2007M-13	H. Kikuchi	Fukui U	μ SR study of The Spin Dynamics of Gapless <i>S</i> =1 1D Antiferromagnet with Bond-alternation	PSI
2007M-14	K. Kubo	ICU	Positive Muons in Tricalcium Phosphate	PSI
2007M-15	N. Kojima	U Tokyo	μ SR Investigations of The Ferromagnetic Ordered State and Novel Charge Transfer Phase Transition in Iron Mixed Valence Complexes, (n-C _n H _{2n+1}) ₄ N[Fe ^{II} Fe ^{III} (dto) ₃] (dto = C ₂ O ₂ S ₂)	PSI
2007M-16	Y. Kohori	Chiba U	Novel Phenomena in Filled Skutterudite Systems Probed by μ SR	PSI
2007M-17	T. Goto	Sophia U	Magnetic Ordering and Anomalous Critical Phenomenon in Solid-solution of The Two Spin-gap Systems	PSI
2007M-18	K. Shimomura	KEK-MSL	Negative Muon Spin Rotation Studies of Nitrogen Impurity in Oxide Semiconductors	PSI
2007M-19	J. Sugiyama	Toyota Central R&DLabs. Inc.	One-dimensional Cobalt Oxides under High-pressure	PSI
2007M-20	H. Suzuki	NIMS	μ SR Studies of Unconventional Ferromagnet CuCrZrS ₄	PSI
2007M-21	T. Nakano	Osaka U	μ SR Study on Ferromagnetism of Potassium Clusters in Zeolite A	PSI
2007M-22	W. Higemoto	JAEA	Quadrupole, Octupole and Hexadecapole Degrees of Freedom Probed by Field-angle Dependence of Muon Knight Shift	PSI
2007M-23	T. Mochida	Kobe U	μ SR Study of The Proton Dynamics in 9-Hydroxyphenalenone Derivatives	PSI

List of Proposal in FY2007 (2007-2)

Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2007M-24	R. Kadono	KEK-MSL	Development of New TDC and Data Acquisition System for the Next Generation μ SR	RIKEN-RAL
2007M-25	X. Zheng	Saga U	Magnetic Transitions in a New Geometric Frustrated System of $M_2X(OH)_3$ [M =Cu, Co, Ni, Mn, Fe, etc; X =Cl, Br, I]	TRIUMF
2007M-26	X. Zheng	Saga U	Spin Dynamics in Magnetic Nanoparticles	TRIUMF
2007M-27	T. Nakano	Osaka U	μ SR Study on Ferromagnetism of Rubidium Clusters in Zeolite A	RIKEN-RAL
2007M-28	Y. Matsuda & Y. Miyake	RIKEN KEK-MSL	μ SR Studies in a Thin $Nd_{0.5}Sr_{0.5}MnO_3$ / Upgrading of Slow Muon Beam Line	RIKEN-RAL
2007M-29	H. Kikuchi	Fukui U	Magnetic Order of The Frustrated Triangular Lattice Antiferromagnet $HCrO_2$	RIKEN-RAL
2007M-30	T. Mochida	Kobe U	μ SR Study of The Proton Dynamics in 9-Hydroxyphenalenone Derivatives	RIKEN-RAL
2007M-31	T. Adachi	Tohoku U	μ SR Study of the Impurity-induced Development of Magnetic Correlation in the Bi-2201 high- T_c Superconductor	RIKEN-RAL
2007M-32	M. Mihara	Osaka U	Electronic Structure and Dynamical Properties of Hydrogen in WO_3 Probed by Muon	RIKEN-RAL
2007M-33	P. Strasser	KEK-MSL	Muon Transfer Studies in Solid D_2 with Implanted Alkali and Alkaline-earth Ions	PSI
2007M-34	S. Enoki	U Tokyo	Study on the Pressure Induced Charge Transfer Phase Transition in $(C_5H_{11})_4N [Fe^{II}Fe^{III}(C_2S_2O_2)_3]$ by Means of μ SR Spectroscopy	RIKEN-RAL
2007M-35	R.H. Heffner & K. Ohishi	JAEA	Superconductivity and Magnetism in f -Electron Materials X_nMnIn_{3n+2m}	TRIUMF
2007M-36	A. Shinohara	Osaka U	Molecular Effects on The Muon Transfer Reaction from Muonic Hydrogen	RIKEN-RAL
2007M-37	R.H. Heffner	JAEA	Competition between Broken Symmetry Ground States Near a Quantum Critical Point	PSI
2007M-38	K. Ohishi	JAEA	Study of Heavy Fermion State in Ce-based Compounds	TRIUMF
2007M-39	K. Ohishi	JAEA	μ SR Study Around a Quantum Critical Point in Heavy Fermion Compounds	RIKEN-RAL
2007M-40	K. Satoh	Saitama U	Study of Strongly Correlated Electron Systems by μ SR under High Pressure	TRIUMF
2007M-41	S. Takagi	Tohoku U	μ SR Studies on Strongly Correlated Cubic Tm and Pr Compounds with Orbital Degrees of Freedom in the Crystal-field Ground State	RIKEN-RAL
2007M-42	W. Higemoto	JAEA	Novel property of Superconductor without Inversion Symmetry	TRIUMF
2007M-43	W. Higemoto	JAEA	Static and Dynamic Properties of Multipoles in f -electron Systems (E1083)	TRIUMF

List of Proposal in FY2008 (2008-1)

Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2008M-01	T. Goto	Sophia U	On the exotic magnetic ground state in bond-disordered quantum spin system IPA-Cu(Cl,Br) ₃	PSI
2008M-02	X.G. Zheng	Saga U	Magnetic transitions in a new geometric frustrated system of $M_2X(OH)_3$ [$M = Cu, Co, Ni, Mn, Fe, etc; X = Cl, Br, I$]	TRIUMF
2008M-03	S. Takeshita	KEK-MSL	Electronic ground state of Quasi-1D conducting β -vanadium bronzes	TRIUMF
2008M-04	R. Kadono	KEK-MSL	Novel metallic phase induced by geometrical electronic correlation	TRIUMF
2008M-05	R. Kadono	KEK-MSL	Superconductivity of the Electron-Doped Layered Nitride Li_xZrNCl	TRIUMF
2008M-06	R.H. Heffner	JAEA	Competition between broken symmetry ground states near a quantum critical point	PSI
2008M-07	T. Mochida	Kobe U	μ SR Study of the Proton Dynamics in 9-Hydroxyphenalenone Derivatives	RIKEN-RAL
2008M-08	T. Adachi	Tohoku U	μ SR study of the impurity-induced magnetic order in the hole-doped high- T_c superconductor $La_{2-x}Sr_xCuO_4$	PSI
2008M-09	J. Sugiyama	Toyota Central R&DLabs. Inc.	Complex Phase Diagram of $Ca_{1-x}Na_xV_2O_4$	TRIUMF
2008M-10	J. Sugiyama	Toyota Central R&DLabs. Inc.	Magnetism and muon diffusion in Li_xMO_2	PSI
2008M-11	H. Kikuchi	Fukui U	Magnetic ordering of frustrated 2D triangular antiferromagnet $AgNiO_2$	PSI
2008M-12	M. Mihara	Osaka U	Dynamical properties of hydrogen in tungsten bronze probed by muon	PSI
2008M-13	K. Kubo	ICU	Positive Muons in Tricalcium Phosphate	PSI
2008M-14	T. Nakano	Osaka U	μ SR study on ferromagnetism of alkali-metal clusters in zeolite A	PSI
2008M-15	K. Shimomura	KEK-MSL	Negative Muon Spin Rotation in Oxide Semiconductor and SiC	PSI
2008M-16	K. Shimomura	KEK-MSL	Pre-martensitic phenomena of thermoelastic martensitic transformation of NiTi alloys studied by muon spin relaxation	PSI
2008M-17	E. Torikai	U Yamanashi	Spin-dependent exchange scattering of conduction electrons with Mu in solids	RIKEN-RAL
2008M-18	W. Higemoto	JAEA	Novel multipole ordering in Pr-based compounds	PSI
2008M-19	R. Kadono	KEK-MSL	Magnetism and Superconductivity of $Bi_2Sr_2CuO_{6+\delta}$	TRIUMF
2008M-20	P. Strasser	KEK-MSL	Muon transfer studies in solid deuterium with implanted rare-earth ions.	TRIUMF

List of Proposal in FY2008 (2008-2)

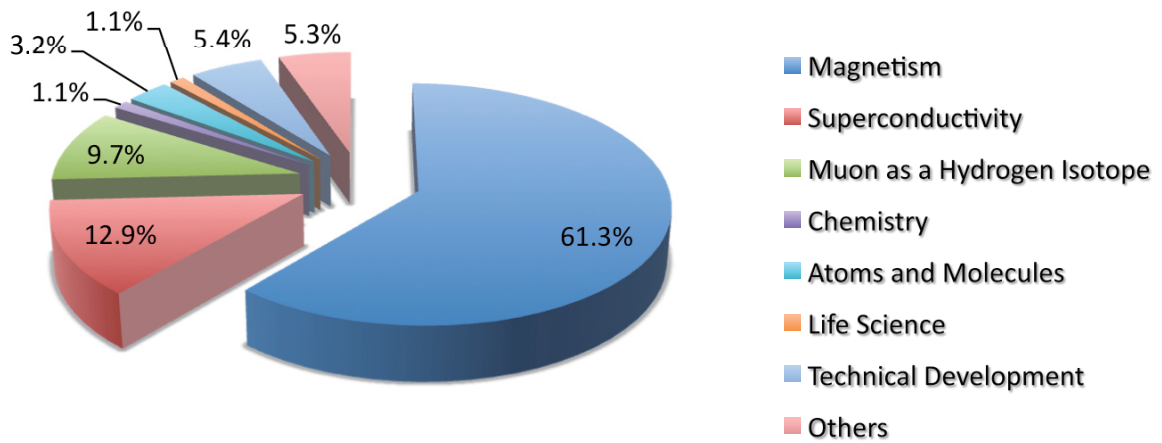
Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2008M-21	M. Hiroi	Kagoshima U	μ SR study of Heusler Compounds $\text{Ru}_{2-x}\text{Fe}_x\text{CrSi}$	RIKEN-RAL PSI
2008M-22	T. Adachi	Tohoku U	μ SR study of the impurity-induced magnetic order in the hole-doped high- T_c superconductor $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$	RIKEN-RAL
2008M-23	M. Mihara	Osaka U	Diffusion of muon in hydrogen tungsten bronze	TRIUMF
2008M-24	K. Satoh	Saitama U	New Insights for Magnetism and Superconductivity in Strongly Correlated Electron Systems under High Pressure	TRIUMF
2008M-25	S. Takeshita	KEK-MSL	Superconductivity in layered oxypnictide $\text{LaFeAs}(\text{O},\text{F})$	
.....				
2008B0004	R. Kadono	KEK-MSL	Muonium as a Shallow Donor Center in SnO_2	J-PARC
2008B0005	R. Kadono	KEK-MSL	Correlation between Magnetism and Superconductivity in Iron-Oxypnictide Superconductors	J-PARC
2008B0010	J. Sugiyama	Toyota Central R&D Labs. Inc.	Lithium diffusion in lithium-transition-metal-oxides	J-PARC
2008B0015	K. Tokiwa	Tokyo U Science	μ SR study of magnetic properties of CaFe_2O_4 -type NaMn_2O_4 and LiMn_2O_4	J-PARC
2008B0021	K. Satoh	Saitama U	μ SR study of organic antiferromagnet β' -(BEDT-TTF) $_2$ IBrCl	J-PARC
2008B0031	Y. Miyake	KEK-MSL	Muon Beam Commissioning I in the Decay-Surface Muon Channel	J-PARC
2008B0035	M. Doyama	Teikyo U Science & Technology	Determination of shape and intensity distribution of muon beam by imaging plates	J-PARC

List of Proposal in FY2009 (2009-1)

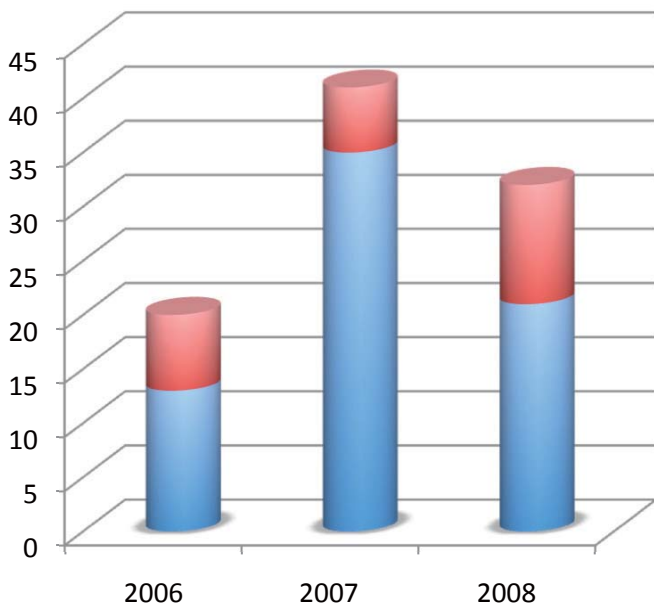
Exp-No	Spokesperson	Affiliation	Title	Overseas Facility
2009A0080	R. Kadono	KEK-MSL	Correlation between Magnetism and Superconductivity in Iron-Oxypnictide Superconductors	J-PARC
2009A0090	M. Azuma	Kyoto U	Magnetic ground state of a frustrated S=3/2 honeycomb antiferromagnet $\text{Bi}_3\text{Mn}_4\text{O}_{12}(\text{NO}_3)$	J-PARC
2009A0098	M. Aoki	Osaka U	Measurements of an Extinction Ratio and a Muonic Atom Formation Rate	J-PARC
2009A0109	J. Sugiyama	Toyota Central R&DLabs.Inc.	Lithium diffusion in lithium-transition-metal-oxides	J-PARC
2009A0138	K. Kubo	ICU	Development of non-destructive multi-elemental analysis system by muonic X-ray	J-PARC
2009A0147	K. Tokiwa	Tokyo U Science	μSR study of magnetic properties of CaFe_2O_4 -type NaMn_2O_4 and LiMn_2O_4	J-PARC
2009A0153	K. Shimomura	KEK-MSL	μSR study on isolated hydrogen charge state in oxygen deficient SrTiO_3	J-PARC

Distribution of Proposed Subject

Approved Proposal (Subject)

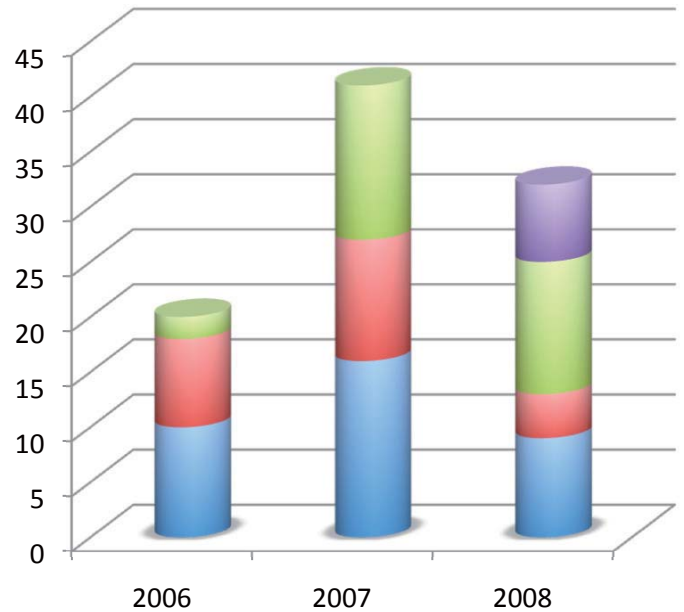


Distribution of Affiliation



■ Proposed by Internal User
■ Proposed by External User

Distribution of Overseas Facility



■ TRIUMF ■ RIKEN-RAL ■ PSI ■ J-PARC

5. List of Research Participants

List of Research Participants (2006 – 2008)

KEK-IMSS			
	<i>Muon Science Laboratory</i>		
	K. Nishiyama	Professor	
	R. Kadono	Professor	
	Y. Miyake	Professor	
	K. Shimomura	Associate Professor	
	P. Strasser	Associate Professor	
	A. Koda	Assistant Professor	
	S. Makimura	Engineer	
	K. Nagamine	Diamond Fellow/Research Physicist	UCR
	K. Nakahara	Post Doctoral Fellow	==>University of Maryland
	S. Takeshita	Post Doctoral Fellow	==>RIKEN SPring 8
		Graduate Student	SOKENDAI: 3 K.H. Satoh, M. Hiraishi, M. Miyazaki
KEK-IPNS			
	T. Uchida	Post Doctoral Fellow	
	J. Haba	Professor	
	M. Tanaka	Associate Professor	
	Y. Yasu	Chief Engineer	
KEK-Computing Research Center			
	S. Suzuki	Research Associate	
JAEA			
	R.H. Heffner	Visiting Researcher	
	W. Higemoto	Senior Research Scientist	
	K. Ohishi	Post Doctoral Fellow	==>RIKEN
RIKEN			
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	M. Iwasaki	Chief Scientist	
	T. Matsuzaki	Senior Research Scientist	
	K. Ishida	Senior Research Scientist	
	I. Watanabe	Senior Research Scientist	
	Y. Matsuda	Research Scientist	==>The University of Tokyo
	Y. Ishii	Contract Researcher	
	Y. Kobayashi	Senior Research Scientist	
	T. Kawamata	Contract Researcher	
	S. Ohira-Kawamu	Contract Researcher	==>JAEA
	T. Suzuki	Contract Researcher	
	P. Bakule	Contract Researcher	(ISIS/RAL)
	F.L. Pratt	Researcher	(ISIS/RAL)
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	A. Yamamoto	Contract Researcher	
	<i>Cross-correlated Materials Research Group (CMRG), ASI</i>		
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	I. Shirotani	Professor	
	C. Sekine	Associate Professor	
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	<i>Graduate School of Engineering</i>		
	Y. Koike	Professor	
	T. Adachi	Assistant Professor	
		Graduate Student	2: Y. Fukunaga, Y. Tanabe

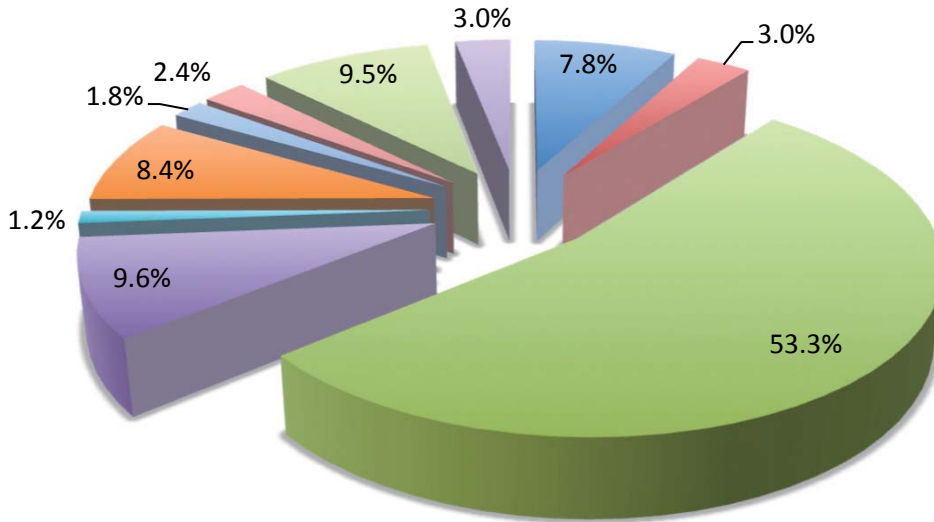
	<i>Graduate School of Science</i>		
	Y. Murakami	Professor	==>KEK CMRC
	S. Takagi	Associate Professor	
	<i>Institute for Materials Research</i>		
	K. Yamada	Professor	
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Y. Iwasa	Professor		
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Y. Kohori	Professor		
H. Fukazawa	Research Assistant		
K. Hachitan	Post Doctoral Fellow		
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S. Akutagawa	Post Doctoral Fellow		
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M. Enomoto	Assistant Professor		
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H. Ueda	Assistant Professor		
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	H. Hosono	Professor	
<i>ERATO-SORST</i>			
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University of Yamanashi			
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	I. Shiraki	Assistant Professor	
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<i>Graduate School of Science</i>			
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<i>Institute for Chemical Research</i>			
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	M. Azuma	Assistant Professor	
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<i>International Innovation Center</i>			
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	T. Nakano	Assistant Professor	
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	A. Shinohara	Professor	
	W. Satoh	Assistant Professor	
		Graduate Student	2: K. Ninomiya(=>JAEA), R. Nakagaki
	M. Mihara	Assistant Professor	
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		Graduate Student	1: D. Ishikawa
<i>Nanoscale Characterization of Structure-Sensitive Properties</i>			
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	H. Araki	Associate Professor	
	M. Mizuno	Assistant Professor	
Osaka City University			
<i>Graduate School of Engineering</i>			
	T. Ohzuku	Professor	
	K. Ariyoshi	Assistant Professor	
Kobe University			
<i>Graduate School of Science</i>			
	T. Mochida	Professor	
		Graduate Student	1: M. Oyama
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<i>Department of Materials Science</i>			
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The University of Tokushima			
<i>Institute of Technology and Science</i>			
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<i>Faculty of Science and Engineering</i>			
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		Graduate Student	4: M. Fujihara, T. Gyotoku, M. Hagihala, T. Yamashita
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<i>Graduate School of Science and Engineering</i>			
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		Graduate Student	2: T. Hisamatsu, O. Murayama
NIMS			
	H. Sakurai	Researcher	
	H. Suzuki	Chief Scientist	
	H. Takeya	Researcher	
	T. Furubayashi	Chief Scientist	
TRIUMF			
	P.L. Russo	PDF	
	T. Goko	Researcher	
PSI			
	A. Amato	Head of Bulk μ SR	
	D. Andreica	Facility Scientist	
	R. Scheuermann	Researcher	

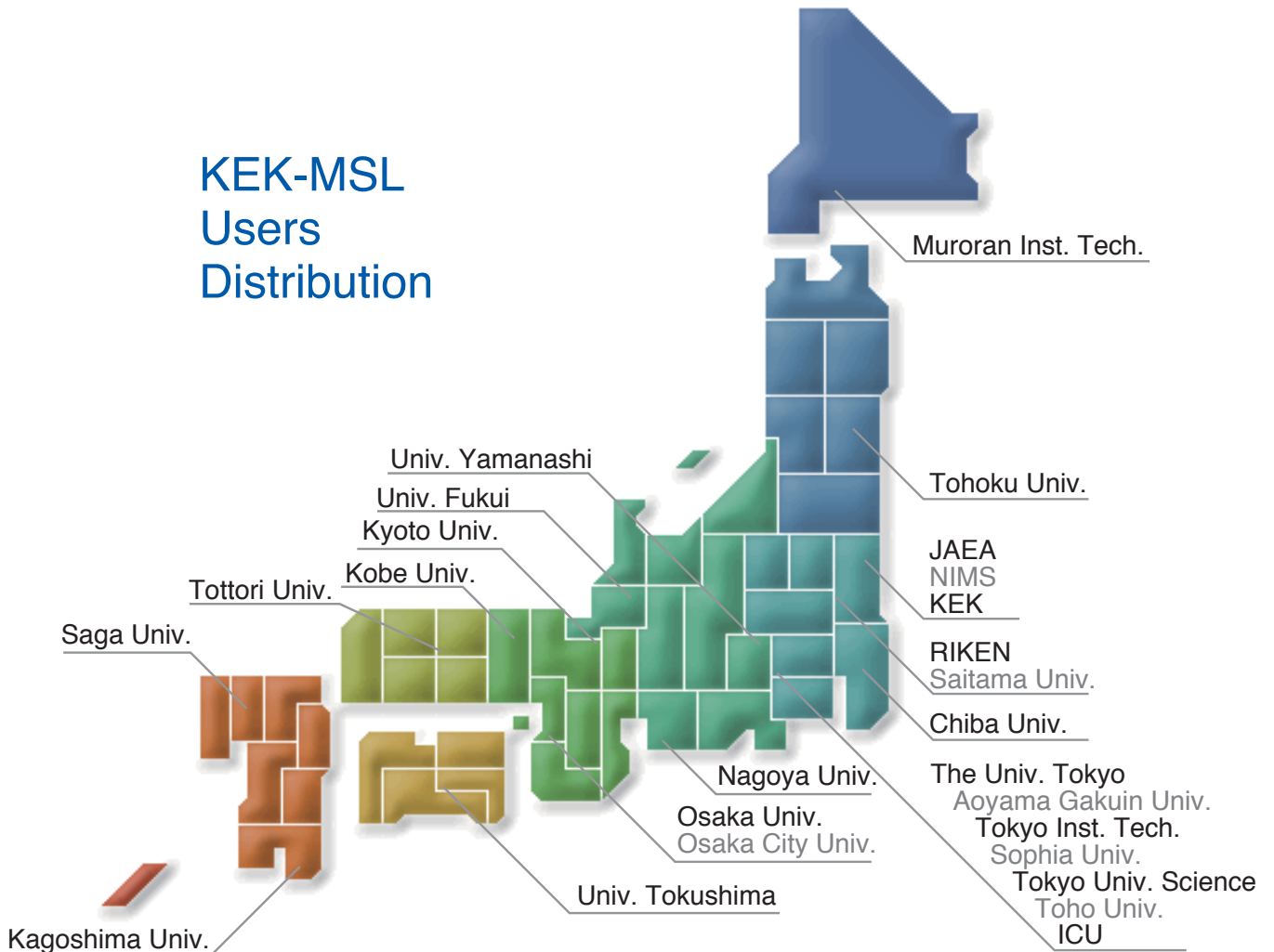
Los Alamos National Laboratory, LANL			
		E.D. Bauer	
		H. Miyadera	Visiting Researcher
CEA-Grenoble			
		A. Yaouanc	
		P. Dalmas de Réotier	
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		J.H. Brewer	Professor
Columbia University			
		Y.J. Uemura	Professor
University of California, Riverside			
		J.S. Schultz	Professor
		D.E. MacLaughlin	Professor
McMaster University			
		G.M. Luke	Professor
Stanford University			
		T. Sasagawa	Research Associate ==>Tokyo Tech
Technische Universiteit Delft			
		P.C.M. Gubbens	
Toyota Central R&D Labs. Inc.			
		J Sugiyama	Chief Researcher
		H. Nozaki	Researcher
		K. Mukai	Researcher
		M. Harada	Researcher
		Y. Ikedo	Researcher ==>KEK-MSL

Distribution of Rrsearch Participants



- KEK-MSL
- Nation. Univ.
- Prefect, Public Univ.
- JAEA
- Foreigner
- KEK
- Priv. Univ.
- RIKEN
- NIMS
- Priv. Company Inst.

KEK-MSL Users Distribution



6. Symposia & Meetings

International Symposiums Organized by MSL

Year	Date	Location	Organizer	Title	Attenants
2008	July 21-25	Tsukuba	KEK-MSL RIKEN JAEA	11 th International Conference on Muon Spin Rotation, Relaxation, Resonance (μ SR2008) 200	200

Scientific or Technical Meetings Organized by MSL

Year	Date	Location	Organizer	Title	Attenants
2007	Jan. 11-13	KEK	KEK-MSL	5 th Muon Science Advisory Committee Meeting (MuSAC)	30
2007	Feb. 22	KEK	KEK-MSL	KEK-MSL Users Meeting for Scientific Activities (2006, 2007)	40
2008	Jan. 15-16	Tokai	KEK-MSL	6 th Muon Science Advisory Committee Meeting (MuSAC)	30
2008	Feb. 28	KEK	KEK-MSL	KEK-MSL Users Meeting for Scientific Activities (2007, 2008)	40
2009	Mar. 6-7	Tokai	KEK-MSL	7 th Muon Science Advisory Committee Meeting (MuSAC)	30
2009	Mar. 24	KEK	KEK-MSL	KEK-MSL Users Meeting for Scientific Activities (2008, 2009)	40

Scientific or Technical Meetings Supported by MSL

Year	Date	Location	Organizer	Title	Attenants
2008	Mar. 5-7	Mito	J-PARC	International Symposium on Pulsed Neutron and Muon Sciences (IPS 08)	300
2008	Oct. 16-17	Tsukuba	IMSS	Institute of Materials Structure Science Symposium '08	150
2009	Nov. 17-18	Tsukuba	IMSS	Institute of Materials Structure Science Symposium '09	100

7. Education

Thesis Obtained Based on KEK-MSL Facility

< Doctor Thesis >

T. U. Itoh

“ μ^+ SR Studies of Multiple Ordering in f-electron Systems”

Tokyo Institute of Technology

March 2008

K. H. Satoh

“ μ SR Studies on the Mixed State of Electron-doped Cuprate Superconductor $\text{Sr}_{1-x}\text{La}_x\text{CuO}_2$ ”

Department of Materials Structure Science, The Graduate University for Advanced Studies

March 2008

Y. Tanabe

“Studies on Impurity Substitution Effect and Inhomogeneous Superconductivity in La-Cuprates”

Department of Applied Physics, Tohoku University

March 2009

N. Kida

“Studies on Multifunctionality and Related Charge Transfer Phase Transition and Ferromagnetism”

Department of Applied Physics, Tohoku University

March 2009

< Master Thesis >

M. Hagihara

“Spin-lattice control in geometrically frustrated series $(\text{Co}_{1-x}\text{Fe}_x)_2(\text{OH})_3\text{Cl}_{1-y}\text{Br}_y$ ”

Department of Physics, Faculty of Science and Engineering, Saga University

March 2008

T. Yamashita

“Magnetism in triangular lattice botallackite-type compounds $\text{Cu}_2(\text{OH})_3\text{Br}$ and $\text{Cu}_2(\text{OH})_3\text{I}$ ”

Department of Physics, Faculty of Science and Engineering, Saga University

March 2008

T. Yoshida

“ μ SR Study on the Magnetism of β' -(BEDT-TTF) $_2\text{ICl}_2$ under High Pressure”

Graduate School of Science and Engineering, Saitama University

March 2008

K. Sato

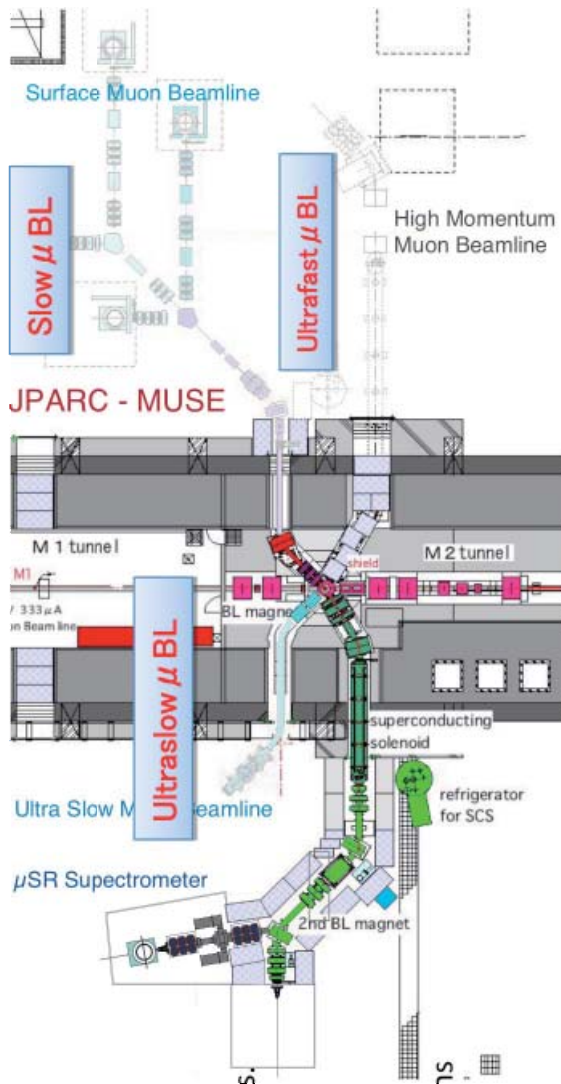
“ μ SR Study on the Magnetism of β' -(BEDT-TTF) $_2\text{ICl}_2$ under High Pressure”

Graduate School of Science and Engineering, Saitama University

March 2009

8. Future Plan

J-PARC Muon Science Experiment Facility



Roadmap for MUSE

1) Ultraslow Muon Beamline

...Recommendation of J-PARC User Association with the first priority among upgrading plans throughout entire facilities.

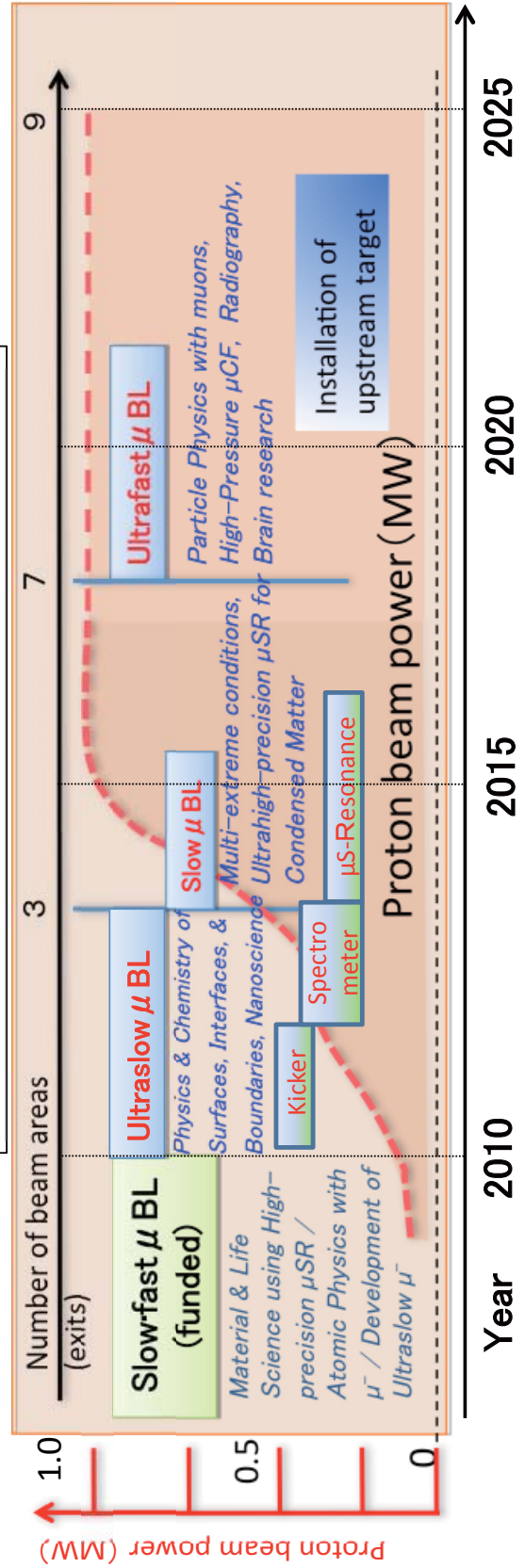
2) Slow Muon Beamline

...for the high-intensity "surface" muons.

3) Ultrafast Muon Beamline

...originally for the high-momentum muons to be used for muon-catalyzed nuclear reaction, etc.

Upgrading plan ("Roadmap") for J-PARC MUSE



MuSAC V Executive Summary 2007

Executive summary:

The Muon Science Advisory Committee (MuSAC) met at KEK on January 11, 12 and 13 2007 to review the progress in the construction of the J-PARC muon facility (MUSE), to comment on some of the 24 Letters of Intent which had been previously received from potential users and which had not been heard at the MuSAC4 meeting, to consider the transition in the organization to prepare for the beginning of beam operation and to review the plan for the development of the beam facilities in the second phase of the construction.

The overall progress on J-PARC facilities is consistent with maintaining the approved schedule for the turn-on of the accelerators, and the Committee was pleased to hear that the Injection LINAC had achieved acceleration to 50 MeV without any difficulty. This bodes well for the quality of the machine and its careful implementation. The difficulties encountered with the RF cavities breakdown are being addressed and some have met the 1000 Hours high power tests requirements.

On the technical side for MUSE, major advances were noted: more than 70 % of the budget is committed, installation of components is in progress and on schedule, and preparations for initial commissioning and operation are underway. The team is working very hard with a minimal budget and is meeting its milestones.

The concern raised at the last meeting — that the requested 100ns proton pulse width might possibly, seriously, compromise the full beam power available for neutron users — remains. Any degradation of the proton beam pulse width beyond 100 ns would have serious consequences for all muon users in terms of time resolution and, for example, make the muon source less and less attractive compared to the ISIS-RAL source. Since this was raised as a flag by the accelerator team, it is important to study the space charge effect causing this degradation and to mitigate it during the commissioning period. In particular, an understanding of the relationship between pulse width and charge should be undertaken as soon as feasible to give a benchmark for the level of compromise that could be afforded.

The Committee reviewed some of the Letters of Intent which were received last year but not presented and received an update on the core projects that would contribute to enhancing the bare initial complement of muon channels. The initial program will make use of the refurbished decay channel from KEK. The plans for developing the facilities as part of phase II have been slightly changed from the original concept six years ago to take advantage of the recent development of ultra-slow muon beams and to account for the ever increasing demand for surface muon beam of high brightness. More concrete ideas were presented to develop unique capabilities at J-PARC in terms of ultra-slow muon beams or pencil-beams, which would open very important scientific fields in surface or interface physics, molecular and biophysics, etc. The Committee considers that these initiatives should be at the highest priority in the foreseen development of the facility so that the J-PARC muon facilities can be positioned to offer the Japanese and the world communities with unique instruments.

With the start of operation envisaged for FY2007, it is important that an operational budget be made available consistent with the expectations of both muon and neutron users for beginning users beam delivery in 2008.

MuSAC VI Executive Summary 2008

Executive summary:

The sixth MuSAC meeting took place at Tokai on January 15th and 16th 2008. The committee heard presentations on the construction status of the J-PARC complex, the accelerators, the Life and material science facilities including the MUSE facility. Construction of the phase 1 projects is on time and commissioning with beam will occur in the fall 2008. The committee had a chance to see the Muon target hall as the services (electrical, plumbing and air conditioning) are finalized and the final shielding is being placed. The meticulous execution of the project is truly impressive. The proton beam line has been evacuated and the vacuum achieved is well within specification. Cabling and plumbing is continuing to meet the September deadline for beam-on commissioning. No road blocks are envisaged at this stage. The reconditioned KEK superconducting solenoid was being installed during the visit and could be ready in time for the first beam commissioning. As the committee was meeting, budget discussions were on going to determine the level of operation funding that would be available to the group. It was clear to the committee that the minimum requirement to assure an early muon beam delivery during the planned two month cycle of beam delivery to neutron users was crucial to deliver an early physics output from the lone first muon channel at J-PARC and provide the incentive to the muon user community to seek alternative supplementary funding for core user projects and hence to complete the facility as early as possible. Attracting foreign users and industrial investments is directly linked to having an early minimal initial program available at start up.

The committee strongly pushed to have the decay channel operational during the first beam delivery period planned in FY 2008. The committee would like to have a specific plan to provide ultra slow muons as soon as possible as it is seen as the most innovative and unique opportunity for Muon users.

The committee congratulates the MUSE team for delivering on its promises to have an operational facility September 08.

MuSAC VII Executive Summary 2009

Executive summary:

MuSAC met at TOKAI on March 6 and 7th 2009 just as the first muon beam user period was ending successfully. The committee was very pleased that in demanding conditions the MUSE team was able to deliver beam to 7 proposals approved by the PAC in November and produces quality results worthy of publications with the refurbished beamline and the spectrometer from KEK, with some new addition from JAEA. The committee applauds this cooperation between the two parent institutions of J-PARC and congratulates the MUSE and the J-PARC team as a whole for an outstanding performance in completing the project on time and on budget.

A decent operational budget must allow for the construction of the high intensity channel and for improving the performance of the instruments at the end of the channel to capitalize on the foreseen beam intensities in the near term.

The committee was charged to review three new Letters of Intent focused on the exploitation of the unique Ultra Slow Muon beams potentially available at J-PARC. All three would provide ground breaking physics results and would place MUSE on the map of muon facilities in the world. MuSAC reiterates its strong support for this program and encourages the MUSE management to place the development of such a beam at the top of all priorities. The original concept for the full development of the muon beamlines is being revised to take into account the strong user demand for such beams and MuSAC agrees with this strategy. The difficulties in identifying funds for the high intensity muon beamline remain while users are exploring other funding avenues. Such may come with strings attached that will demand strong scientific leadership to maintain a proper course for the long term objectives of MUSE. However MuSAC believes that by placing science first, the whole MUSE program will benefit from the strong partnerships which are being considered. The committee recommends that a strong scientific leadership be maintained to carry MUSE forward. A strong commitment of both KEK and JAEA will be required, as well as support from the users and other Japanese research institutes like RIKEN, Universities and industrial partners.

The J-PARC project has come a long way and is about to deliver on its promise. In evolving into a user facility, science is coming to the forefront and the role of MuSAC may be reconsidered. This was discussed in the closing session. Although a strong PAC will be better suited for assessing the scientific program running on the commissioned facilities, MuSAC can play a role in helping shape the future facilities to optimize them to the user demands (expressed or anticipated).

MuSAC has been very fortunate to participate in this adventure and thank the parent organizations of J-PARC and the J-PARC management for allowing us the witness this great success.