



KEK-JAERI Joint Project on High Intensity Proton Accelerators

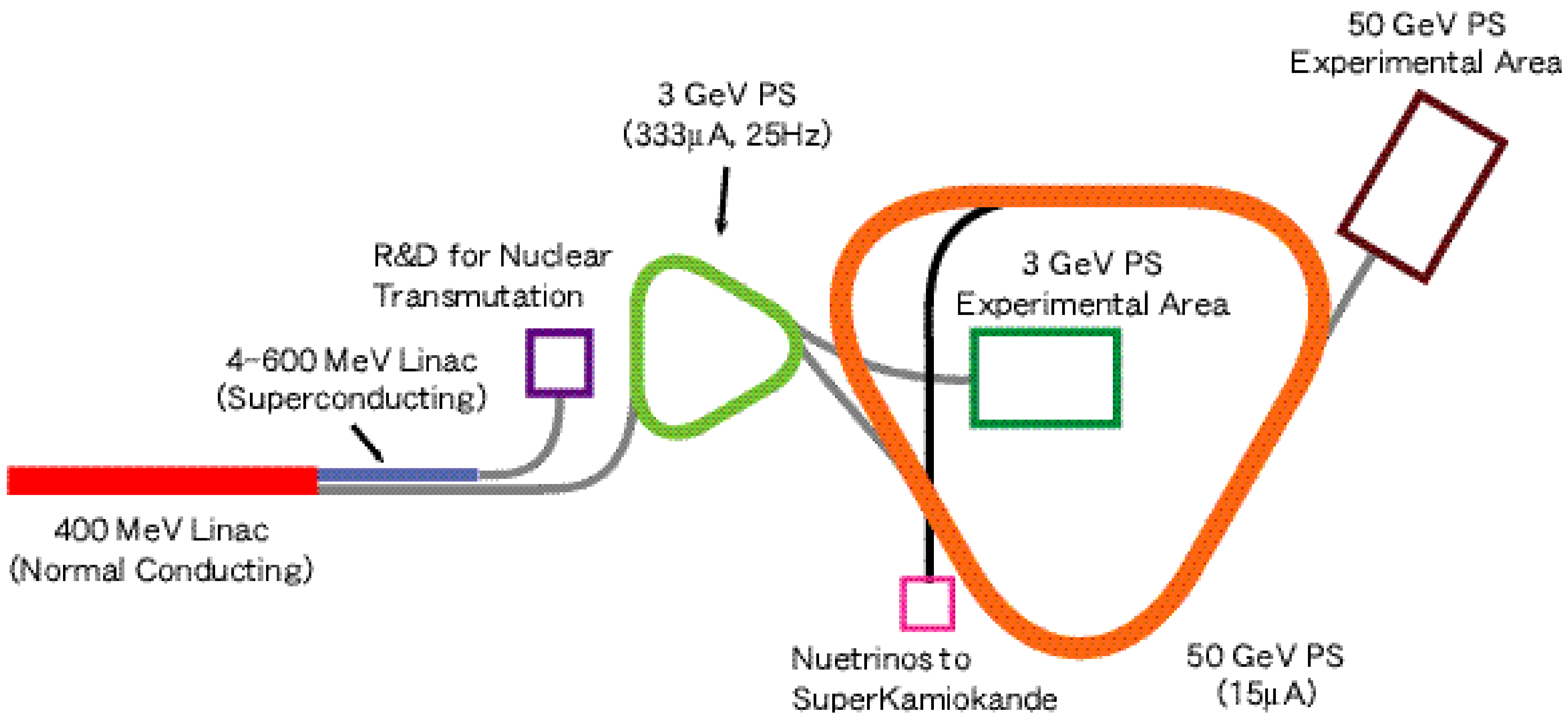
Shin'ya Sawada
KEK

- What is the Joint Project ?
- Sciences with the Joint Project
- Recent Progress and the Future Project Plan

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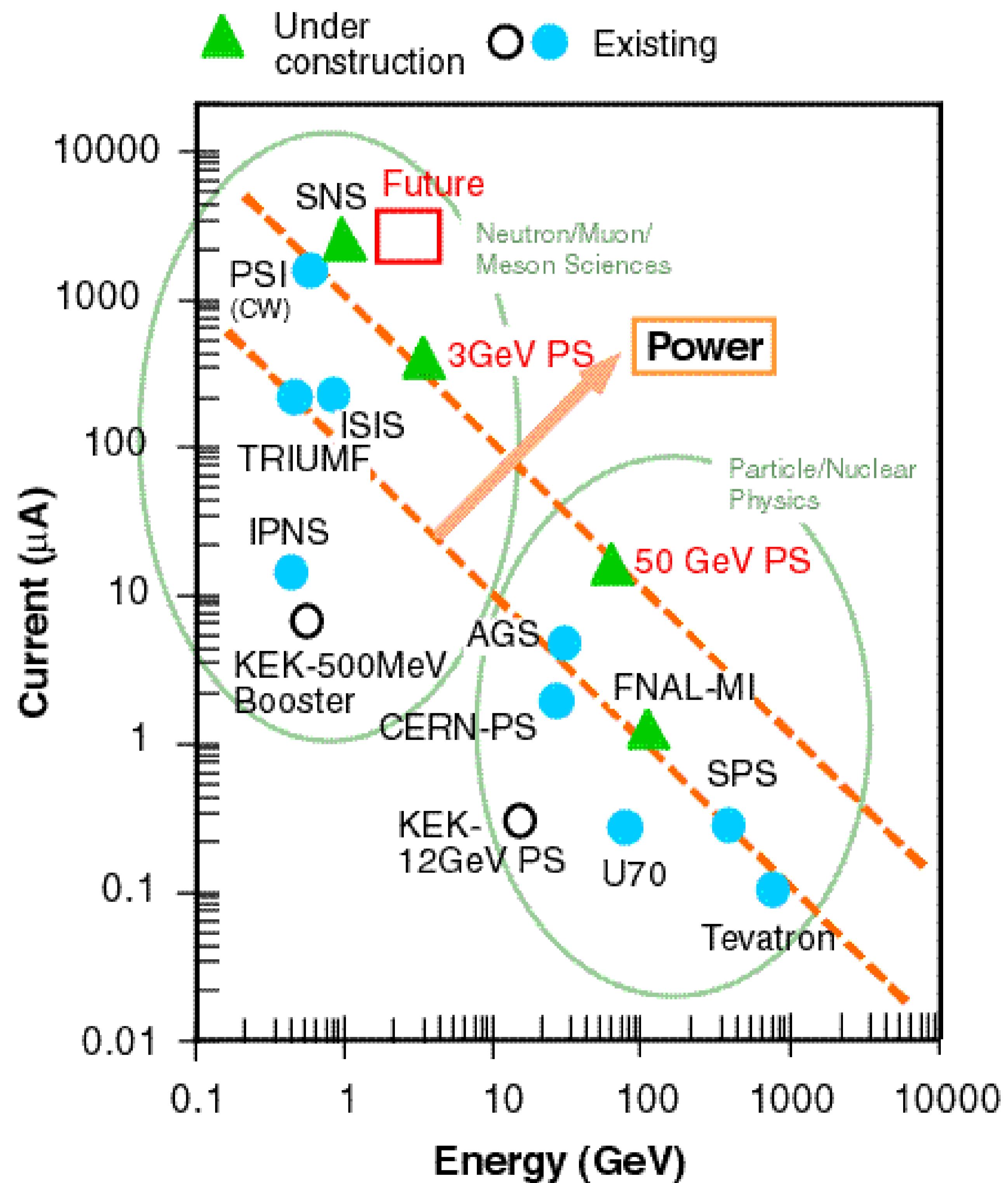
Configuration of the Accelerator Complex



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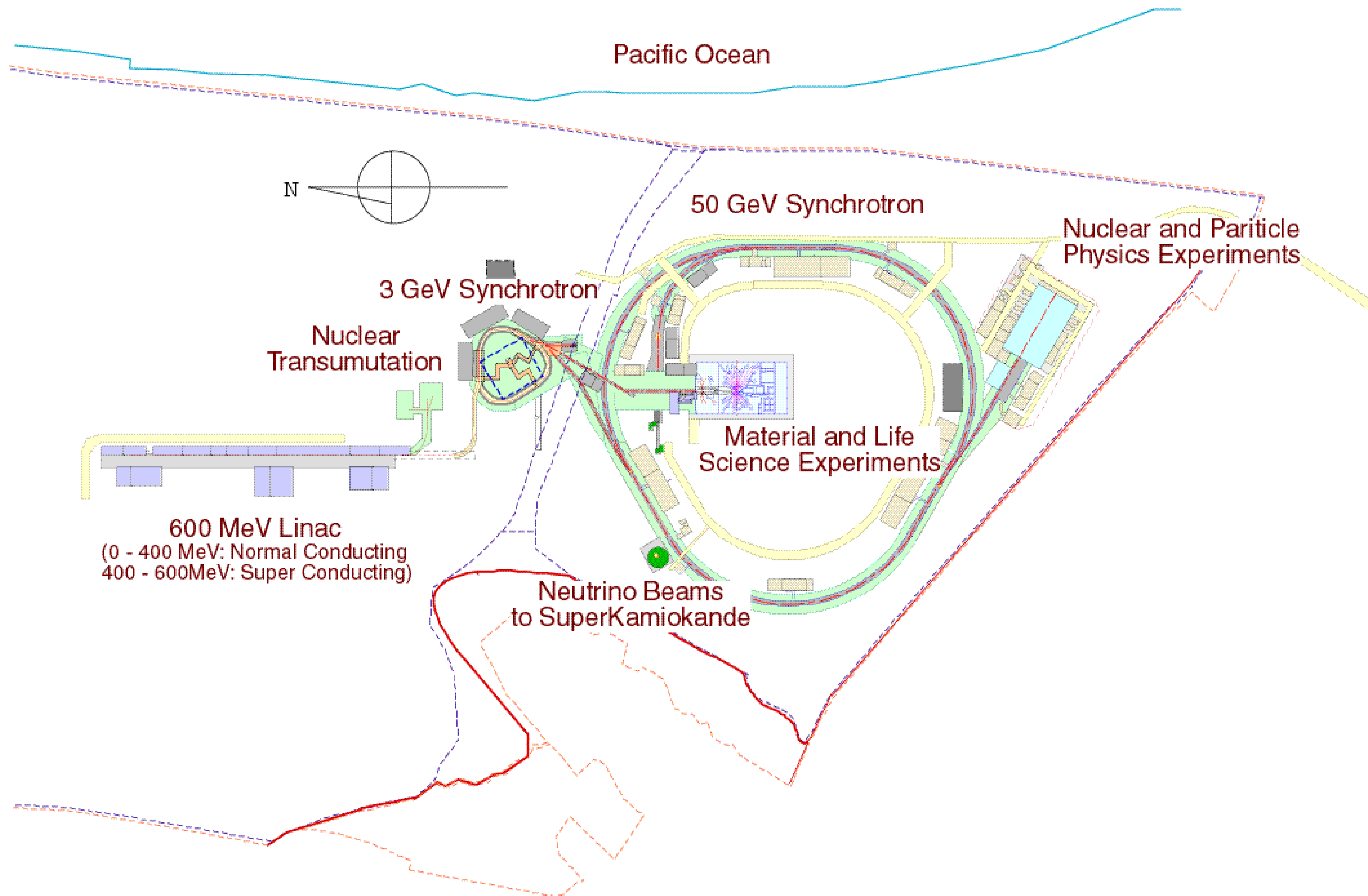
Accelerators



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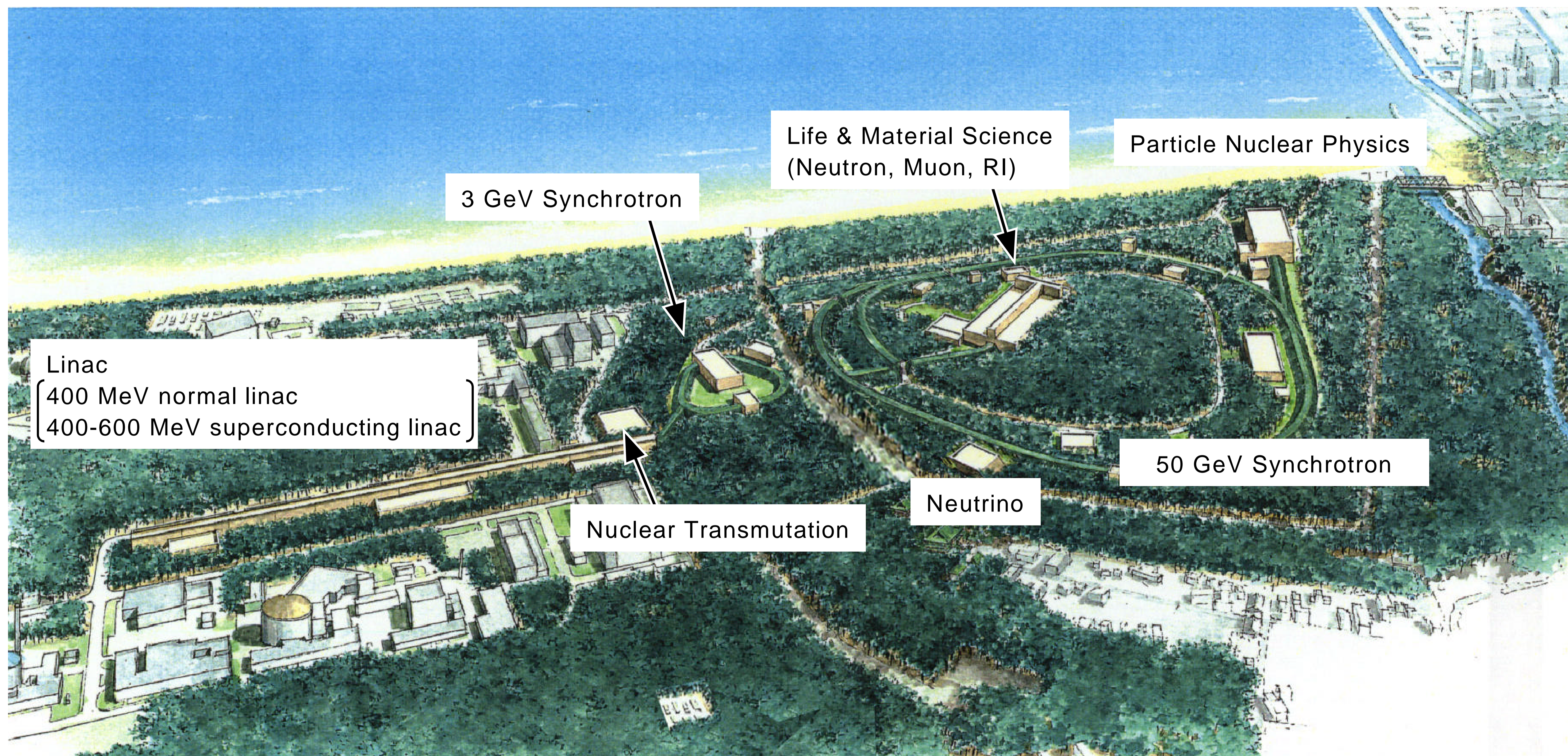


Plan View





Site View of the Project

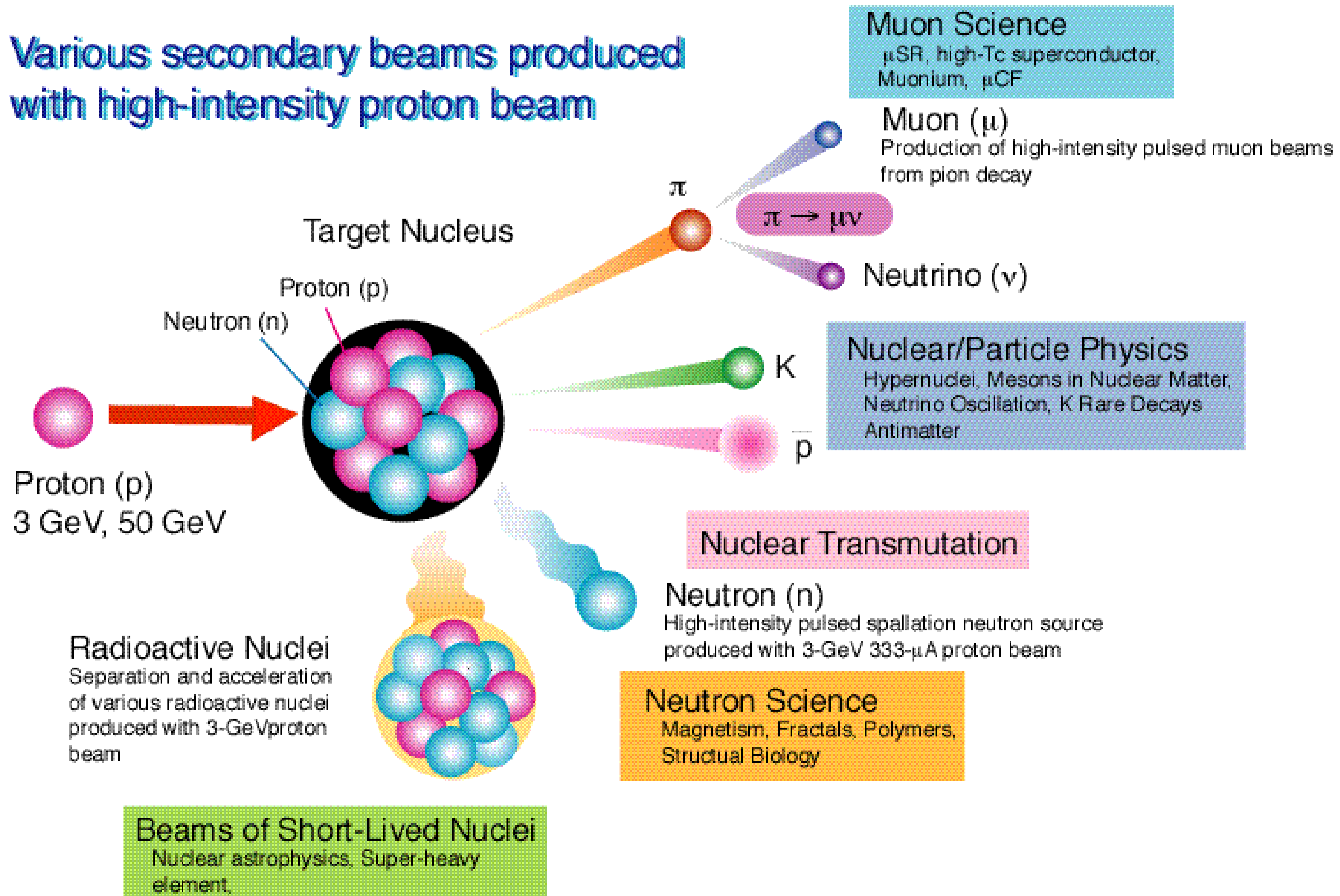




Why Do We Need High Intensity Protons?

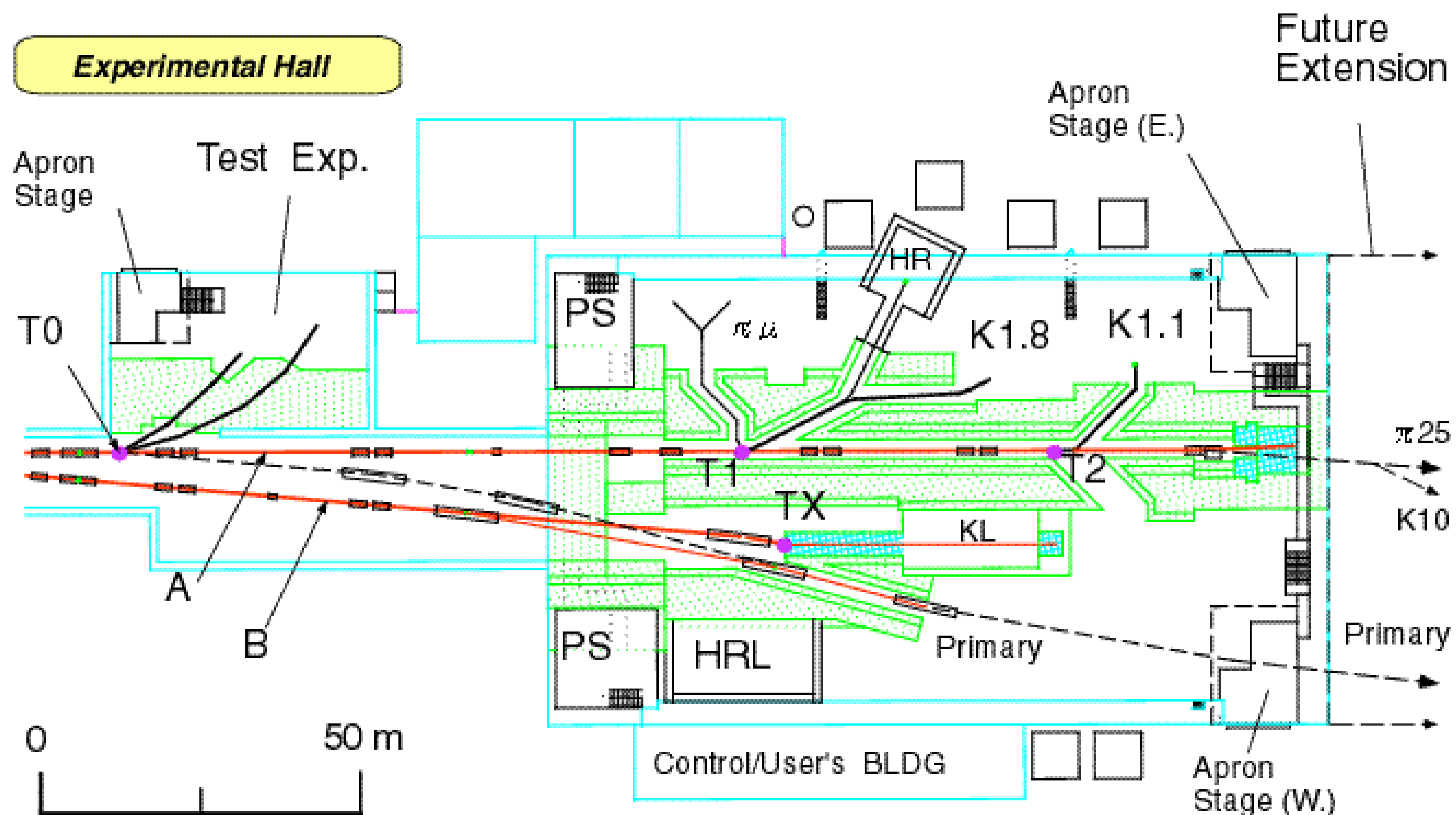


Various secondary beams produced with high-intensity proton beam





Exp. hall for Nuclear/Particle Physics



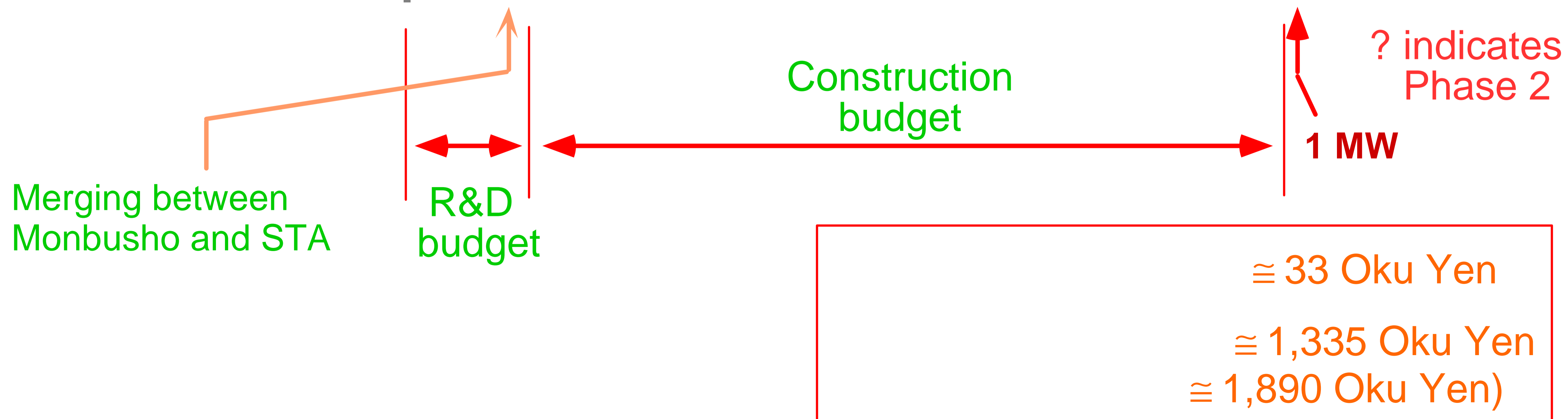
name of beam channel	K1.8	K1.1	KL
Momentum Range (GeV/c)	1.0 ~ 2.0	0.5 ~ 1.1	1-8
Acceptance($\text{msr} \cdot \%$) ² $\Omega \cdot \Delta p / p$	10	30	² $\Omega = 6.8 \mu\text{sr}$
Length (m)	40	25	20
Particle Separation	2-stage DC	2-stage DC	none
Average Beam Intensity (@ 1×10^{14} pps)	$K^-(1.8): 1.5 \times 10^7$ $pbar(1.8): 6 \times 10^6$	$K^+(0.8): 1 \times 10^7$	$K_L(2.0): 4 \times 10^8$
production angle (degree)	6	5	10



Schedule



	FY											
Linac	[Solid red bar]											
Superconducting Linac					?	[Dashed red bar]						
3 GeV Synchrotron		[Solid red bar]										
50 GeV Synchrotron	[Dashed red bar]											
Neutron Scattering Facility			[Solid red bar]									
Muon Facility			[Solid red bar]								[Dashed red bar]	
Transmutaion R&D					?	[Dashed red bar]						
Nuclear/Particle Phys. Facility			[Solid red bar]								[Dashed red bar]	
Neutrino Facility				?	[Dashed red bar]						[Dashed red bar]	



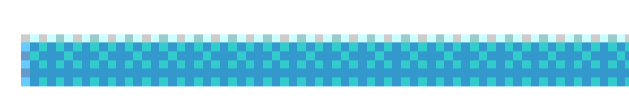
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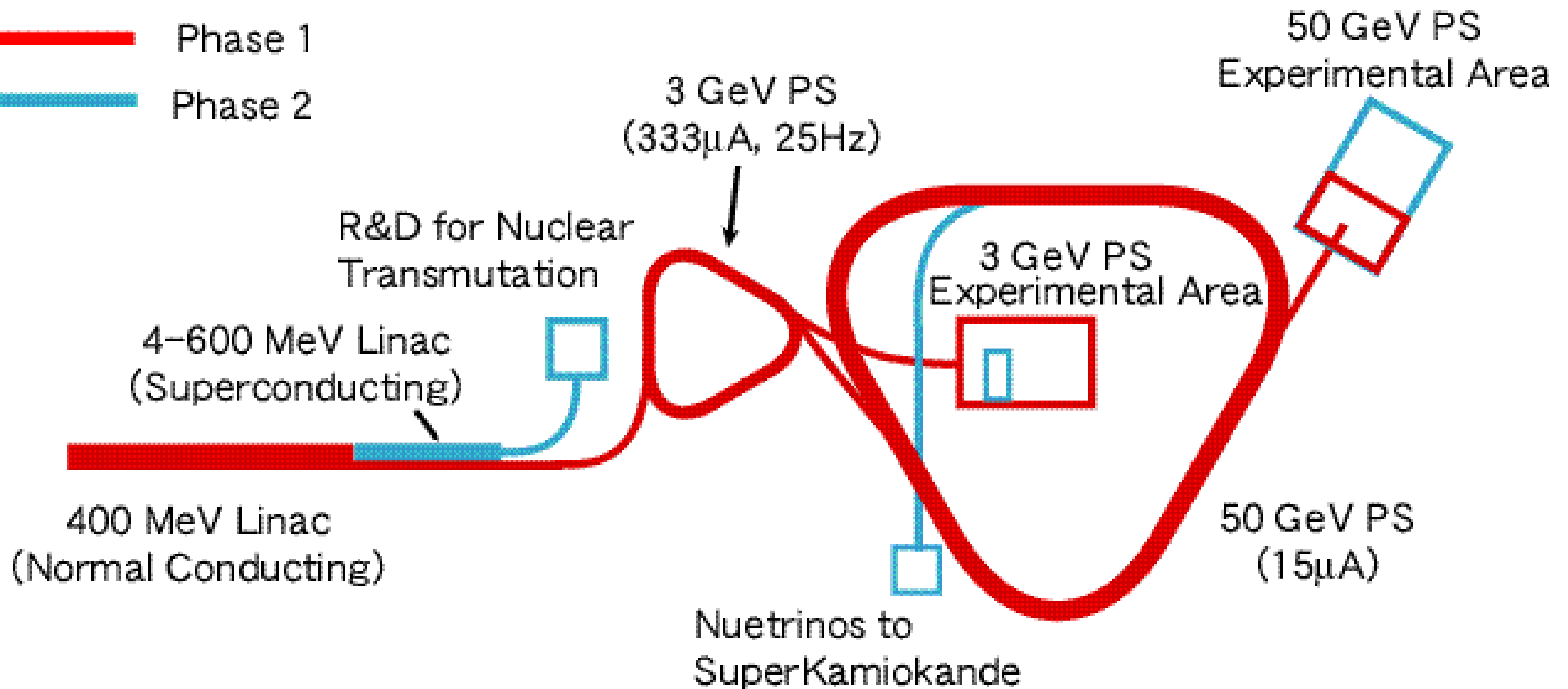
Phase 1 and Phase 2



Phase 1

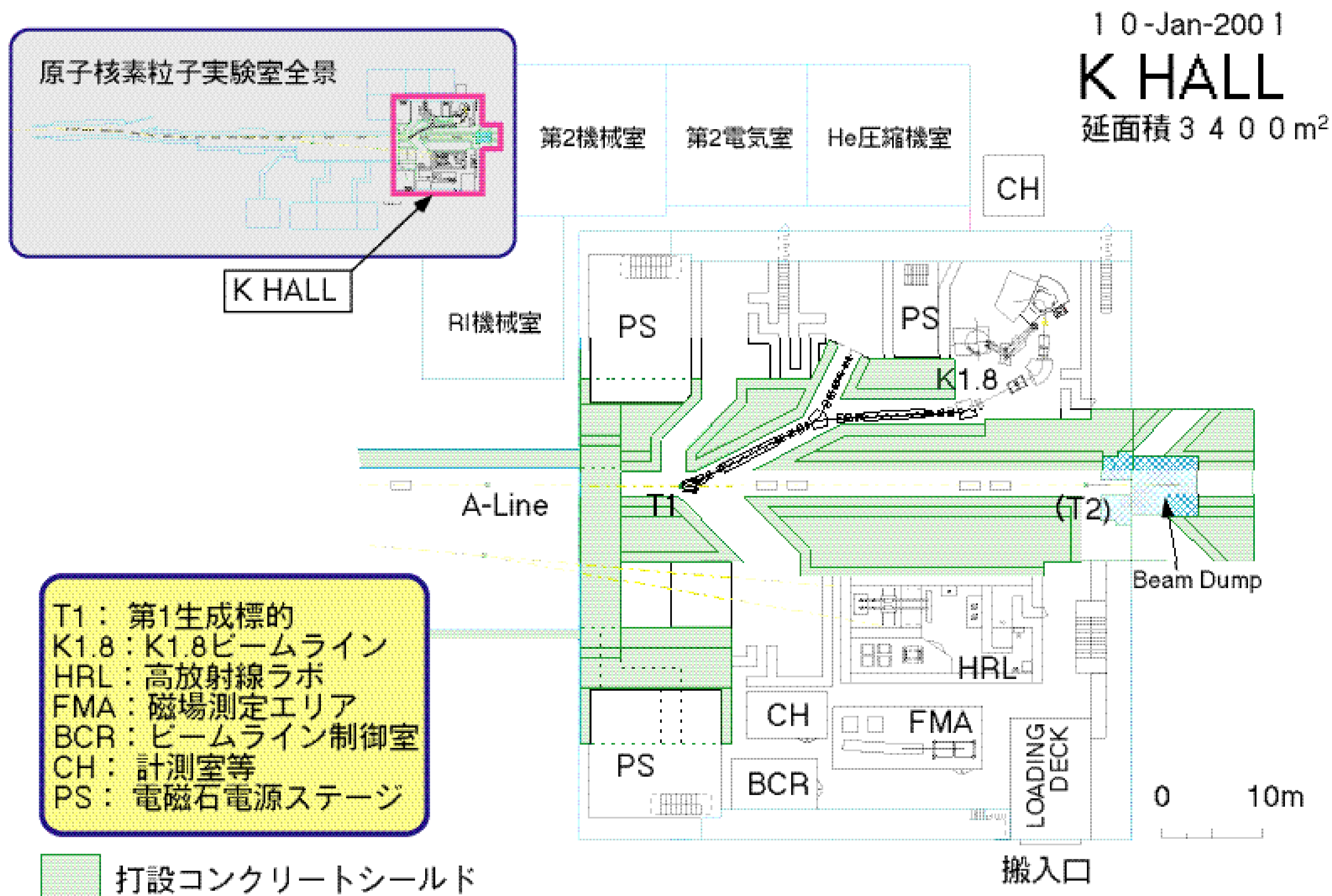


Phase 2





Phase 1 Nuclear/Particle Physics Facility





Nuclear/Particle Physics

- There are various possibilities - - - Nuclear Physics Possibilities:

Nuclear Physics

	Topics	Motivation	Goal
Strangeness nuclear physics	Λ -hypernuclear spectroscopy	Precise studies of Λ -hypernuclei	$\Delta E \sim 2$ keV resolution by γ -ray spectroscopy
	S=-2 hypernuclei	Ξ -hypernuclei, $\Lambda\Lambda$ -hypernuclei, search for H particle	
	Hyperon-nucleon scattering	Study of YN interaction Flavor SU(3)	Collect Λp , Σp , Ξp data as in NN data
	KN interaction	Measurement of Σ_{KN}	
	Charmed-hypernuclei	Production of Λ_C hypernuclei	
Chiral Symmetry	Vector mesons in nuclear medium	Restoration of chiral symmetry breaking	ϕ , ρ , J/Ψ in nuclear medium (dilepton)
Structure function	Nucleon and nuclear structure function	Quark-gluon (parton) distribution	Low Q^2 , high x region
Hadron spectroscopy	Exotic searches	Search for Glueball and hybrid	
	Antiproton beam	Energy region above LEAR	
	Normal baryon/meson spectroscopy	QCD confinement (DGL theory etc.)	Complete SU(3) baryon/meson spectra
Heavy-ion physics	High-density matter	Search for QGP	
	Multi-strangeness fragments	Search for S<-2 strangeness matter	
Atomic physics	Anti-hydrogen physics	Precision spectroscopy, CPT test	



■ Particle Physics Possibilities:

Particle Physics

	Topics	Motivation	Goal
Rare K decays	Study of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ decay	Determination of CKM matrix element ($ V_{td} $)	About 100 events $B(K^+ \rightarrow \pi^+ \nu \bar{\nu}) \sim 9 \times 10^{-11}$ is predicted.
	Search for $K_L \rightarrow \pi^0 \nu \bar{\nu}$ decay	Determination of CP-violating phase (η) in CKM matrix	About 1000 events $B(K_L \rightarrow \pi^0 \nu \bar{\nu}) \sim 3 \times 10^{-11}$ is predicted.
	$K \rightarrow \pi \gamma \gamma$, $K \rightarrow \pi \pi \gamma$	Test of chiral perturbation theory	
Fundamental Symmetry	Search for P_T in $K^+ \rightarrow \pi^0 \mu^+ \nu$ decay	Search for T violation	$P_T < 10^{-4}$
	Δm_K in $K \rightarrow \pi \pi$	Search for CPT violation	$\Delta m_K / m_K \sim 10^{-18}$
Muon Lepton Flavor Violation	Search for $\mu^- + N \rightarrow e^- + N$	SUSY-GUT SUSY and heavy ν_R	$B(\mu^- + N \rightarrow e^- + N) \sim 10^{-18}$ with PRISM beam
	Search for $\mu^+ \rightarrow e^+ \gamma$ and $\mu^+ \rightarrow e^+ e^- e^+$	SUSY-GUT SUSY and heavy ν_R	$B(\mu^+ \rightarrow e^+ \gamma) \sim 10^{-15}$ $B(\mu^+ \rightarrow e^+ e^- e^+) \sim 10^{-15}$
Neutrino Physics	Neutrino Oscillation	Determination of neutrino mass and mixing	$\Delta m^2 < 10^{-3}$ (for long-baseline)
	Neutrino scattering	Determination of electroweak form factors	
Neutron Physics	Search for EDM of neutron	New physics with CP violation	$d < 10^{-28}$ e cm



Nuclear/Hadron Physics

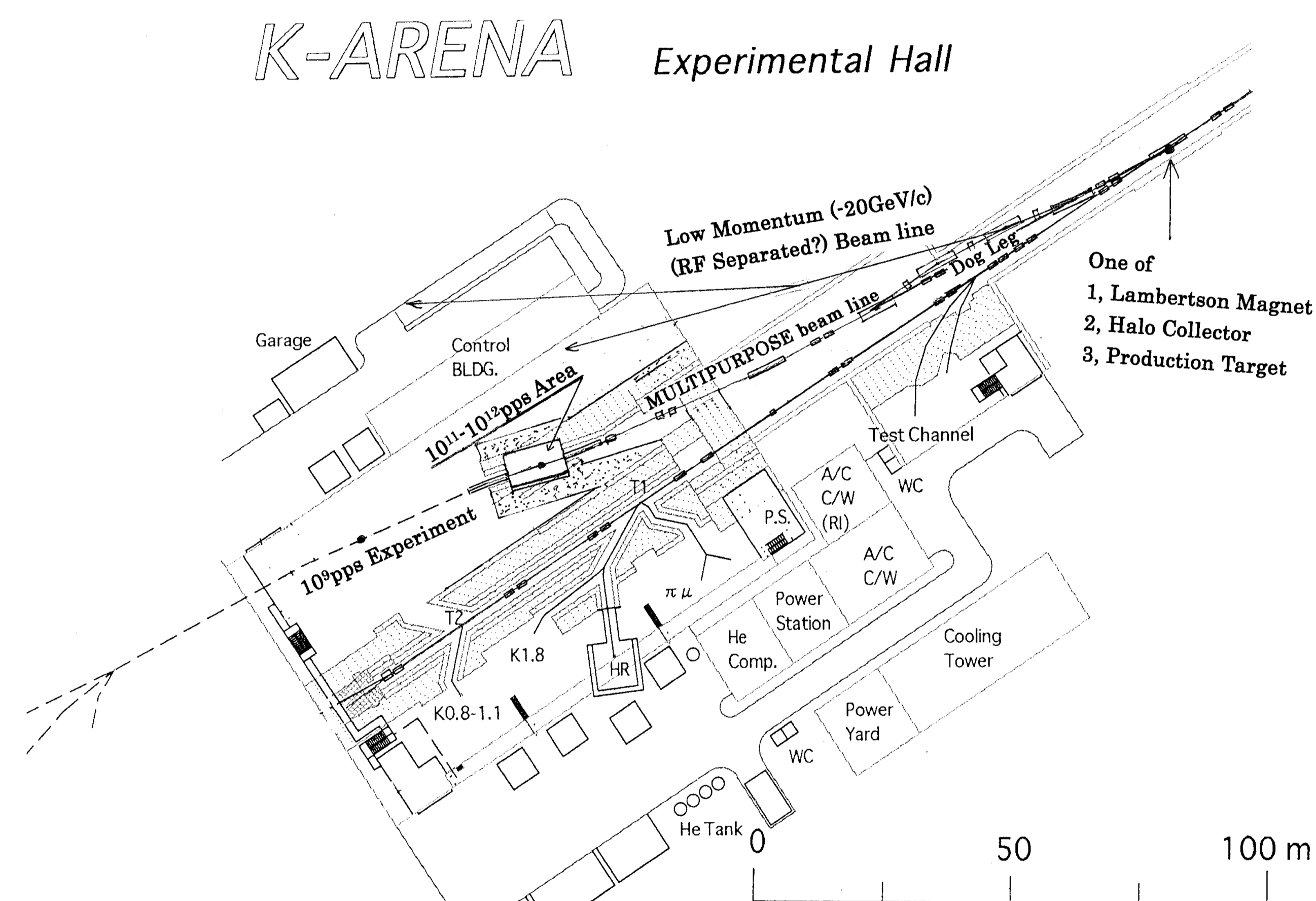
- Using Various Kinds of Hadron Beams with Various Energies from the 50-GeV Synchrotron
- Key Words = QCD in medium
- Nuclear Matter

- “Expression of Interest for Nuclear/Hadron Physics Experiments at the 50-GeV Proton Synchrotron”, KEK Report 2000-11, October 2001.
 - Chiral property of dense nuclear matter through measurements of the meson-spectral-change in medium
 - High-mass dimuon production
 - Multifragmentation
 - Strangeness nuclear physics with heavy ion beams
 - Collective behavior in hadron production with heavy ion beams
 - Polarized beam/target experiments
 - Proposal of a multipurpose beam line



Multipurpose Beam Line

- To accommodate various needs for beams from hadron physics experiments;
 - 50-GeV protons with 10^8 pps \leq Str. Fn.
 - 50-GeV protons with 10^9 pps \leq Vec. Meson
 - Very small beam size (1mm^2), stable, very small beam halo
 - 5 50GeV variable energy protons with 10^9 pps \leq Multifragmentation
 - 5 30GeV variable energy secondary particles with 10^9 pps \leq Multifragmentation & others
 - HI beams with 10^{10} ions per second





Nuclear/Particle Physics

- People have showed their expression of interests on three subjects.
 - Neutrino oscillation, hyper-nuclear physics, and nuclear/hadron physics.
 - These EOI(LOI)'s are not official.
 - They can be obtained from the web site
<http://jkj.tokai.jaeri.go.jp/NuclPart/Science.html>
- LOI's will be officially called in the near future (though not yet determined).
- Contribution from the world is very much welcome.



ぜひ進めたいこと・私見 (まとめに代えて)

- 短期的な課題 (ここ数年)
 - もちろん 建設作業
 - 具体的なproposalの準備 来年度の課題 引き続き実験準備へ
 - 施設完成後初期は低運動量のK, 等を利用する実験。あわせて、「高運動量多目的ビームライン」の提案。
- 中期的な課題 (ここ数年 ~ 2006年頃)
 - 原子核素粒子実験施設の100mまでの早期の完成
 - 56mの施設ではユーザをdiscourageするのみ...
- 長期的な課題
 - 原子核素粒子実験施設200m長へ
 - 保安林等難しい問題はあるが...100mでは東カウンターホールと同じ
 - 鬼が笑うかもしれないが、軽重イオン加速
- 常に頭に置いている課題
 - 反陽子、ミュオン、ニュートリノ(長基線以外)等々の物理の検討と具体的な計画
 - 今まで手が回っていなかった分野