HRIBF Integrated Strategic Plan

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Science	Experimental Systems	Facility
Major research areas: **Nature of nucleonic matter** Limits of nuclear existence & weakly-bound systems Effects of proton/neutron asymmetry on nuclear properties	**Goal:** Development of efficient, selective, and flexible detection systems that are specialized for RIB research in in-beam reaction and decay studies	**Goal:** Deliver high-quality beams for science Develop new proton-rich beams Develop new neutron-rich beams
Origin of elements Nova & X-ray burst nucleosynthesis Supernova & r-process nucleosynthesis	**Goal:** Continous improvements to endstations and their associated detectors	**Goal:** Improved beam quality and purity
Solar physics **Synthesis of heavy elements**	**Goal:** Provide computational resources for data acquisition, analysis, simulations, and modeling	**Goal:** Deliver 3000-4000 RIB hours/year. 7-day operations
Goal: World leadership in major research areas.	**Goal:** Maintain leadership in applications of digital spectroscopy	**Goal:** Increase existing p-rich beam intensities by ~5x to 10x; increase key n-rich beams by ~100x
Goal: Creating exciting and stimulating environment for users and visitors. Increase involvement of external users. Nurture future leaders of RIB science	**Principle:** Optimal utilization of resources	**Goal:** Operate HPTL for ISOL R&D for 300-400 hours/year **Goal:** Continuous improvement of RIB production and experimental system reliability
Principle: Fitting into the Strategic Plan of the DOE's Office of Science		**Principle:** Optimal utilization of resources
Principle: Flexibility to adapt to changing scientific opportunities		

Principle: Promoting and implementing safe work environment

HRIBF Strategic Plan Implementation

Year	Physics: Research Opportunities	Experimental Systems: Instrumentation: CLARION, HYBALL, Gas Jet…	Facility Production Systems R&D: Developments: Facility, Beams, ISOL targets
2008	Study fragmentation of single particle strengths in neutron-rich nuclei and carry out pectroscopy of neutron-rich radioactive nuclei around the N=50 and N=82 closures	Commission LeRIBSS to use Clover Array for Recoil Decay Spectroscopy (CARDS) and tape collector with low-energy beams	Reliability upgrades on ORIC continue
	Studies of fusion mechanism with massive neutron-rich projectiles	Continue design / R&D for high density gas jet target	Driver upgrade conceptual design begins
	Continue p +^{7}Be capture experiments	Commission 100 MHz digital electronics	Establish new high-activity ^{7}Be production capability
	Studies of N~Z nuclei relevant to the path and time scale of the rp-process. Continue measurements of reactions that are important for understanding stellar explosions such as novae and X-ray bursts	Develop Accelerator Mass Spectrometry tools to investigate ^{3}He concentration in He used in EDM experiment at SNS	Deliver high-intensity beams of ^{10}Be and ^{26}Al (sputter source) Continue release and production studies on new-format actinide targets Develop n-rich Sr beams
		Initiate acquisition of digital electronics for CLARION-Plus project	
	Investigate the role of polarization as a spectroscopic tool in transfer and scattering reactions, in preparation for polarized target implementation	Initiate construction of a new beamline for ORRUBA and Spin Spectrometer	Proceed with devlopment p-rich Al beams
		Continue development of beta-delayed neutron spectrometer	Complete expanded ion source assembly and testing station capabilities
	Study submicrosecond charge-particle radioactivities with 100 MHz digital electronics	Continue development/design of next-generation detector system for study of close (fusion-like) collisions	
	Joint wear studies with ^{7}Be beam		
	Studies of molecular states in light nuclei		Injector for Radioactive Ion Species #2 (IRIS2) construction continues
	Pursue the coupled cluster calculations based on realistic two- and three-nucleon interactions to heavier nuclei		
	Toward modeling core collapse supernovae, perform the first Newtonian two-dimensional neutrino radiation hydrodynamics		

ORRUBA

β-delayed neutron detector

CLARION -Plus electronics

IRIS2 construction, laser

Driver upgrade design

	Study halo nuclei, including correlations between halo constituents, with the continuum shell model.		
2009	Use the new decay-spectroscopy station and RIBs to study structure of n-rich nuclei.	Start construction of of high-density gas jet target	Development of laser purified ^{56}Ni (by photo-detachment) for experiments
	Studies of magnetic moments on neutron-rich nuclei using RIV and transient field method	Commission Oak Ridge Rutgers University Barrel Array (ORRUBA)	Testing of new-format targets at HPTL.
	Initiate Coulex studies of p-rich nuclei	Initiate operation of CLARION-Plus with GS detectors	
	Initiate 2-neutron transfer studies in neutron-rich nuclei and continue neutron transfer reactions to help understand r-process element synthesis in supernovae	Commission Spin Spectrometer	Development of radioactive Cl beams
	Near barrier fusion induced by neutron-rich beams	Complete construction of new beamline for ORRUBA and Spin Spectrometer	Radioactive Sr beams available
	Studies of molecular states in light nuclei	Initiate construction of neutron array VANDLE	Radioactive Al beams available
		On-line testing of multipass time-of-flight spectrometer (MTOF)	Implement surface ionization sources on IRIS1 for production of pure n-rich beams (Rb, Br, I)
	Continue measurements of reactions that are important for understanding stellar explosions such as novae using new p-rich beams and X-ray bursts		Complete feasibility study for on-line laser photodetachment on IRIS1
		Initiate acqisition of upgraded HRIBF computer cluster	
	Develop a microscopic mass formula, based on the density functional theory, that includes ground state correlations		Driver upgrade conceptual design complete
			IRIS2 project complete, Quarter-4
2010	Extend studies of far-from-stability nuclei using radioactive ion beams and upgraded CLARION	Evaluate LBNL total absorption spectrometer for decay studies	Implement photo-detachment capability at IRIS2
	Transfer studies using Spin Spectrometer	Commission beta-delayed neutron detector	Full on-line implementation of resonant laser ion sources
	Decay studies with MTOF-purified beams	Initial implementation of HRIBF computer cluster complete	Radioactive Cl beams available
	Employ Spin Spectrometer to extend transfer reaction studies of fragmentation of single particle strengths in neutron-rich nuclei	Begin construction of next-generation detector system for study of close (fusion-like) collisions	Driver upgrade implementation begins
	Studies of (d,pγ) reactions in inverse kinematics as a surrogate for neutron capture for stewardship science	Start construction of of high-density gas jet target	Begin routine use of IRIS2
	Extend the coupled cluster calculations to Ca	Initiate site preparation to receive GRETINA	
	Perform three-dimensional studies of flame propagation in white dwarfs in type Ia supernovae.	Initial implementation of new concept advanced targets to be used with radioactive beams (e.g. active and/or polarized targets).	High-quality ^{56}Ni beams available
2011	Study heavy-ion fusion mechanism with neutron-rich beams	Comission MTOF	Implementation of new ion source and beam manipulation technologies on IRIS2 result in availability of wider array of isotopically pure beams.
		Complete site preparation to receive GRETINA	
	Determine the beta-delayed neutron branching ratios for selected nuclei in the path of rapid neutron capture process.	Initiate implementation of new electronics for BaF array	
		Commission high density gas jet target	Driver upgrade implementation continues
	Description of excited states within the nuclear density functional theory		
2012	GRETINA campaign focused on structure of neutron-rich nuclei	Initiate commissioning of next-generation detector system for study of close (fusion-like) collisions	Driver upgrade implementation continues
	Determine very weak fusion rates that are important bottlenecks in the rp-process using a high density gas jet target.	Initiate construction of Compact Efficient Radioactive Decay Array (CERDA)	
2013	Measurement of beta strength function with total absorption spectrometer.	Complete upgrade of BAF array electronics	Driver upgrade implementation continues
	Systematic studies of g-factors in neutron-rich nuclei	Complete construction of neutron array VANDLE	
	Realistic calculations of spontaneous fission		
2014	Two-neutron transfer in neutron-rich nuclei	Complete construction of advanced targets (active / polarized)	Driver upgrade implementation continues
	Perform realistic multidimensional simulations of stellar core collapse in core collapse supernovae, including realistic neutrino transport, magnetic fields, and general relativity		
2015	Systematic studies of g-factors in neutron-rich nuclei		Driver upgrade implementation complete
		Complete construction of CERDA	
2016	Experiments with neutron-rich nuclei produced using high-power electron beams.		Intense n-rich photofission beams available for research
	Fusion of the heaviest elements with neutron-rich beams		
	g-factor b-NMR measurements with polarized radioactive ion beams		

Gas Jet

Computer cluster

VANDLE neutron detector

Driver update implementation

Symbols and colors

Nuclear Physics Program Milestones		
2009	Extend spectroscopic information to regions of crucial doubly-magic nuclei far from stability such as Ni-78	
	Measure properties of and reactions on proton-rich nuclei in the rp-process to determine radionuclide production in novae	
2012	Measure masses, lifetimes, spectroscopic strengths and decay properties of neutron-rich nuclei in supernova r-process, and reactions to predict radionuclide production in supernovae	
2013	Carry out microscopic calculations for medium-mass nuclei with realistic interactions, develop a realistic nuclear energy density functional for heavy nuclei	
	Perform realistic multidimensional calculations of core collapse supernovae	
2014	Perform mass measurements and nuclear reaction studies to infer weak interaction rates in nuclei in order to constrain models of supernovae and stellar evolution	
	Measure or constrain key nuclear reaction rates to improve accuracy of astrophysical models of novae and X-ray bursts and allow astronomical data to be used to infer novae and neutron star properties	
2015	Measure properties and production mechanisms of the elements above Z~102 to understand the nature and behavior of these nuclei, and to assist theoretical predictions for the structure and production of superheavy elements	
2016	Measure changes in shell structure and collective modes, from the most proton-rich to the most neutron-rich nuclei accessible, in order to improve our understanding of the nucleus, and to guide theory in every region of the theoretical roadmap (i.e., the light-element region where ab-initio calculations can be performed, the medium-mass region where effective interactions are used, and the region of heavy nuclei, the domain of density functional theory).	

Legend (color code)
Research (experiment)
Research (theory)
Instrumentation
Instrumentation (project start, end)
Development (facility)
Development (beams, targets)
Development (project start, ends)