COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER: (to be assigned by SBOE)	AMOUNT REQUESTED: $75,000

TITLE OF PROPOSED PROJECT:

Commercialization of Trace Element Detection Technology

SPECIFIC PROJECT FOCUS:

Trace element analysis utilizing photon activation has the potential of providing a powerful tool in a wide variety of settings. These include mining (assay of gold ores and rare earth elements), the health professions (counterfeit drug detection), the aerospace industry (analysis of aircraft parts), environmental monitoring, and the legal field (forensics, identification of fraudulent products, counterfeit documents, and attribution of the origins of contraband). Thus far, this technique has been developed in the context of specific applications. We argue that the chief barrier to full utilization of this technology in the wide variety of commercial settings in which it could be brought to bear is that a comprehensive, element by element study of its sensitivity has not been performed. As such, we propose to perform such a study so that the technique can be presented to a variety of future commercial partners.

PROJECT START DATE: 07/01/2016	PROJECT END DATE: 06/30/2017
NAME OF INSTITUTION: Idaho State University	DEPARTMENT: Idaho Accelerator Center and Dept. of Physics, Nuclear and Electrical Engineering

ADDRESS: 921 S. 8th Ave., STOP 8046 Pocatello, ID 83209-8046

E-MAIL ADDRESS: resdev@isu.edu	PHONE NUMBER: 208-282-2592

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR/PRINCIPAL INVESTIGATOR	Daniel Dale	Professor of Physics	Daniel S. Dale
CO-PRINCIPAL INVESTIGATOR	Jon Stoner	Director of Technical Operations, IAC	Jon Stoner

NAME OF PARTNERING COMPANY: Boeing	COMPANY REPRESENTATIVE NAME: Pamela Leutkemeyer

	NAME:	SIGNATURE:
Authorized Organizational Representative	Cornelis J. Van der Schyf	[signature]

SUMMARY PROPOSAL BUDGET

Name of Institution: Idaho State University

Name of Project Director: Daniel Dale

A. PERSONNEL COST (Faculty, Staff, Visiting Professors, Post-Doctoral Associates, Graduate/Undergraduate Students, Other)

Name/ Title	Salary/Rate of Pay	Fringe	Dollar Amount Requested
Dr. Dan Dale	$9,500	$2,700	$12,200
Dr. Frank Harmon	$3,200	$300	$3,500
Graduate Student	$17,300	$1500	$18,800
Undergraduate Student	$1700	$200	$1900

% OF TOTAL BUDGET:		SUBTOTAL:	$36,400

B. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
SUBTOTAL:	0

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
					SUBTOTAL:	0

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	
4. Other Graduate Student Fees	
SUBTOTAL:	

I. Other Direct Costs:	Dollar Amount Requested
1. Materials and Supplies	$27,200
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	
4. Computer Services	
5. Subcontracts	
6. Other (specify nature & breakdown if over $1000) Graduate Student Tuition and Fees	$11,400
SUBTOTAL:	$38,600
J. Total Costs: (Add subtotals, sections A through I) TOTAL:	$75,000
K. Amount Requested: TOTAL:	$75,000
Project Director's Signature: Daniel S. Dale	Date: 4/1/2016

INSTITUTIONAL AND OTHER SECTOR SUPPORT

(add additional pages as necessary)

A. INSTITUTIONAL / OTHER SECTOR DOLLARS

Source / Description	Amount
ISU will provide resources listed in Facilities and Equipment.	

B. FACULTY / STAFF POSITIONS

Description

A portion of the PI's salary will be covered by institutional funds.

C. CAPITAL EQUIPMENT

Description

D. FACILITIES & INSTRUMENTATION (Description)

Commercialization of Trace Element Detection Technology

Executive Summary

Trace element analysis utilizing photon activation has the potential of providing a powerful tool in a wide variety of settings. These include mining (assay of ores, gold, silver, copper and rare earth elements), the health professions (counterfeit drug detection), industry (quality control of parts, materials, *etc.*), environmental monitoring (analysis of effluents, spoil, *etc.*), and the legal field (forensics, identification of fraudulent products, counterfeit documents, and attribution of the origins of contraband). Key features of the technique are that it:

- is relatively nondestructive,
- enables simultaneous multi-element analysis over a large portion of the periodic table at the parts per billion level,
- requires little or no sample preparation,
- samples the bulk of the object rather than just the surface,
- is sensitive to isotopic as well as elemental composition,
- has a short turn around time (on the order of minutes to a few hours).

Thus far, this technique has been developed by us in the context of specific applications. We argue that the chief barrier to full utilization of this technology in the wide variety of commercial settings in which it could be brought to bear is that a comprehensive, element by element study of its sensitivity has not been performed. As such, we propose to perform such a study so that the technique can be presented to a variety of future commercial partners.

<u>"Gap" Project Objective and Total Amount Requested</u>

The Idaho State University Idaho Accelerator Center has already performed extensive work involving the use of photon activation analysis in very specific contexts. One example is the evaluation of the gold content in various ores. This proposed project seeks to evaluate and document the sensitivities for detection of a number of elements in a variety of matrices, so that the technique can be convincingly marketed as an effective tool for future commercial partners. It is our strong belief that this study will be crucial in bridging the gap between a mature research program which has proven the effectiveness of the technique, and the effective application of this technique in a number of commercial areas.

The total of funds requested for this proposed work is $75,000.

<u>How resource commitments reflect the priorities of the home institution</u>

Goal 4 of the Idaho State University Strategic Plan, *Mapping our Future: Leading in Opportunity and Innovation, 2016-2020* states:

Goal 4: COMMUNITY ENGAGEMENT AND IMPACT – Idaho State University, including its outreach campuses and centers, is an integral component of the local communities, the State and the intermountain region, and benefits the economic health, business development, environment, and arts and culture in the communities it serves.

Objective 4.1 ISU directly contributes to the economic well-being of the State, region, and communities it serves.

This proposal seeks to capitalize on work performed at the ISU Idaho Accelerator Center in the area of trace element analysis in a few specific circumstances, and to develop it to the level that it can be used in a wide variety of commercial applications. It aims to bring this technology to the level that Idaho State University can serve as a catalyst for economic activity in the State of Idaho. The applicability of the technique is quite general. Applications under current development include the analysis of industrial byproducts (*e.g.* coal ash, mining slag), mining ores, and the detection of high value counterfeit products such as pharmaceuticals and aircraft parts. However, many other future applications are possible. Areas of particular promise include forensics in the context of criminal justice topics, nondestructive analysis of works of art, archeological studies, as well as a number of scientific studies such as the analysis of the composition of meteorites. The goal of this proposed work is to provide the fundamental data base which will establish the general applicability of the technique, and to provide the springboard for a number of commercial initiatives in the State of Idaho. We argue that the ISU Idaho Accelerator Center is uniquely positioned to accomplish this.

<u>Evidence that the project will have a potential impact to the economy of Idaho</u>

Here, we mention four areas where this technology will have the potential for significant impact on the economy of the State of Idaho:

(1) The Idaho Accelerator Center previously engaged in a collaboration with Newmont Mining Company which showed the capability to analyze the gold content of ores at the 10's of parts per billion level.

(2) Boeing Corporation has indicated a strong interest in this technology in the context of detecting counterfeit parts on their airplanes. Their particular concern here involves

situations where planes are serviced overseas, and the potential of substitution of substandard and/or counterfeit parts is possible.

(3) The health care mission is of high importance at Idaho State University. Scientists at the Idaho Accelerator Center have been in discussions with faculty at the ISU College of Pharmacy in regards to the important issue of the detection of counterfeit medications. Preliminary studies have shown that photon activation analysis is highly effective in detecting counterfeit medications.

(4) Scandium is a rare earth element which is currently priced, per gram, at more than one fourth the price of gold. Preliminary investigations, discussed below, have shown a strong, unambiguous signature for this element in slag from the former FMC plant in Pocatello, ID. In this work, we propose to evaluate the economic value of scandium and other rare earth elements in this and other "wastes".

The Market Opportunity

This project proposes to provide a technique of trace element analysis which has a number of significant advantages over existing technologies. The strengths of the currently proposed technology include:

- It is relatively nondestructive. High value items are not significantly altered by the measurements.
- It enables simultaneous multi-element analysis over a large portion of the periodic table at the parts per billion level.
- It requires little or no sample preparation.
- It samples the bulk of the object rather than just the surface. This is of particular interest when the sample may be inhomogeneous.

- It is sensitive to isotopic as well as elemental composition. This is an advantage over chemical techniques.
- It has a short turn around time (on the order of minutes to a few hours). This has been of particular interest in the case of the assay of gold ores and applies to other applications.

The initial potential market audience includes the mining industries in Idaho, the pharmaceutical industry, and the aerospace industry. While other techniques for trace element analysis are in current use (optical microscopy, polarized light microscopy, fluorescence conventional visible-light spectroscopy, x-ray fluorescence spectroscopy, infrared spectroscopy, Raman spectroscopy, mass spectrometry, atomic spectroscopy), none of these possess the unique suite of advantages listed above.

The potential market for this technology has been largely untapped. Here, we present some figures to indicate the magnitude of its potential applications.

- The counterfeit drug industry amounts to about $75 billion per year worldwide. We believe the proposed technique is highly effective in the detection of such counterfeits.
- A United States Senate investigation in 2011 found 1,800 incidents of counterfeit parts being sold to the US military. On the commercial side, the Boeing Corporation has expressed interest in this technology.
- 85% of rare earth elements, used in high-tech equipment for health care, transportation, national defense, aerospace, green energy, and other industries (computers, smart phones, rechargeable batteries, electric vehicles, magnets, chemical catalysts) are produced in China. The US Geological Survey expects worldwide demand to grow 5% annually through 2020. Preliminary work at the Idaho Accelerator Center has found strong

signatures for the presence of several rare earth elements (scandium, yttrium, praseodymium, lanthanum, cerium, and europium) in slag from the former FMC plant as well as coal ash and fly ash obtained from Utah Power and Light Company. Photon activation analysis provides the potential for the identification and extraction of new resources in Idaho and the surrounding region.

We argue that the chief barrier to the significant use of this technology arises from the lack of a comprehensive analysis of its sensitivity in matrices which will be encountered in real world settings. We have already demonstrated that photon activation analysis is highly sensitive in certain specific applications. In order to market the technology to any potential industry partners, it is crucial that we be able to present them with hard data on its effectiveness over a range of elements and a range of matrices in which the elements of interest are found.

<u>Technology and Path to Commercialization</u>

Photon activation analysis is a technique based on photonuclear reactions. This is best achieved with a linear accelerator that accelerates electrons to 20 MeV or above. The electrons then hit a

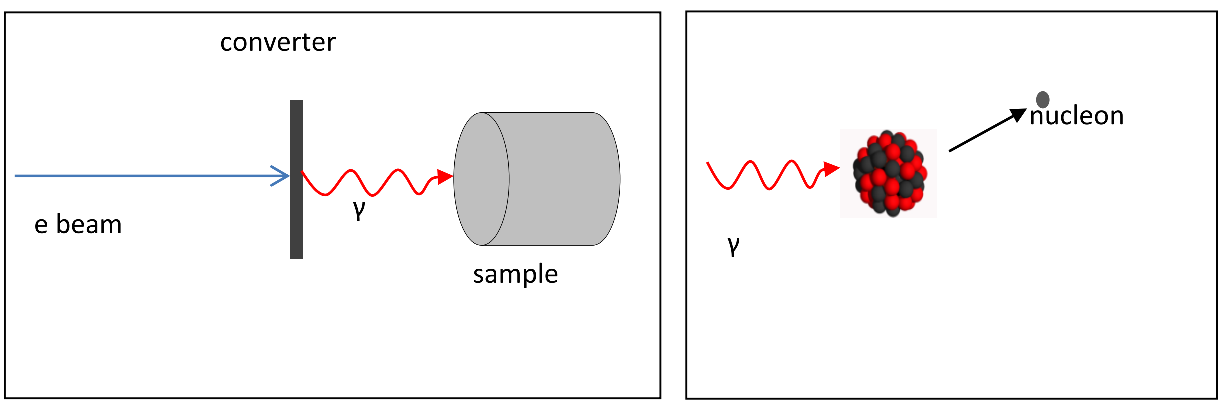

Figure 1. A schematic of the photon activation analysis technique: (left) Experimental setup. Accelerated electrons strike a converter and produce bremsstrahlung photons which irradiate the sample. (right) A photon strikes a nucleus and excites it. A nucleon (a neutron or a proton) is emitted and leaves a radioactive daughter nucleus.

converter, which is a metal foil that converts the electron's energy into high-energy bremsstrahlung photons. The photons continue onward and are absorbed by the nuclei of a sample, which causes the nuclei to be in an excited state (Figure 1). These excited nuclei, in turn, decay by emitting neutrons or protons leaving usually short-lived radioactive daughter nuclei which emit delayed radiation.

Typically, PAA accuracy is ensured by activating a reference material with known concentrations of elements in addition to the sample of interest. By comparison of the yields of particular daughter nuclides in the calibration material, the concentration of parent nuclides in the sample can be determined. Induced yields will be measured using high resolution high purity germanium gamma ray detectors and associated electronics, data acquisition and custom analysis software. A typical

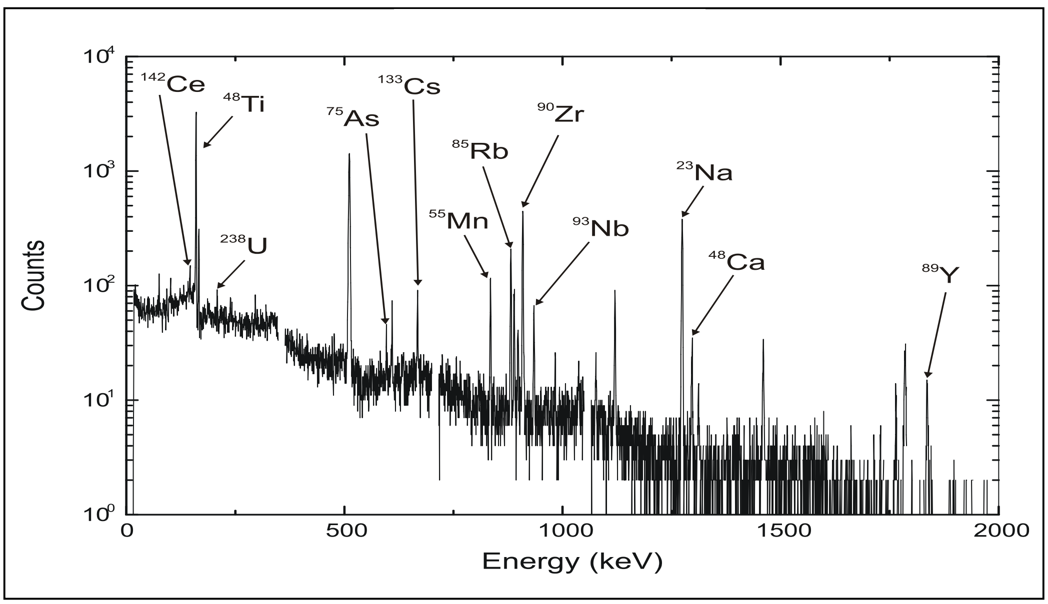

Figure 2. A typical spectrum obtained at the Idaho Accelerator Center by placing an irradiated sample in the high-purity germanium detector. The parent nuclides are labeled with each peak which corresponds to a nuclear transition which is accompanied by the emission of a high energy photon.

gamma ray energy spectrum from such a detector is shown in Figure 2.

As one example of a potential economic resource on which photon activation could be brought to bear, Figure 3 shows a gamma ray peak which clearly indicates the presence of scandium in slag from the former FMC plant in Pocatello. Scandium is an extremely expensive element ($15/gram) which is used in fuel cells, alloys of aluminum, ceramics, electronics, lighting and phosphorous displays. Its widespread commercial use has thus far been limited by its price. Availability of scandium would make a particular impact in the aluminum alloy industry.

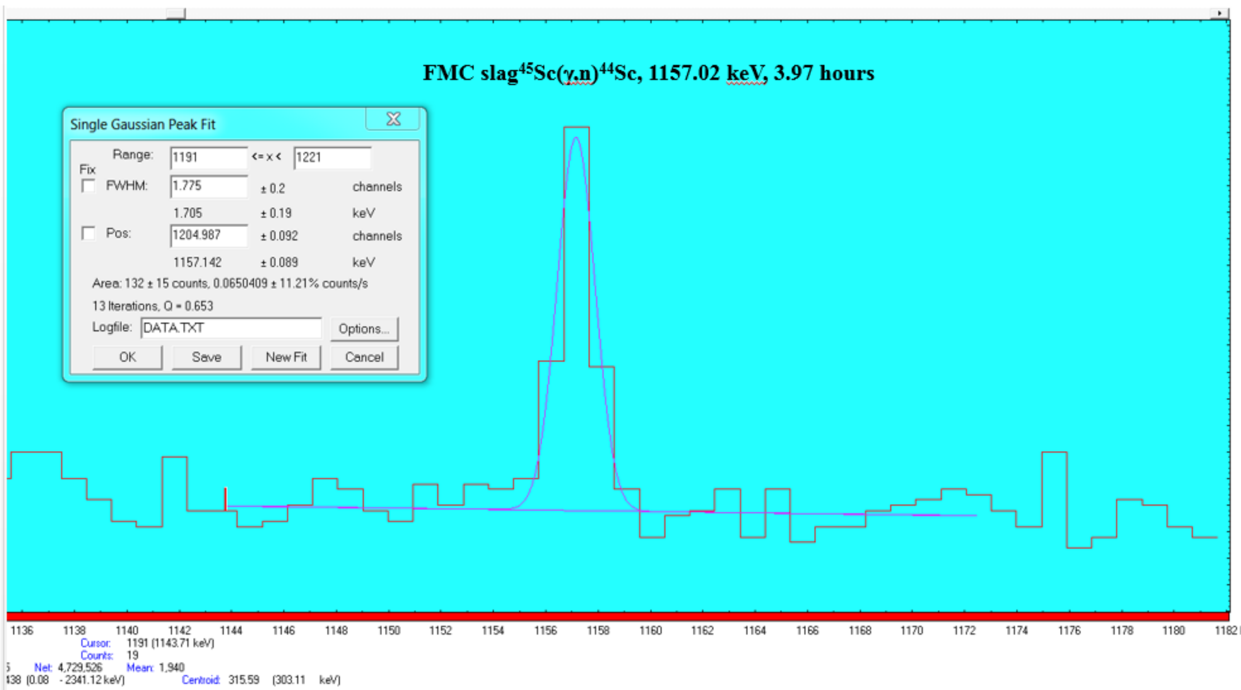

Figure 3. A portion of the photon activation analysis spectrum of slag from the former FMC plant in Pocatello, ID, showing a clear signature for the strategic element scandium.

We believe that the first step in bringing this technology to market has already been taken. Specifically, work at the Idaho Accelerator Center has developed the instrumentation (accelerators, detectors, data analysis techniques) needed to conclusively demonstrate that this technology is effective in certain applications. The second and third steps are the subject of this proposal. The second step involves a comprehensive series of measurements which will evaluate the sensitivity of the technique over a range of different elements which are embedded in different matrices. The third step, also a subject of this proposed work, involves the thorough documentation of these results. Initial documentation would be in the form of a website to which potential commercial partners could be referred so that they can consider the implementation of this technology to their particular application. In addition, publication of the results in the scientific literature will further "spread the word".

<u>Commercialization Partners</u>

Commercial partners who have expressed an interest in this technology include:

- Boeing Corporation. They have expressed an interest in developing this technology to identify counterfeit or substandard aircraft components.
- Newmont Mining Corporation. They have been partners in developing photon activation analysis for the assay of gold ores.
- Utah Power and Light. This company has graciously supplied samples of coal ash and fly ash for analysis at the Idaho Accelerator Center. Preliminary experiments show an unambiguous signature for a number of rare earth elements which are of potential commercial value.

As previously mentioned, the availability of further measurements on sensitivities of this technique will enable further marketing of this technology.

<u>Market Penetration Plan</u>

The results of our data collection and verification will be presented to potential licensees primarily through two avenues: direct marketing and web based marketing. In direct marketing we will contact companies we have associated with in the project as well as other companies that we believe can take advantage of this technology. These companies include precious metal and rare earth mining companies, phosphate companies, pharmaceutical companies, component manufacturers and government groups associated with forensic analysis. Web based marketing will utilize the IAC web site and a new social media project under development at the IAC. The web presence will highlight the data and applications of this technique as well as promote a discussion thread the will allow networking outside of our previously identified target audience.

Specific Project Plan and Use of Funds

The attached table shows the proposed use of funds.

Professional Salaries	$	15,600
Graduate/Undergraduate	$	20,700
Student Fees	$	11,400
Materials and supplies	$	27,200
Total	$	74,900

The attached timeline shows the project plan.

Detection Technology Timeline				
Key Milestones	July-Sep 2016	Oct-Dec 2016	Jan-March 2017	Apr - Jun 2017
Identification of Key elements and Matrix				
Experimental Setup				
Data collection				
Summary report				
Direct Marketing				
Web Marketing				

Institutional and Other Sector Support

ISU will be providing resources listed Facilities and Equipment. In addition, a portion of the PIs salary will be covered by institutional funds.

Appendices

Facilities and Equipment

This proposal seeks to develop and construct a unique, state of art facility for investigations of elemental analysis. The work will be done at the Idaho Accelerator Center in Pocatello, Idaho. Personnel at the Idaho Accelerator Center have extensive experience designing and commissioning accelerators. The IAC has five operating accelerators in five research facilities with over 40,000 sq. ft. of laboratory space. The operational and user personnel at these facilities consist of twenty scientists, four engineers and three administrative assistants. The main IAC laboratory is built into the hills that surround Pocatello, Idaho and the 2,010 sq. ft. hall is twenty feet underground, providing ample radiation shielding. This accelerator hall currently houses a 44 MeV Short Pulsed Linac and a 25 MeV linac. In addition, this accelerator hall has a well shielded experimental cell that is separated by a six foot wall from the accelerator hall. This wall has four penetrations allowing collimated bremsstrahlung beams to be delivered to a "low" radiation environment, which is critical for precise photonuclear measurements. A picture of the main IAC laboratory is shown below (Figure 4).

Figure 4. The main Idaho Accelerator Center laboratory.

The high power accelerator, 40 MeV, 4 kW machine, is located in a well shielded hall with standard interlocks, warning lights and radiation area monitors. The high photon and neutron fluxes associated with this device require additional shielding above and beyond the standard concrete-shielded accelerator halls that we currently employ. To address this we have constructed a ~ 2000 kg removable concrete shielding with HEPA ventilation system around the bremsstrahlung target and sample holder that will simultaneously strongly attenuate gamma dose beyond the sample irradiation region while producing much less neutrons than, for example, a comparable shield made of lead.

The high power accelerator is composed of two 2856 MHz sections, the first section is a standard standing wave, side coupled cavity, buncher/pre-accelerator injecting a 27 MeV beam (unloaded) into the second section which is a standard SLAC type traveling wave accelerator. Each section is provided with microwave power from its own 5 MW peak output klystron. The total unloaded output energy is expected to be ~ 50 MeV. Post-irradiated samples will be pneumatically translated to a low-radiation environment and/or shielded location, depending upon their activity, where they can be subsequently analyzed by HPGe detectors.

The Idaho Accelerator Center (IAC) has all the necessary equipment for the PAA technique, from high power linear electron accelerators to HPGe detectors and data acquisition system. Many samples, including metal foils, ceramic pellets, medicines and dust filters were irradiated over the last several years and their gamma activity was measured. These preliminary experiments revealed that trace elements and impurities can be detected at the ppm to ppb level. The detection limit can be further improved by optimizing the electron beam energy and power as well as the time of the irradiation.

Biographical Sketching and Individual Support

Daniel Stanton Dale
Professor of Physics

Idaho State University
Department of Physics and the Idaho Accelerator Center
Pocatello, Idaho 83209-8106 USA
Phone: (208) 282-3467 Fax: (208) 282-4649 e-mail: daledani@isu.edu

Education and Training

Stanford University, Stanford, CA	Physics BS (1984)
Univ. of Il. at Champaign-Urbana , Urbana, IL	Physics MS (1985)
Univ. of Il. at Champaign-Urbana , Urbana, IL	Physics PhD (1991)

Appointments

2007 – present	Senior Scientist and Affiliate Professor, Idaho Accelerator Center
2009 – present	Professor, Idaho State University
2006 – 2009	Professor and Chair, Idaho State University Department of Physics
2003 – 2005	Sabbatical Scientist, Jefferson Laboratory
2000 – 2006	Associate Professor, University of Kentucky
1994 – 2000	Assistant Professor, University of Kentucky
1991 – 1994	Mass. Inst. of Technology, Research Staff
1985 – 1991	Research Assistant, University of Illinois

Related Publications

- High precision photon flux determination for photon tagging experiments, A. Teymurazyan, *et al.,* Nucl. Inst. Meth., A767: 300-309, 2014.
- A New Measurement of the π^0 Radiative Width, I. Larin, *et al.*, the PrimEx Collaboration, Phys. Rev. Lett. 106:162303, 2011.
- Photofission of Actinides with Linearly Polarized Photons, D.S. Dale, R. Bodily, P.L. Cole, A. Conn, T.A. Forest, K. Kelly, O. Kosinov, S. Setiniyaz, R. Shapovlov, V. Starovoitova, and J. Swanson, AIP Conf. Proc. 1265 (2010).
- Nuclear Targets for a Precision Measurement of the Neutral Pion Radiative Width, the PrimEx Collaboration, Nucl. Instr. Meth. A612:46-49, 2009.
- Energy calibration of the JLab bremsstrahlung tagging system. S. Stepanyan *et al.*, Nucl. Instr. Meth. A572:654-661, 2007.

Recent Talks

- *Two Neutron Correlations in Photofission*, The 2015 International Conference on Applications of Nuclear Techniques, Crete, Greece, July 2015.
- *Linac Based Photonuclear Applications at the Idaho Accelerator Center*, Eleventh Topical Meeting on Nuclear Applications of Accelerators, Brugges, Belgium, August 2013.
- *Applied Physics Research at the Idaho Accelerator Center*, invited talk at the Korean Atomic Energy Research Institute, Workshop on Electron Beam Applications, Daejon, Korea, March 2011.
- *Active Interrogation at the Idaho State University Idaho Accelerator Center,* Lawrence Berkeley Laboratory, January 2010.

Current Support

Title: Two Neutron Correlations in Photo-fission
Source of Support: National Nuclear Security Administration
Amount: $750,000
Period of Performance: 7/7/2014-7/6/2017
Effort: 2 months
Status: funded

Jon L. Stoner
209 Stanford Ave.
Pocatello, ID
208-760-0692

EXPERIENCE

Director of Technical Operations — Date: March 2014 - present
Idaho Accelerator Center
Office of Research
Idaho State University

CJ Tech Consulting LLC — Date: April 2008 – March 2014
CEO/ Founder
Contracted Researcher at Idaho Accelerator Center

Chief Technology Officer, Sr. Vice President, — Date: 2001- March 2008
General Manager of Image Sensor Products
Sr. Vice President, Acquisitions, Strategy
AMI Semiconductor

Director Business Development, Director Standard Product BU — Date: 1988-2000
Director R&D, Project Manager, Fab 10
Director R&D, Director Operations Engineering, Director Foundry Engineering
AMI Semiconductor

Various roles in engineering in Operations, R&D,
Product Engineering and Development — Date: 1980-1985

EDUCATION & TRAINING

- MS Physics – Idaho State University
- Graduate School University of Montana, Utah State University (Chemistry, Engineering)
- University of Minnesota School of Dentistry
- BA Chemistry – University of Montana with Honors
- Additional coursework in management, product development, and marketing

OTHER

- Member Idaho State University Radiation Safety Committee and Chair of Accelerator Safety Review
- Member of Advisory Committee to Idaho State Board of Education on Engineering education – 6 years
- Member Advisory Board for BSU school of Engineering 8 years
- Governor appointed member EPSCORE (Experimental Program for Competitive Research) committee for State of Idaho 6 years

RELEVANT PUBLICATIONS

High Specific Activity e- LINAC Production of 67Cu, Jon Stoner, Alan Hunt, Timothy Gardner, Frank Harmon, American Nuclear Society meeting, 12th Annual International Conference on Applications of Accelerators, November 2015, Washington DC

Optimization of Commercial Scale Photonuclear Production of Radioisotopes, Bindu KC, Frank Harmon, Valeriia Starovoitova, Jon Stoner, Douglas P Wells, 22nd International Conference on the Application of Accelerators in Research and Industry, August 2012, Fort Worth, TX

Cu-67 photonuclear production, Valeriia Starovoitova, Bindu KC, Frank Harmon, Jon Stoner, Douglas P Wells, 7th ICI, September 2011, Moscow, Russia

PATENTS (applications in progress)

Methods for producing medical isotopes
Device for producing medical isotopes

Current Support

- 100% funded under appropriated lines

Frank Harmon

Affiliation and official address:

Idaho Accelerator Center
Idaho State University
Pocatello, ID 83209

Telephone: (208)282-5877
email:harmon@physics.isu.edu

Date and place of birth:
02/23/39 Van Wert, Ohio

Nationality: American

Education (*degrees, dates, universities*)

Portland State University	Physics	B.S. 1963
University of Wyoming	Physics	M.S. 1965
University of Wyoming	Physics	Ph.D. 1968

Career/Employment (*employers, positions and dates*)

2006-present:	Senior Scientist, Idaho Accelerator Center
1997-2006:	Director Idaho Accelerator Center
1983 - 1997:	Chairman of Department of Physics
AY 91/92:	Acting Director of Particle Beam Laboratory
Spring 1990:	Sabbatical leave at University of Münster, Germany
1981 - 2006:	Idaho State University, Professor of Physics
1972 - 1977:	Idaho State University, Chairman of Department of Physics
1973 - 1980:	Idaho State University, Associate Professor of Physics
1969 - 1973:	Idaho State University, Assistant Professor of Physics
1968 - 1969:	Research Associate - Associate Instructor (Post-Doctoral appointment) Physics Dept., University of Utah, Salt Lake City, UT

Specialization

Applied Nuclear Physics
Instrumentation
Accelerator Applications

Honours, Awards, Fellowships, Membership of Professional Societies

Principle for more than 100 grants and contracts from various sources
Distinguished Researcher 1998 – 1999
The ISU Achievement Award 2000
Director of ISU Organization (Idaho Accelerator Center) which launched two new businesses.
Consultant to LANL, INEEL

Publications
-Number of papers in refereed journals: 38
-Number of communications to scientific meetings: 60

Current support:

Grant P.O 15-0017-147 120 hours (part time employee)

Idaho State
UNIVERSITY

Office for Research
921 South 8th Avenue, Stop 8130 • Pocatello, Idaho 83209-8130

April 1, 2016

Idaho State Board of Education
Higher Education Research Council
650 W. State Street, 3rd Floor
Boise, Idaho 83702

Re: HERC Incubation Fund - Commercialization of Trace Element Detection Technology

Dear HERC Incubation Fund Committee:

Idaho State University strongly supports the proposal entitled "Commercialization of Trace Element Detection Technology", submitted by Dr. Dan Dale of the ISU Department of Physics, Nuclear & Electrical Engineering and the Idaho Accelerator Center.

This project has great potential for the future commercialization of trace element detection and ISU is poised to be a key component in this effort with extensive work already completed involving the use of photon activation analysis. This proposal will work to bridge the gap between a research program with proven effectiveness and the effective application of this technique in a commercial environment.

Should you have any questions about this proposal, please don't hesitate to contact Dr. Dale or me.

Sincerely,

Cornelis J. Van der Schyf
Vice President for Research and Dean of the Graduate School