Victor Ninov's 'Discovery' of Element 118: A Case of Alleged Data Fabrication

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6/1/07

Outline

- ***Introduction to and Historical Background of Superheavy Nuclei Synthesis***

- ***Ninov's Professional Background and events leading up to the heavy nuclei synthesis experiments at LBNL***

- ***Description of experiments, timeline of events leading up to alleged misconduct***

- ***Investigations and allegations of data fabrication***

- ***Ninov's denials, reactions of co-workers and collaborators***

- ***Lessons learned, implications, conclusions, & postcripts***

Superheavy Nuclei Synthesis: Introduction, Motivations, and Historical Background

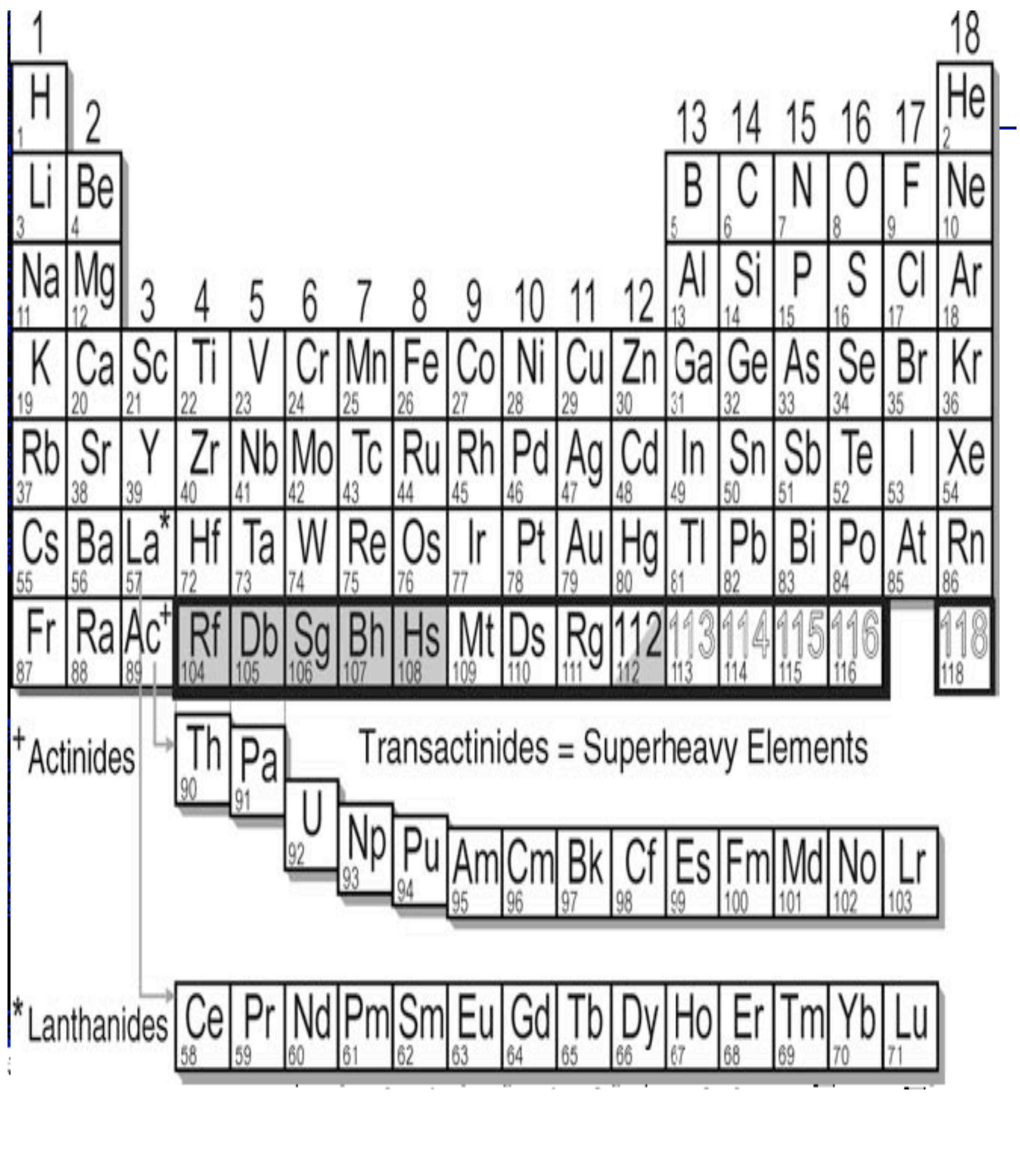
- ***Synthesis of new heavy nuclei has fundamental interest for physics & chemistry.***

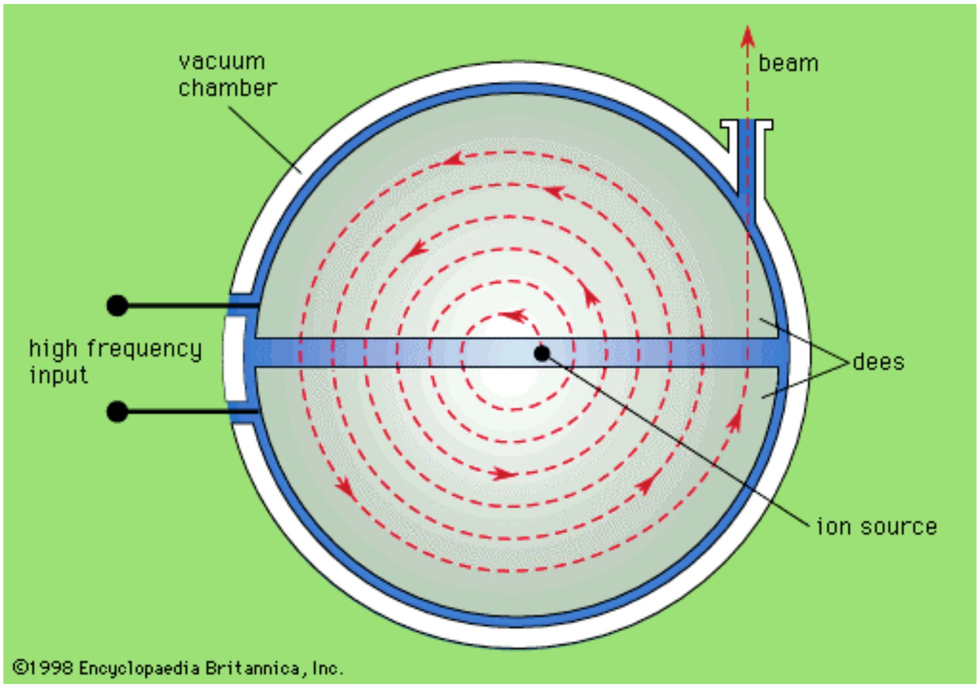
- ***Heaviest nuclei provide lab to test ideas of nuclear structure at limits of large numbers of protons and neutrons in the nucleus.***

- ***Some of these superheavy elements have relatively long half-lives and so could prove useful in treating cancer and in creating medical diagnostic procedures.***

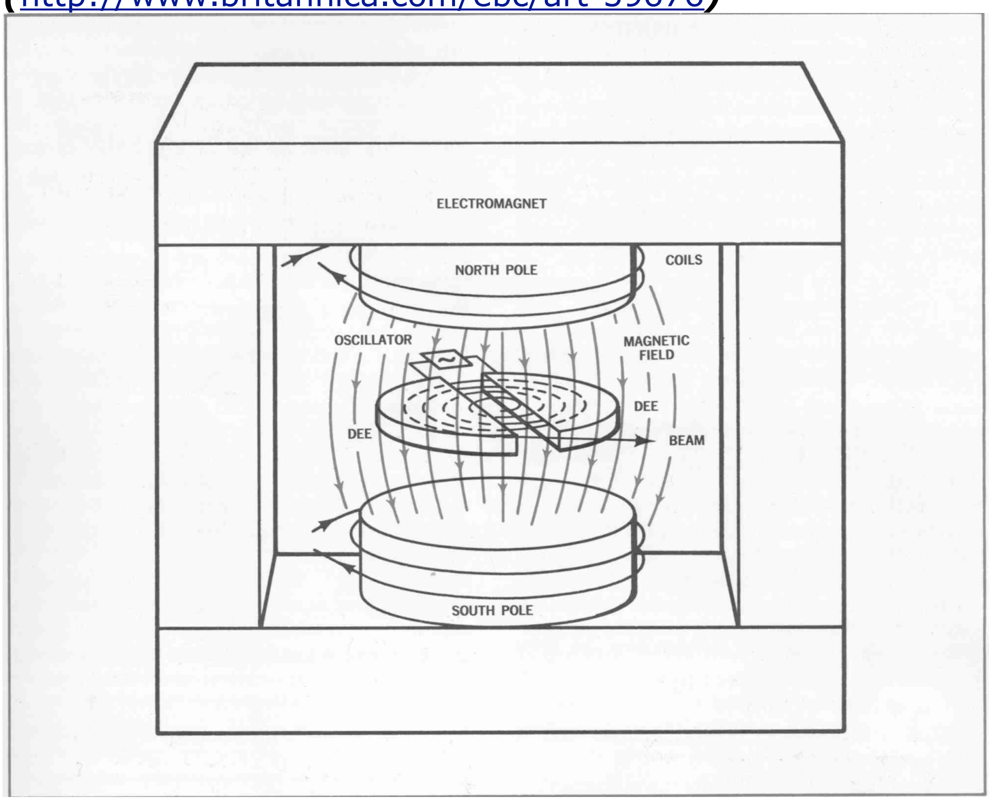
Periodic Table of the elements

("Chemistry of Superheavy Elements" by Matthias Schadel; Angewandte Chemie International Edition, Volume 45, Issue 3, pages 368-401, 2006)

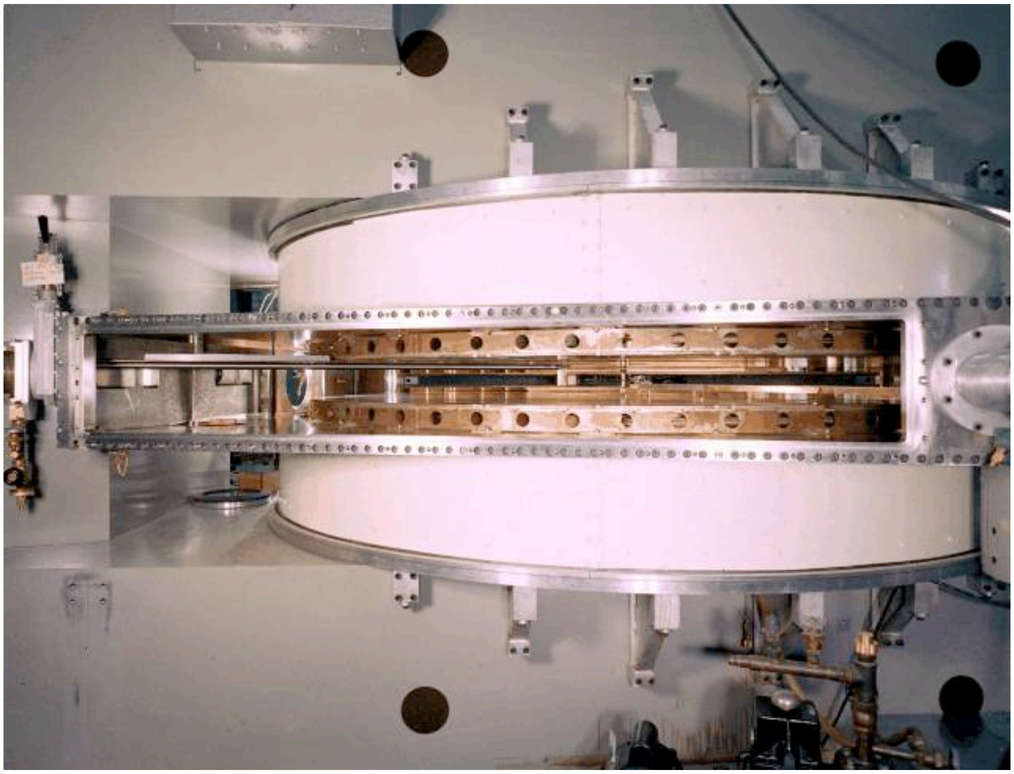




"classical cyclotron." Encyclopedia Britannica Online. (http://www.britannica.com/ebc/art-59676)



"Three Generations of Cyclotrons" (http://www.lbl.gov/nsd/user88/cycgreenbook.html)



88-Inch(magnetic pole diameter) Sector-Focused Cyclotron at LBNL(**http://www.lbl.gov/nsd/user88/cycgreenbook.html**)

Introduction and Historical Background

- ***Mid-1930's**: Race for elements beyond uranium started. Involving groups in Rome, Berlin, & Paris.*

- ***1940**: Team at LBL used cyclotron to create element 93 (Neptunium) and element 94 (Plutonium).*

Neptunium: When H (element #1; 1 proton in nucleus) fuses with Uranium (Z=92), produce artificial element Z=93.

- ***Early to Mid-1940's**: After further discoveries (i.e., synthesis and separation of americium & cirium at U.C.B.), G. T. Seaborg hypothesized that new series of elements called actinoid series was being produced & that this new series begin with thorium (Z=90).*

- ***Thereafter, heavy-element discoveries were sought and made in accordance with this hypothesis.***

- ***Radical revision and expansion of the periodic table.***

Introduction and Historical Background

Table of Discovery of Transuranium elements at: ***(http://www.britannica.com/eb/article-9115859/Table-27-Discovery-of-the-Transuranium-Elements)***

- ***Over next 40 years, researches at LBNL discovered 12 more transuranium elements, more than at any other institution during that time.***

Mid-1950s: Theoretical developments concerning atomic nucleus.

- ***Nuclear shell models/theory: similar to electrons in atoms & molecules and based on same quantum mechanical laws, protons and neutrons form closed shells with "magic #s". Nuclei w/closed shells exhibit extra and sometimes pronounced stability (e.g., longer half-lives).***

- ***"Superheavy" elements, starting with Rutherfordium (Z = 104) – only exist because of their microscopic shell stabilization.***

Introduction and Historical Background

- ***"Island of Stability"*: Region of periodic table (starting at around Z=108 (N=162) – Z =114 (N=184)) consisting of superheavy elements w/half-lives significantly longer than their slightly lighter superheavy neighbors on the periodic table.**

- ***1961:* 88 inch cyclotron at LBNL later used by Ninov and collaborators was constructed.**

- ***1965 onwards* (over next 25 years): researchers have sought to find or synthesize superheavy nuclei at or near the region Z=114 & N = 184 (i.e., near center of "island of stability".**

- ***1980's*: LBNL no longer world leader in synthesis of transuranium elements.**

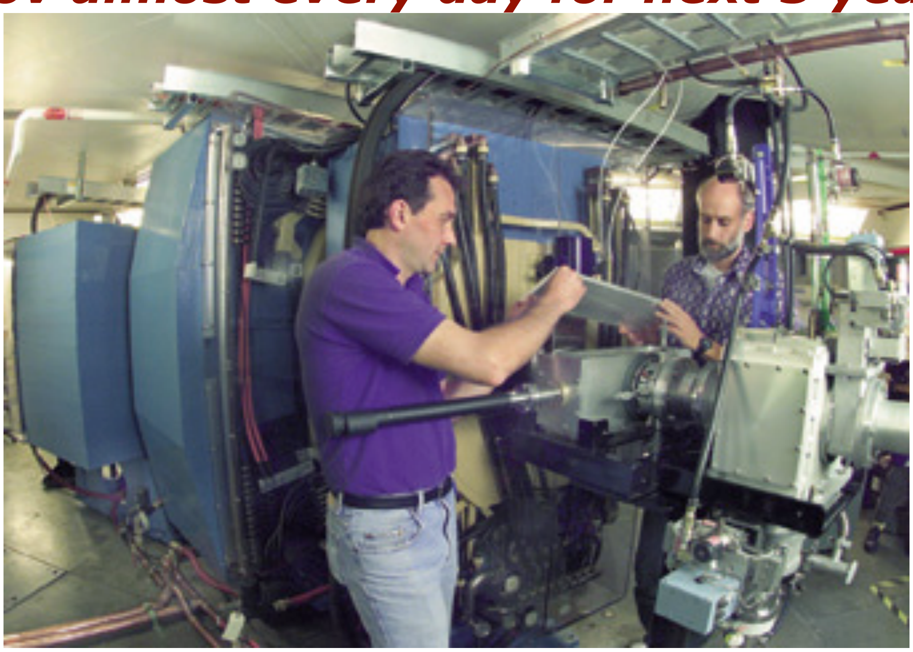
- ***Other U.S. facilities: SLAC, Brookhaven National Lab, etc...***

- ***Early 1990's: Changing priorities.***

Ninov's Professional Background and events leading up to the heavy nuclei synthesis experiments at LBNL

- ***By early 1990's, GSI (Institute for Heavy Ion Research) in Germany and Joint Institute for Nuclear Research, in Dubna, Russia, were taking more of leading role in sythesizing heavy nuclei.***
- ***Early 1990's: Ninov does his PhD (1992) and post-doc work at GSI.***
- ***Mid-1990's: Ninov helps to discover elements 110,111, and 112 at GSI with use of data analysis code that he developed. This establishes his reputation as world-class expert in the field.***
- ***During most of 1990's, low excitation energy fusion reactions failed to take scientists beyond element 112-114.***
- ***Extrapolations of existing data on synthesis of elements 110-112 indicated that to reach still heavier elements would require orders of magnitude increases in accelerator beam currents & new target technologies.***
- ***Mid-Late 1990's: synthesis of elements 110-114 had invogorated quest for "island of stability".***

- ***1996:* LBL hires Ninov as part of effort to search for "island of stability".**
- ***LBL research team specifically wanted help building Berkeley gas-filled separator (BGS) instrument, similar to one Ninov had helped to construct at GSI.***
- ***1996-1998: Ninov joined nuclear chemist and Project Leader (Kenneth E. Gregorich) on project to construct BGS (based on design proposed by A. Ghiroso).***
- ***Starting in 1996 Gregorich worked with Ninov almost every day for next 5 years.***



LBNL photo of Ninov (left) working with Gregorich (right) at BGS during 1999 experiments

Events leading up to heavy nuclei synthesis experiments at LBNL

- ***Ninov spent his first 2 years at LBL working with Gregorich in constructing BGS.***

Description and function of BGS:

- ***Atoms accelerated with cyclotron and then slammed into metal target. Newly fused elements and other reaction products would then pass through BGS, consisting of magnets, He gas, and detectors.***
- ***Strong magnets in BGS would then focus, sift out, and separate ions of interest from all of un-interesting reaction products, which are produced in much larger quantities.***
- ***Various detectors in BGS would identify and record energy, position, and timing of reactions associated with "events", i.e., decay chains of interest.***

Events leading up to heavy nuclei synthesis experiments at LBNL

- ***In all work done on synthesis of heavy nuclei up to that point, researchers had found it progressly more difficult ot produce more massive elements by fusing projectile & target.***

- ***Early 1999:* *Ninov & Gregorich were finishing construction of BGS and planning range of experiments to test, debug, improve performance, and ready it for experiments.***
- ***Approached by visiting scholar and LBL Fullbright Fellow, Robert Smolanczuk, from Soltan Institute for Nuclear Studies in Warsaw, Poland.***

  - ***According to Smolanczuk's calculations (R. Smolanczuk, Phys. Rev. C 59, 2634, 1999),
under right conditions could leap across gap of increasingly improbable atoms – elements 113-117-- and generate element 118.***

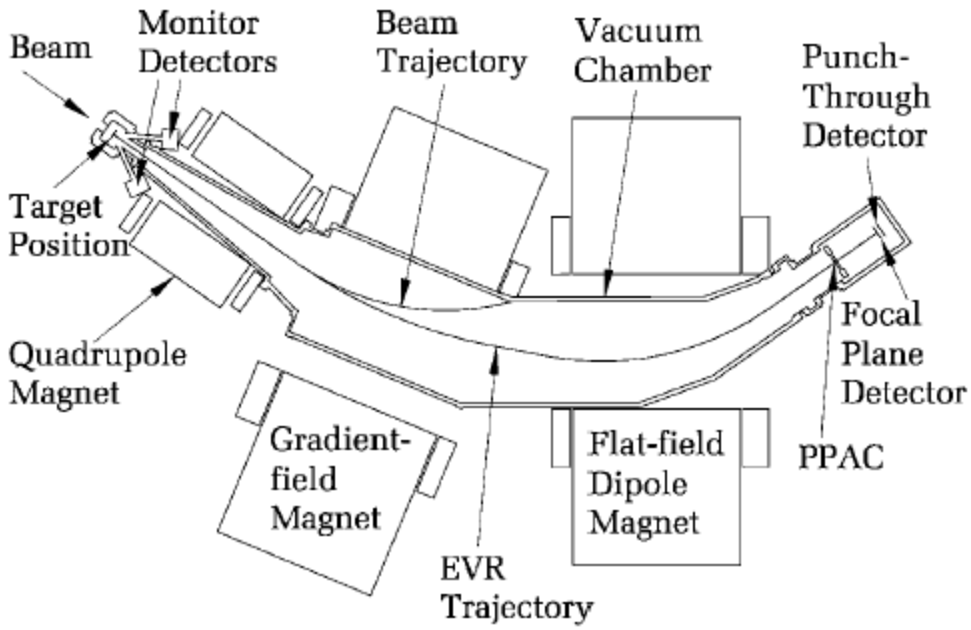
- ***Smolanczuk's calculations suggested that 118 would be relatively easy to create by bombarding a lead target (Z=82) with a low-energy krypton beam (Z = 36) (i.e., chance of producing 118 was much greater than had been expected due to much larger nuclear reaction cross section).***
- ***Ninov & Gregorich were persuaded by other team members to test Smolanczuk's theory.***
- ***Bypassed all testing and debugging plans and decided to use next available beam-time to try to synthesize 118.***

Description of experiments, timeline of events leading up to alleged misconduct

April 8-12 1999, Experiment #1
April 30-May 5 1999, Experiment #2
(Experiment Repeated)

- *Directed beam of krypton ions from cyclotron to some very thin lead targets mounted in B.G.S.*

- *B.G.S. was configured to capture and detect, with high efficiency, any ion of element 118 in downstream plane of detectors. Detectors would record precisely when and where ion came to rest, as well as times and energies of telltale sequences of alpha-particles (He nuclei) emitted in chain of decays to lower Z.*



(Ninov, et al., Phys. Rev. Lett. 83, 1104 (1999))

- ***Because of Ninov's previous work at GSI, he played pivotal role in these experiments.***
- ***Enormous amount of raw data processed and analyzed by Ninov using data analysis software he had developed and mastered at GSI.***
- ***As only team member familiar with software, Ninov was put in charge of data analysis.***

- ***Ninov was only one to deal with original raw data, which came from detectors in binary form and was stored on magnetic tape.***

- ***Ran computer-analysis program that converted binary files into text files of words and numbers for rest of team to interpret.***

- ***During this time (1999), NO ONE ELSE KNEW HOW TO USE PROGRAM, SO RELIED ON NINOV TO SUPPLY RESULTS.***

- ***Ninov was seeking pattern that would indicate Kr (36p) and Pb (82 p) had fused to momentarily produce nucleus of 118, which would subsequently decay to chain of smaller elements and release of alpha particles.***

- ***After completing initial analysis, Ninov claimed that he had in fact found evidence for this decay chain.***
    - ***This decay sequence agreed particularly well with Smolanczuk's calculations.***
    - ***Appeared that in one instant, team had discovered 2 new elements (116 & 118).***
    - ***Initially, reported that 3 high-energy decay chains were observed (experiment #1).***

Description of experiments,...

- ***When Ninov showed team his data analysis results, everyone reacted with surprise and caution:***
  - ***Examined Ninov's results several times.***
  - ***Re-ran experiment (April 30-May 5) after making improvements to B.G.S.***
  - ***Ninov's analysis of experimental results appeared to reveal another "event" (decay chain) – enough to convince rest of team that they had real, reproducible discovery.***
  - ***After group had closely reviewed Ninov's calculations, W. Loveland (another member of team) filled a binder with supporting evidence; 1 of decay chains was thrown out, but this still left 3 good decay chains.***
  - ***Scientits at GSI also examined results and agreed that something noteworthy might have occurred.***
- ***Everyone was working from numbers Ninov had obtained from his analysis. No one felt need to examine original raw data.***

Description of experiments,...

- **Pressure/Competition from other labs in, e.g., Germany and Russia.**
- **Researchers quickly wrote up the results and submitted them to Physical Review Letters.**
- **August 9, 1999: Paper published in P.R.L. on synthesis of element 118.**

VOLUME 83, NUMBER 6 PHYSICAL REVIEW LETTERS 9 AUGUST 1999

Observation of Superheavy Nuclei Produced in the Reaction of ^{86}Kr with ^{208}Pb

V. Ninov,[1] K. E. Gregorich,[1] W. Loveland,[2] A. Ghiorso,[1] D. C. Hoffman,[1,3] D. M. Lee,[1] H. Nitsche,[1,3] W. J. Swiatecki,[1] U. W. Kirbach,[1] C. A. Laue,[1] J. L. Adams,[1,3] J. B. Patin,[1,3] D. A. Shaughnessy,[1,3] D. A. Strellis,[1] and P. A. Wilk[1,3]

[1] *Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720*

[2] *Department of Chemistry, Oregon State University, Corvallis, Oregon 97331*

[3] *Department of Chemistry, University of California, Berkeley, California 94720*

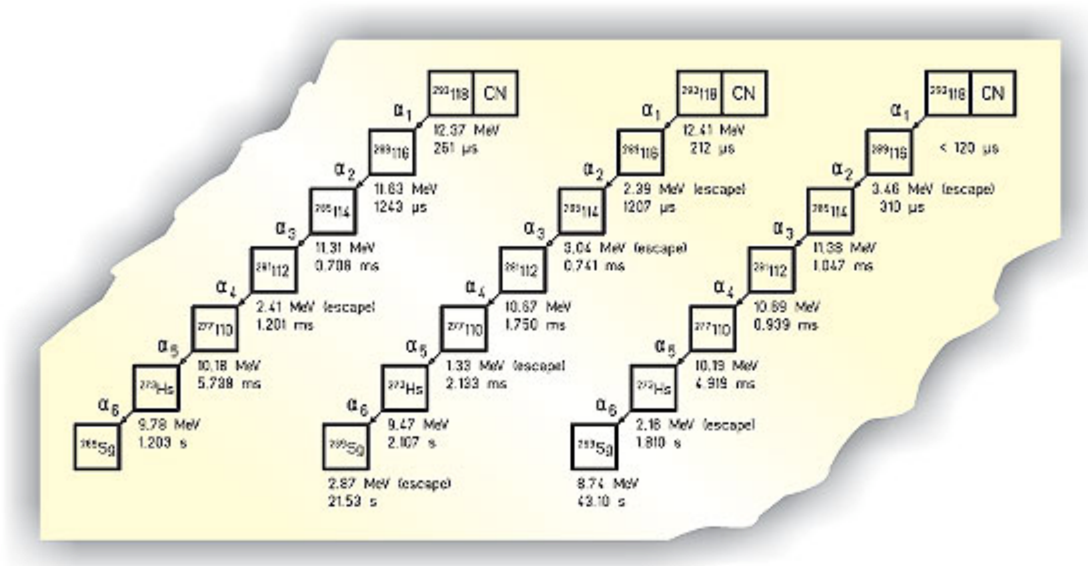
(Received 27 May 1999)

Following a prediction by Smolańczuk [Phys. Rev. C **59**, 2634 (1999)], we searched for superheavy element formation in the bombardment of ^{208}Pb with 449-MeV ^{86}Kr ions. We have observed three decay chains, each consisting of an implanted heavy atom and six subsequent α decays, correlated in time and position. In these decay chains, a rapid (ms) sequence of high energy α particles ($E_\alpha \geq 10$ MeV) indicates the decay of a new high-Z element. The observed chains are consistent with the formation of ^{293}118 and its decay by sequential α-particle emission to ^{289}116, ^{285}114, ^{281}112, ^{277}110, ^{273}Hs ($Z = 108$) and ^{269}Sg ($Z = 106$). The production cross section is $2.2^{+2.6}_{-0.8}$ pb.

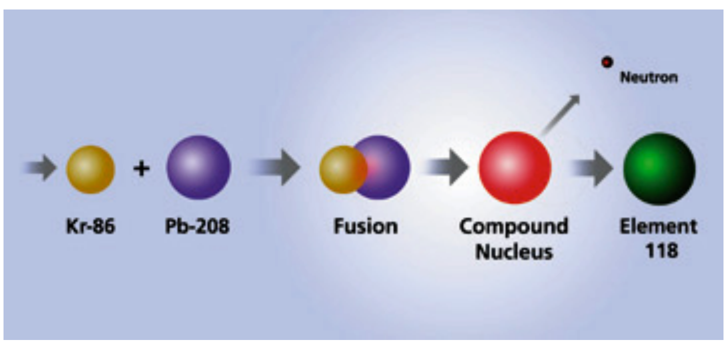
PACS numbers: 25.70.Jj, 27.90.+b

The synthesis of new heavy nuclei has fundamental interest for nuclear physics and chemistry. The heaviest nuclei provide a laboratory to test our ideas of nuclear structure at the limits of large numbers of protons in the nucleus. For over 25 years, scientists have sought to find or synthesize superheavy nuclei at or near the region $Z = 114$ and $N = 184$ [1], although some calculations suggest that the region of maximum stability may be near $Z = 120$ or $Z = 126$ [2,3].

(sandwiched between 40 μg/cm^2 C on the upstream side and 10 μg/cm^2 C on the downstream side) [15]. Nine of them were mounted on a wheel that was rotated at 400 rpm. The beam energy at the center of the target was 449 MeV [16]. The beam intensity was monitored by two silicon detectors (mounted at ± 30 deg with respect to the incident beam) that detected elastically scattered beam particles from the target. During the first experiment (8–12 April 1999), a dose of 0.7×10^{18} ions was delivered



(LBNL; Physic Today.org, A.I.P. 2003, http://www.aip.org/pt/vol-55/iss-9/p15.html)



(LBL Research Review, Summer 1999, http://www.lbl.gov/Science-Articles/Research-Review/Magazine/1999/departments/breaking_news.shtml)

Gregorich: " During 11 days of experiments, 3 ... alpha decay chains were observed, indicating production of 3 atoms of 118 ... Decay energies and lifetimes for these new isotopes of elements 118,116,114, 112,110,108, & 106 provide strong support for existence of predicted island of stability ..."

Investigations and Allegations of Data Fabrication

Summer 1999

- ***GSI team (lead by S. Hofmann) repeated LBL experiment with its own cyclotron but did not detect any 118 decay chains.***
- ***Research groups in Japan and France also repeated experiment, but did not find any evidence for 118.***

Spring 2000

- ***Ninov, Gregorich, and rest of LBL repeated experiment, but found no trace of experiment.***

Possible Explanations:

- ***Statistical variations due to random processes?***
- ***Computer program playing "tricks" on research team?***

Internal independent review committee was assembled to investigate.

- ***Made several recommendations to improve on original experiment.***
  - ***Suggestion: Have several people analyze raw data. (But this suggestion was not taken up immediately).***

Investigations and Allegations…

- ***Ruled out most obvious technical explanations:***
  - ***discrepancies in beam alignment***
  - ***detector inefficiencies***
  - ***flaws in gathering & processing data.***
- ***No consideration of possible fraud at this point.***

April 2001

- ***Improvements made in detection equipment and Gregorich & Ninov again got beam time to retry experiment.***
  - ***Initially, Ninov reported that he had found another 118 decay chain***

- ***By now, W. Loveland had learned how to use Ninov's data analysis software, and did not find decay chain reported by Ninov in his re-analysis.***
- ***Ninov and several other collaborators also re-analyzed the data with his software and did not find decay chain.***
- ***Colleagues finally re-analyized 1999 experiment results, some using their own data analysis programs, and found that there were no decay chain events in the original (raw) data files.***

Investigations and Allegations…

- ***By this time, LBL had appointed 2nd internal review committee which included computer experts.***
    - ***Appeared as if the 3 events reported in 1999 were in processed text file that several researchers had examined, but NOT in original binary file.***
- ***3rd review committee, including working group chaired by D. Hoffman, senior member of B.G.S. team, examined both '99 and '01 data files, and found that none of them contained record of any decay sequence (proof) for elements 116 or 118.***
- ***Plausible theory: someone had inserted false data into text file …, and Ninov might have been in best position to do this… (?)***
- ***Issue needed to be examined by experts from outside the research team.***

June-July 2001

1. ***Gregorich & colleagues issued press release withdrawing discovery of element 118 and told researchers at other labs to disregard claim for element 118.***

Investigations and Allegations … RETRACTION

- ***July 26, team submitted letter to PRL retracting its original finding.***

VOLUME 89, NUMBER 3 PHYSICAL REVIEW LETTERS 15 JULY 2002

Editorial Note: Observation of Superheavy Nuclei Produced in the Reaction of ^{86}Kr with ^{208}Pb [Phys. Rev. Lett. 83, 1104 (1999)]

V. Ninov, K. E. Gregorich, W. Loveland, A. Ghiorso, D. C. Hoffman, D. M. Lee, H. Nitsche, W. J. Swiatecki, U. W. Kirbach, C. A. Laue, J. L. Adams, J. B. Patin, D. A. Shaughnessy, D. A. Strellis, and P. A. Wilk
(Received 26 July 2001; published 1 July 2002)

DOI: 10.1103/PhysRevLett.89.039901 PACS numbers: 25.70.Jj, 27.90.+b, 99.10.+g

All but one of the authors of the original Letter have asked us to publish the following retraction:

In our Letter, we reported the synthesis of element 118 in the ^{208}Pb(^{86}Kr, n) reaction based upon the observation of three decay chains, each consisting of an implanted heavy atom and six sequential high-energy alpha decays, correlated in time and position. Prompted by the absence of similar decay chains in subsequent experiments [1–4], we (along with independent experts) reanalyzed the primary data files from our 1999 experiments. Based on these reanalyses, we conclude that the three reported chains are not in the 1999 data.

We retract our published claim for the synthesis of element 118.

[1] S. Hofmann and G. Münzenberg, Rev. Mod. Phys. **72**, 733 (2000).
[2] K. Morimoto *et al.*, in *Tours Symposium on Nuclear Physics IV, Tours, 2000,* AIP Conf. Proc. No. 561 (AIP, New York, 2001), p. 354.
[3] C. Stodel *et al.*, in Ref. [2], p. 344.
[4] K. E. Gregorich *et al.* (to be published).

  - ***1 short paragraph offering few details, letter simply states that experiment had not detected 118 in 1999.***
- ***Ninov stood by original findings and refused to sign retraction letter, so PRL journal editors rejected retraction letter.***
- ***Ninov had insisted to journal editors that it was premature to repudiate discovery before more experiments were done, and this delayed publication of retraction later until July 2002.***

Investigations and Allegations …

- ***Ninov later complained that retraction had been submitted behind his back.***

Fall 2001:

- ***Head of LBNL's computing division, Stewart Loken, had received technical report from yet another review committee and had conducted interviews with Ninov and other principals.***
    - ***Recommendation: Lab should proceed to formal investigation of Ninov's conduct under LBNL's stated policy on integrity in research.***

November 2001

- ***LBL puts Ninov on paid leave on November 21.***
- ***Lee Schroeder, director of LBNL's nuclear science division team, convenes formal investigative committee chaired by Caltech physicist Rochus Vogt (Vogt Committee) a week after Ninov place on administrative leave.***

December 2001

- ***In process of writing up paper on discovery of element 112, Hofmann and colleagues at GSI went back to original data tapes and re-analyzed data from original 1994-1996 experiments on elements 110-112 that Ninov was involved with.***
  - ***Found that 2 decay chains reported in original papers were not in original raw data files.***
  - ***Decay chains appeared only in text files that Ninov had produced in primary data.***
  - ***Given that Ninov was in charge of data processing and analysis at that time, Hofmann believes that evidence points squarely at Ninov for creating these false events.***
  - ***Possible evidence here that Ninov may have been fabricating alpha-decay chains since 1994.***

March 2002

- ***Taking this and all other facts into account Vogt committee reported its findings to Schroeder and LBNL director Charles Shank at LBNL:***

"We find clear and convincing evidence that data in 1999, upon which reported discovery was based, were fabricated …"

"[We] regret that our findings revealed intentional fabrication … instead of honest error or honest differences in interpretation."

".. There is clear evidence that Ninov [carried] out this fabrication … If anyone else had done [it], Ninov would almost surely have detected it."

- ***Possible "Smoking Gun": computer "log file" created by Ninov's data analysis software that had automatically recorded everything that had occurred during handling of 1999 and2001 runs.***
    - ***page lengths were inconsistent***
    - ***timing of some events was off***
    - ***elements passed off as 118 decay chain could have been manufactured by cutting and pasting few lines from elsewhere in file and changing some numbers , i.e., some of original chains may have been edited by someone using account "Vninov" .***

Investigations and Allegations …

- ***Vogt report closes with criticism of team's procedures in 1999 experiment and criticism of co-authors and collaborators:***

"[We] find it incredible that no one else in group, other than Ninov, examined original data to confirm purported discovery of 118" – Responsibility of co-authors.

May 2002
LBNL fires Ninov

July 2002
Official retraction finally published in PRL as "Editorial Note" with introductory explanation pointing out that "all but one of authors of original Letter have asked us to publish following retraction…"

August 2002
LBNL makes Vogt report public.

Ninov's denials, reactions of co-workers and collaborators

- ***Ninov emphatically denied accusations of Vogt Committee.***
- ***Fall 2002-- initiated grievance proceedings and prepared detailed rebuttal of charges, which he claimed were filled with errors and contradictions***
- ***Notes that there was simply no motivation for scientist with his impressive publication record to commit fraud – and in such sloppy manner.***
- ***Acknowledges that decay chains are not in raw data and admits that data files appear to have been tampered with.***
- ***Perplexed as anyone.***
- ***Computer account on lab computer system was used by everyone in his group and his password was open secret.***
- ***Contends that any colleague could have carried out deception.***

- ***"Why create data so bad that flaws can be detected in few min. of examination? … Why did my expert colleagues never question obviously flawed data? … Why, having apparently successfully perpetrated scientific fraud, did I never think to delete the incriminating evidence ..? .. To these questions, answer can only be because the file was not of my creation … I'm a scapegoat …" Conspiracy theories?***

Reaction of Colleagues

- ***Perplexed – why would promising scientist decide to fabricate data?***
- ***D.M. Lee: "It's unbelievable that anyone would do this sort of thing … There was absolutely no need for him to do this …his career did not depend on this."***
- ***Ghiorso: speculates that Ninov was buying time for team by inserting events so that lab would let experiment run longer and provide opportunity to catch some real decay chains.***
- ***Gregorich and other collaborators felt that criticism of Vogt committee direct against team was unjustified, arguing that no-one operates on supposition that his/her collaborator is fabricating data***

Lessons learned, implications, conclusions, & postcripts

- ***LBNL officials maintain that several people should have been involved in essential step of data analysis, but other scientists say even that safeguard can't always thwart fraud.***
- ***Prof. Denis L. Rousseau: "In science, we always depend on integrity of co-workers. When that breaks down, it's very difficult to correct for that …"***
    - ***Science has built in protection, however, in fundamental rule that investigators must try to reproduce interesting findings***
    - ***Necessary to repeat other people's experiments, not just for catching cases of fraud, but for catching genuine mistakes as well.***

- ***LBNL Deputy Director Pier Oddone (2002): "The message is that experimenters must exercise vigilance, not so much against fabrication, but against honest error and misjudgement. And against these, first line of defense is vigorous, independent checking within experimental group …"***

November 2002
As direct result of Schon and Ninov incidences, APS issued new ethics guidelines:

"APS Expands and Updates Ethics and Professional Conduct Guidelines for Physicists"
http://www.aps.org/publications/apsnews/200301/guidelines.cfm

APS Expands and Updates Ethics and Professional Conduct Guidelines for Physicists

"Prompted by recent highly publicized episodes of misconduct in physics, the APS has updated and expanded its professional ethics guidelines. The changes, adopted November 10, 2002, at the APS Council meeting, clarify the roles and responsibilities of coauthors…"

The APS Council has adopted new Guidelines on the Responsibilities of Coauthors and Collaborators. The guidelines state that ***"all coauthors share some degree of responsibility for any paper they coauthor" and that "some coauthors have responsibility for the entire paper. These include, for example, coauthors who are accountable for the integrity of the critical data reported in the paper, carry out the analysis"*** **…**

To assist coauthors in fulfilling their responsibilities, the APS Council resolved that, "Collaborations are expected to have a process to ***archive and verify the research record***; to facilitate internal communication and allow authors to be fully aware of the entire work; and respond to questions concerning the joint work and enable other responsible scientists to share the data. All members of a collaboration should be familiar with, and understand, the process."

"These actions are our initial response to the recent findings of major research misconduct"**…**

June 2003

Goerge Trilling – "Co-authors are responsible too", Physics World, June 2003 *(http://physicsworldarchive.iop.org/)*

George Trilling is faculty scientist at the Lawrence Berkeley National Laboratory and emeritus professor at the University of California, Berkeley, US, e-mail ght@lbl.gov

Postscripts

- ***Ninov's denials refuted and not taken very seriously by LBNL.***
- ***Grievance hasn't gone anywhere.***
- ***2004-?: Appealed LBNL firing decision (?)***
- ***2003, 2004 - ?: Teaches undergrad physics at UOP, where his wife was professor while he worked at LBNL.***
- ***October 2006: LLNL and Joint Institute for Nulcear Research (Dubna, Russia) report discovery of element 118, using approach different from that proposed by Smolanczuk. Results published in October 2006 edition of Physical Review C. Progress towards mapping "island of stability".***

Additional Key References:

- ***"Atomic Lies – How one physicist may have cheated in the race to find new elements", Richard Monastersky, Chronicle of Higher Education, August 16, 2002***
  http://chemed.chem.pitt.edu/joeg/documents/chronicle_16Aug02.pdf
- ***"At Lawrence Berkeley, Physicists Say a Colleague Took Them for a Ride", George Johnson, N.Y. Times, October 15***

2002 ***(http://sanacacio.net/118_saga/story.html)***