Life with a Scientific Cyclone: Personal reflections on my collaborations with John D'Auria

Thomas J. Ruth, PhD

Emeritus – Life Sciences

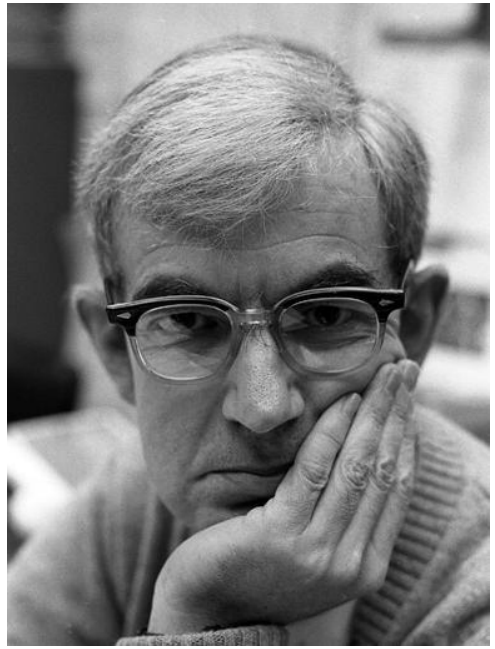
TRIUMF

TRIUMF, 1980

- I was recruited from Brookhaven National Lab in 1980 to help establish the PET Program, a collaboration between TRIUMF and UBC and associated hospitals. At that time PET was not being used clinically, only for brain research. I would become Director of PET in 1989.

- Thus my plate was full, however …

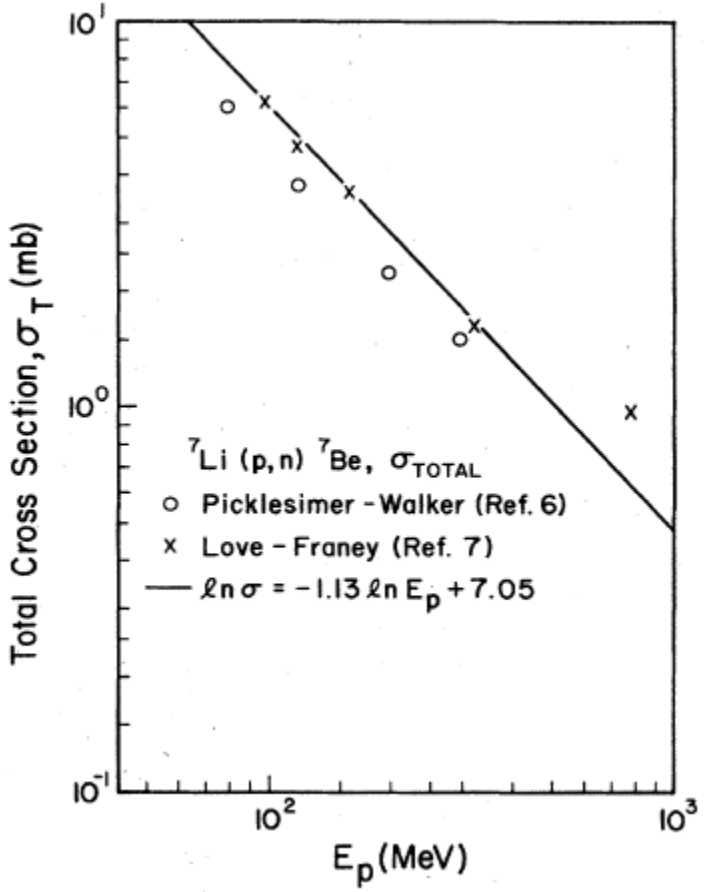
- No sooner did I unpack my bags when John came with a list of experiments with which I may be interested in being involved.



Brain Pate
Associate Director, TRIUMF

Activation measurements of the $^{7}Li(p,n)^{7}Be$ reaction from 60–480 MeV

JM D'Auria, M Dombsky, L Moritz, TJ Ruth, G Sheffer, TE Ward, CC Foster, JW Watson, BD Anderson, J Rapaport.



Double Charge Exchange Reaction

$$^{A}X(\pi^{+}, \pi^{-})^{A}Z$$

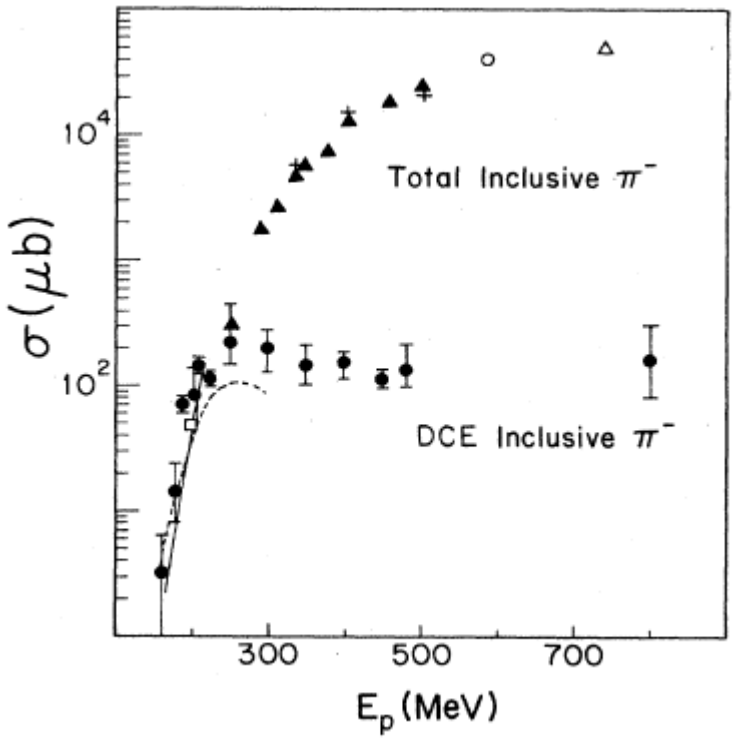
Radiochemical approach

$$^{209}Bi(\pi^{+}, \pi^{-})^{209}At$$

PHYSICAL REVIEW C VOLUME 32, NUMBER 1 JULY 1985

Inclusive measurement of (p,π^-xn) double charge exchange reactions on bismuth from threshold to 800 MeV

M Dombsky, JM D'Auria, I Kelson, AI Yavin, TE Ward, JL Clark, TJ Ruth, G Sheffer.



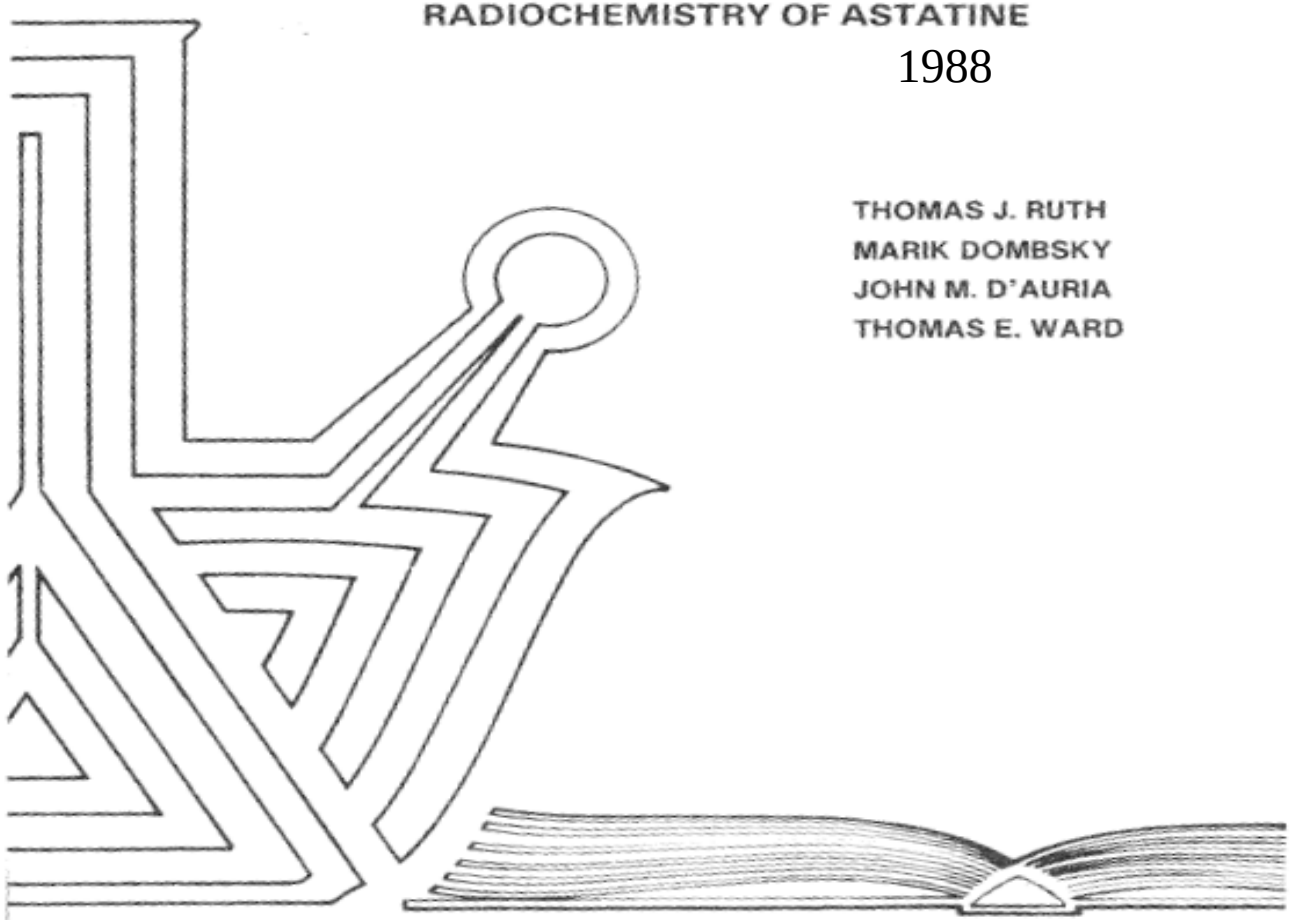
NUCLEAR SCIENCE SERIES

Radiochemistry of the Elements

RADIOCHEMISTRY OF ASTATINE

1988

THOMAS J. RUTH
MARIK DOMBSKY
JOHN M. D'AURIA
THOMAS E. WARD



Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

Suzanne Gardner
Feasibility of Producing ^{186}Re, a Potential Therapeutic Radioisotope
Master of Science SFU, (1987)

Production of ^{186}Re with 500 MeV Protons

^{197}Au(p,spall.)	0.025 mCi/mAh
^{nat}Pt(p,spall.)	0.2 mCi/mAh
^{nat}Ir(p,spall.)	1.6 mCi/mAh

Journal of Radioanalytical and Nuclear Chemistry, Articles, Vol. 171, No. 1 (1993) 219–224

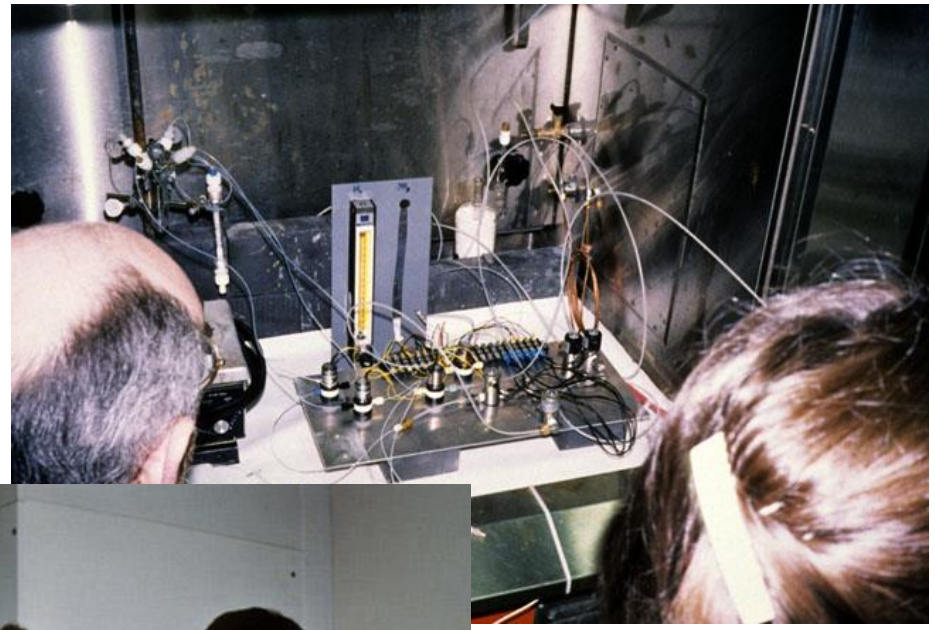
THE SFU/TRIUMF RADIOCHEMISTRY INSTITUTE AN INTENSIVE TRAINING PROGRAM FOR RADIOPHARMACEUTICAL CHEMISTRY

T. J. RUTH,* J. M. D'AURIA**

Selected Lecture Topics

- Basic Nuclear Science
- Interaction of radiation w/ matter
- Radiation detection
- Instrumentation –
  - Gas detectors
  - Liquid scintillators
  - Solid scintillators
  - Semi-conductors
- Radioisotope production
- Radiopharmaceutical syntheses –
  - Strategies
  - β^+'s
  - Halogens
  - Metal chelation
- Quality control –
  - Radio-HPLC
  - Radio-TLC
  - NMR (^{1}H, ^{19}F)
  - Pyrogens and sterility

Lab Experiments



Faculty for the Institute

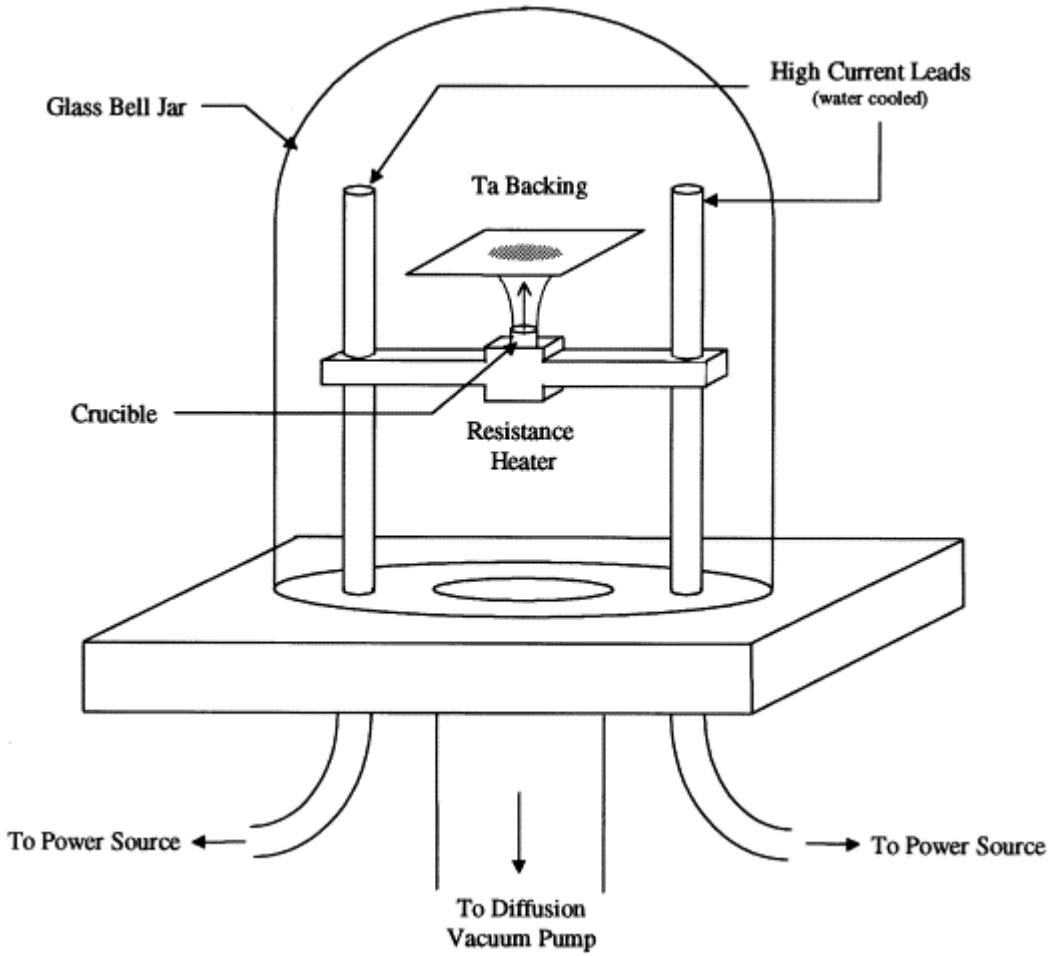
Name	Affiliation	Expertise
John D'AURIA	Chemistry Dept., SFU	Nuclear and radiochemistry
Thomas RUTH	Director, UBC/TRIUMF PET program	Radioisotope production; automation
John MERCER	Biomira, Inc.	Nuclear pharmacy
Michael ADAM	TRIUMF	Radiopharmaceutical Syntheses
Ralph KORTELING	Chemistry Dept., SFU	Nuclear and radiochemistry
Brian ABEYSEKERA	Nordion Inter. Inc.	Radioiodinations
Kenneth KROHN	PET program, U. of Wash.	Protein labelling

Preparation of a radioactive ^{44}Ti target

R. Lange[a], J. D'Auria[a,*], U. Giesen[a,1], J. Vincent[b], T. Ruth[b]

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

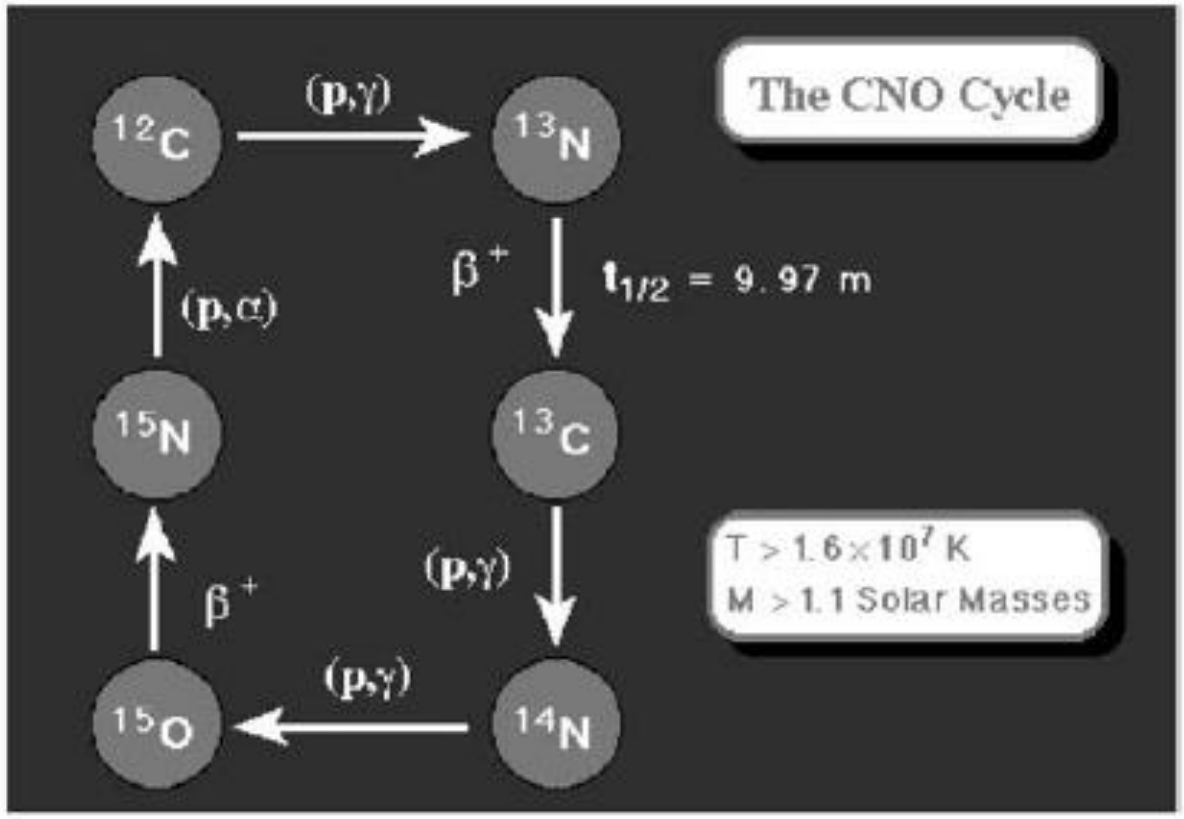
Nuclear Instruments and Methods in Physics Research A 423 (1999) 247–255



^{44}Ti $(p, \gamma)^{45}$V

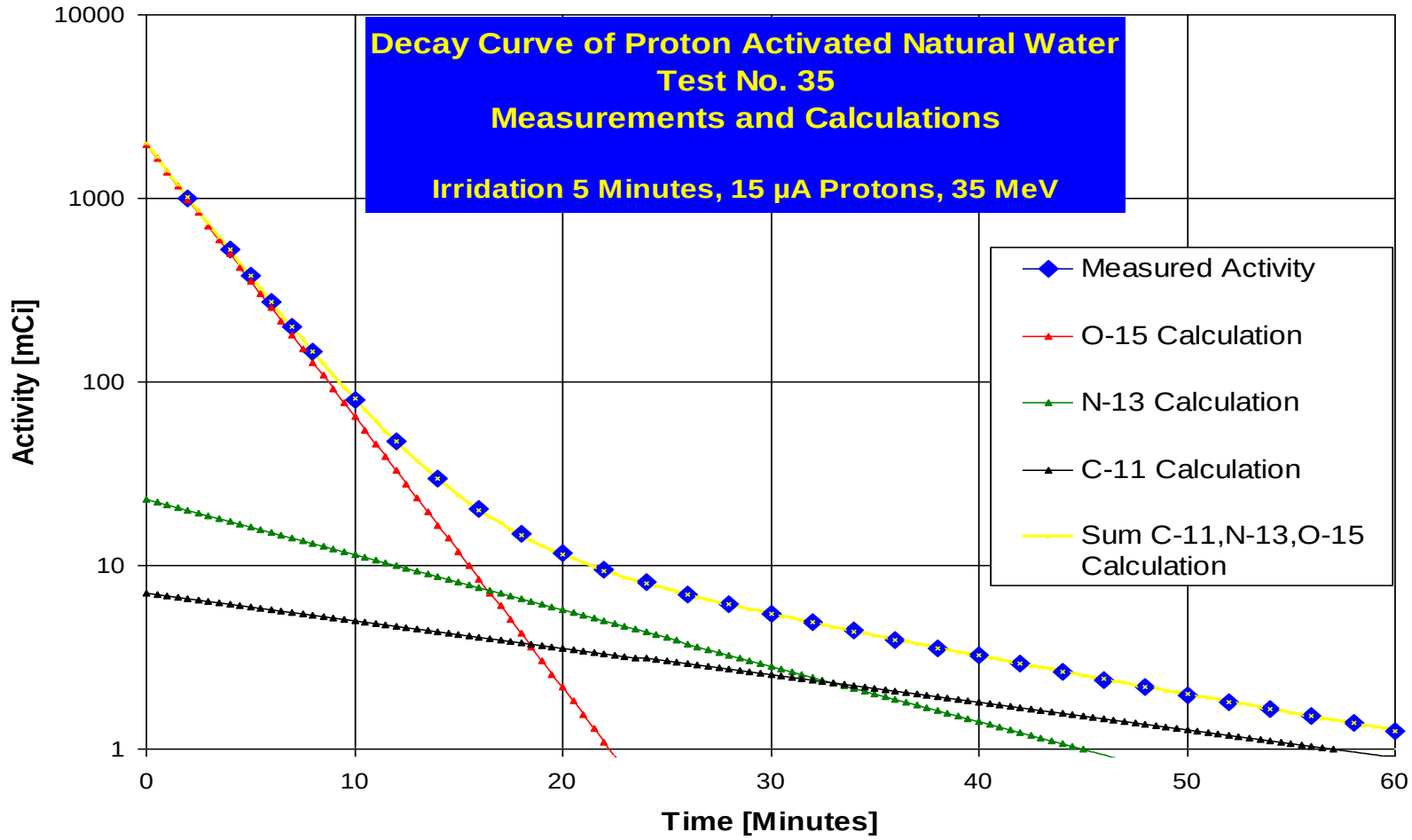
^{44}Ti $(\alpha, p)^{47}$V

^{15}O of Interest for studies of the CNO Cycle



ELSEVIER
Nuclear Instruments and Methods in Physics Research A 480 (2002) 124–127
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A
www.elsevier.com/locate/nima

E Fosshag, M Hecht, KR Buckley, DW Becker, K Jayamanna, JM D'Auria, JS Vincent, TJ Ruth
A target system for the production of ^{15}O beams for ISAC



Lapi, S., T.J. Ruth, A. Zyuzin, J.M. D'Auria.

Production of an Intense ^{15}O Radioactive Ion Beam using low energy protons.

Nucl Instr. Meth. **204**: 444-446 (2003).

Production, conversion trapping of $^{14/15}O$ for ISAC experiemnts

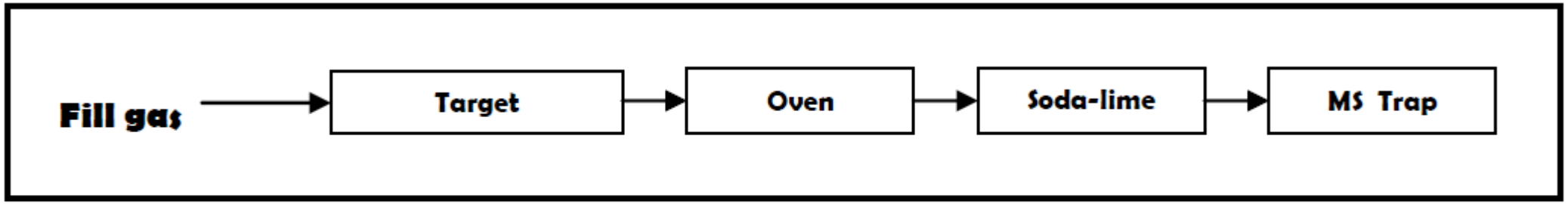


Figure 3.3 Schematic for the conversion of $H_2{}^{15}O$ to $C^{15}O$.

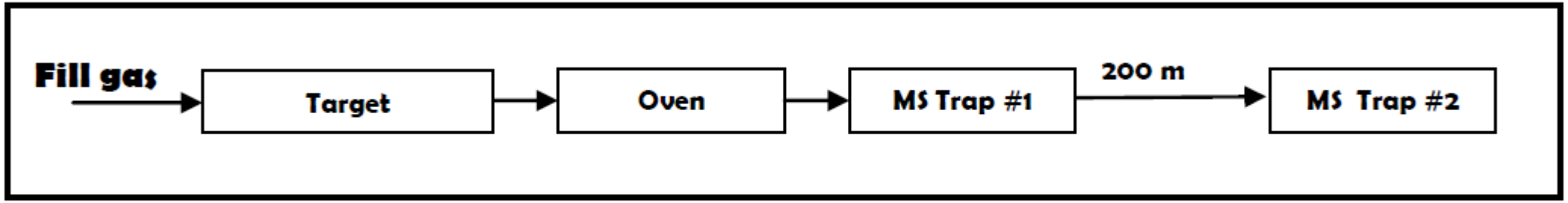


Figure 3.5 Schematic for trapping and transfer of $C^{15}O$

M. Trinczek, S. Lapi, B. Guo, F. Ames, K.R. Buckley, J.M. D'Auria, K. Jayamanna, W.P. Liu, C. Ruiz, T.J. Ruth.

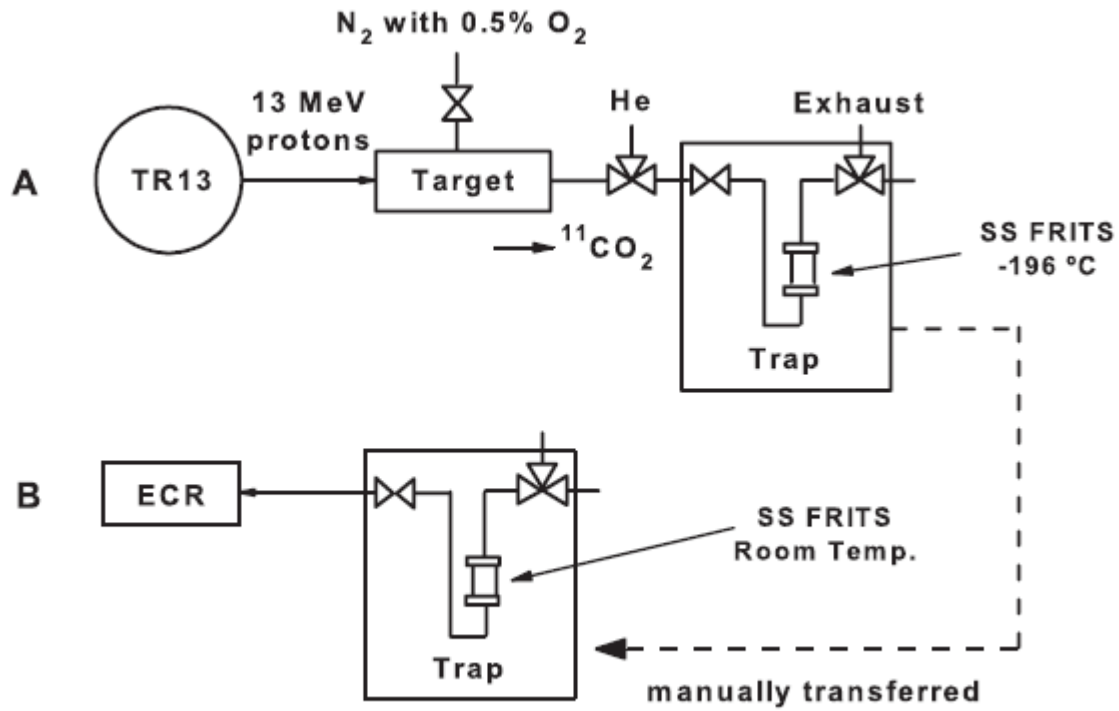
Production of intense radioactive beams at ISAC using low-energy protons.
Can. J. Phys., 84: 325- 333 (2006).

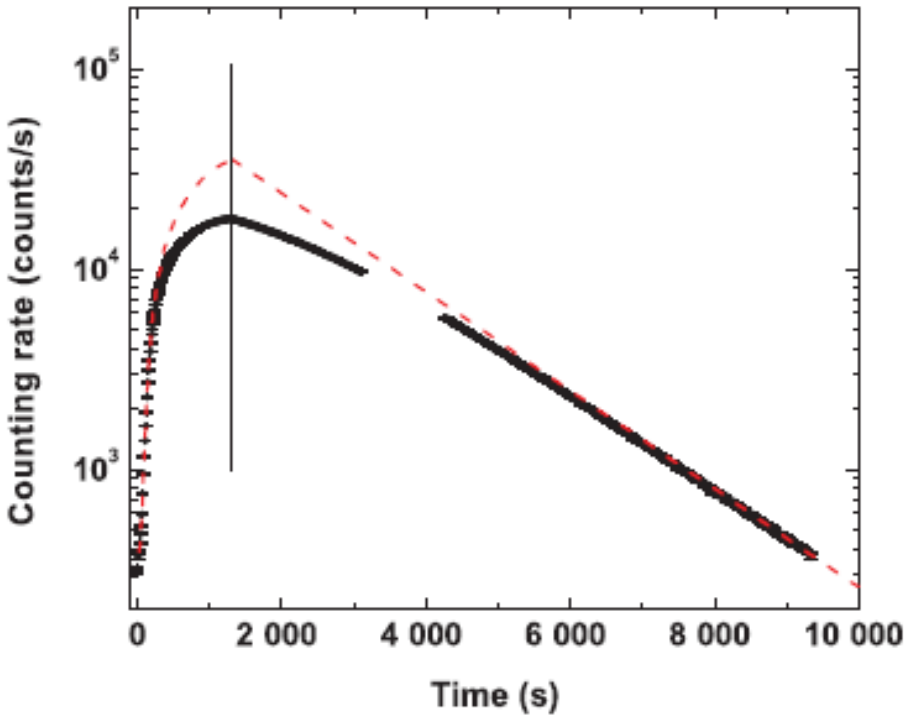
Table 1. Calculated production rates in a thick target using 50 μA of 13 MeV protons for some desired species.

Isotope	Half-life	Target material	Production reaction	Rate of production (s^{-1})	Desired intensity at experiment (s^{-1})
^{11}C	20.39 min	N_2(g)	$^{14}N(p,\alpha)^{11}C$	2.4×10^{11}[a]	$10^7 - 10^9$
^{14}O	70.606 s	N_2(g)	$^{14}N(p,n)^{14}O$	2×10^{10}[b]	$10^5 - 10^6$
^{15}O	122.24 s	$^{15}N_2$(g)	$^{15}N(p,n)^{15}O$	2.1×10^{11}[a]	$10^8 - 10^{11}$
^{13}N	9.965 min	O_2(g)	$^{16}O(p,\alpha)^{13}N$	4.8×10^{10}[a]	$10^8 - 10^9$
^{17}F	64.46 s	Ne(g)	$^{20}Ne(p,\alpha)^{17}F$	1.5×10^{8}[c]	$10^8 - 10^9$

[a] From IAEA at http://www-nds.iaea.org/medical/positron_emitters.html.
[b] Ref. 6.
[c] From W. Gruhle and B. Kober. Nucl. Phys. A, **286**, 523 (1977).

Fig. 1. Schematic of the proposed production process.





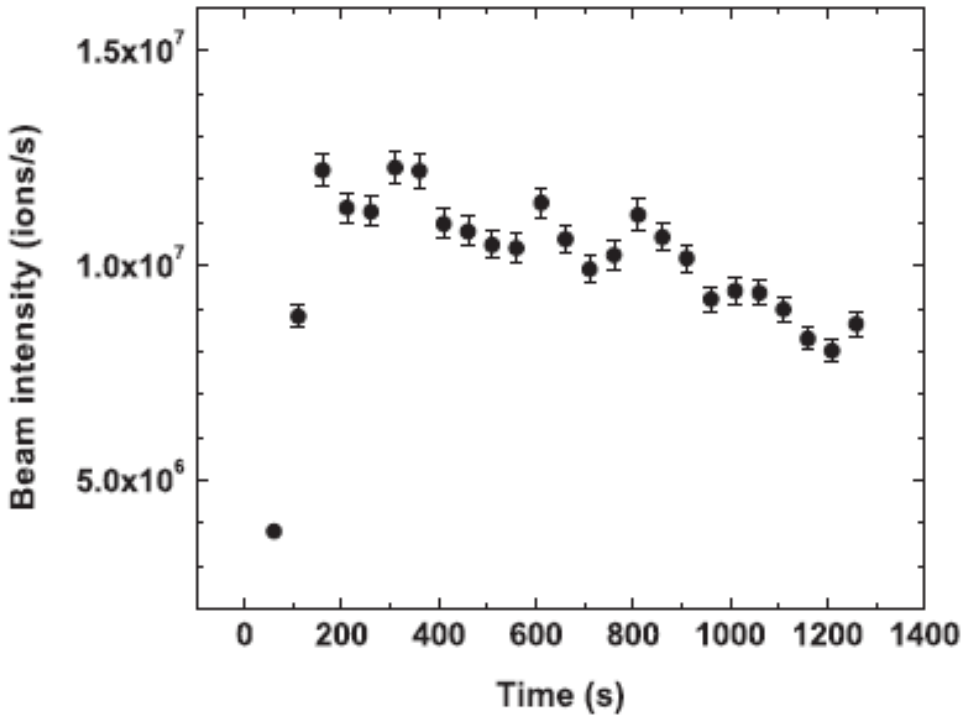


Table 2. Summary of results for the ^{11}C tests.

Run	Beam intensity	Source efficiency
1	$(9.9 \pm 0.4) \times 10^6$ ions/s	$\geq (1.9 \pm 0.2)\%$
2	$(3.9 \pm 0.3) \times 10^6$ ions/s	$(0.72 \pm 0.07)\%$

Measurement of cross-sections for $^{nat}W(p,xn)^{181-186}Re$ reactions up to 19 MeV

S. Lapi; J. M. D'Auria; J. Ressler; T. J. Ruth

16th Intern. Symp. Radiopharm. Chem. June 2005.

Pacifichem 2005, Honolulu, Dec. 2005.

G.C. Ball, R. Baartman, J. Behr, P. Bricault, L. Buchmann, J.M. D'Auria, P. Delhei, M. Dombsky, G. Dutto, D. Hutcheon, K.P. Jackson, R. Kiefl, R. Laxdal, P. Levy, J-M. Poutissou, P. Schmor, G. Stanford, T.J. Ruth.

The ISAC radioactive beam facility at TRIUMF: Present and future plans.

In *The Nucleus: New Physics for the New Millennium*. New York: Kluwer Academic/Plenum Pub. 69-76 (2000).

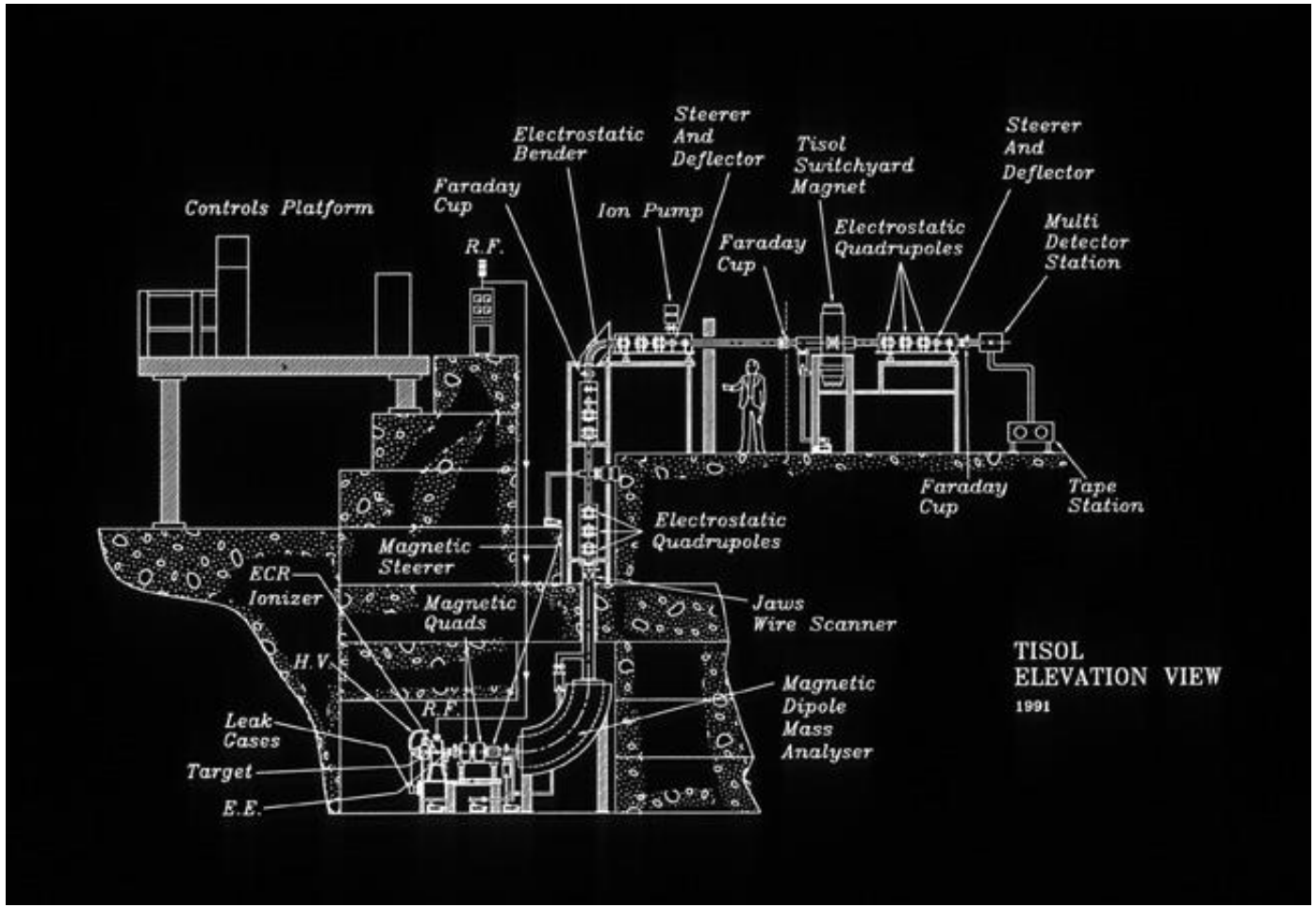
R.E. Azuma, L. Buchmann, J.M. D'Auria, U. Giesen, D. Hunter, D.A. Hutcheon, J.D. King, J. Rogers, G. Roy, T. Ruth, J. Vincent.
A gas target system for reaction studies in nuclear astrophysics at ISAC.
CAP Congress, Calgary: June 1997.

TISOL:

United States
Patent Application Publicatio
Vincent et al.

RADIOACTIVE ION

Inventors: **John S. Vincent**, Vancouver (CA);
Thomas J. Ruth, Vancouver (CA);
Alexander Zyuzin, Vancouver (CA);
John M. D'Auria, North Vancouver (CA); **David F. Ottewell**, Delta (CA);
Dale R. Harshman, Lynden, WA (US)



JS Vincent, A. Zyuzin, J. D'Auria, T. Ruth ,
D. Ottewell , D. Harshman.
Feasibility of ^{125}Xe Implantation for Brachytherapy.
Pacifichem 2000, Honolulu, Dec. 2000.

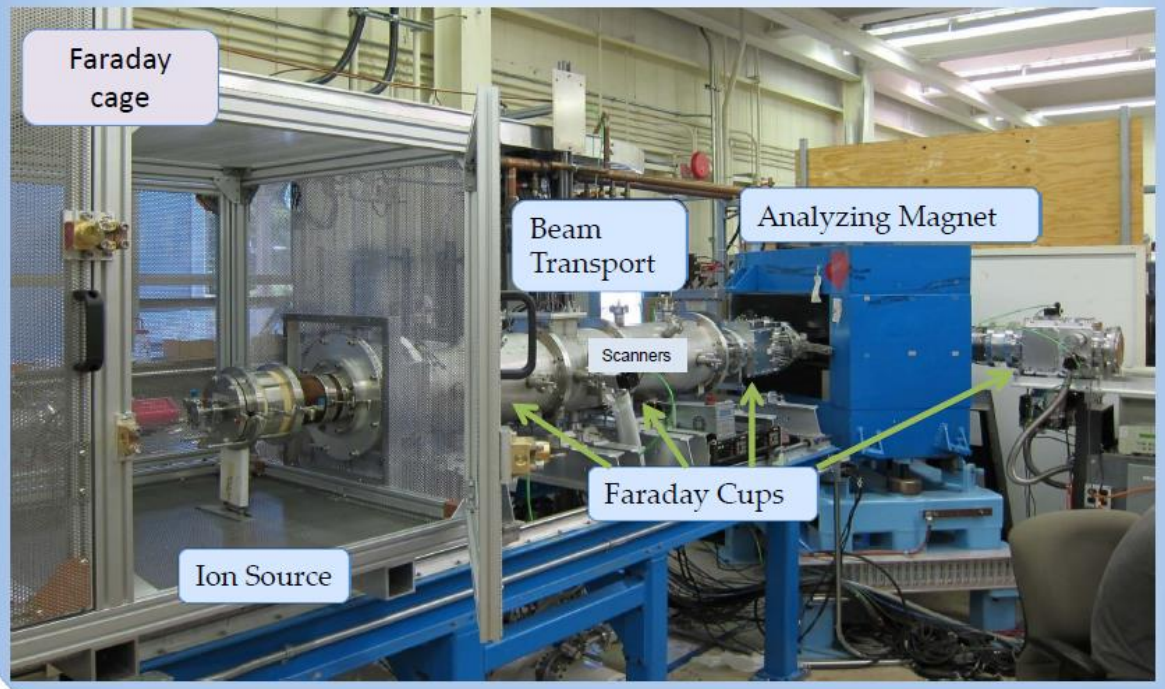
TJ Ruth, M Dombsky and JM D'Auria,
Exploration of the production of Rn-211
as a source of At-211 via the TISOL facility.
American Chemical Society, 1993.

An alternate approach to the production of radioisotopes for nuclear medicine applications

Cite as: Rev. Sci. Instrum. **84**, 034705 (2013); https://doi.org/10.1063/1.4797459
Submitted: 13 December 2012 . Accepted: 09 March 2013 . Published Online: 25 March 2013

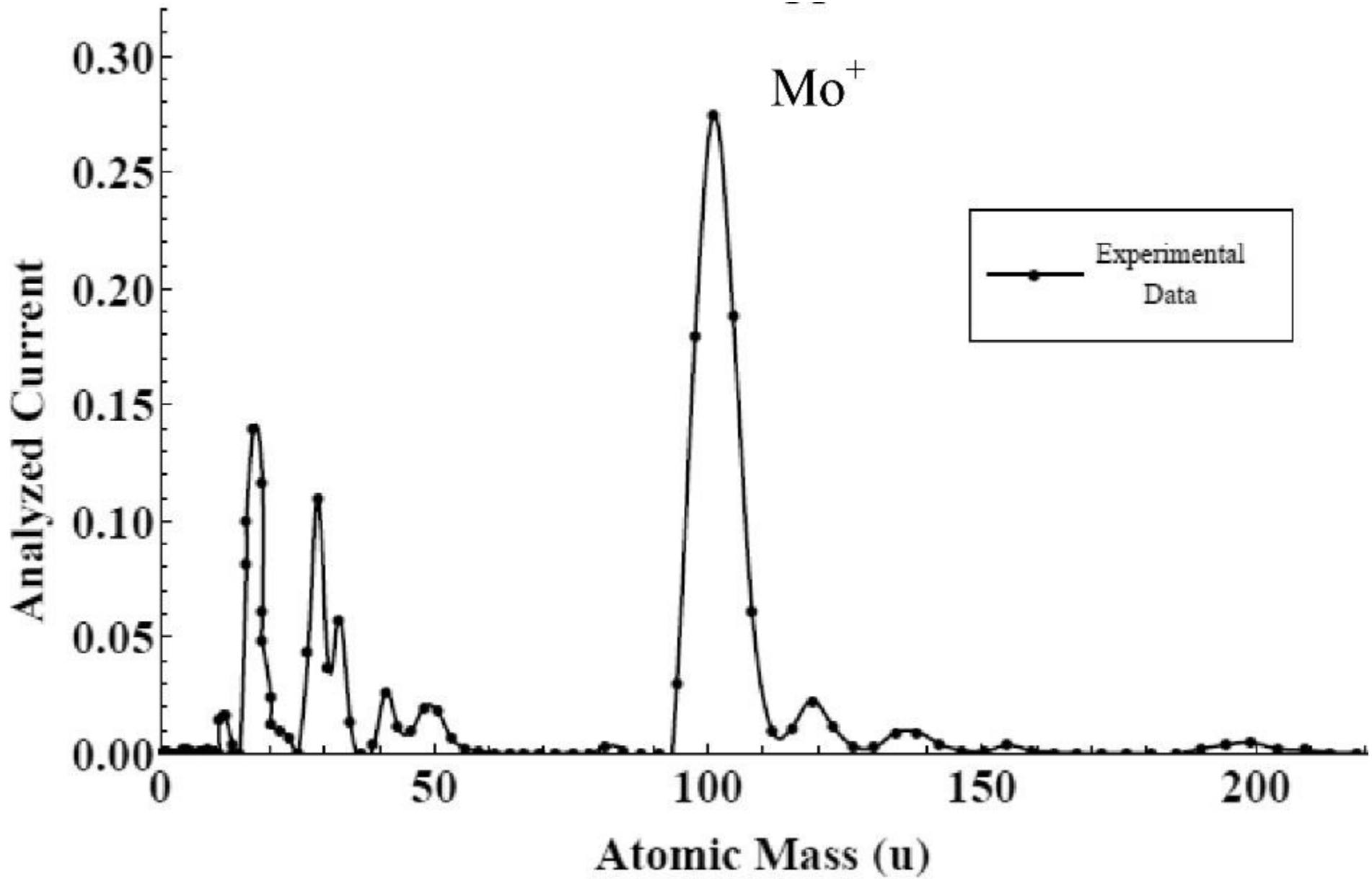
John M. D'Auria, Roderich Keller, Keith Ladouceur, Suzanne E. Lapi, Thomas J. Ruth, and Paul Schmor

Isotope Separator Test Facility



Patents based on using off-line isotope separator

US-COA published; claims (i) method of isolating isotopes, of SA > 30 Ci/mg, with (n,γ) or (γ,n) reaction, desired isotope – ^{186}Re or ^{99}Mo, (ii) isolated radioisotope material, (iii) isolated 2nd isotope for making therapeutic/diagnostic radiopharmaceutical


Mo+
Experimental Data
Analyzed Current
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
50
100
150
200
Atomic Mass (u)

History of TRIUMF
John D’Auria,
with Geoff D’Auria and Colin Jones

Reflecting on the resourceful capacity of the TRIUMF Scientists for re-inventing the scientific program through the years.

Acknowledgements

- First of all I wish to thank Corina for organizing this symposium in honor of John.
- I wish to thank Suzanne Gardner and Kate Scheel for their assistance with the Summer Institute
- Thanks are due to Keith Ladouceur for his constant efforts with the MoRe project, and beyond
- And of course Suzanne Lapi, student, colleague and friend who was involved in a great number of projects discussed here.
- Many, Many more from TRIUMF and SFU who made these projects happen.

Funding: Thanks to NSERC, CIHR and AAPS who all made this possible by their generosity. ;)

And finally to Brian Pate who recruited both John and me to Vancouver, 15 years apart, but still!

Thank you
Merci