Women In Nuclear: Why are there so few?

by

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University of Saskatchewan
Women in Physics, 5th annual conference.

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Highlights

The year 2003 was the 100th anniversary of Marie Sklodowska Curie's first Nobel Prize. Eight years later, she also received an unprecedented second Nobel Prize. **On this occasion Denise Ham published in 21st CENTURY, Winter 2002-2003 issue, the article untitled: 'Marie Sklodowska Curie: The Woman Who Opened The Nuclear Age' with the abstract: '*A new look at a revolutionary scientist's passion for truth, and how she inspired a generation of Americans'.***

However while working at **nuclear industry**, before joining UofS in 2009, I have noted that there are still **very few women there**.

In this presentation I will try to show few examples of **research area in nuclear physics** that I have been involved. I found it not only interesting but also useful for humanity, which I think is very important for the members of WIPH to consider of being involved!

In the end I will also provide information about the new local **WIN** (http://www.wincanada.org/) Chapter in Saskatchewan & Alberta that we have been involved in lunching in 2012 at the CNS annual conference in Saskatoon and which is associated with WIM under the name WIM/WIN (http://wimwinsk.com/).

Marie Sklodowska Curie: The Woman Who Opened The Nuclear Age

by Denise Ham

A new look at a revolutionary scientist's passion for truth, and how she inspired a generation of Americans.

In my quest to examine the life of Marie Curie, I had the good fortune to rediscover her life's work, particularly her discovery of polonium and radium, and her great discovery concerning the nature of the atom. In this journey, I was happy to become intimately aware that discovery itself, is an issue of passion. It surprised me considerably that my understanding of her work grew enormously, because I simply loved trying to understand that which she discovered. Since my formal education is more than bereft, especially in science, I think that I am fortunate in being able to discover in myself that very passion for knowledge which drives the creative individual to make critical discoveries that transform the physical universe. I have many people to thank for helping me in this project, which took more than a year; foremost, I wish to thank Madame Marie Sklodowska Curie, and say that her life is an inspiration which I have loved.

AIP Niels Bohr Library

Marie Sklodowska Curie (1867-1934) in her laboratory.

but not many women in nuclear industry!

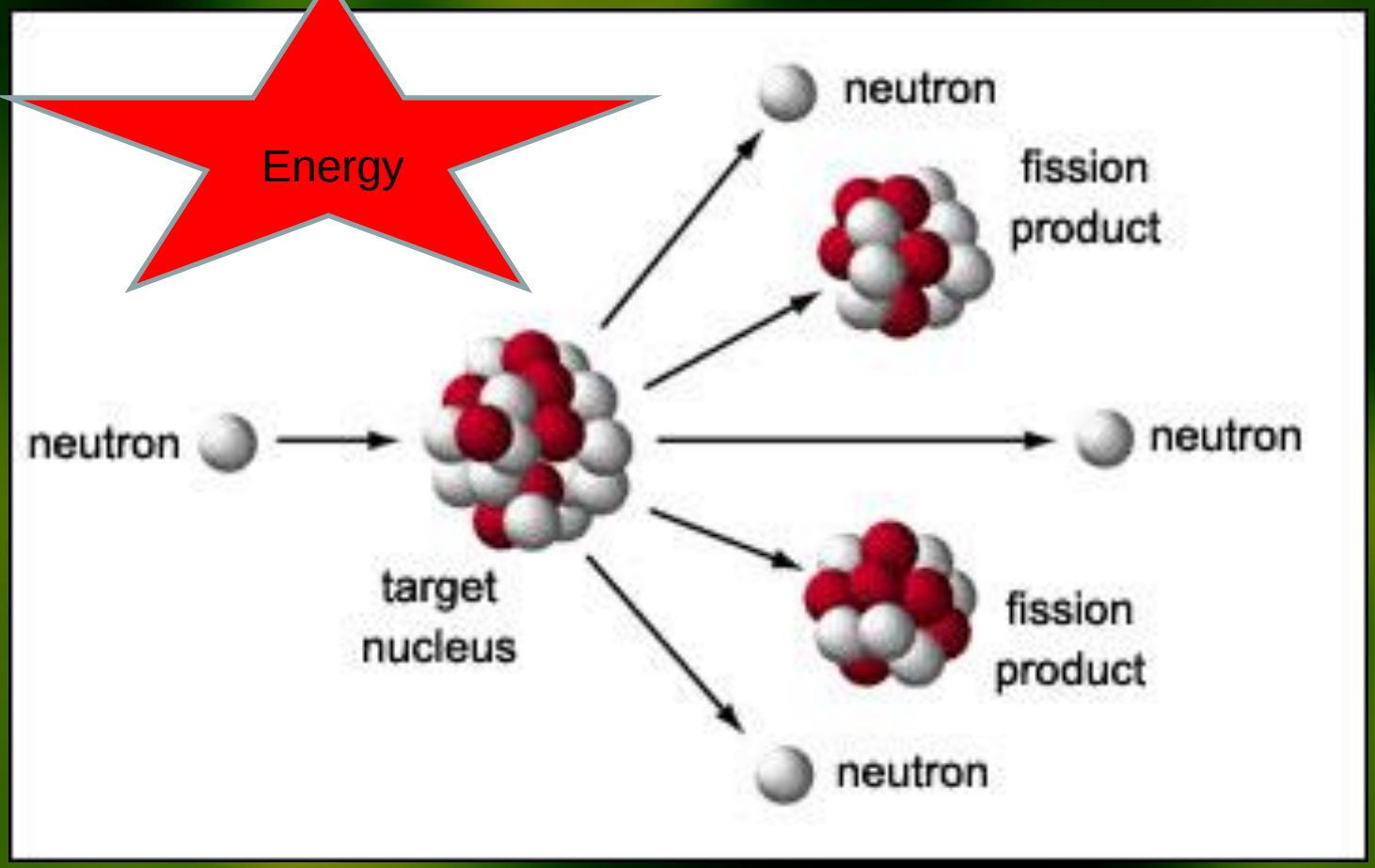
Big opportunity for you to curry interesting research, which also helps humanity!

Benefit:

Fission

Efficiency: 30%

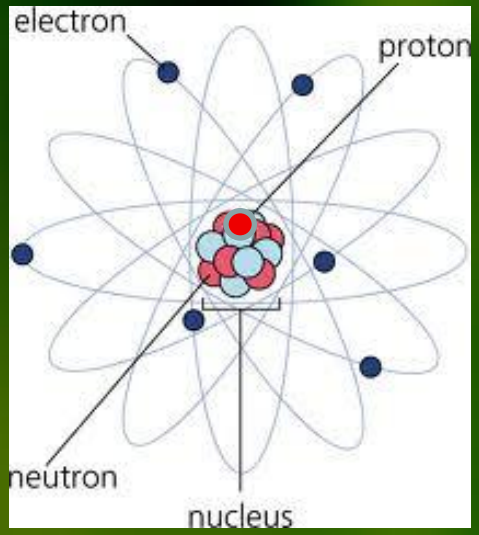
Nuclear reactor: Energy ➡ electricity

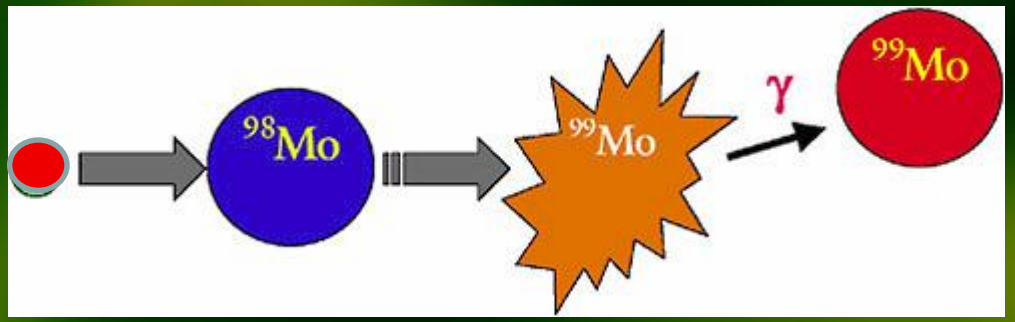


Benefit:

Artificial transmutation

Nuclear reactor: medical isotopes





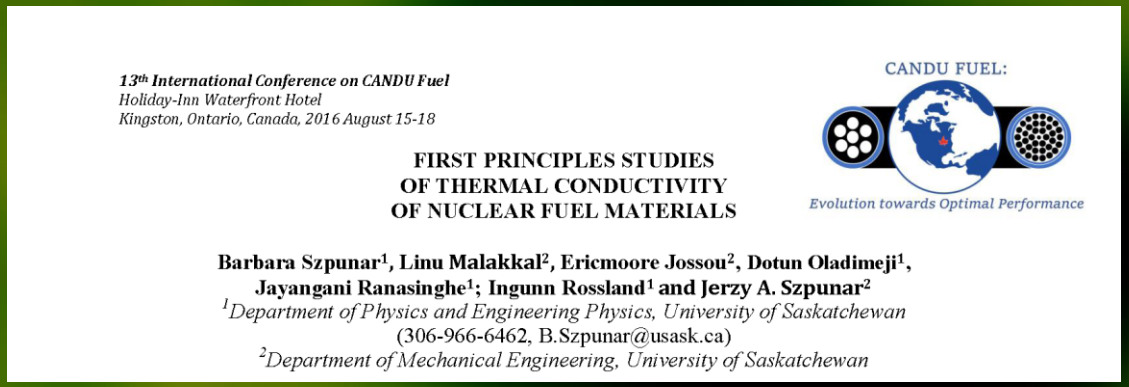
$$^{99}_{42}Mo \rightarrow {}^{99m}_{43}Tc + {}^{0}_{-1}e + \overline{\nu}$$

Problem:

Fukushima nuclear accident demonstrated:

- **Safety problems with the current design** of nuclear reactors.
- Nuclear mishap should be viewed using **interdisciplinary tools.** See new course at the UofS:

http://homepage.usask.ca/~bas627/MultidisciplinaryRS/MultidisciplRSPhys.htm



13th International Conference on CANDU Fuel
Holiday-Inn Waterfront Hotel
Kingston, Ontario, Canada, 2016 August 15-18

CANDU FUEL:
Evolution towards Optimal Performance

FIRST PRINCIPLES STUDIES OF THERMAL CONDUCTIVITY OF NUCLEAR FUEL MATERIALS

Barbara Szpunar[1], Linu Malakkal[2], Ericmoore Jossou[2], Dotun Oladimeji[1], Jayangani Ranasinghe[1]; Ingunn Rossland[1] and Jerzy A. Szpunar[2]
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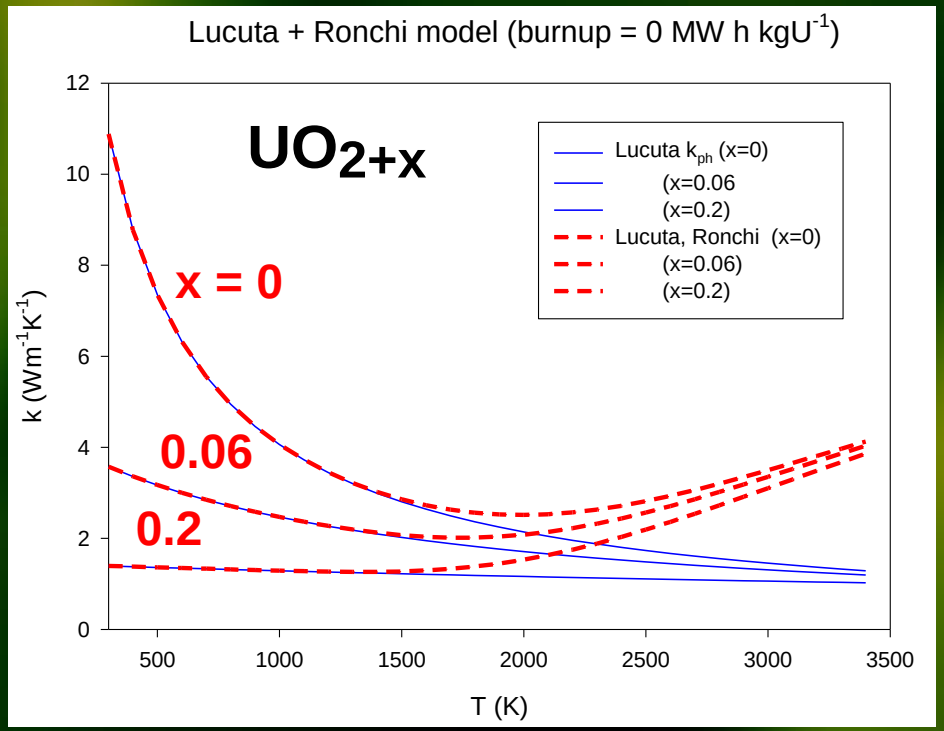
Problem:

Low Thermal Conductivity of Urania Fuel

Degradation of thermal conductivity of urania with x and temperature

UO_{2+x}



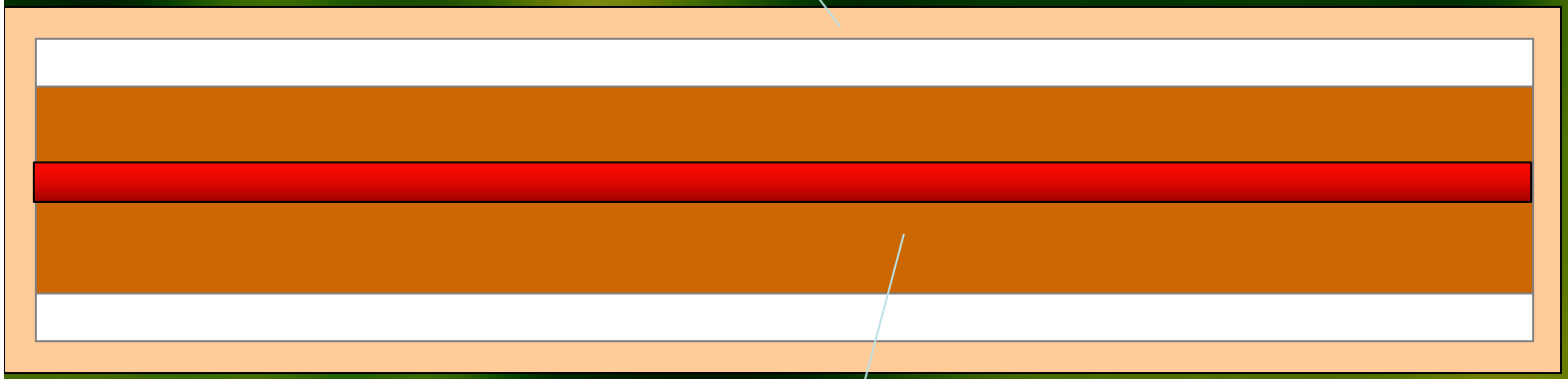
Lewis B. J., Szpunar B. and Iglesias F. C., J. Nucl. Mater., 306 (2002) 30-43
Fink J.K., J. Nucl. Mater. 279 (2000) 1-18.

Problem:

NUCLEAR ACCIDENT: Melting

Zr Oxidation Completed

Central melting due to poor heat dissipation.



Fuel Oxidation

$xH_2O+UO_2=UO_{2+x}+xH_2$

Problem:

NUCLEAR ACCIDENT:

Meltdown of fuel rods

Zr Oxidation Completed

Corium, complete meltdown.

Fuel Oxidation

$xH_2O+UO_2=UO_{2+x}+xH_2$

Solution:

Accident tolerant nuclear fuel

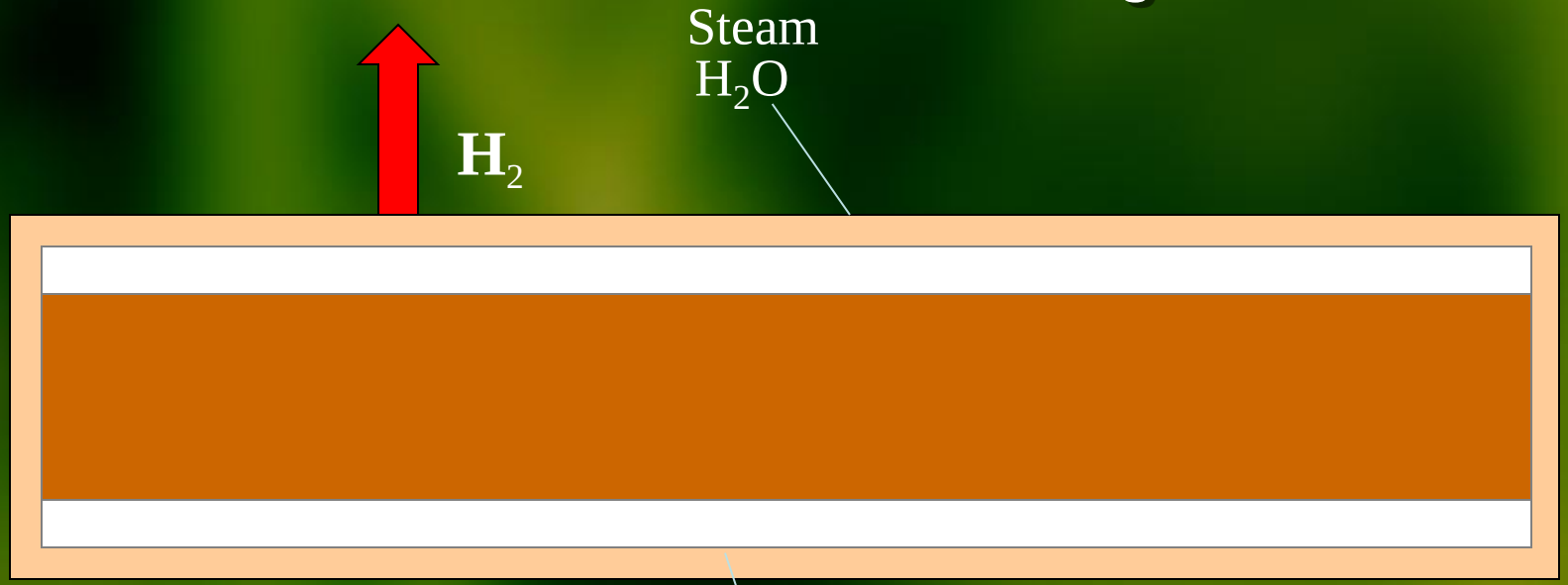
Higher thermal conductivity and no oxidation!

Comment: Maybe Saskatchewan should step in and produce accident tolerant nuclear fuel and not just export uranium ore?

Problem:

NUCLEAR ACCIDENT:

Oxidation of fuel cladding



Zr corrosion accelerated above several hundreds °C:

$Zr+2H_2O=ZrO_2+2H_2$

NUCLEAR ACCIDENT:

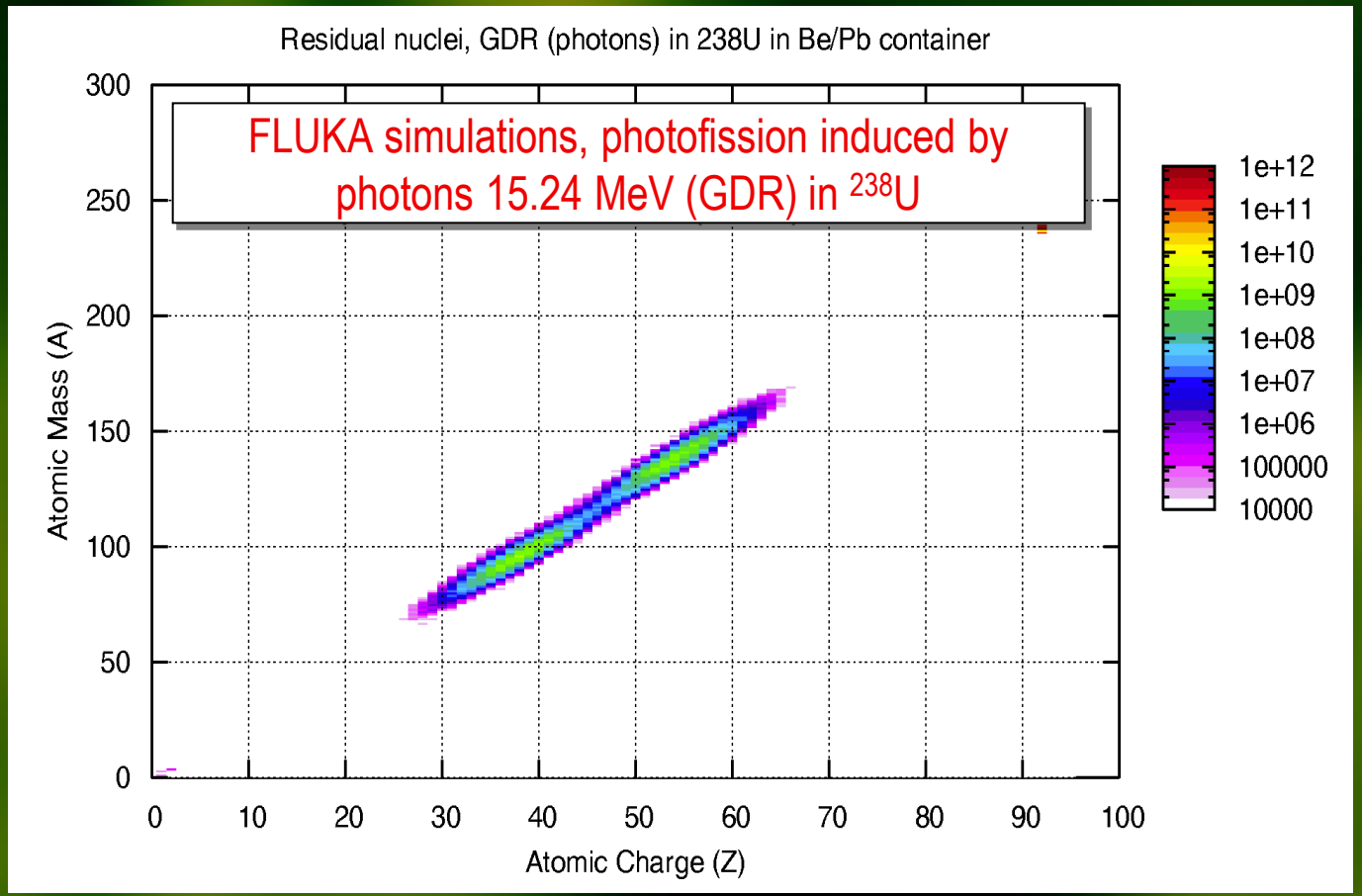
Solution:

Accident tolerant fuel cladding

More benign to reaction with steam and no hydrogen gas generation!

Problem & solution:

Only 0.711% of uranium is used in CANDU nuclear reactor (fission induced by thermal neutrons in ^{235}U) and **99.284% of ^{238}U not used!** Fast neutrons, high energy photons can induce fission in ^{238}U ➡ more energy, less nuclear wastes!



Problem & solution:

Nuclear waste & treatment example:

^{135}Cs transmutation by GDR (15.01 MeV)

Produced Isotope (reaction)	Yield [per photon per target]	Error [%]
$(n,\gamma)\ ^{136}Cs^{\#}$	1.35×10^{-04}	3.1
$(\gamma,e^+e^-)_{atomic}\ ^{135}Cs$	1.67×10^{-03}	1.1
$(\gamma,n)\ ^{134}Cs$	**2.22×10^{-02}**	**0.2**
$(\gamma,2n)\ ^{133}Cs$	2.76×10^{-04}	4.4
$(\gamma,p)\ ^{134}Xe$	3.00×10^{-06}	23.6

#Secondary neutron capture

2.3×10^6 years half-life time of ^{135}Cs

↓

2.0648 years ^{134}Cs

or 13.16 d ^{136}Cs (secondary neutron capture)

SUMMARY

PLENTY OF OPPORTUNITIES TO MAKE A DIFFERENCE!

CNS CONFERENCE, 2016, TORONTO

https://www.cns-snc.ca/CNS/western-branch/

The Nobel Prize winner in Physics in 2015 **Arthur B. McDonald**

with equal number of women and men!

UNIVERSITY OF SASKATCHEWAN

Women in Nuclear

http://www.wincanada.org/, http://wimwinsk.com

WiN-Global, WiN-Canada:

- World-wide organization of women in various field of nuclear energy, nuclear medicine and radiation science

Heather Kleb
President
WiN-Canada
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28th July, 2016

WiN-Canada was formed in early **2004** and has been working to support the **objectives of WIN-Global** and emphasize and support the **role that women** can and do have in addressing the **general public's concerns** about nuclear energy and the application of radiation and nuclear technology.

Saskatchewan Chapter: WiM/WiN, lunched in 2012 during CNS conference in Saskatoon.

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