NCSU Nuclear Engineering Seminar

Thursday February 6, 2020

Jezebel: Reconstructing a Critical Experiment from 60 Years Ago

Dr. Jeffrey Favorite
Radiation Transport Applications Group (XCP-7), Los Alamos National Laboratory

Abstract:

The Jezebel experiment of 1954-1955 was a very small, nearly-spherical, nearly-bare (unreflected), nearly-homogeneous assembly of plutonium alloyed with gallium. This experiment was used to determine the critical mass of spherical, bare, homogeneous Pu-alloy. In 1956, the critical mass of Pu-alloy was determined to be 16.45 ± 0.05 kg. The experiment was reevaluated in 1969 using logbooks from the 1950s and updated nuclear cross sections. The critical mass of Pu-alloy was determined to be 16.57 ± 0.10 kg.

In 2013, the ^{239}Pu Jezebel experiment was again reevaluated, this time using detailed geometry and materials models and modern nuclear cross sections in high-fidelity Monte Carlo neutron transport calculations. Documentation from the 1950s was often inconsistent or missing altogether, and assumptions had to be made. The critical mass of Pu-alloy was determined to be 16.624 ± 0.075 kg.

Historic documents were subsequently found that validated some of the 2013 assumptions and invalidated others. In 2016, the newly found information was used to once again reevaluate the ^{239}Pu Jezebel experiment. The critical mass of Pu-alloy was determined to be 16.624 ± 0.065 kg.

This talk will discuss each of these evaluations, focusing on the calculation of the uncertainty as well as the critical mass. We call attention to the ambiguity, consternation, despair, and euphoria involved in reconstructing the historic Jezebel experiment. This talk is quite accessible for undergraduate students as well as non-majors.

About Jeffrey Favorite:

Dr. Jeffrey Favorite received his Bachelor's, Master's, and Ph.D. in nuclear engineering from the Georgia Institute of Technology in 1993, 1994, and 1998, respectively, where he studied variational perturbation methods in nuclear reactor physics under Prof. W. M. Stacey. A paper based on his Master's thesis won the Mark Mills Award from the American Nuclear Society in 1995. In 1998, Dr. Favorite joined X-Division at Los Alamos National Laboratory, where he remains. His work and research are in the areas of neutron multiplication and criticality, neutron and photon shielding, and other neutron and photon simulations and analyses using the MCNP Monte Carlo code, the PARTISN discrete-ordinates code, and other transport codes. His particular interests are in perturbation and sensitivity methods as well as inverse and optimization methods for neutron and photon transport problems. Interface and boundary perturbations are of special interest. In Los Alamos, Dr. Favorite is active in the performing arts, youth programs, and the Episcopal church.

Can't attend in person? Watch Dr. Favorite's seminar on the NCSU Nuclear Engineering YouTube channel: https://www.youtube.com/channel/UC8KOrmhwj0-7EGunN8LN9Tg

Agenda:

Time	Event	Location	Host(s)
Wednesday February 5			
18:00 - 20:00	Dinner	The Players' Retreat 105 Oberlin Rd	John Mattingly
Thursday February 6			
08:30 - 09:30	Breakfast	Holiday Inn Downtown	John Mattingly
09:30 - 09:45	Drive to Centennial campus		
09:45 - 10:15	Tour RADIANS lab	122 Research II	
10:15 - 10:45	Meet with Ryan O'Mara	216B Research II	Ryan O'Mara
10:45 - 11:00	Drive to North campus		
11:00 - 11:45	Discuss career opportunities at LANL with students	3108 Burlington	Sherry Bailey
11:45 - 12:00	Walk to Talley student union		John Mattingly
12:00 - 13:10	Lunch	1887 Bistro	John Mattingly Mohamed Bourham Ge Yang
13:10 - 13:25	Walk to SAS		John Mattingly
13:25 - 13:55	Meet with Ralph Smith	4140 SAS	Ralph Smith
13:55 - 14:00	Walk to Burlington		John Mattingly
14:00 - 14:30	Discuss implementing SA/UQ in THOR	2146 Burlington	Yousry Azmy Dmitriy Anistratov John Mattingly
14:30 - 15:00	Meet with Yousry Azmy	2146 Burlington	Yousry Azmy
15:00 - 15:30	Meet with Dmitriy Anistratov	2105 Burlington	Dmitriy Anistratov
15:30 - 15:45	Break	Global Village coffeehouse	John Mattingly
15:45 - 16:00	Prepare for seminar	1202 Burlington	
16:00 - 17:00	Seminar	1202 Burlington	
17:00 - 17:15	Drive to hotel		
17:15 - 17:45	Rest at hotel	Holiday Inn Downtown	
17:45 - 18:00	Drive to restaurant		John Mattingly
18:00 - 20:00	Dinner	Taverna Agora 326 Hillsborough St	John Mattingly Mike Doster Xu Wu
20:00 - 20:15	Drive to hotel	Holiday Inn Downtown	John Mattingly