

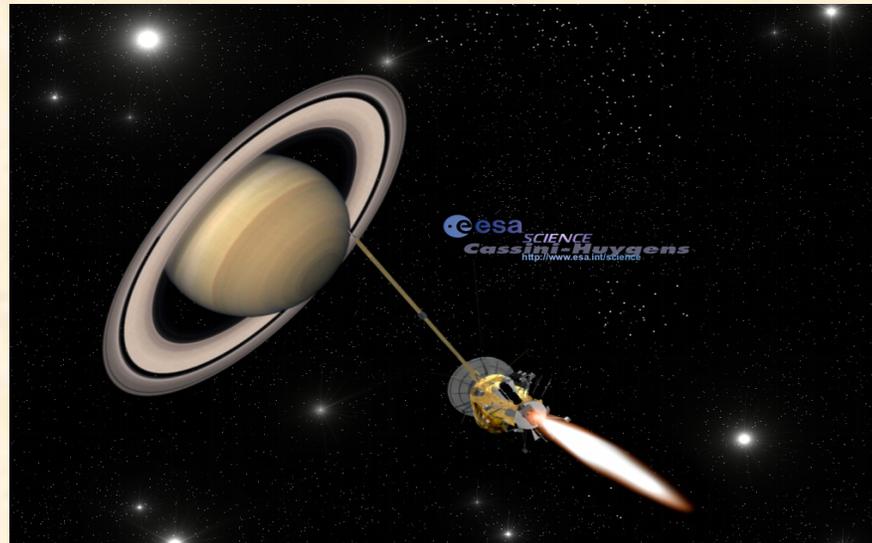
# Project Overview and Status Report or How I Spent my Summer at ORNL

Wesley Frey  
Mentor: Alan Icenhour

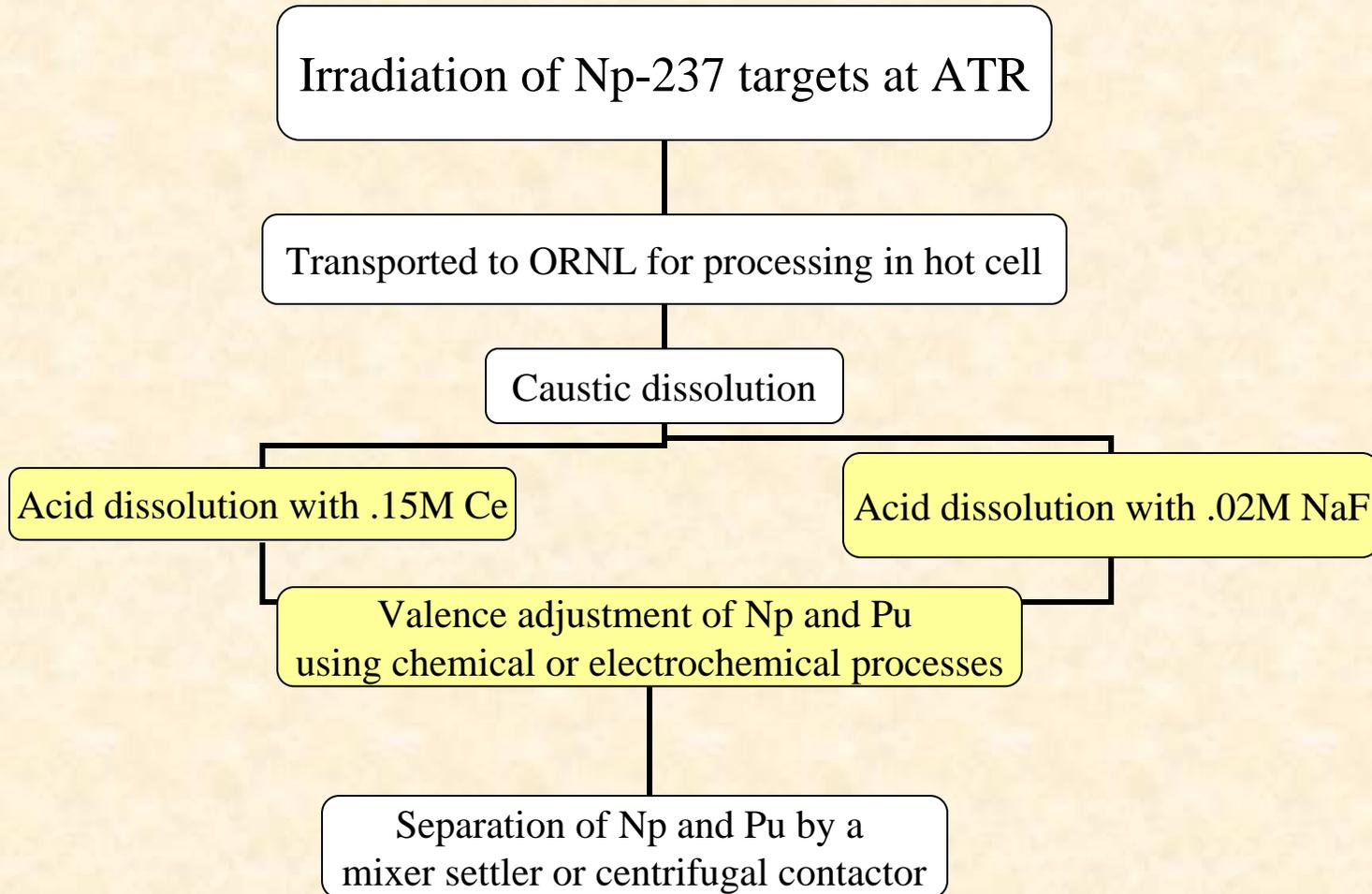
Nuclear Engineering Student Laboratory Synthesis  
Summer 2004

# Pu-238 Production

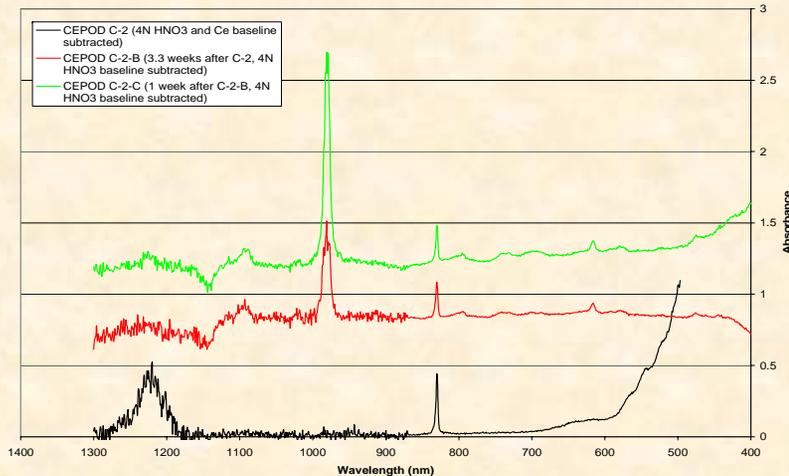
- Why do you want to produce Pu-238?
- Used to make the core of radioisotope thermoelectric generators.
- Primarily used in deep space probes.



# Overview of Pu-238 Production and Separation



# Verification of Valence States by Spectrophotometry



- Provides real time data of the Np and Pu valence states from within the hotcell.
- This data aids in the chemical and electrochemical valence adjustments.



OAK RIDGE NATIONAL LABORATORY  
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE

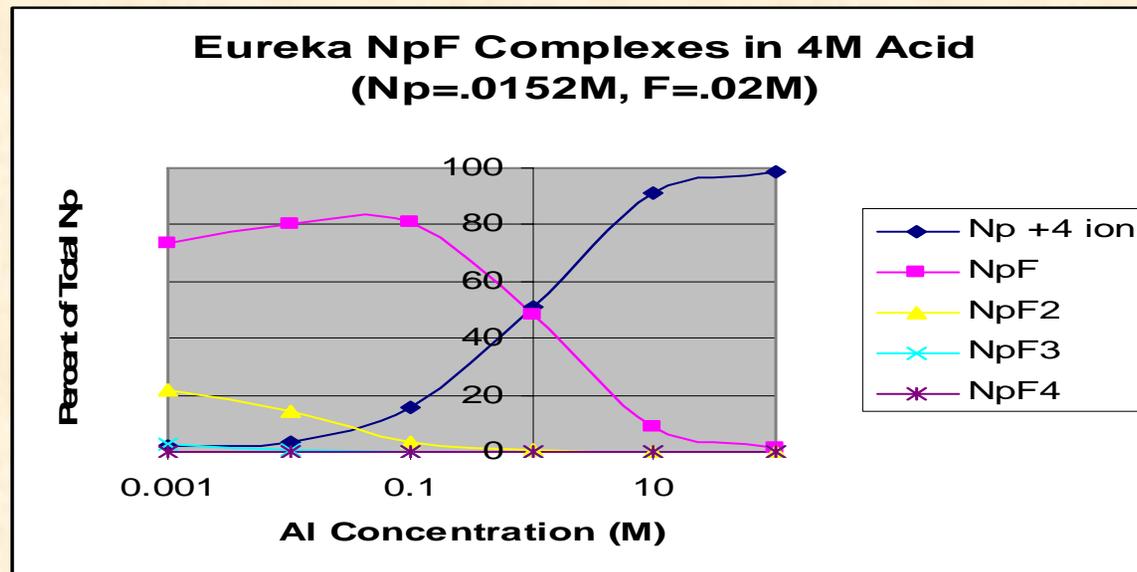
# Current Efforts and Goals of the Group

- Investigate the use of electrochemical manipulation to adjust the valence states of Np and Pu.
- Determine the rate at which radiolysis changes the valence states of Np and Pu.
- Based on the results a decision will be made to use either a mixer settler or centrifugal contactor for the Np Pu separation.



# My Current Efforts

- Determine ionic equilibrium concentrations by setting up a series of simultaneous equations based on known rate equations.
- This programs specific aim was to see if aluminum nitrate could be used to “draw” fluoride way from the NpF and PuF complexes.



## Future Plans

- **Expand this program from a qualitative tool to a quantitative tool.**
  - **Current program is limited in size and can not account for various other actinide complexes.**
    - e.g.  $\text{NpO}_2^{++}$  and  $\text{PuO}_2^{++}$  fluoride complexes
- **Increase the flexibility of the program so that it can automatically run sensitivity test, i.e. change in concentration vs. acidity.**

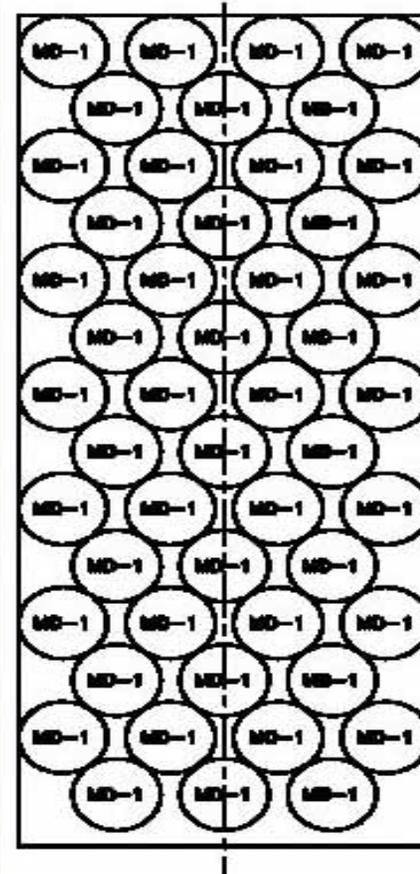
# Thorium Nitrate Transportation Project

- Hope to find exposure rate from a shipping container filled 144 ThN drums from Curtis Bay.
- Previous efforts have found an upper estimate of the exposure rate of French ThN, based on a homogeneous model.
- The goal of this project is to improve upon the homogeneous model and to determine what the exposure rate is relative to DOT limits.



# Quasi-Homogeneous Method

- Used Microshield, a deterministic point kernel program, to run 72 individual dose calculations.
- Most of the exposure will come from the first row of drums because the radiation will have a nearly unobstructed path to the exposure point.
- Geometry of the drums will be completely preserved.
- Geometry of the shielding in the first row will be preserved.
- Shielding between the drum in question and the exposure point will be replaced by an equivalent amount of homogeneous shielding (hence quasi-homogeneous method).



## Results

- Exposure 2 meters away and 1 meter off the ground using homogeneous method: ~12.2 mR/hr.
- Exposure 2 meters away and 1 meter off the ground using quasi-homogenous method: ~11.1 mR/hr and ~8.5 mR/hr with additional polyethylene shielding.
- Maximum exposure permitted by DOT?
  - 10.0 mR/hr

## Future Work

- **Actual exposure measurements will be taken in early August.**
- **Verification of the accuracy of the two models.**
- **Possible modification of the quasi-homogeneous model to improve accuracy for future use.**
- **If quasi-homogeneous model is found to be accurate and actual exposure rate is above 10.0 mR/hr, the model could be used to determine the best way to lower exposure rate to the permissible level.**

Questions?