NIST Center for Neutron Research

Online Platform for Radiological Computations

SURF Colloquium
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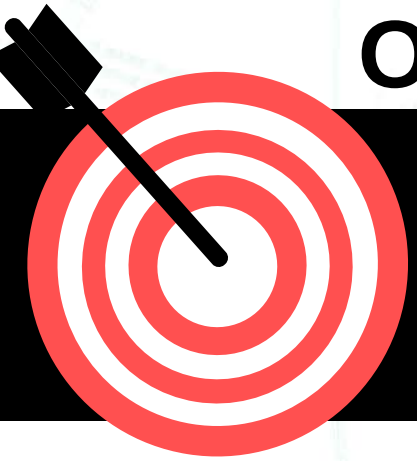
Rowan University
COLLEGE OF SCIENCE & MATHEMATICS

Aubrie Weyhmiller
aubrie.weyhmiller@nist.gov
weyhmilla9@students.rowan.edu

CHRNS
NSF CENTER FOR HIGH RESOLUTION NEUTRON SCATTERING NIST

1. Background
2. Program Applications
3. Program Design, Benefits, Future Integration

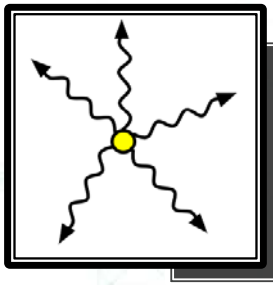
Objectives



Data Consolidation

Program Development

Deployment



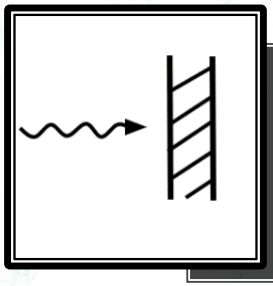
Source Geometry

ALI

Restrictive Values

$P \rightarrow D$

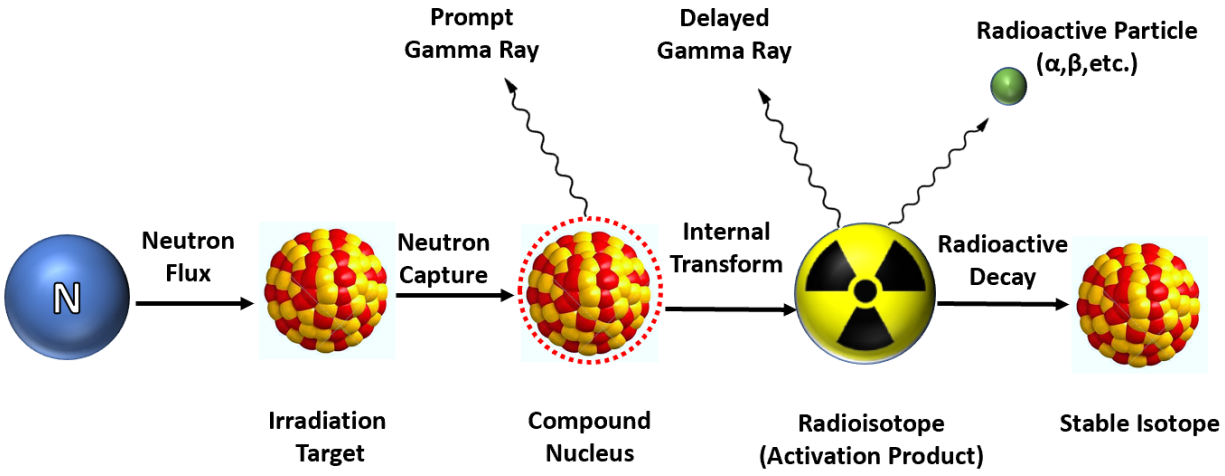
Decay

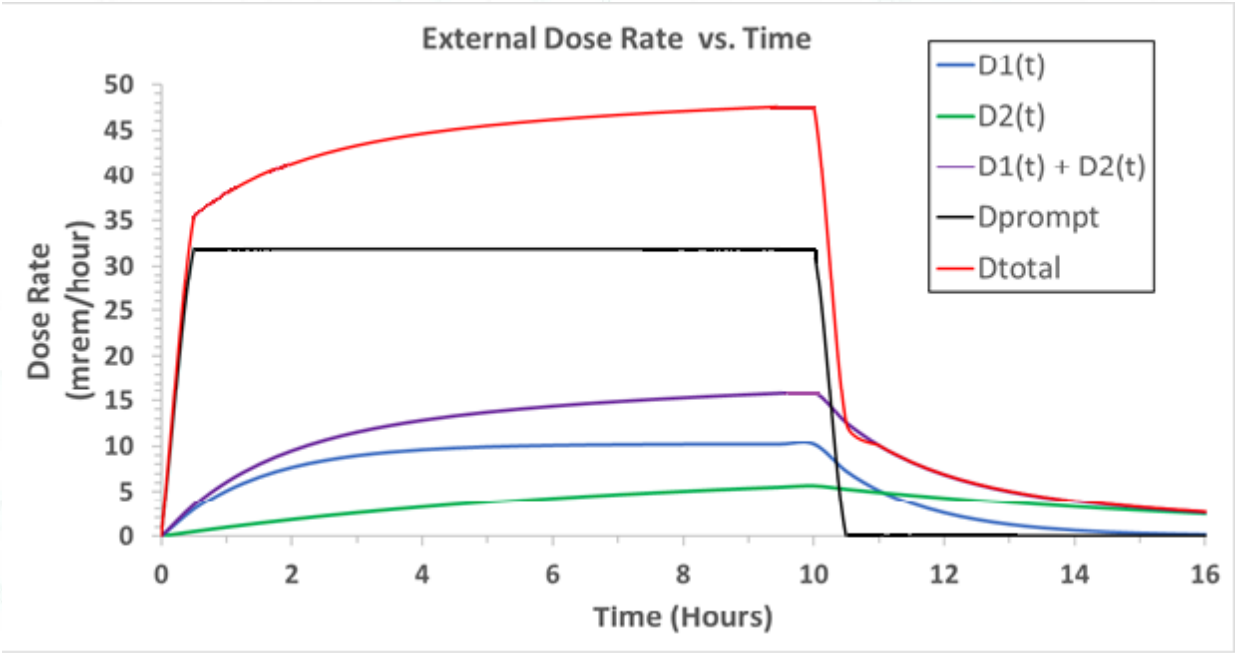


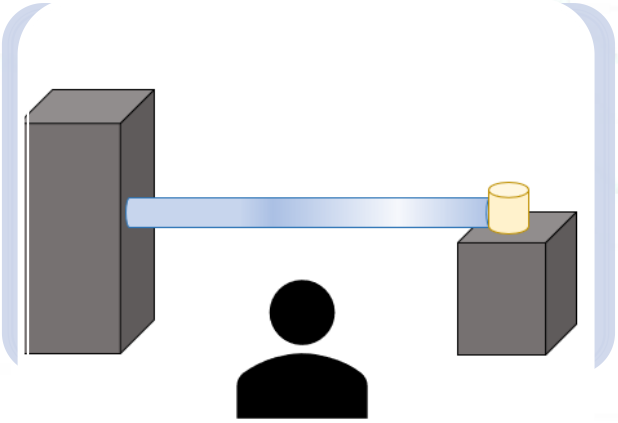
Shielding

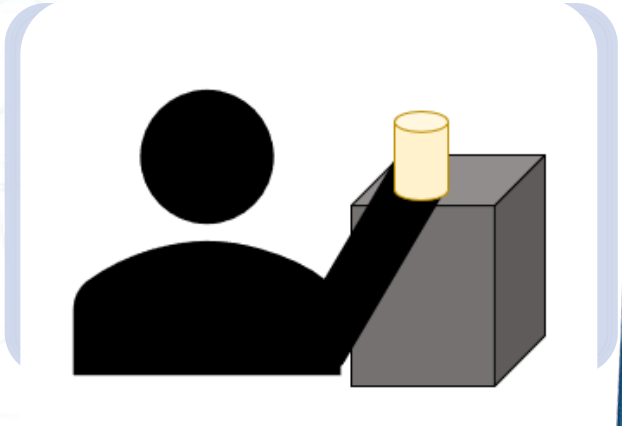
This does not replace the work of Health Physics.

- Neutron Flux (Φ)
  - Irradiation Time
  - Decay Time
- Target Material
  - Cross Sections
  - Mass
- Activation Products
  - Half-life
  - Emission Type
  - Emission Energy
  - Emission Intensity
- Exposure Pathway









External

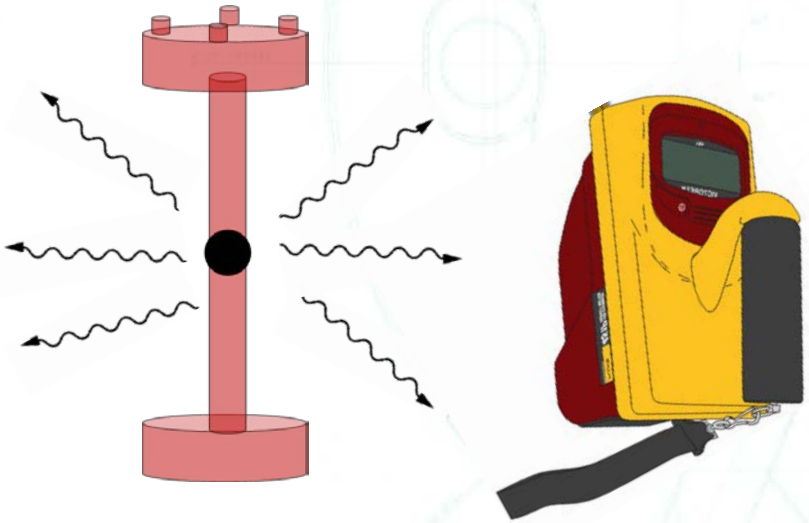
Internal

Skin

Activation of Ho after 2 days at 1.00e+8 n/cm^2/s

Sample in beam: 1.000 g of Ho
Time to decay below 0.100 nCi is 3.3 yrs.

				Activity (µCi)				>0.0001 µCi
element	reaction	product	half life	0 hrs	1 hr	24 hrs	15 days	0.00 sec
Ho-165	act	Ho-166	27.2 h	4.2609e+2	4.1536e+2	2.3114e+2	4.4185e-2	4.2609e+2
Ho-165	act	Ho-166m	1200 y	1.0929e-4	1.0929e-4	1.0929e-4	1.0928e-4	1.0929e-4
total activity				4.2609e+2	4.1536e+2	2.3114e+2	4.4294e-2	4.2609e+2



Summary Table for Ho-166

Summary Decay Data Table for Ho-166

Half-Life: 26.80 h
Mode: β -

Specific Activity: 2.608E+19 Bq / kg
Source: ICRP-07.NDX

Radiation	Number	Frequency Σ Yi (/nt)	Energy Σ Yi * Ei (MeV/nt)	Mean Energy ΣYi * Ei / ΣYi (Mev)
Gamma rays	14	8.033E-02	2.419E-02	3.011E-01
X rays	53	3.661E+00	5.889E-03	1.608E-03
Beta -	7	1.000E+00	6.650E-01	6.650E-01
IC electrons	88	4.616E-01	2.840E-02	6.152E-02
Auger electrons	15	2.987E+00	2.950E-03	9.875E-04
Total Emitted Energy:			7.264E-01	

Average energy of beta spectrum: 6.66E-01 MeV
End point energy of beta spectrum: 1.85E+00 MeV

Note: Yi = intensity of radiation i; Ei = energy of radiation i

Activation of Ho after 2 days at 1.00e+8 n/cm^2/s

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Ho-165	act	Ho-166m	1200 y	1.0929e-4	1.0929e-4	1.0929e-4	1.0928e-4	1.0929e-4
total activity				4.2609e+2	4.1536e+2	2.3114e+2	4.4294e-2	4.2609e+2

Isotope	Final Activity (uCi)	Specific Gamma Constant (mrem m^2 /uCi hr)	Unshielded Specific Gamma Dose Rate at 1 m (mrem hr)	% Contribution to Total Unshielded Specific Gamma Dose Rate
Ho-166	462.0	1.507e-05	0.006963	99.99%
Ho-166m	0.0001093	0.0008697	9.506e-08	0.001365%

Isotope	Final Activity (uCi)	Varskin Contact (Beta + Gamma) Point Source Dose Rate per uCi (mrem/ hr uCi)	Varskin Contact (Beta + Gamma) Point Source Dose Rate Full Source (mrem/hr)	% Contribution to Varskin Contact (Beta + Gamma) Point Source Dose Rate Full Source	Varskin 1 cm (Beta + Gamma) Point Source Dose Rate per uCi (mrem/ hr uCi)	Varskin 1 cm (Beta + Gamma) Point Source Dose Rate Full Source (mrem/hr)
Ho-166	462.0	582.0	268884.0	100.0%	103.0	47586.0
Ho-166m	0.0001093	55.6	0.00607708	2.26e-06%	3.06e-05	3.34458e-09

External	Internal	Skin
• $\Gamma_{constant}$ • $i_{constant}$ Schwahn & Smith/Stabin (IAEA, ICRP107)	• ALI • Ingestion • Inhalation 10CFR20	• VARSKIN • Contact • 1 cm NRC

External

- Γ_{constant}
- $\text{i}_{\text{ dos/unit flux}}$

Schwahn & Smith/Stabin (IAEA, ICRP107)

Skin

- VARSKIN
- 1 cm
- Contact

- NRC

$$\dot{X}_{\text{specific}} = \Gamma \frac{A}{d^2}$$

$$\dot{X}_{prompt} = \text{i}_{\text{ dos/unit flux}} \phi$$

$$\dot{X}_{\text{skin}} = V_{\text{skin}} \times A$$

Co^{60}

$\text{ALI} = 200\ \mu Ci$

$*\ 1\ \text{ALI} =\ 5\ rem$ dose

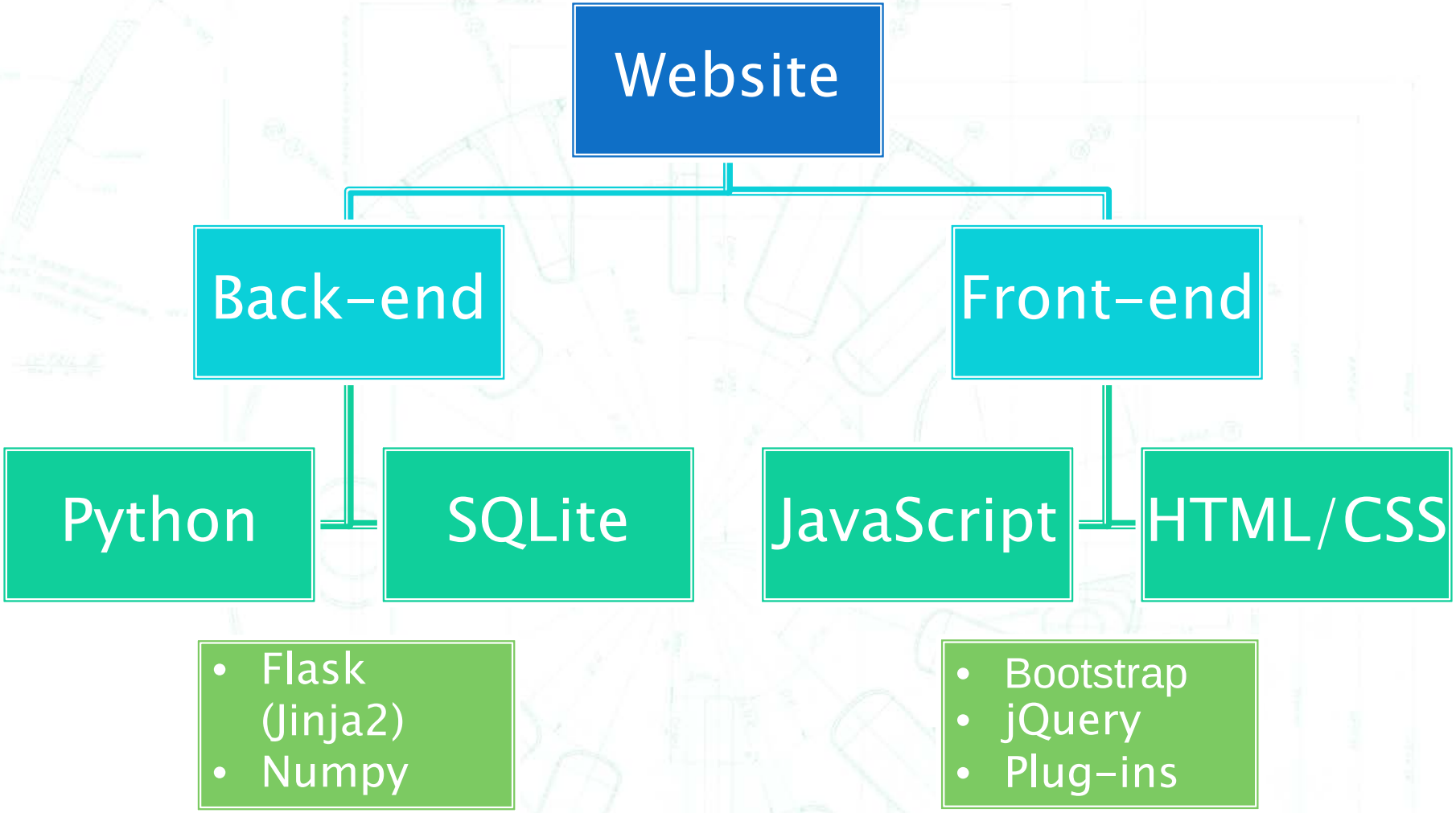
Internal

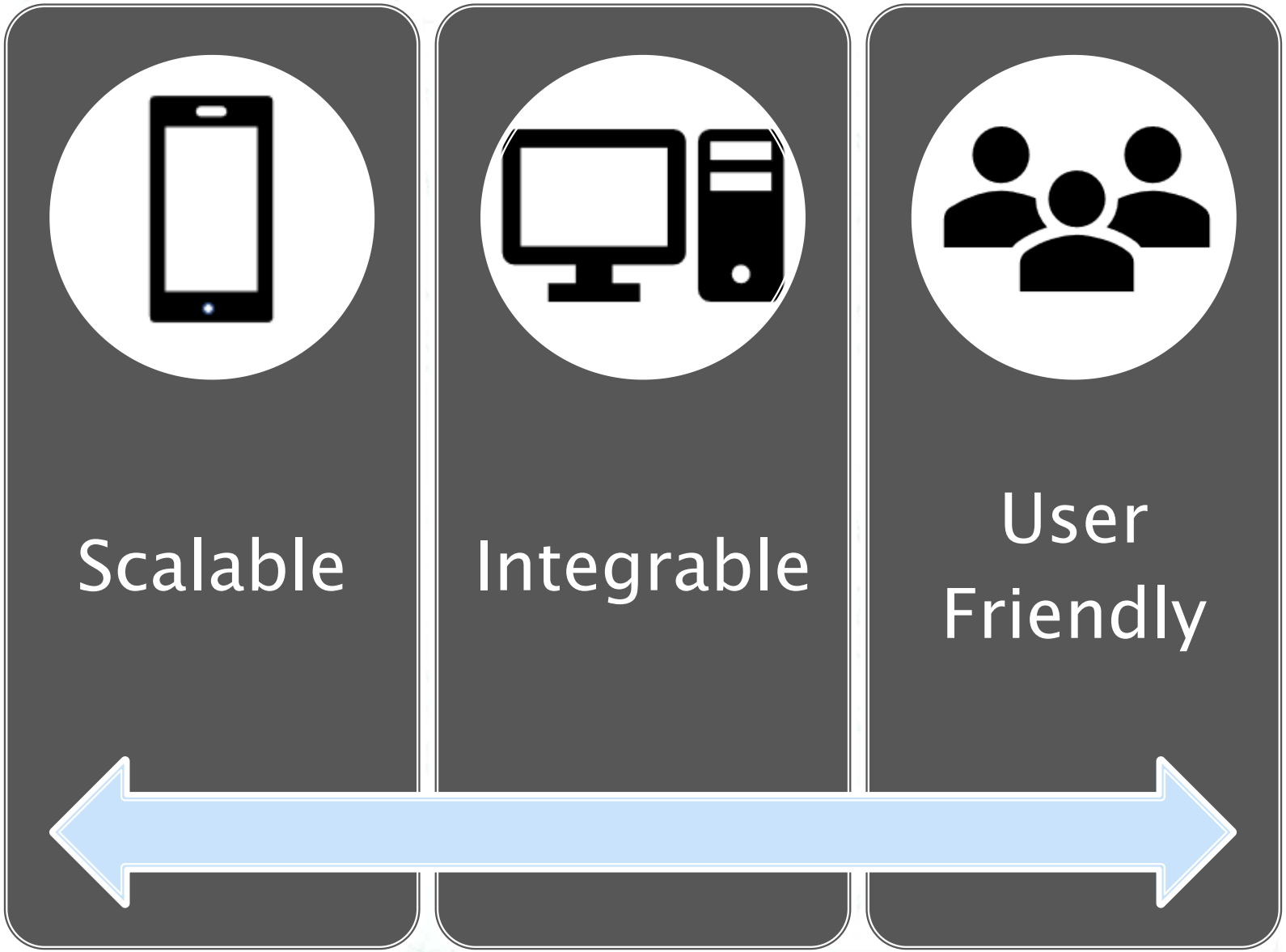
- ALI
- Ingestion
- Inhalation

- 10CFR20

$$\frac{100\ \mu Ci}{200\ \mu Ci} = 0.5\ \text{ALI}$$

$$0.5\ \text{ALI} * 5\ rem = 2.5\ rem$$


Website
Back-end
Front-end
Python
SQLite
JavaScript
HTML/CSS
• Flask (Jinja2)
• Numpy
• Bootstrap
• jQuery
• Plug-ins


Scalable
Integrable
User Friendly

Future Development And Applications

Current

- Deploy locally

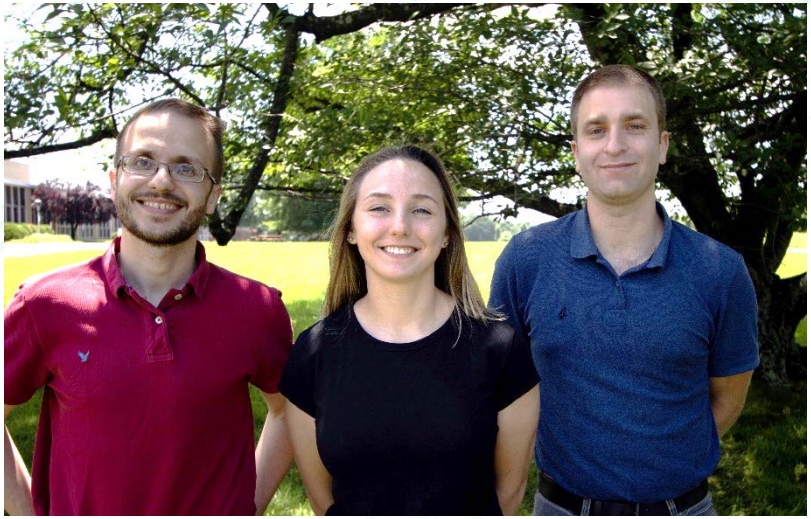
1-2 Years

- Integrate with Activation Calculator

Future

- Integrate with other neutron facilities

Acknowledgements



Tim Barvitskie
NCNR Health Physics

Danyal Turkoglu
NCNR Reactor Operators and Engineers

SURF

ROE SURF group

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