



Hf(n,tot) Measurement in the High Energy Region at the RPI LINAC

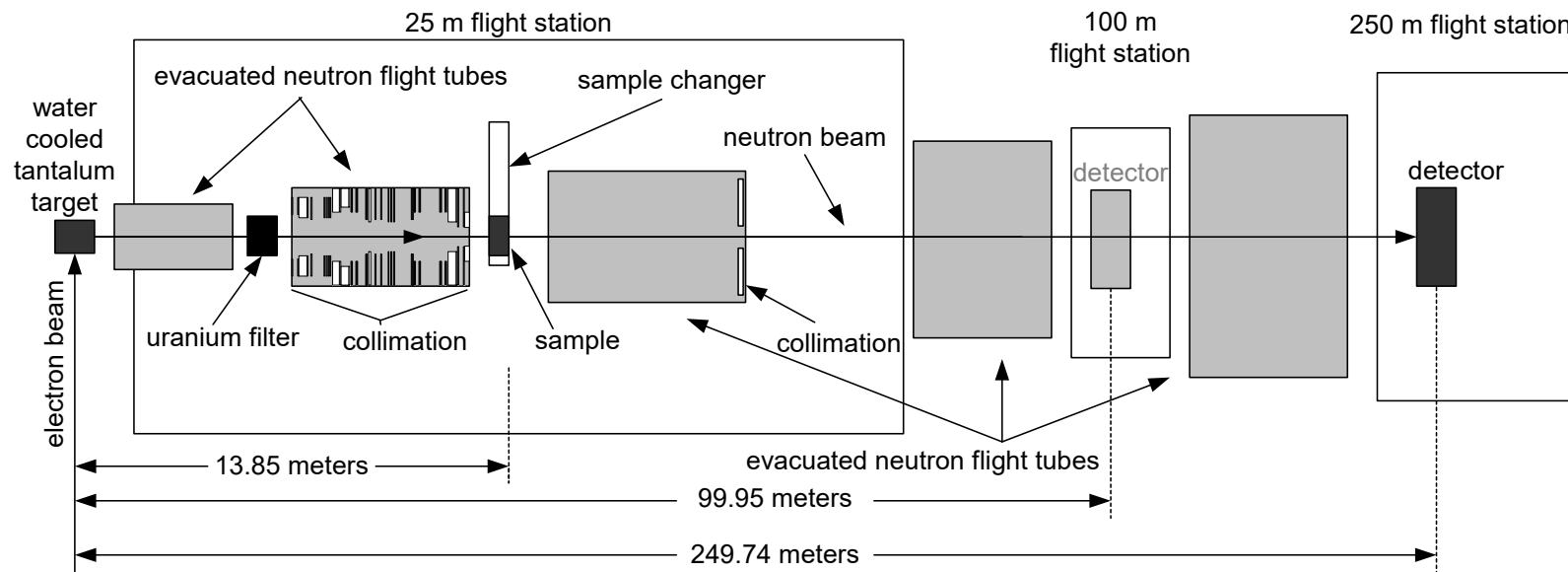
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Cross Section Evaluators Working Group
Experiments Session
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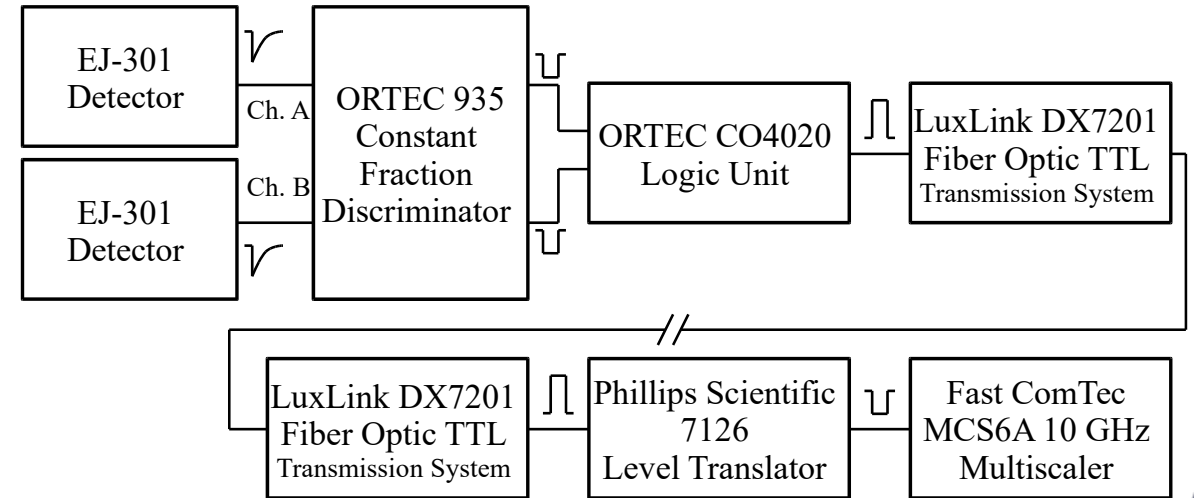
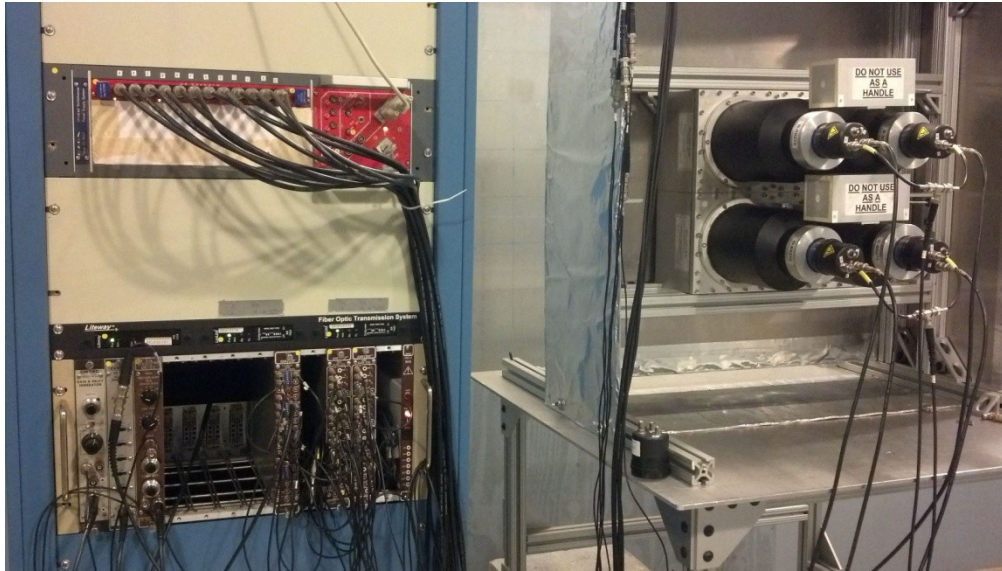
High Energy Transmission System at RPI

- Located at the Gaertner Linear Accelerator (LINAC) Center at Rensselaer Polytechnic Institute (RPI)
- Large area, modular, liquid scintillation detector
 - Located at 250 meter time-of-flight station
 - Long flight path, narrow neutron burst width, fast detector and electronics
 - High-accuracy transmission measurements (~1% - 3%)
 - Excellent counting rate, good signal-to-noise
 - Measurement range of ~0.5 to ~20 MeV
- Fission chambers on independent flight path monitor neutron beam stability



High Energy Transmission System at RPI

Detectors and associated electronics



Hafnium samples



Hf Samples

- 99.9% pure Hf
- Samples
 - 7 cm (2 – 3.5 cm thick cylinders stacked)
 - 9 cm (2 – 4.5 cm thick cylinders stacked)
 - 13 cm thick carbon reference

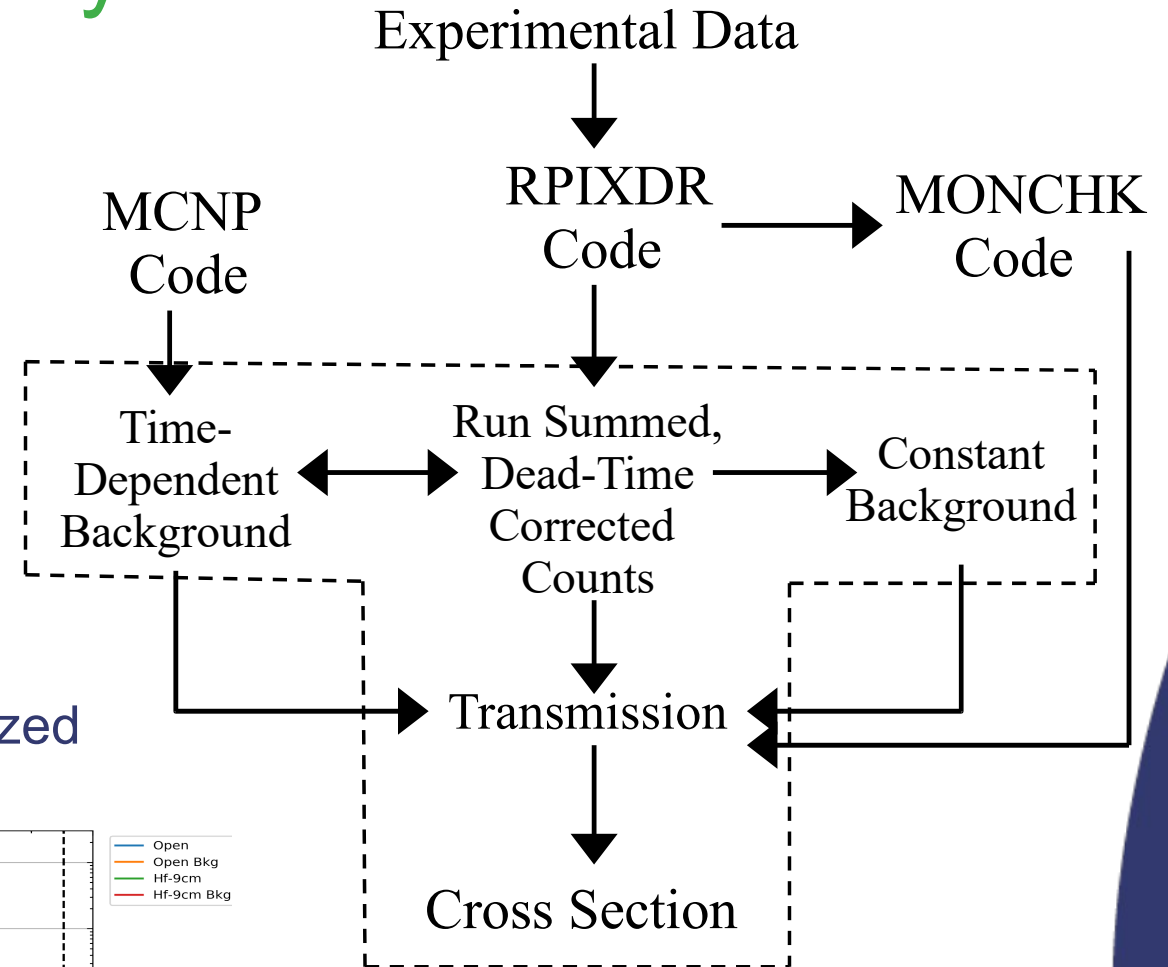
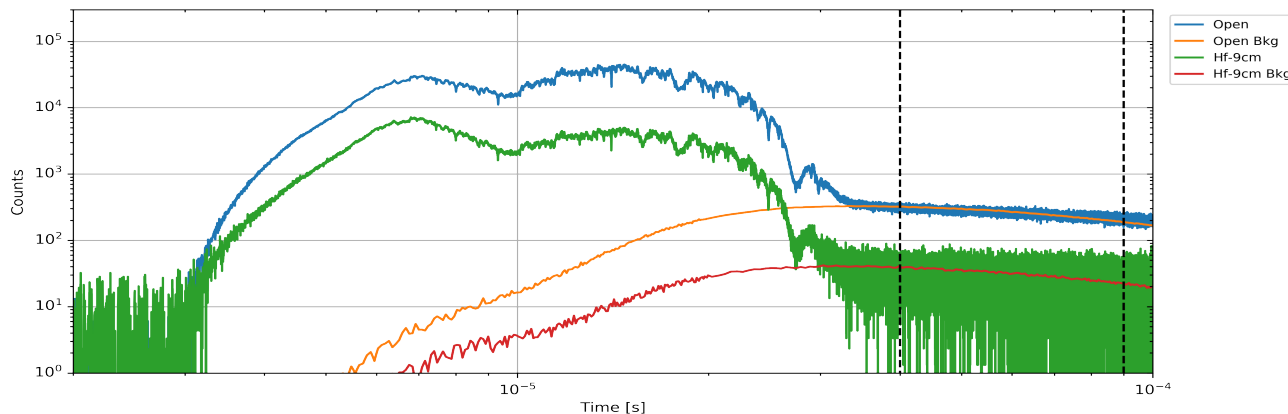
Impurity	PPM	Impurity	PPM	Impurity	PPM	Impurity	PPM
Ag	0.44	Al	0.4	As	<0.005	Au	<0.5
B	<0.005	Ba	<0.005	Be	<0.005	Bi	<0.05
Br	<0.005	Ca	0.008	Cd	<0.5	Ce	<0.005
Cl	0.097	Co	0.16	Cr	1.51	Cs	<0.005
Cu	0.038	Dy	<0.005	Er	<0.005	Eu	<0.005
F	<0.5	Fe	54.2	Ga	<0.005	Ge	<0.005
Hg	<5	Ho	<0.005	I	<0.05	In	<0.005
Ir	0.89	K	0.031	La	<0.005	Li	<0.005
Lu	<0.005	Mg	<0.005	Mn	0.043	Mo	<0.005
Na	0.013	Nb	<0.005	Nd	<0.005	Ni	0.99
Os	<0.5	P	0.009	Pb	<0.05	Pd	<0.05
Pr	<0.005	Pt	<0.5	Rb	<0.005	Re	<0.005
Rh	<0.005	Ru	<0.005	S	0.77	Sb	<0.05
Sc	0.007	Se	<0.05	Si	1.66	Sm	<0.005
Sn	<0.05	Sr	<0.005	Ta	0.22	Tb	<0.005
Te	<0.05	Th	<0.005	Ti	0.31	Tm	<0.005
U	<0.005	V	<0.005	W	0.015	Y	<0.005
Yb	<0.005	Zn	0.029	Zr	0.576		



Sample	thickness (cm)	diameter (cm)	mass (g)	areal number density (atoms/b)
Hf-35mm-01	3.505±0.004	5.081±0.003	938.4±0.1	0.1562±0.0002
Hf-35mm-02	3.508±0.002	5.088±0.002	941.6±0.1	0.1563±0.0001
Hf-45mm-01	4.507±0.002	5.089±0.002	1209.9±0.1	0.2007±0.0001
Hf-45mm-02	4.505±0.002	5.082±0.002	1206.5±0.1	0.2007±0.0001
7cm Hf sample	7.012±0.004	5.084±0.002	1880.0±0.1	0.3124±0.0001
9cm Hf sample	9.012±0.002	5.086±0.001	2416.4±0.1	0.4013±0.0001

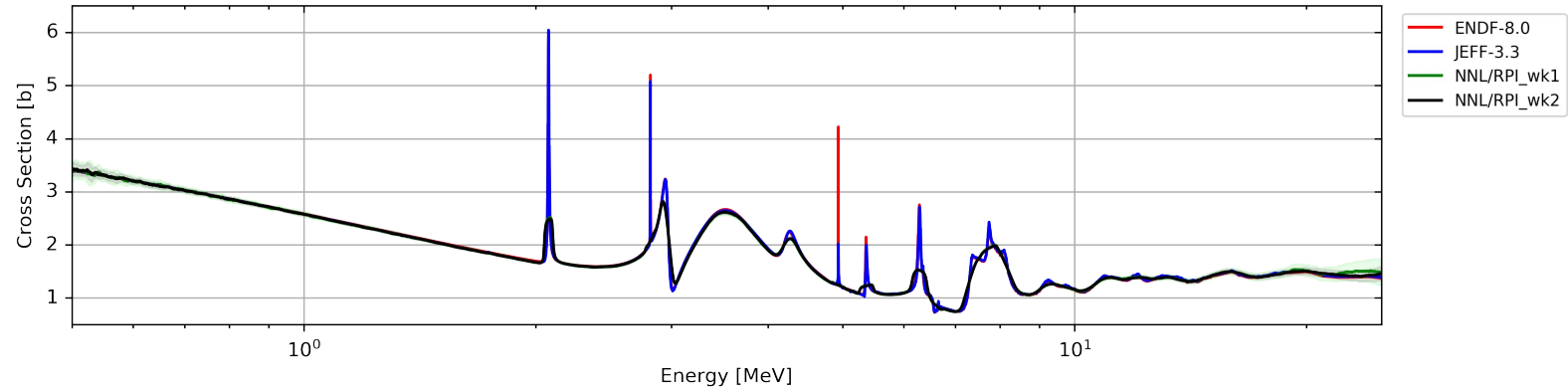
Hf Analysis

- Experimental Data
 - Raw channel binned data
 - Neutron monitor data
- 2 Weeks of data
 - Week 1 - ~ 36 hours
 - Week 2 - ~ 72 hours
- Time-dependent background calculated using an MCNP code simulation normalized to long time-of-flight

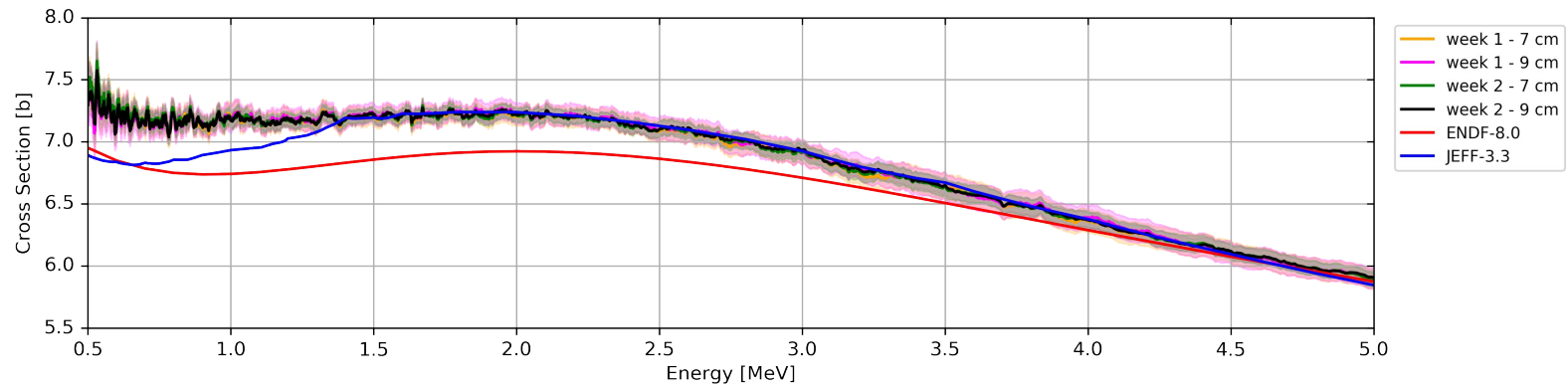


Results

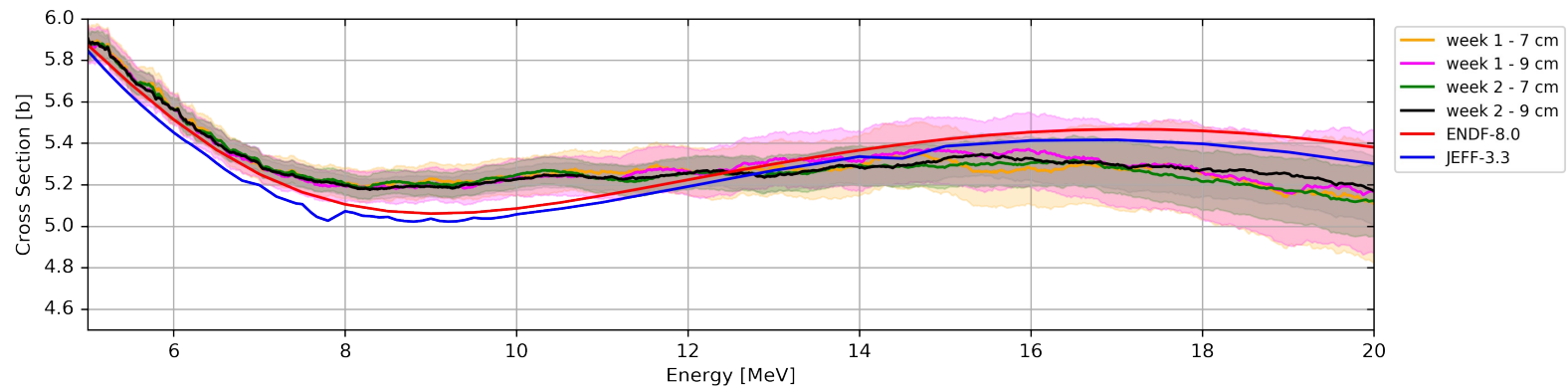
Carbon
0.5 – 20 MeV



Hafnium
0.5 – 5 MeV



Hafnium
5 – 20 MeV



Results

