Experiments to reduce Nuclear Data uncertainties

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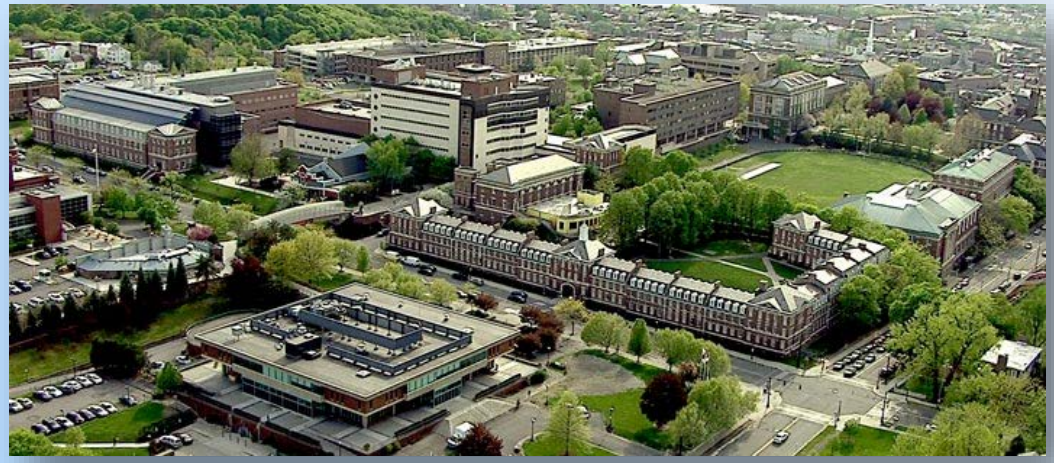

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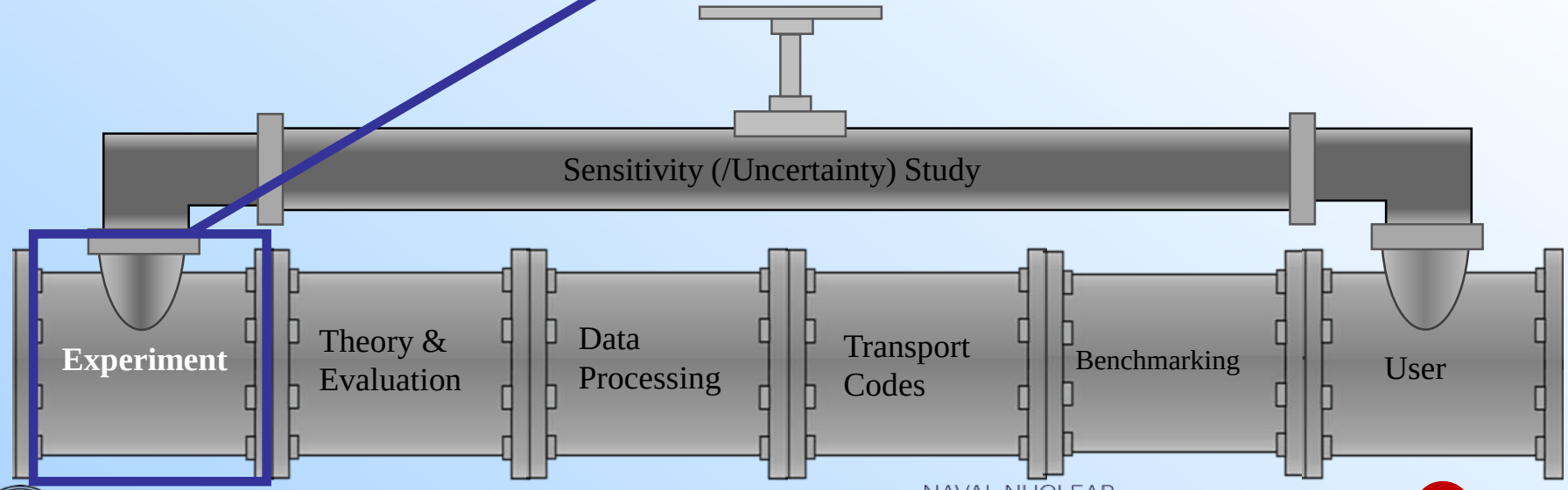
Why do we need experiments ?

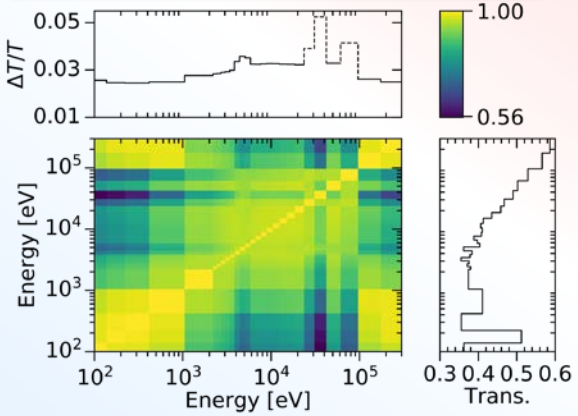
- Do not fully understand the physics
- Can not theoretically calculate Nuclear Data with sufficient accuracy required by applications
  - Experiments constrain the uncertainty of evaluated data files
  - Test the accuracy of evaluated files and transport codes physics

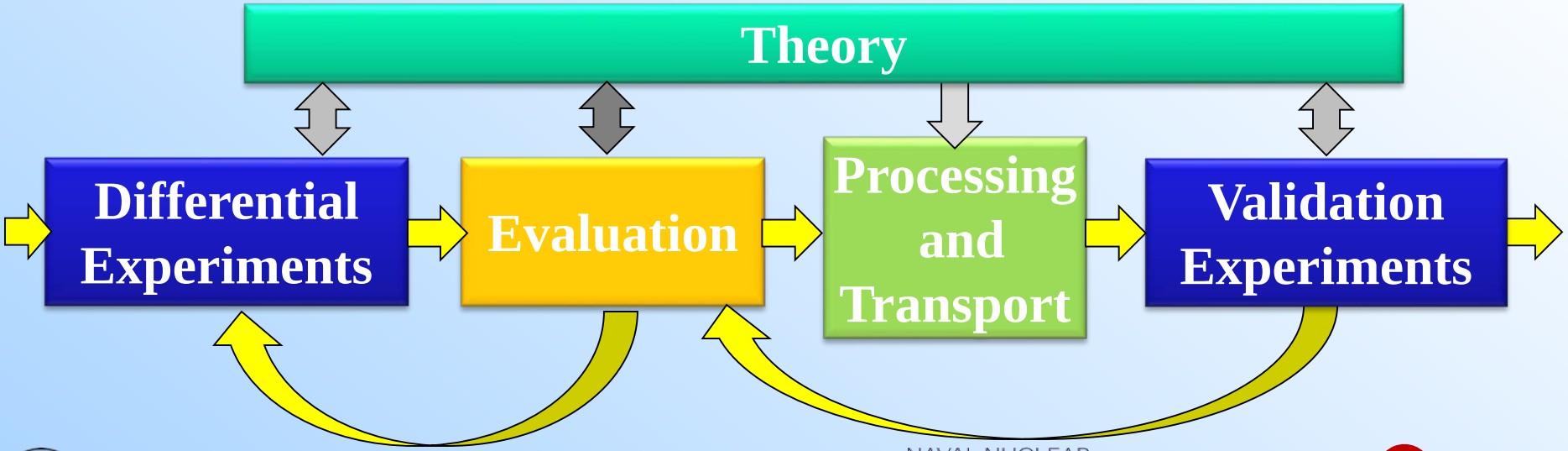


Types of experiments

- **Differential experiments**, examples:
  - Neutron cross section as a function of neutron energy
  - Neutron capture cascades gamma spectrum
  - Fission fragment yields
  - Quasi-differential experiments
- **Validation experiments**, examples:
  - Criticality experiments (benchmarks)
  - Integral shielding measurements
  - Quasi-differential experiments

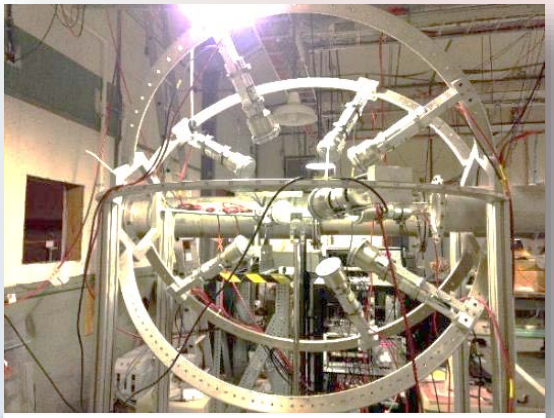
All experiments should report experimental covariance data or equivalent



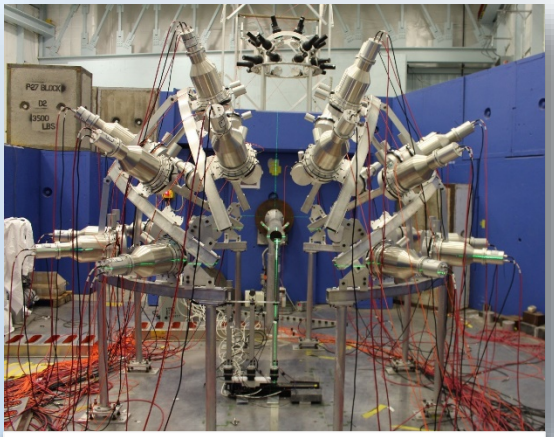


Differential measurements

- **Types of experiments**
  - Neutron transmission (total cross section)
  - Neutron capture yield (capture cross section)
  - Fission cross section
  - Neutron scattering and angular distribution
  - Other novel experiments
- **Facilities and detectors**
  - Requires accelerators facilities
    - Short pulse to provide high energy-resolution
    - High intensity
  - Variety detector arrays and electronics
    - Detect neutrons, gammas, charge particles
  - Samples
    - Pure isotopes, actinides
    - Radiochemistry and thin uniform films
- **People**
  - Need trained and innovative researchers



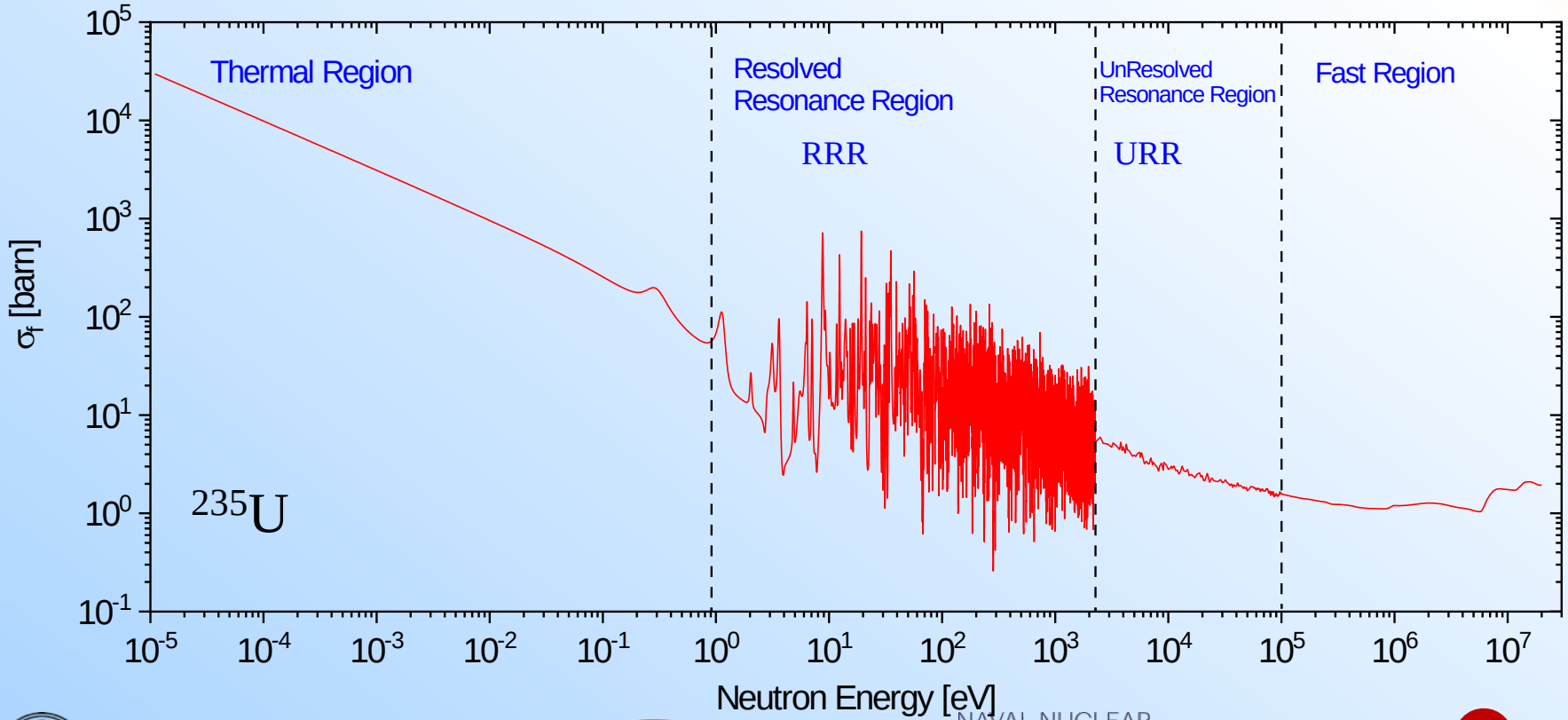
AMANDA Li-Glass detector array at RPI



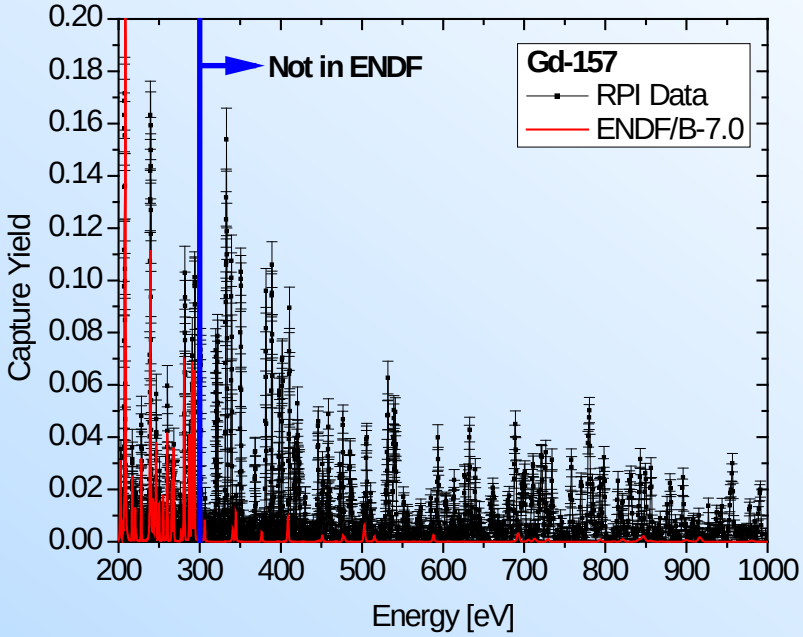
Chi-Nu EJ-309 Detector array at LANL

Neutron reaction cross section experiments

- **All energy regions** - transmission, capture and fission cross sections
- **Thermal Region** - Thermal scattering and accurate scattering cross section (molecular effects)
- **URR and fast region** - elastic and inelastic scattering
- **URR and fast region** - angular distributions



One example – resonance region



Measured using the RPI gamma multiplicity detector

- Capture measurements on ^{157}Gd
- Gd is a strong thermal neutron absorber used in many applications
- Part of a series of measurement on several Gd and Dy natural isotopes.
- New resonances were measured and resonance parameters obtained
- New evaluation in progress