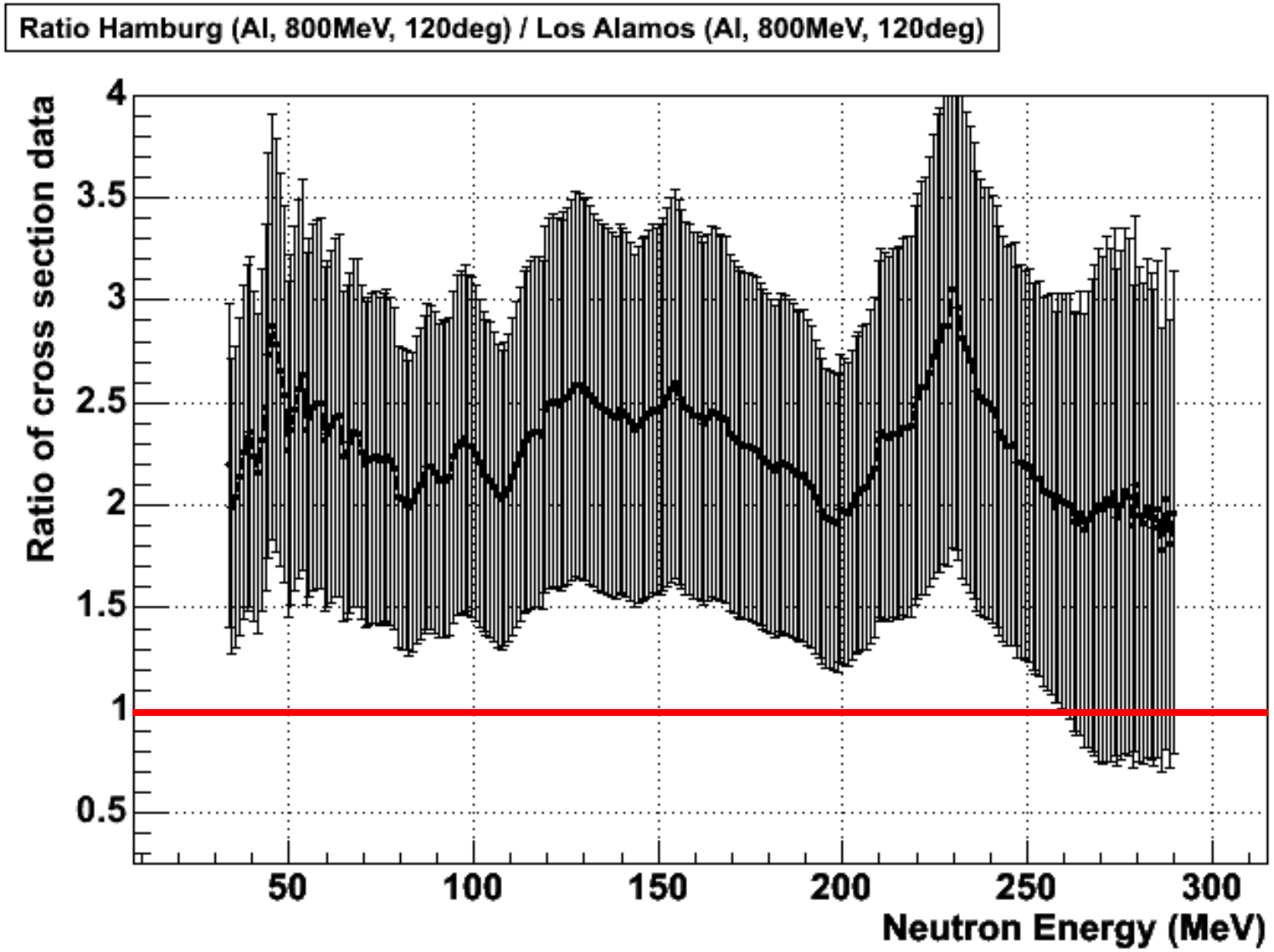
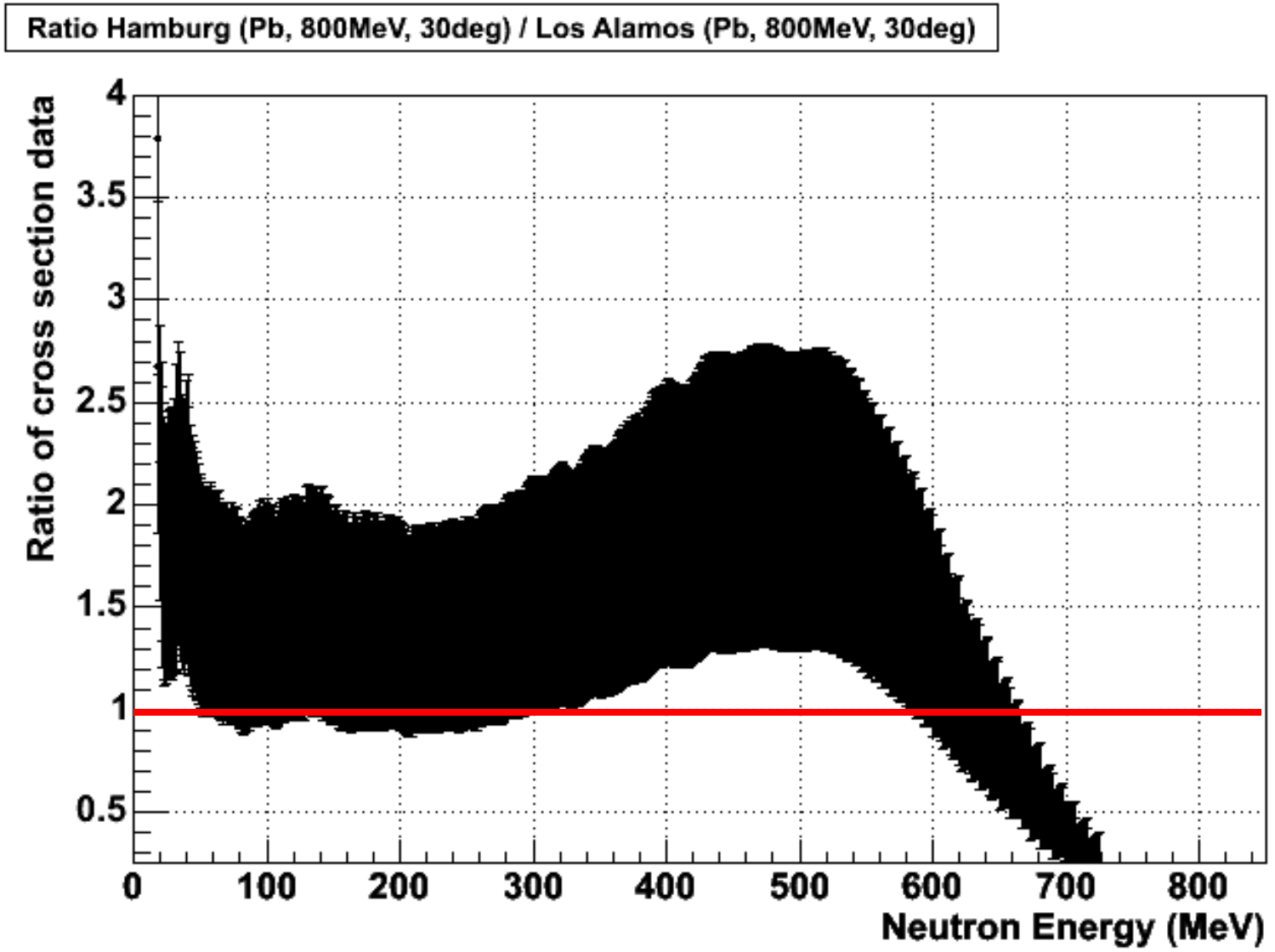
Brief Update on Simple Benchmarks

- **(p,xn) double differential production cross sections:**
  - Mostly worked on understanding errors of experimental data
    - "Los Alamos" data: Nucl Sci Eng 102, 110, 112, 115
    - "Hamburg" data: Phys Rev C47, 1647 (1993)
    - "Saturne" data: Phys Rev Lett 82, 4412 (1999), Phys Rev C 65, 044621 (2002)
  - Documenting results
- **Pion absorption below 1 GeV:**
  - Work in progress

Comparison with Hamburg Data (I)

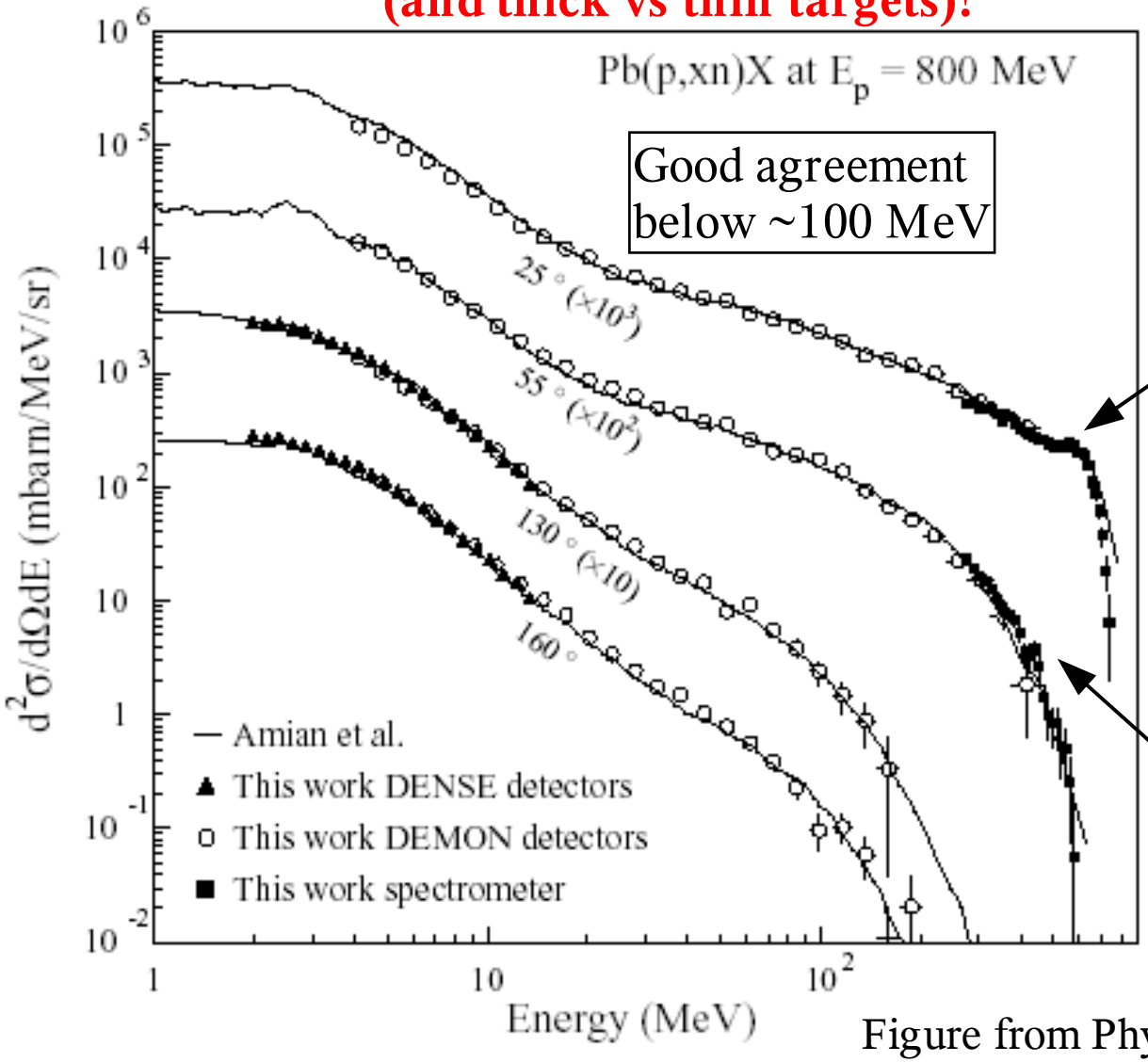


Comparison with Hamburg Data (II)



Comparison with Saturne Data

Warning: data compared for different angles (and thick vs thin targets)!



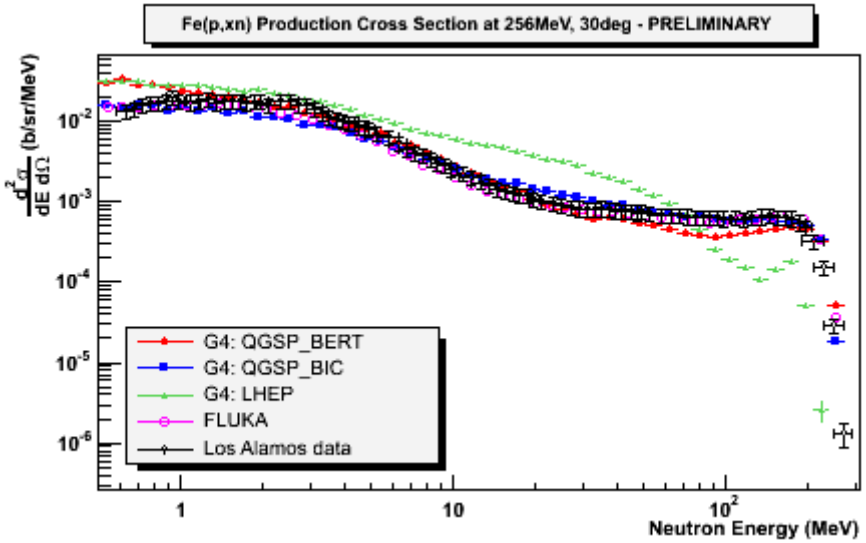
Good agreement below ~100 MeV

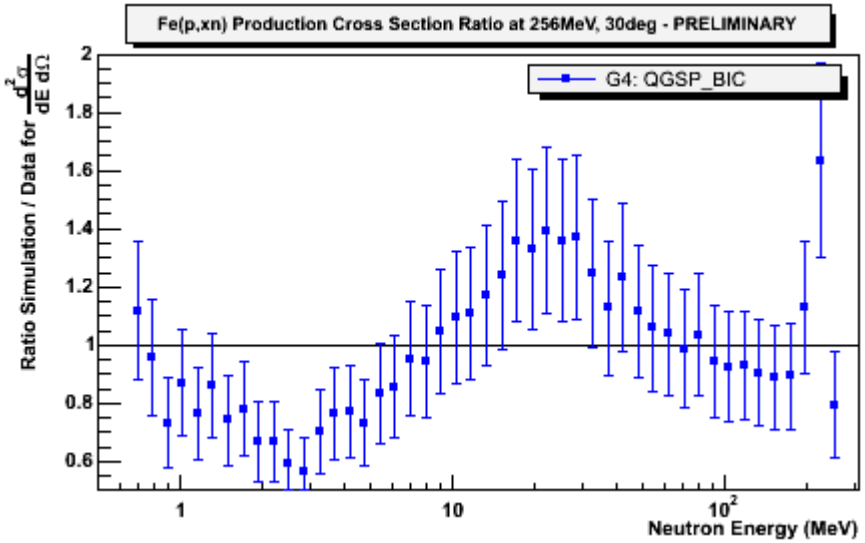
Agreement within ~15%, expect 40% difference

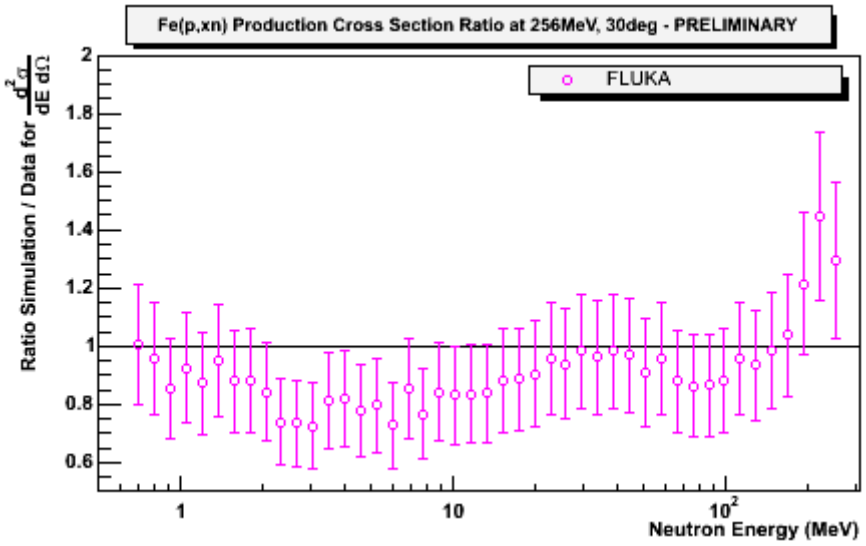
Disagreement of factor ~2 as expected

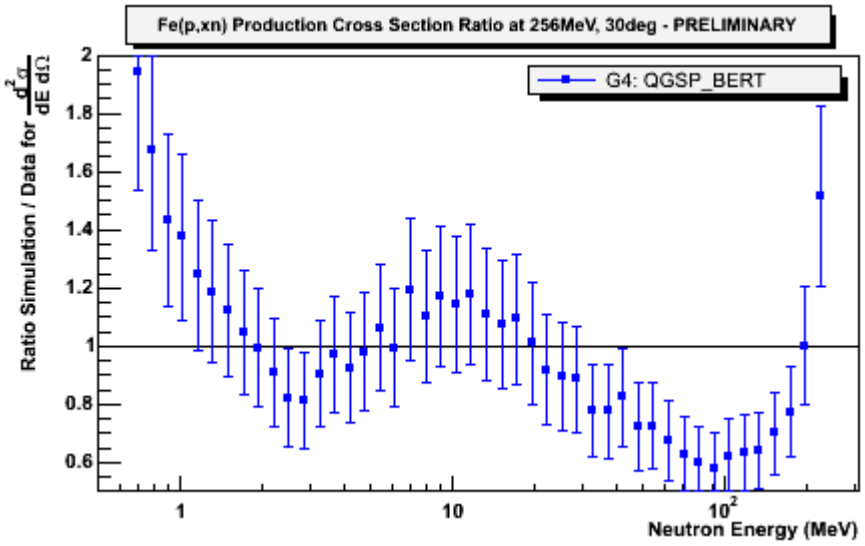
Figure from Phys Rev Lett 82, 4412 (1999)

Sample Results: Fe(p,xn) at 30º (256MeV p)









Conclusion

- **Los Alamos data seems confirmed by Saturne measurements**

- Systematic errors on double-differential cross sections from Los Alamos:
  - Neutron detector efficiency: 20%
  - Uranium filter transmission (only for 597MeV and 800MeV p):
    - 5% below 20MeV neutron energy
    - 20% above 20MeV neutron energy
  - Background, air attenuation, dead time, charge normalization: 9%
  - **Total systematic error: 22% to 30%** (plus <5% statistical error)

- Given the above systematic errors, **typical agreement between Fluka, QGSP_BERT, QGSP_BIC and Los Alamos data is at level of 1 to 2 sigmas**