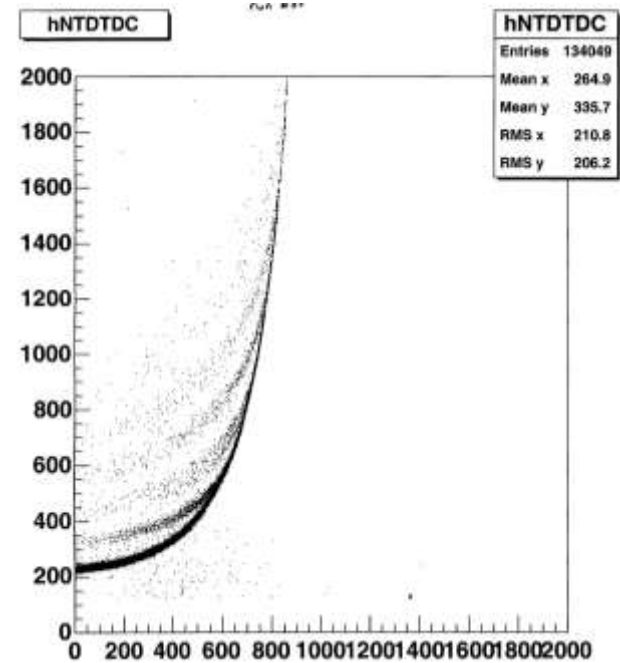
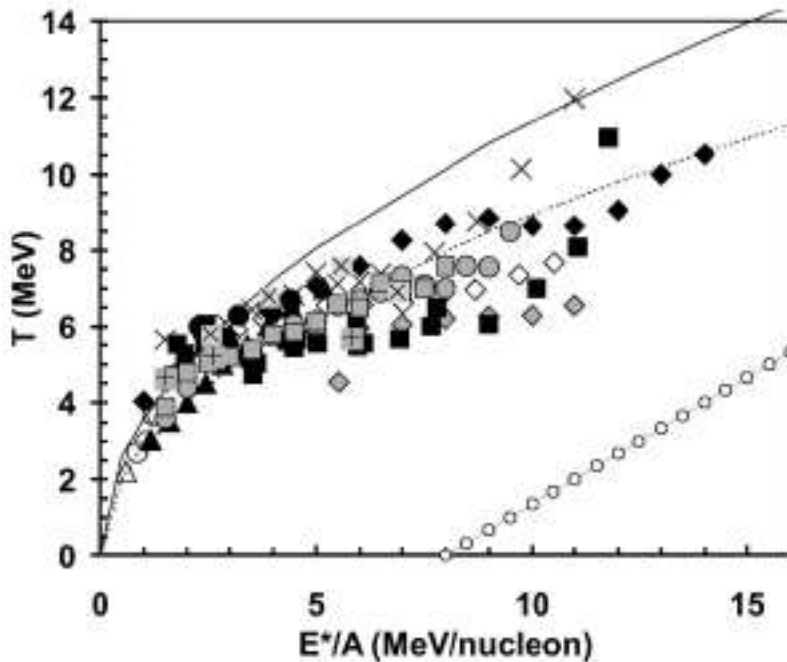


The Nuclear Equation of State and Pulse Shape Discrimination



Michael Sarahan

Chemistry 481, Spring 2005

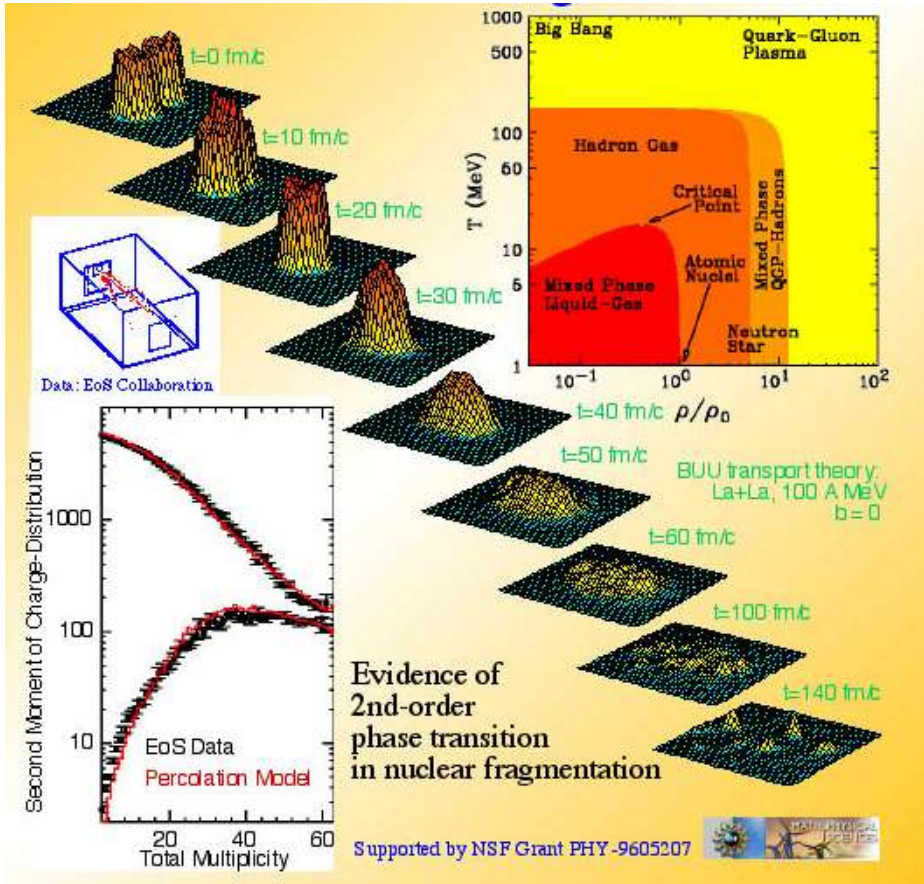
**CYCLOTRON
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Texas A&M University



The Nuclear Equation of State

- Like evaporation of macroscopic materials, the nucleus undergoes a transition from a liquid-like state to a gas-like state when instilled with sufficient excitation energy.
- Experimental results have shown this energy to be in the range of 3-10 MeV



<http://www.pa.msu.edu/~bauer/research/Fragmentation.jpg>

Detector arrays



Evidence collected using detector arrays with large angular coverage such as:

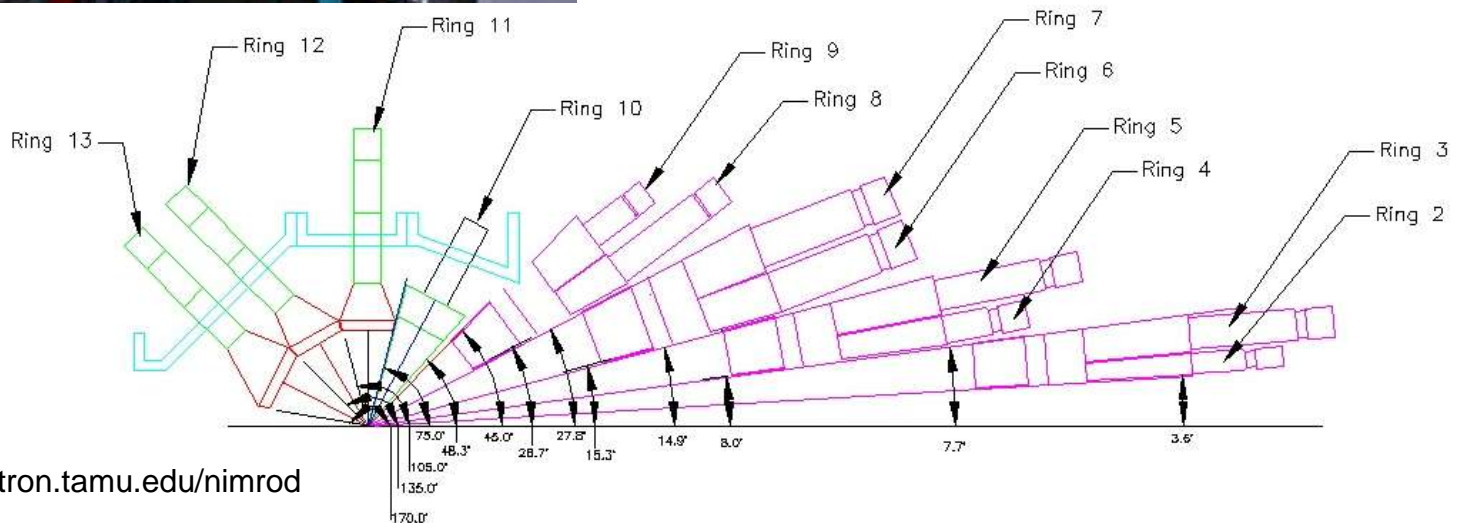
NIMROD

(Neutron Ion Multidetector for Reaction Oriented Dynamics)

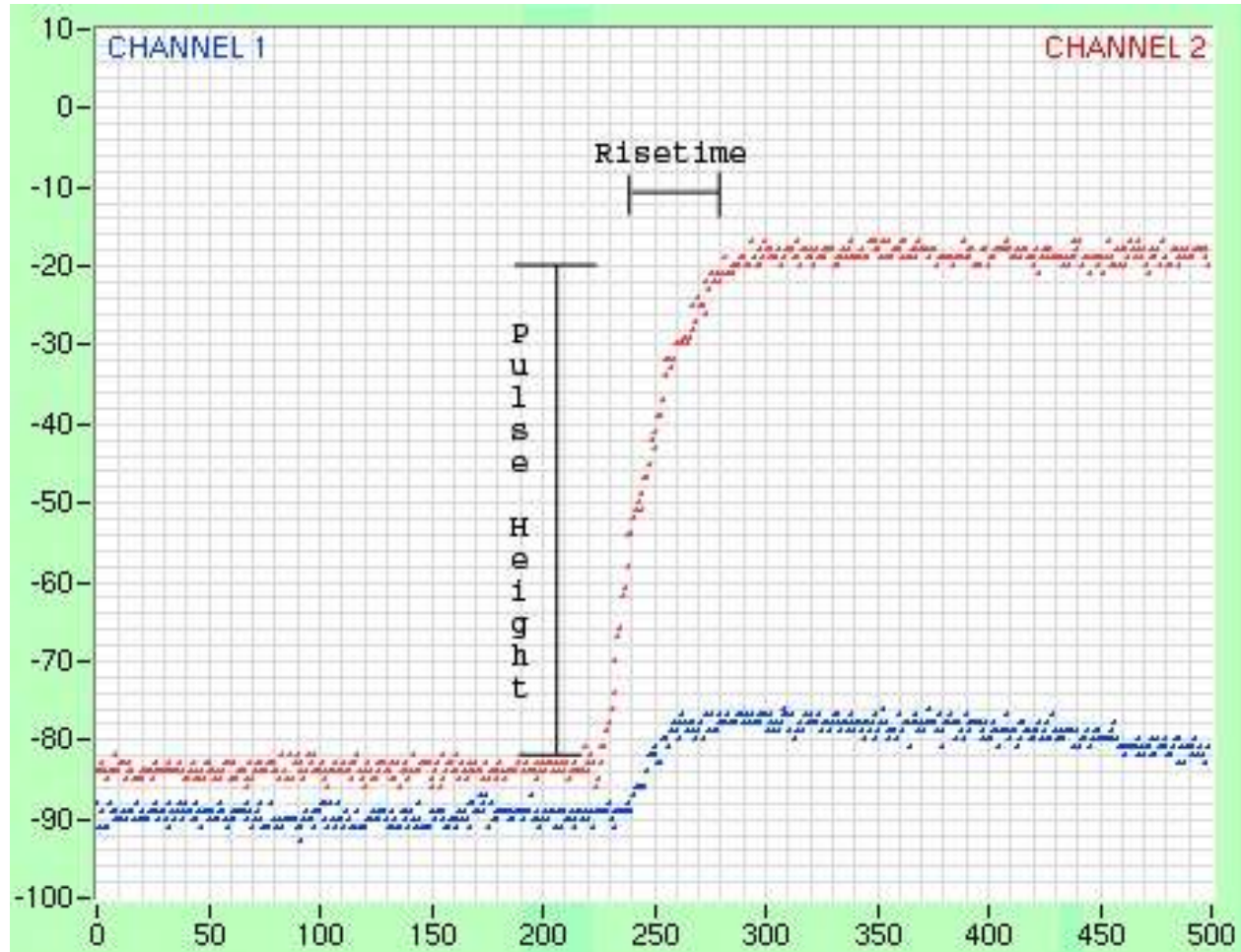
-168 CsI scintillation detectors

-20 silicon telescopes

-96 ionization chambers



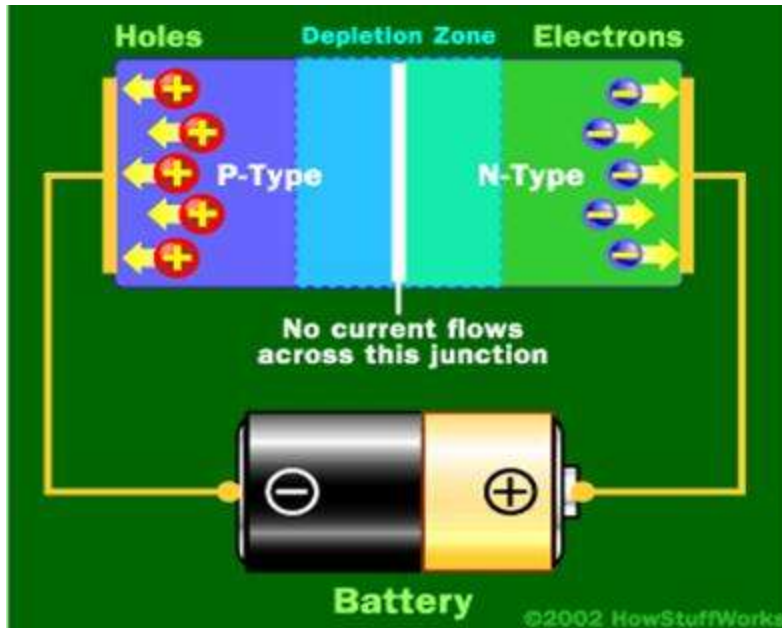
Pulse Shape Discrimination



Pulse height and risetime characterize the particle that hit the detector

PSD with Silicon

- PSD has been done since 1950s with scintillation detectors
- Pulse is result of plasma decay primarily but also charge collection



<http://www.howstuffworks.com>



<http://cyclotron.tamu.edu/sjygroup>

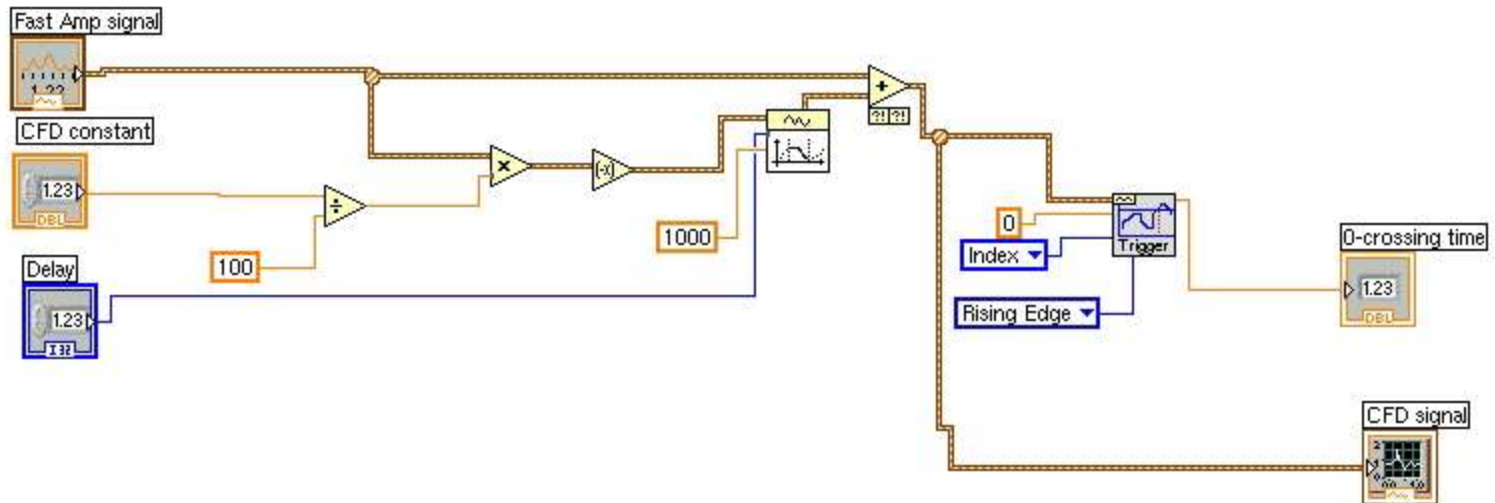
PSD Pulse Processing Modules

- Fast amplifier to shape the pulse
- Constant fraction discriminators and/or leading edge discriminators to measure risetime
- Analog-to-digital converter to measure energy

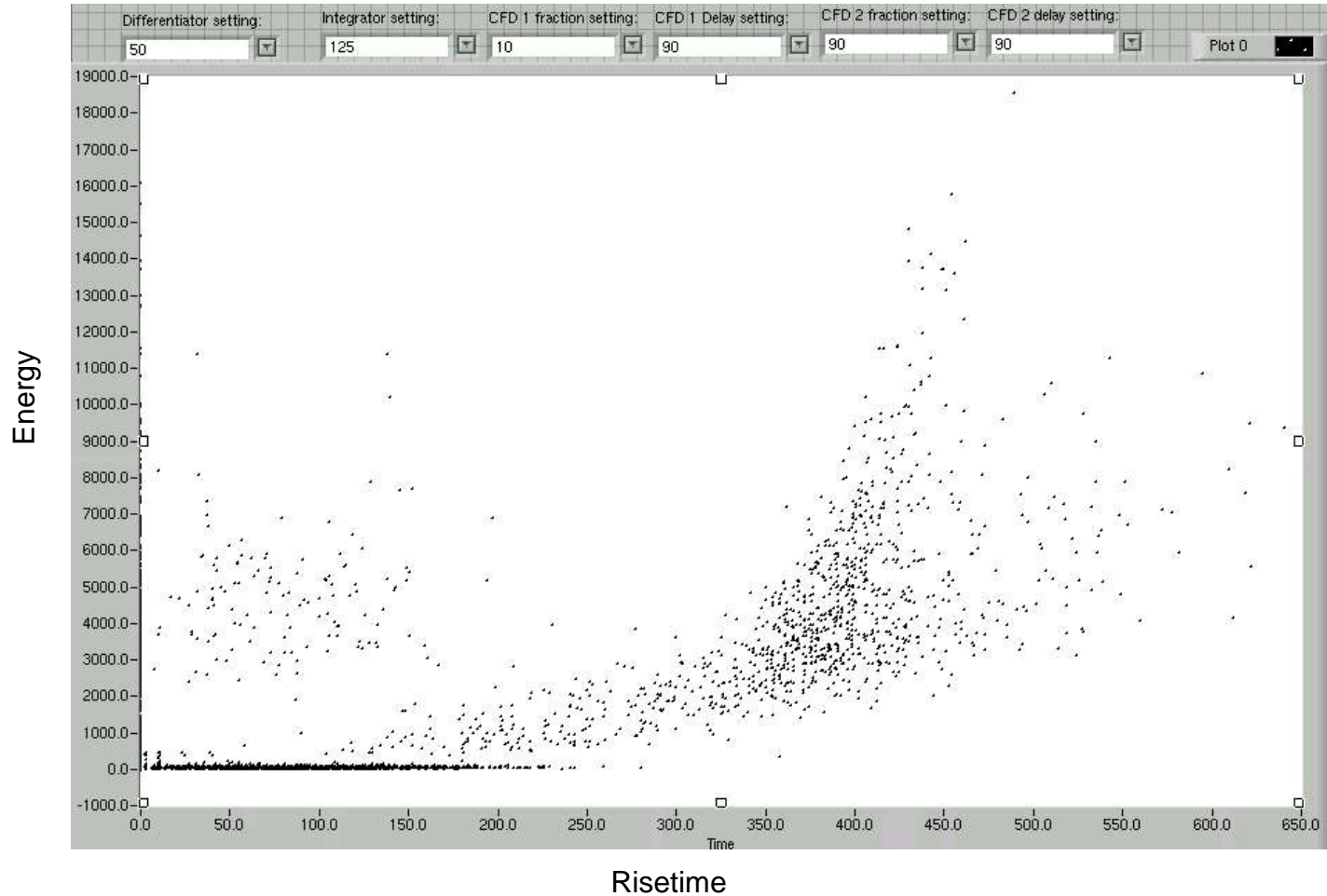


Simulation

- All modules in the setup emulated using LabVIEW software
- Record data from beam, process repeatedly using different combinations of module settings



Simulation Results



- Good match with overall sweep shape, but poor resolution
- Need to improve level trigger of simulated CFD module

Conclusion

- Pulse shape discrimination will continue to be a good technique for identifying particles because of its potential to use fewer detectors to perform necessary identification, allowing lower threshold energies.
- Simulation methods will increasingly become a part of experimental practices to save money and time, and will become more powerful with increasing computer speed