High-Speed Choppers

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Management's View

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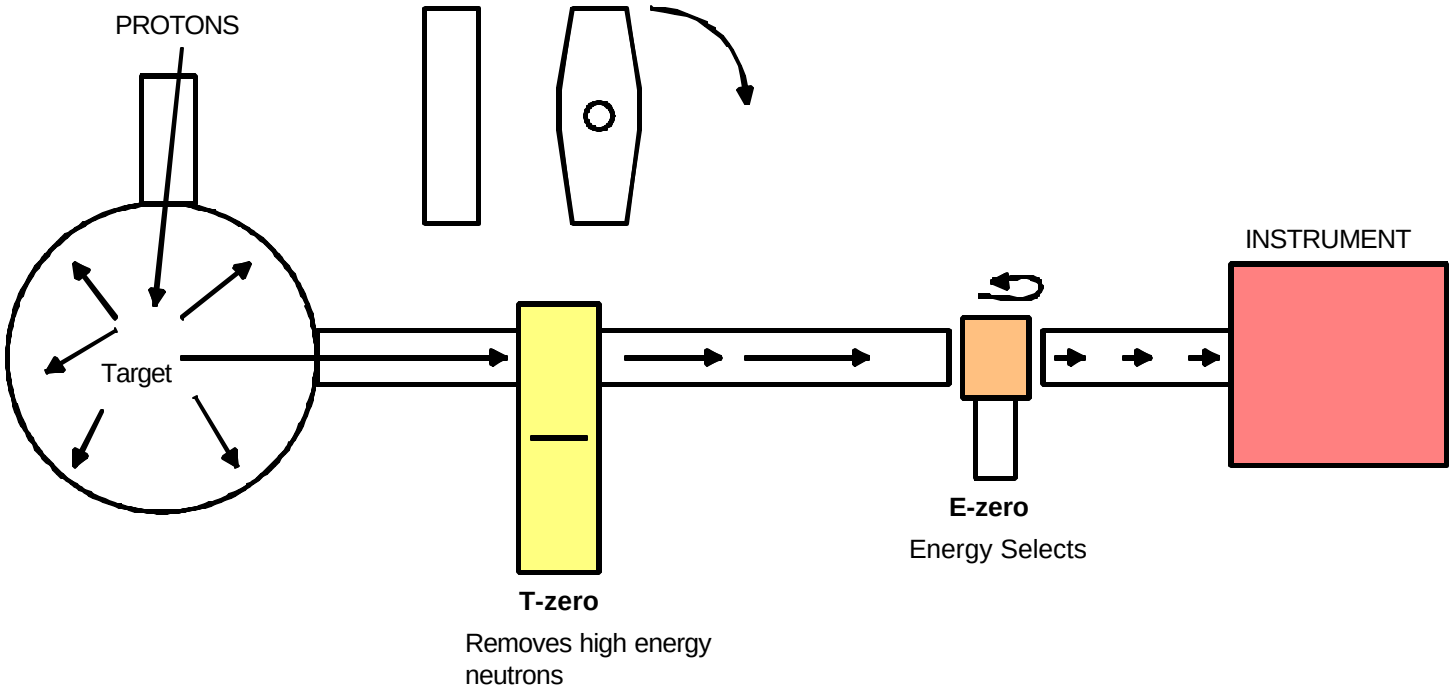
Why Neutron Choppers?



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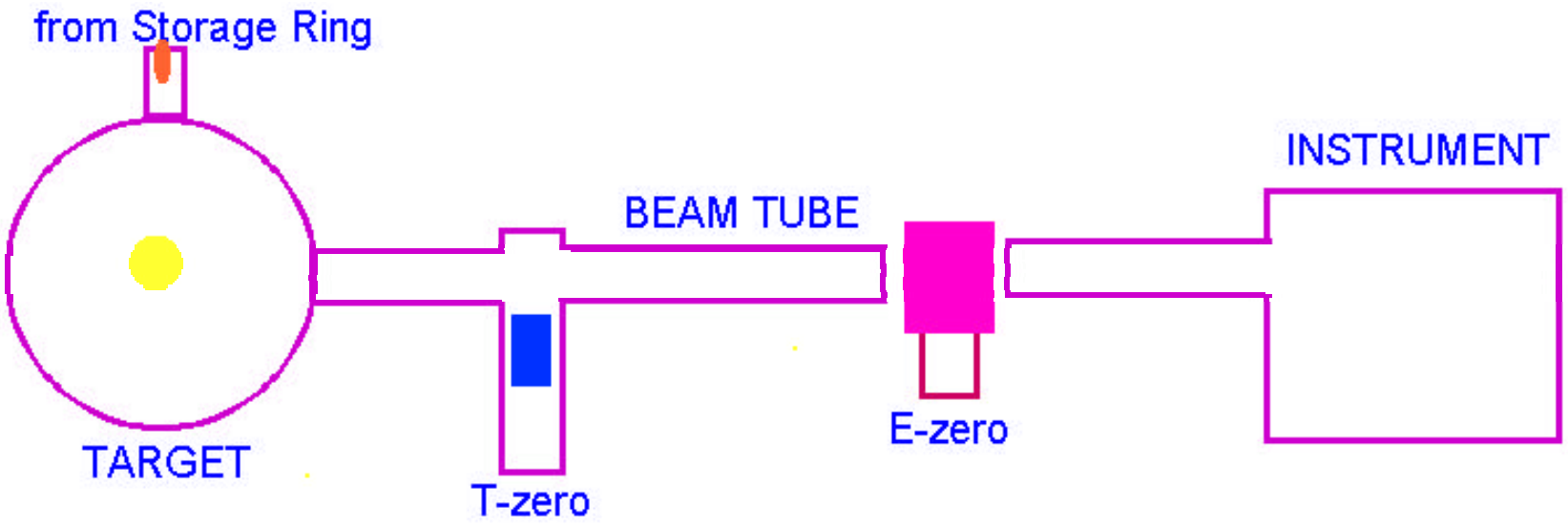
Why Neutron Choppers? 2



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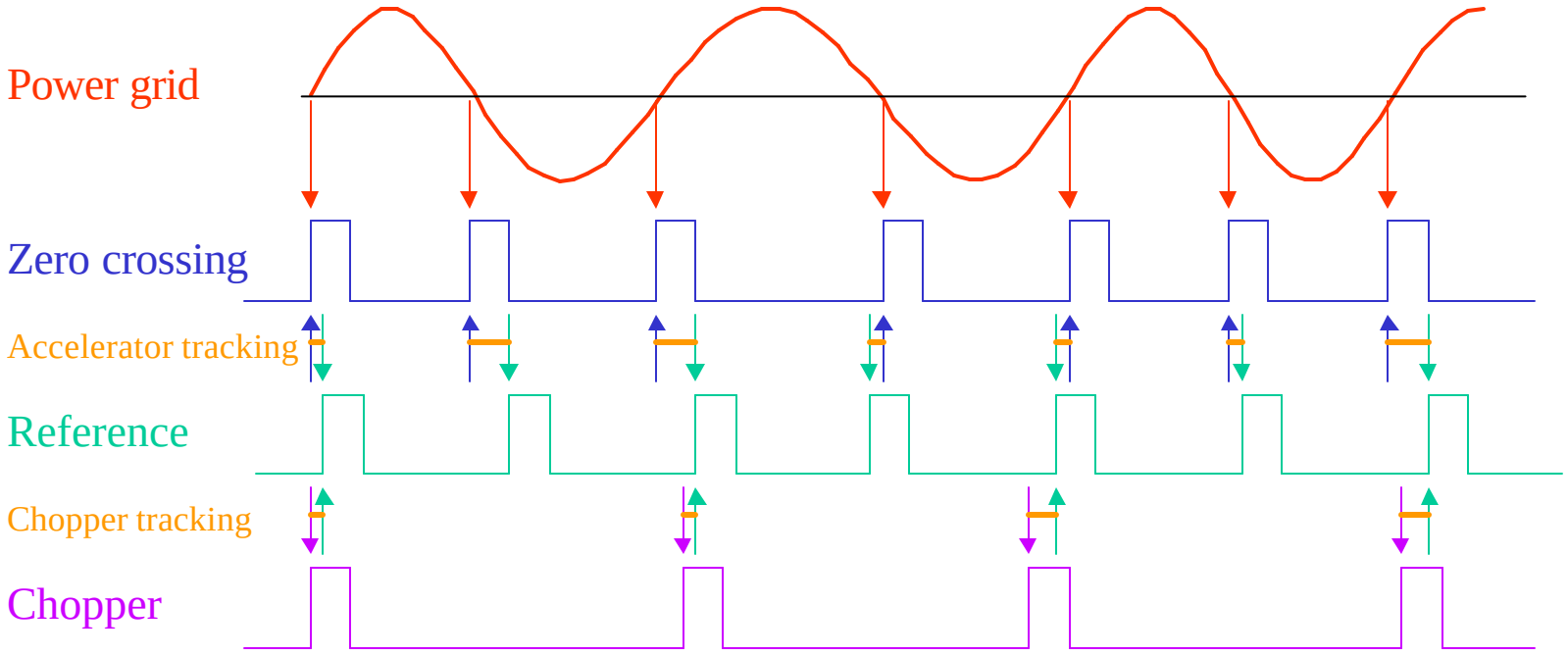
Timing Relationships



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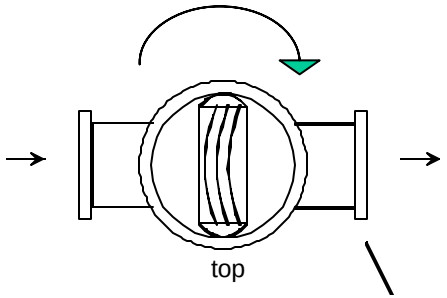
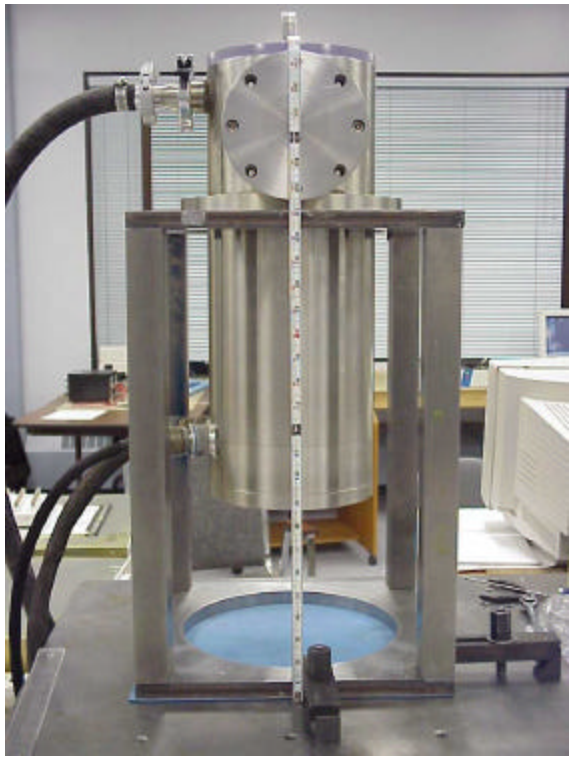
Types of Choppers

- T_0, relatively slow (20, 30, 60 Hz), high mass, large inertia (3-15 kg-m^2). e.g., PHAROS, LQD, SPEAR.
- E_0, relatively fast (600 Hz), low mass, lower inertia (0.01 kg-m^2). e.g., PHAROS.
- Others, disk, frame overlap…

E-zero

- E-zero, PHAROS high-speed, 36,000 rpm





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600-Hz Fermi (E_0) Chopper

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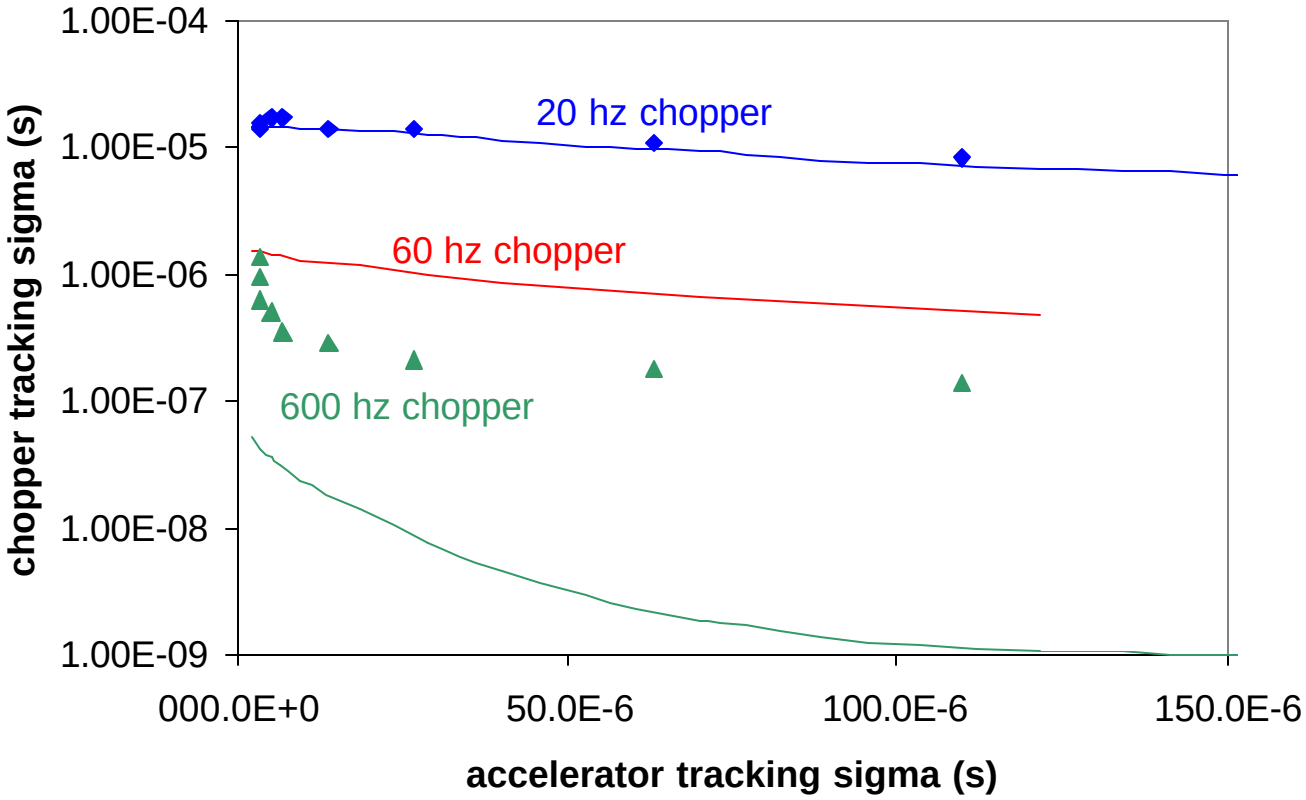
Primary Design Issues

- Accurately Follow the Phase of the Grid
- Rotating Mass—inertia and resultant system bandwidth
- Motor torque—not usually an issue
- Bearings—not usually an issue

Design Methods

- MATLAB/Simulink Models and Simulations—very important!
- DSP-based, Chopper-Simulator Chassis
- DSP-based, Controller Implementation
- DSP-based, Timing-reference Chassis
- Specify and Purchase Magnetic Bearing systems when available

Test Results 1



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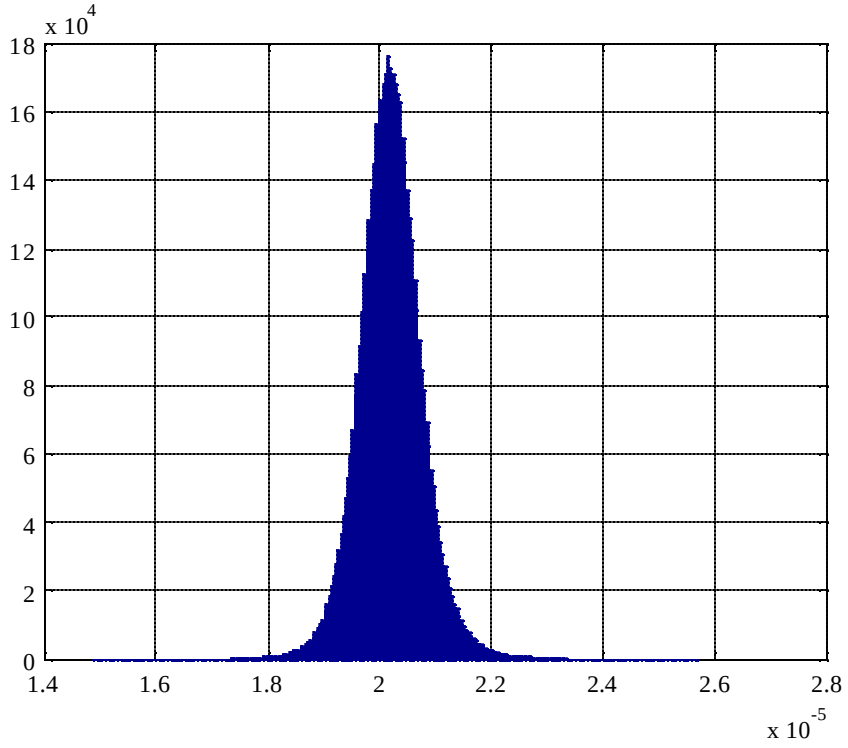
Test Results 2

- 24- hour period
- 5.184 million points
- 256 bins
- production LANSCE timing reference
  - 25-μs grid sigma



Histogram of Fred to HSNC revolve TDC output. 5.184 million points. 256 bins.

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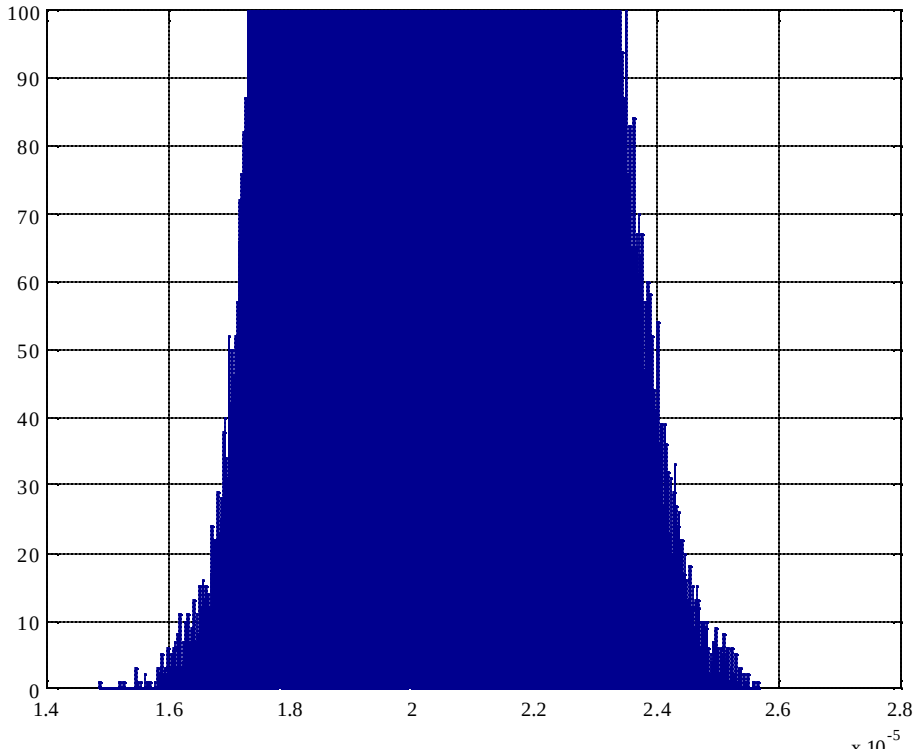
Test Results 3



Histogram of Fred to HSNC revolve TDC output. 5.184 million points. 256 bins.

Does not lose synchronization or phase lock with the reference signal.

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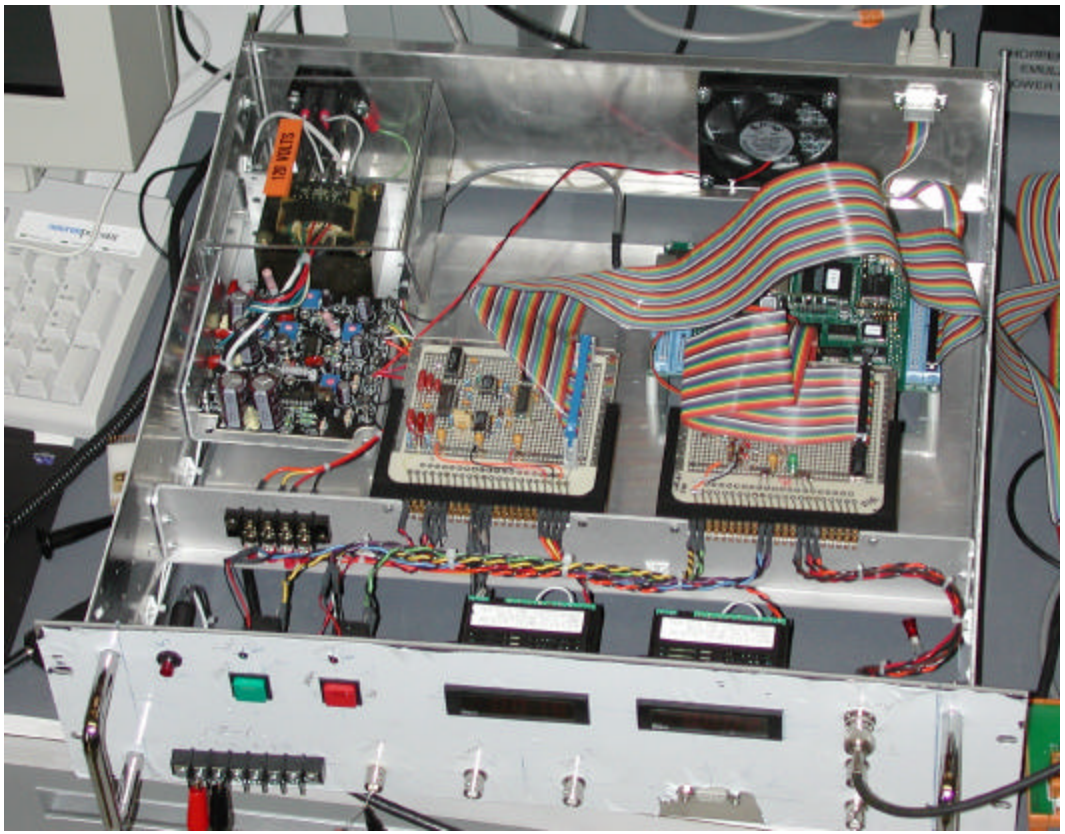
Chopper-Simulator Chassis

- PHAROS T_0 Prototype Simulator
- Developed also for LQD & SPEAR
- Allow Testing of motors and controllers in lab environment



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Conclusions

- Developed new MATLAB/Simulink models for LANSCE neutron choppers—T_0, E_0.
- Developed hardware chopper emulators/simulators
- Measured performance with timing-reference generator.
- Eliminated feedback to accelerator and ring.

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