Simulation and Signal Extraction for the Project 8 Free Space CRES Demonstrator

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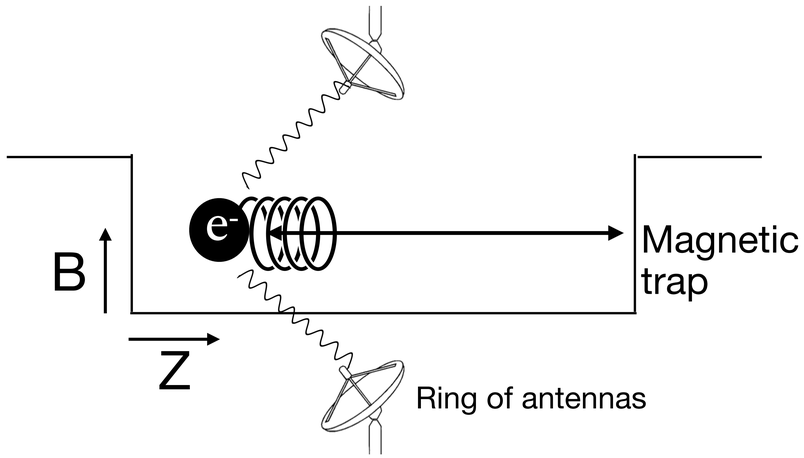
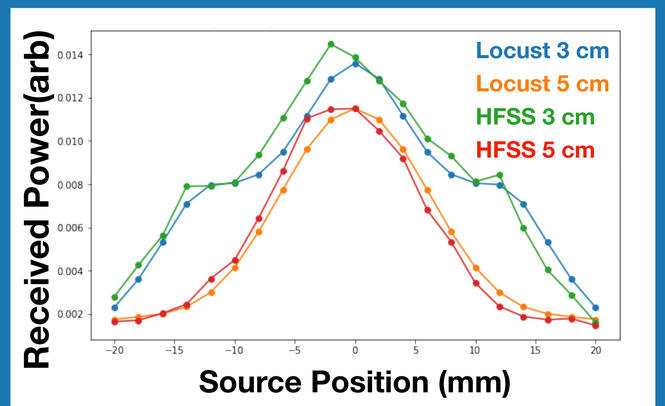
Project 8

- Direct neutrino mass measurement
- Tritium beta decay electrons in magnetic field
- Electron undergoes cyclotron radiation
- Cylotron frequency as proxy for energy (CRES)
- Ongoing R&D for Phase-III Free Space CRES Demonstrator (FSCD)

Other Project 8 posters IDs: **92, 322, 395, 400, 518**

FSCD Toy Model





Locust models the antenna response well

Model the Antenna response

- ANSYS High Frequency Structure Simulator (**HFSS**)
- Industry standard RF software
- Optimized for steady state solutions
- **For Project 8: Model frequency response of antenna**

Simulate Project 8 detector

- **Locust:** Project 8 detector simulation package
- ***Time domain*** simulations
- Basis for antenna development for FSCD

github.com/project8/locust_mc

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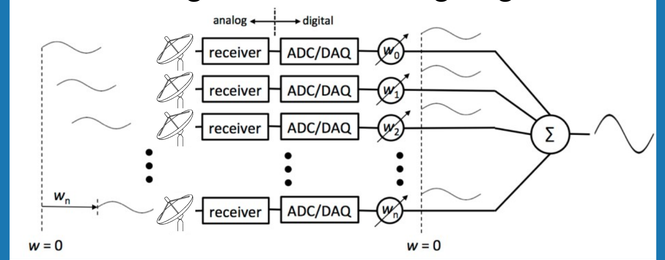
Digital beamforming Logic



Model fields and particle trajectories

- **Kassiopeia** EM and particle tracking software developed by KATRIN collaboration
- **For Project 8: Simulate trap and track EM fields and motion of CRES electrons**

github.com/KATRIN-Experiment/Kassiopeia

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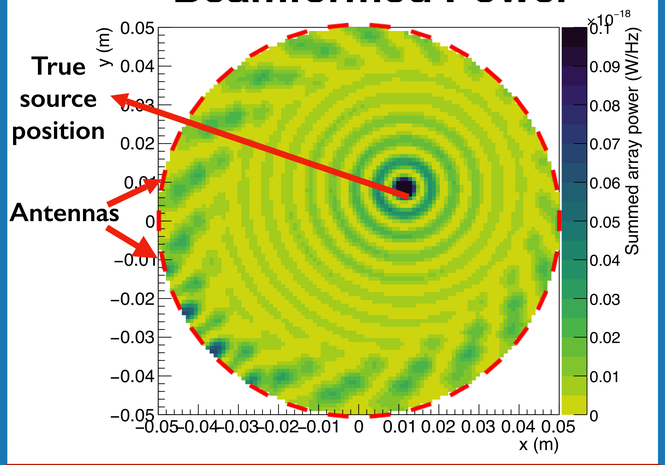
Signal Extraction

- **Katydid:** Project 8 data analysis software
- Used for Phase-I and Phase-II data analysis
- Being enhanced for analysis of FSCD simulation and data

github.com/project8/katydid

Beamformed Power



Digital beamforming is able to identify true source location

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