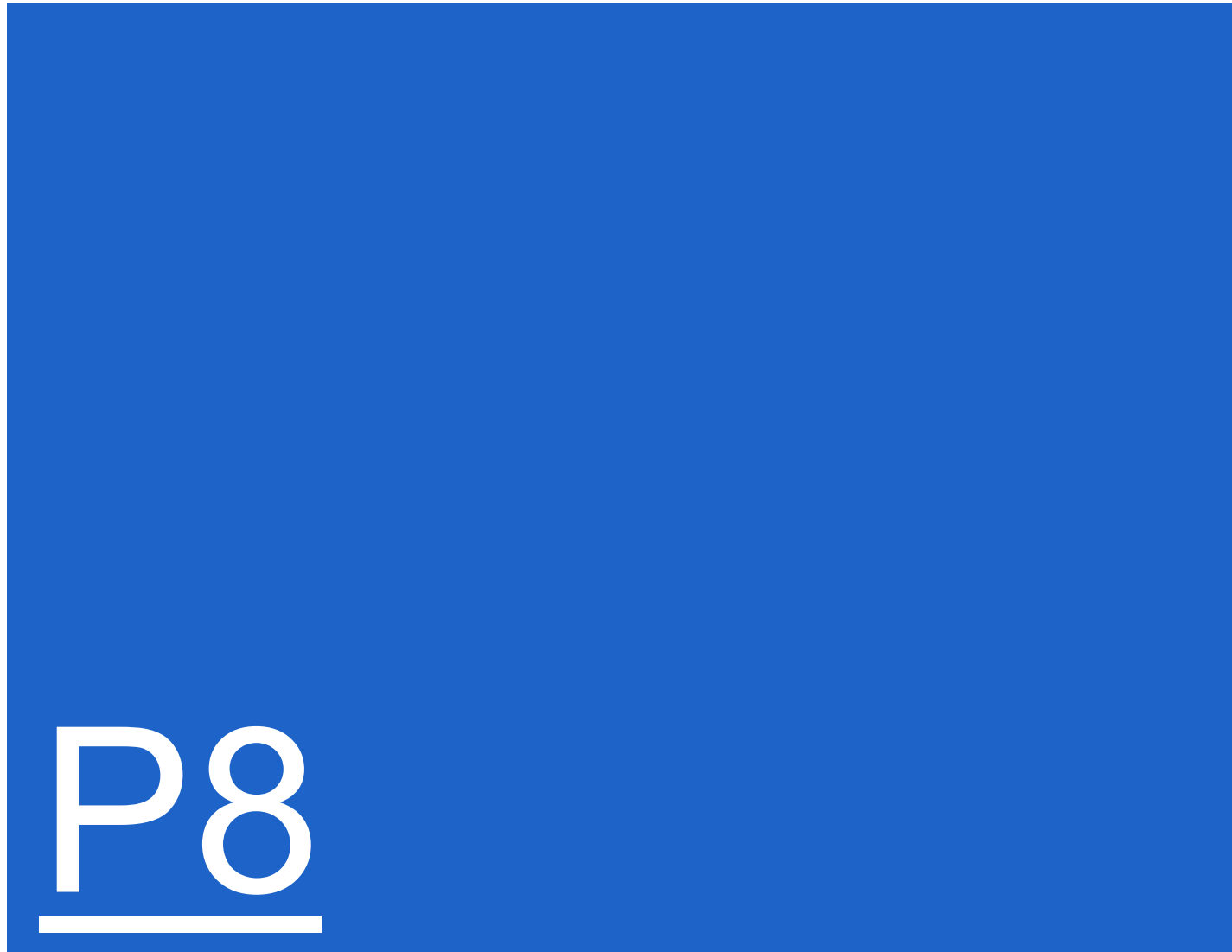




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# PROJECT 8

Intermediary presentation november / Lars Willocx – Juliana Stachurska

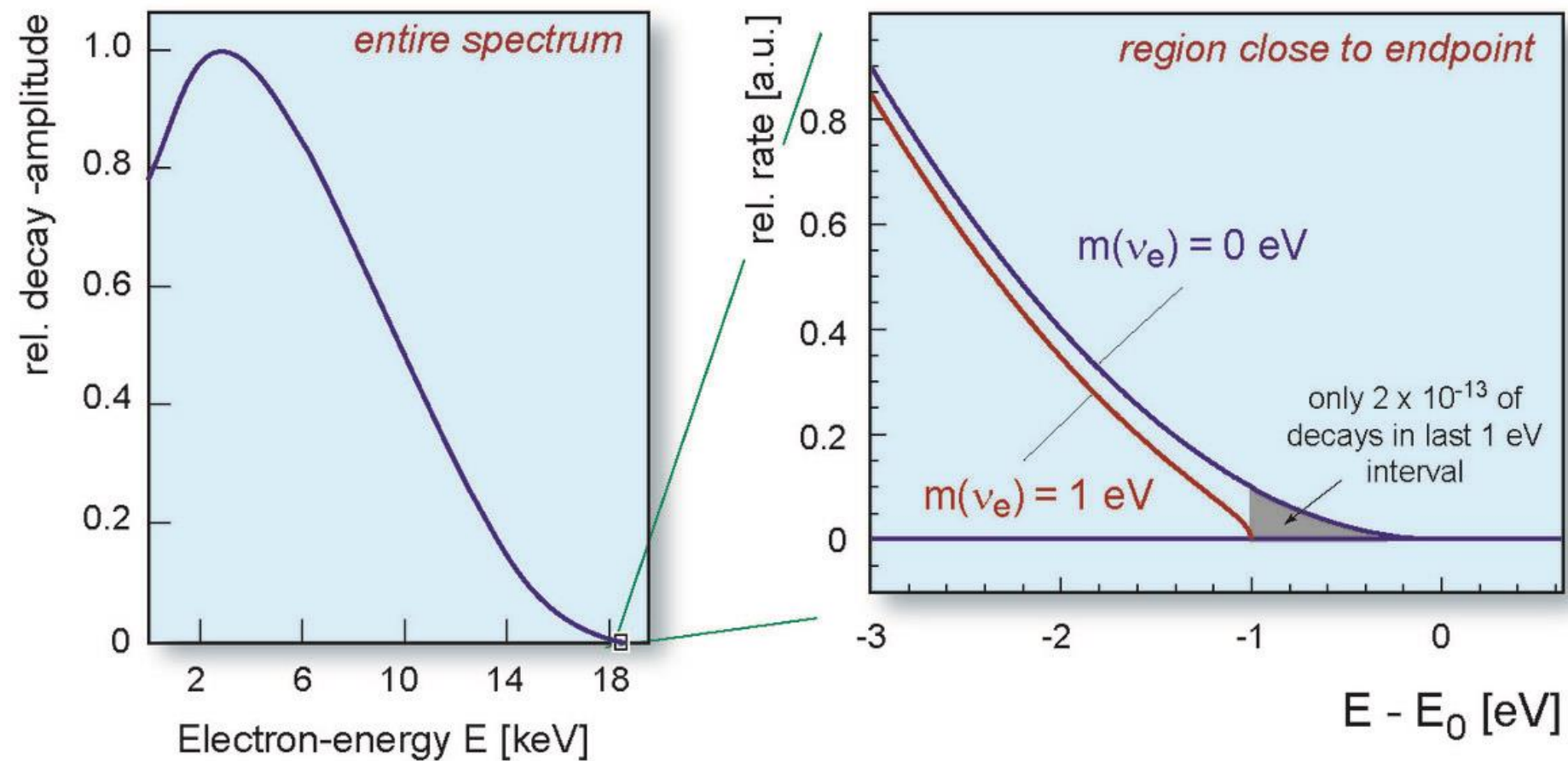


# WHAT?

## Neutrino mass experiment

- $\bar{\nu}_e$
- $\beta$ -decay

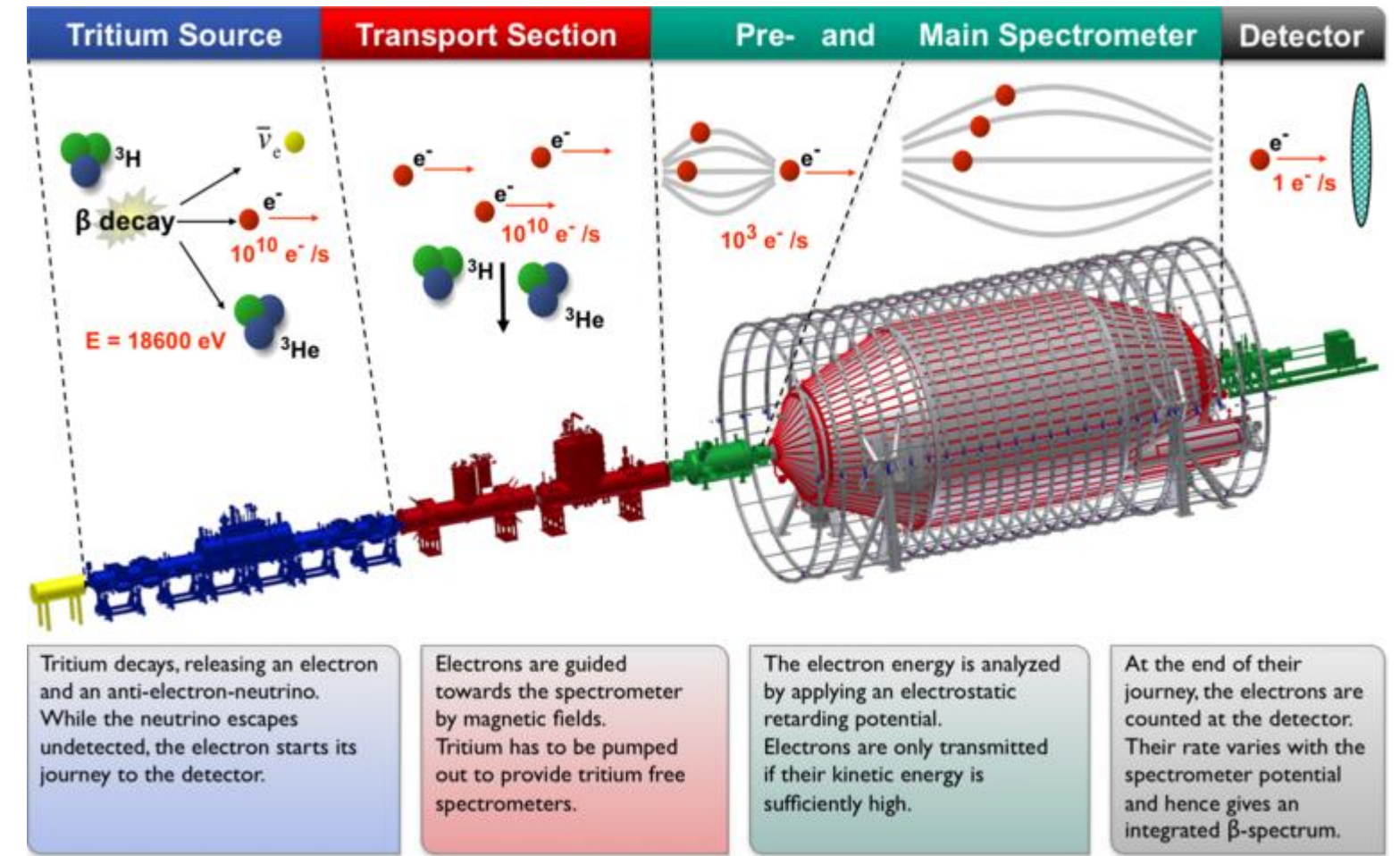
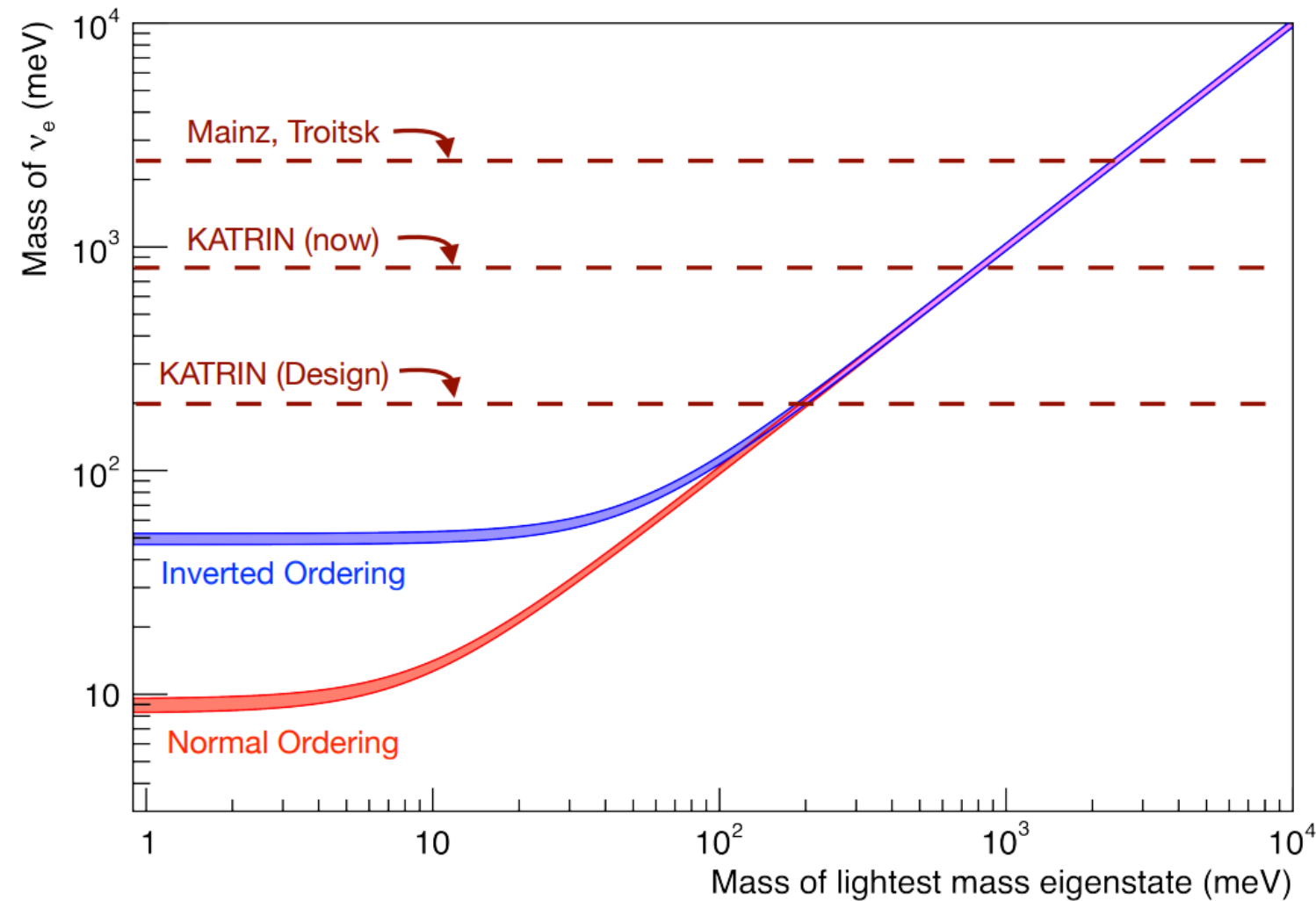
**PROJECT 8**



# WHAT?

## KATRIN

– Size spectrometer  $\propto r$

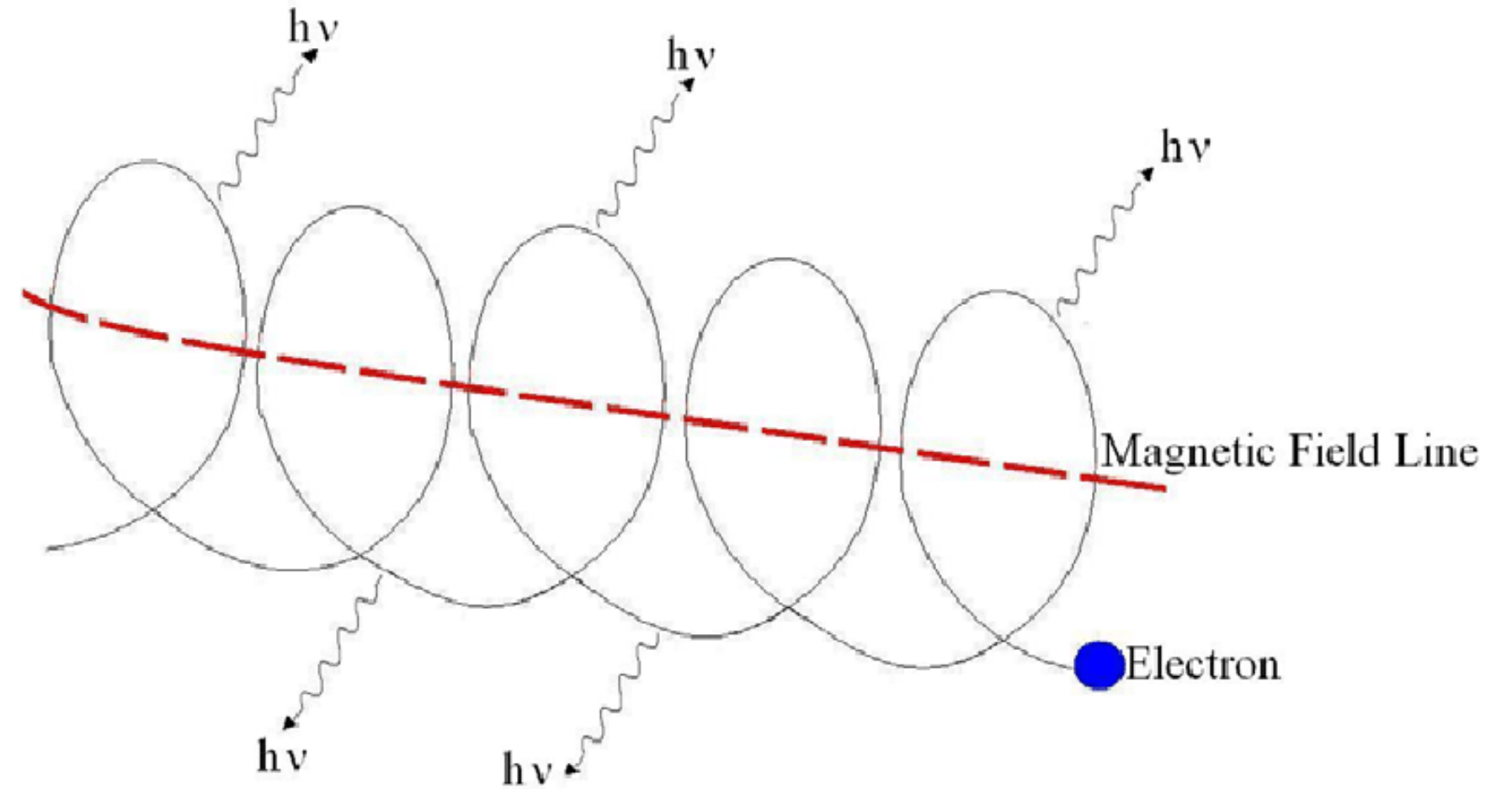
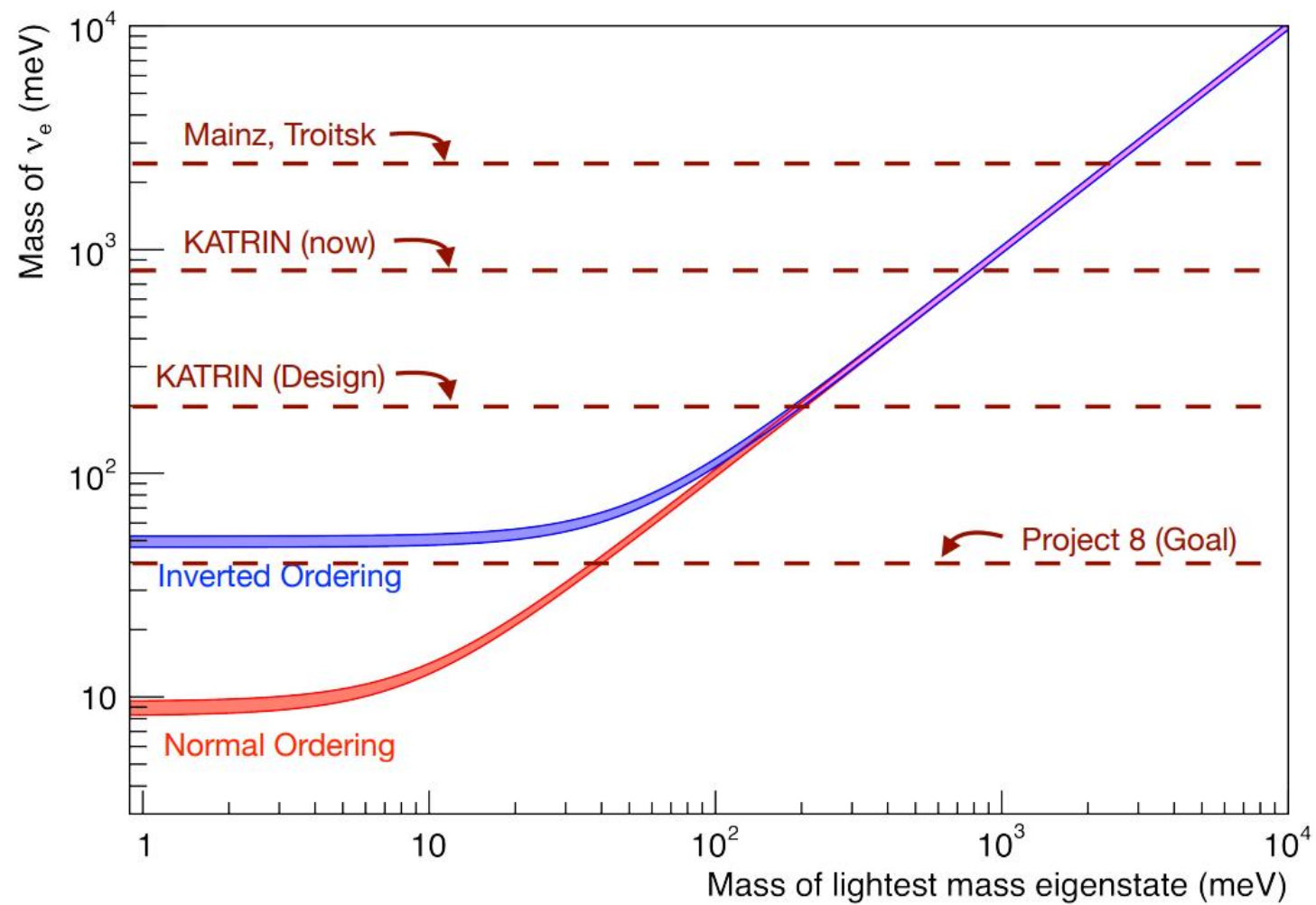




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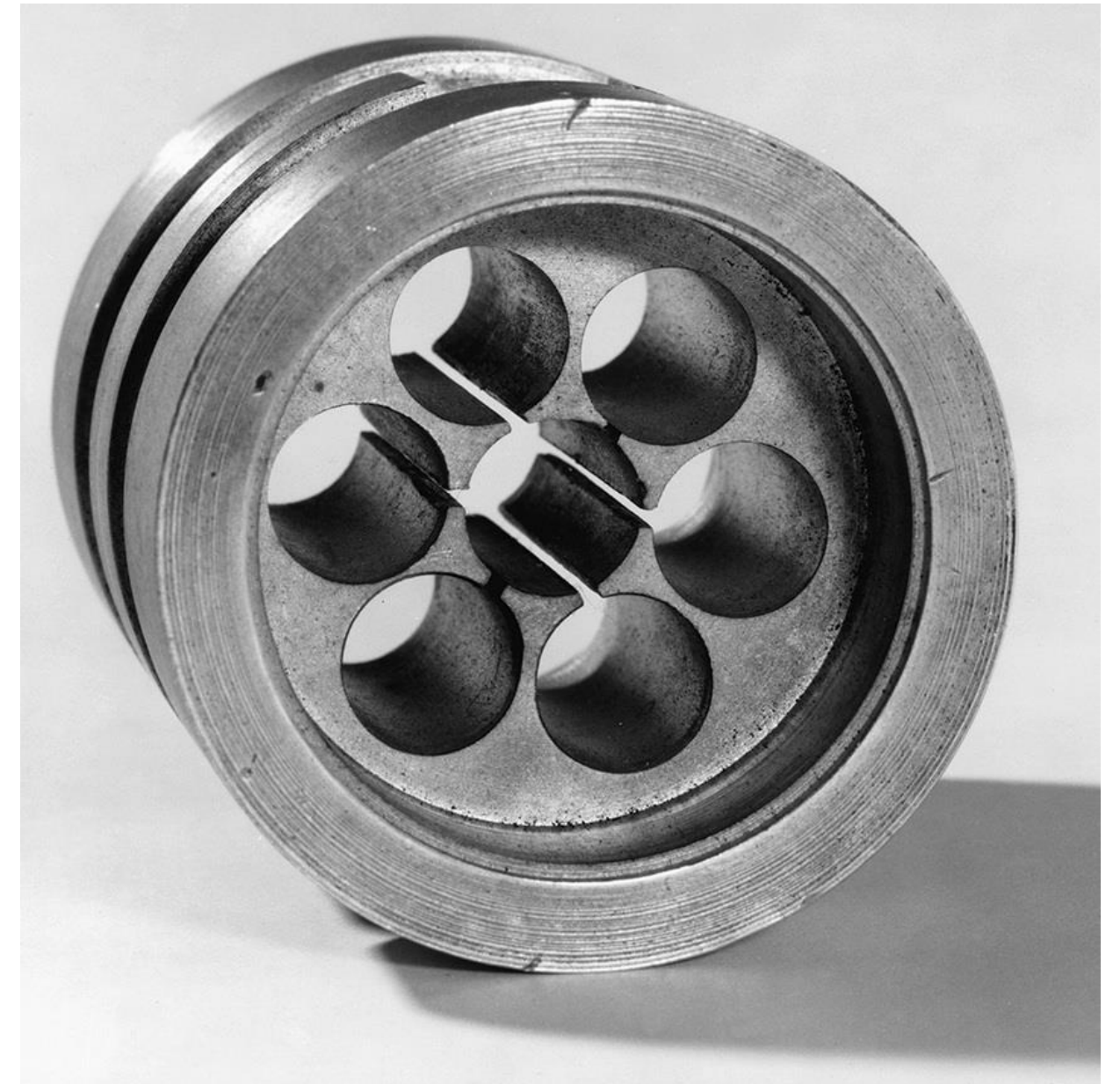
## Project 8:

# CRES (cyclotron radiation emission spectroscopy)



# HOW?

## Microwave magnetron cavity

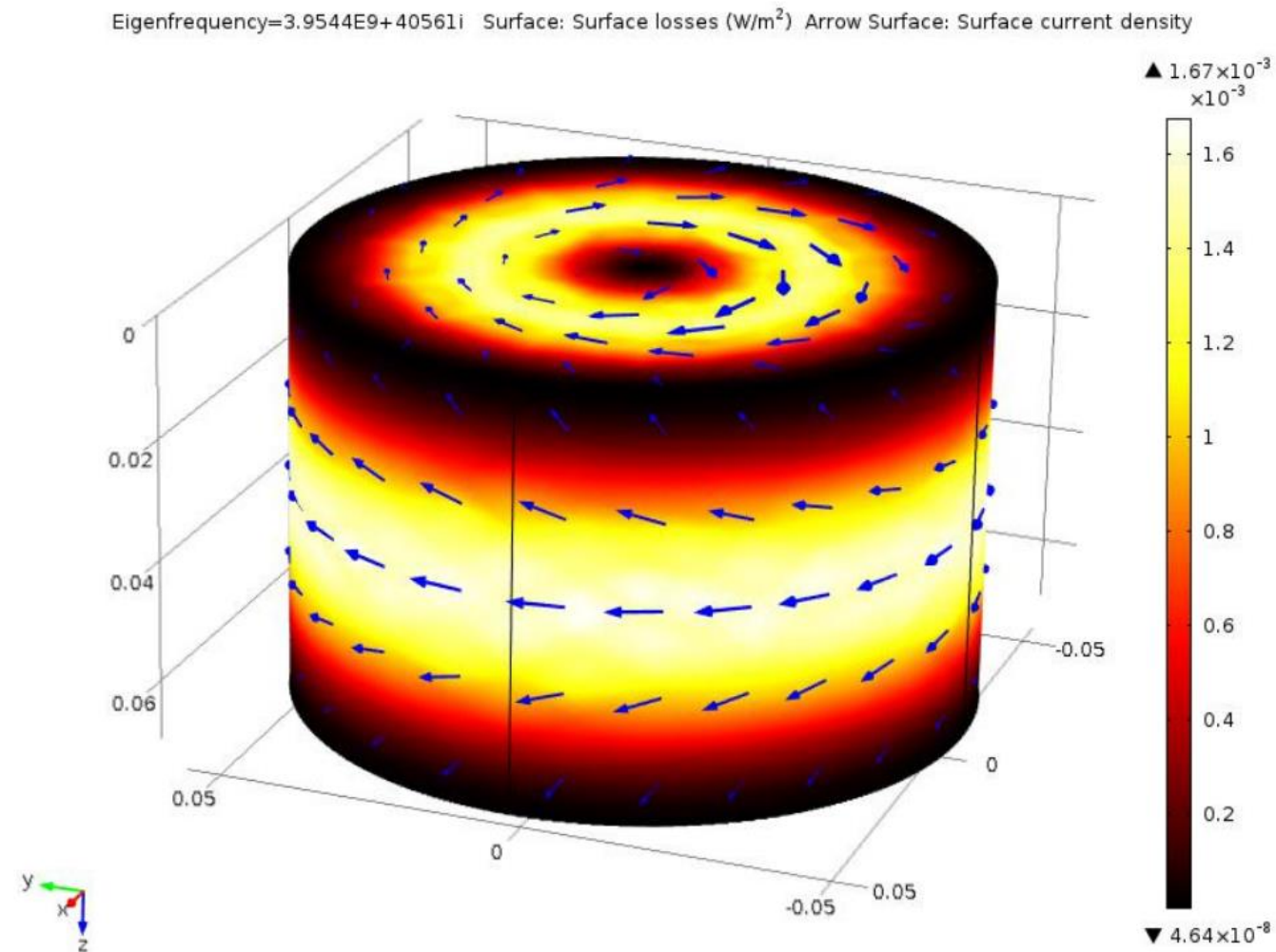
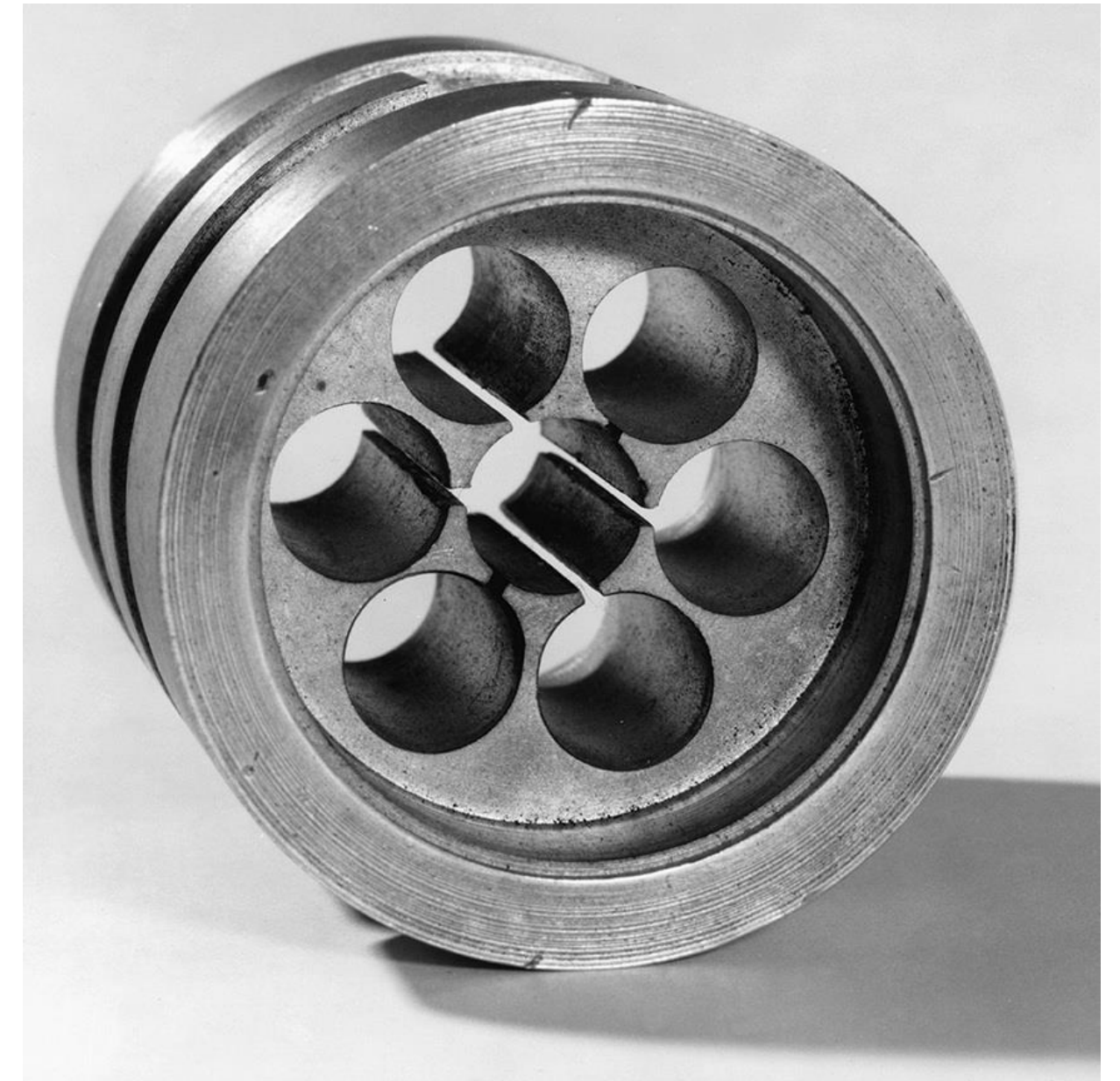




# HOW?

## Microwave magnetron cavity

### Project 8: opposite

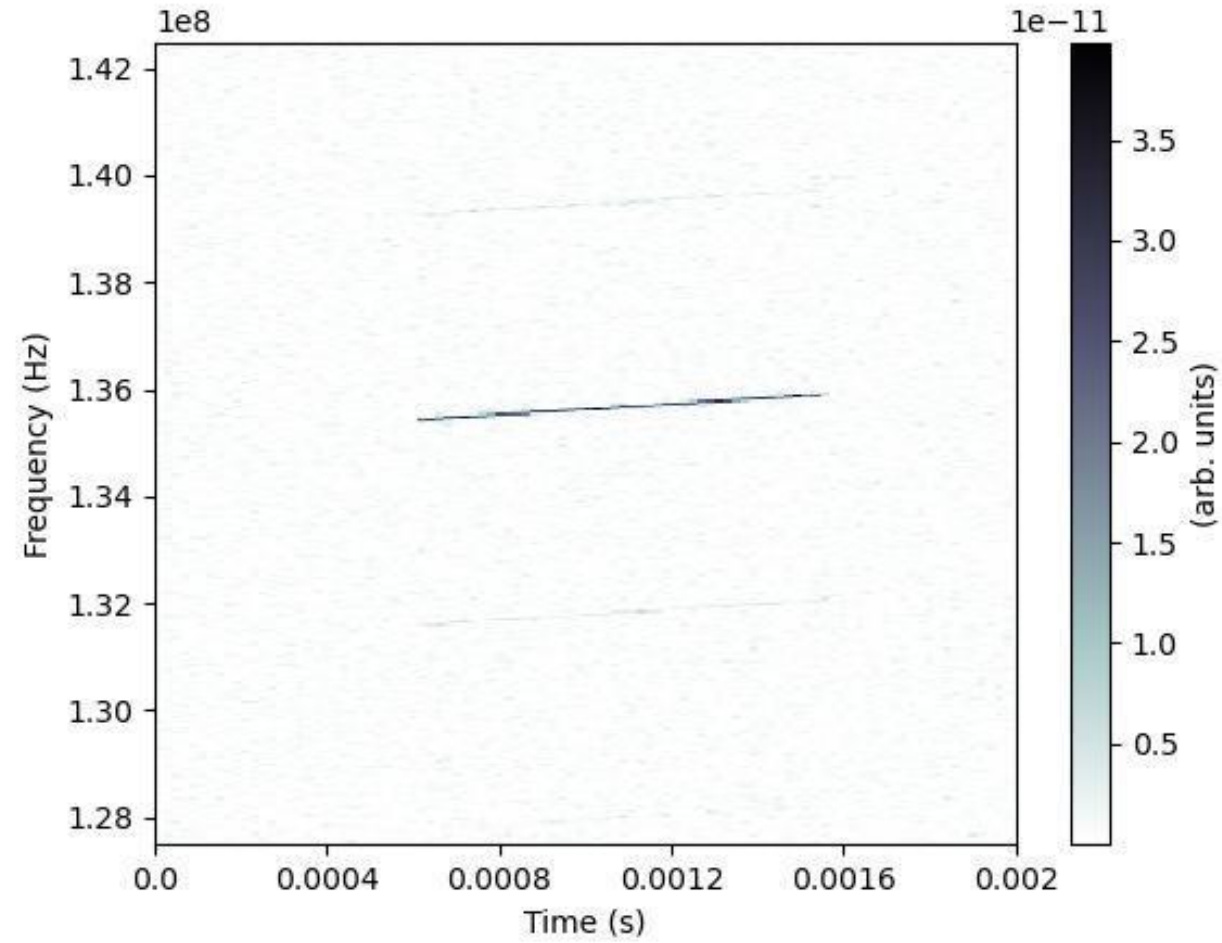


(a)  $TE_{011}$

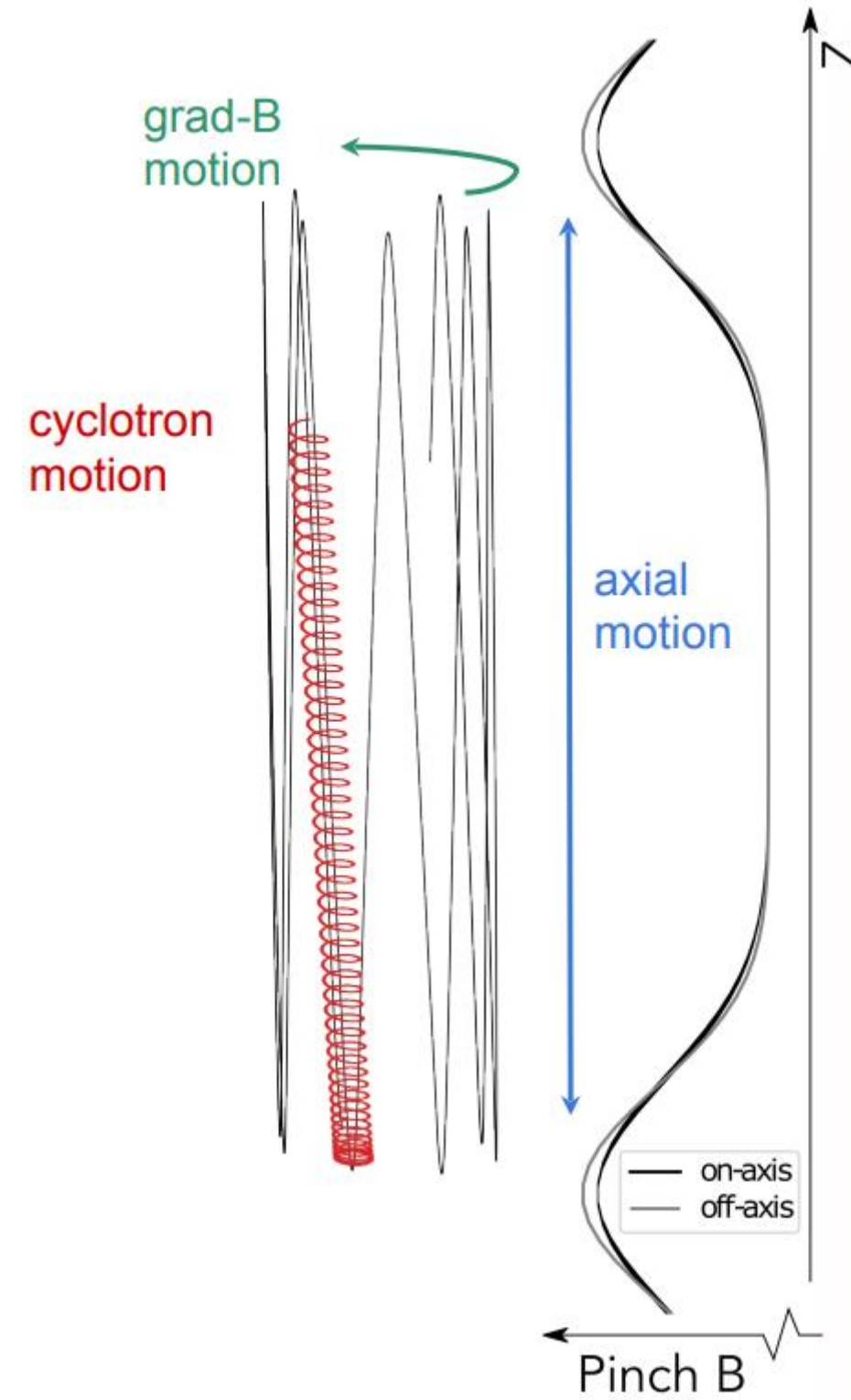


# HOW?

Credit: Srinikitha Bhagvati



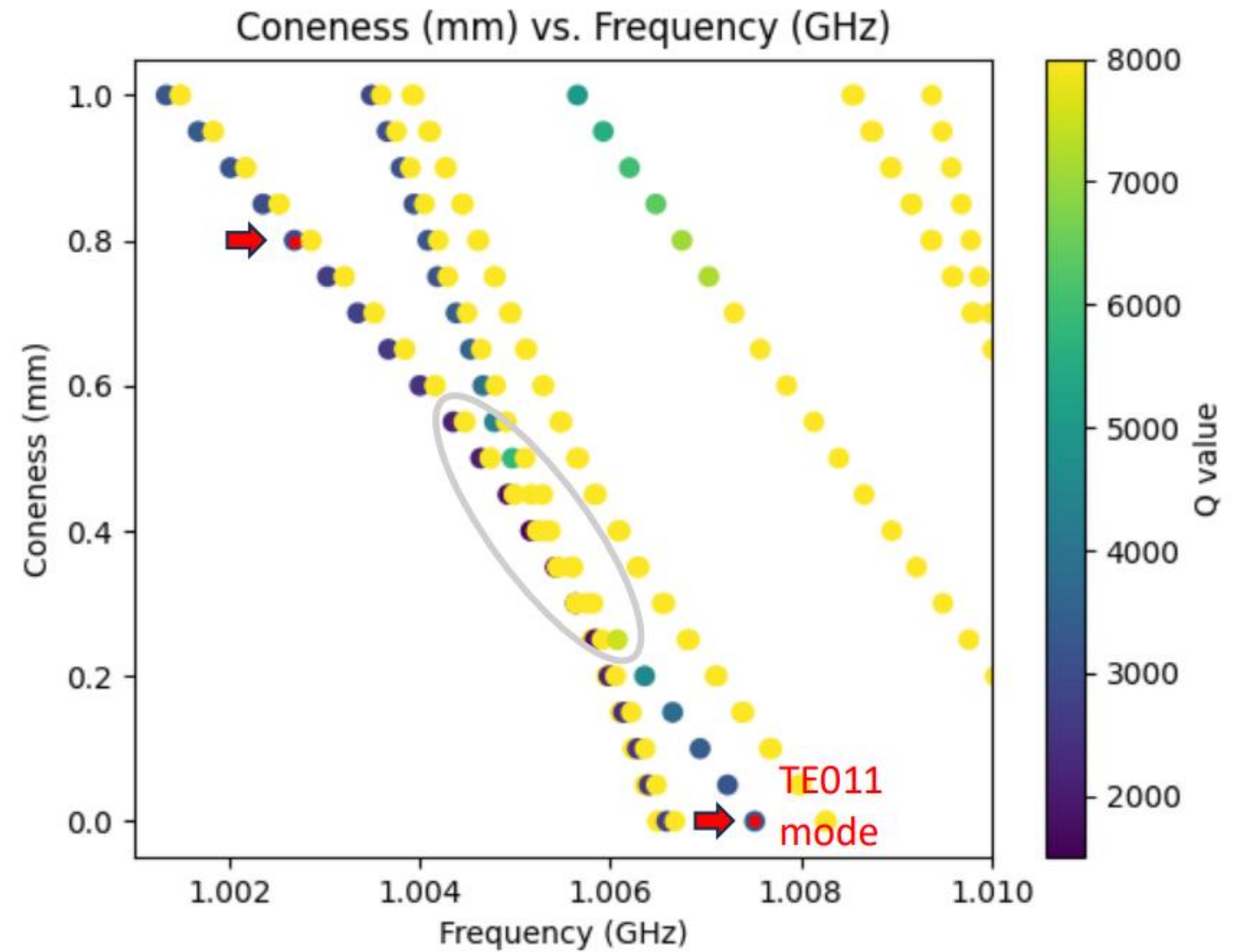
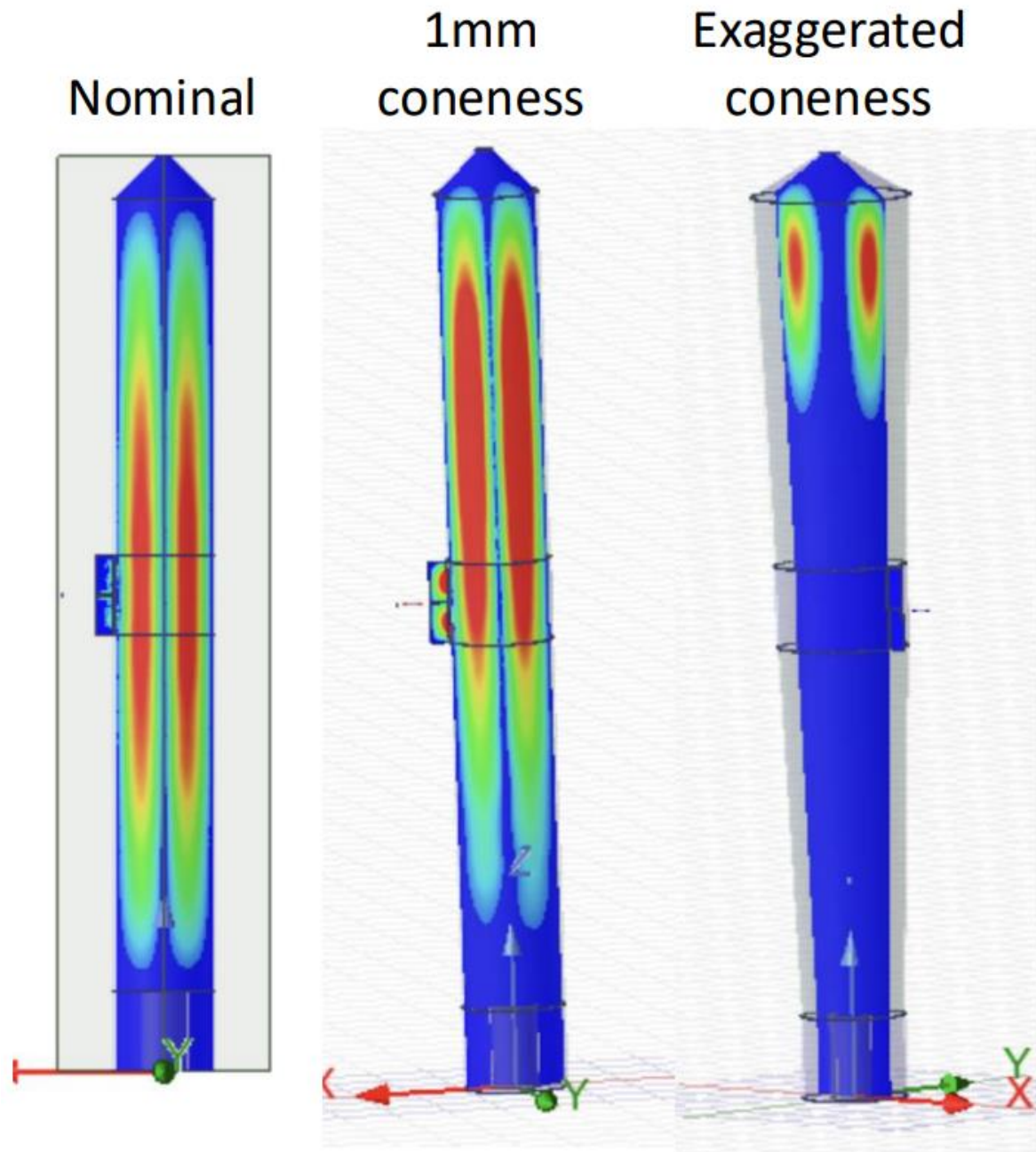
$$f = \frac{f_0}{\gamma} = \frac{1}{2\pi} \frac{eB}{m_e + E_{\text{kin}}/c^2}$$



STUDIES

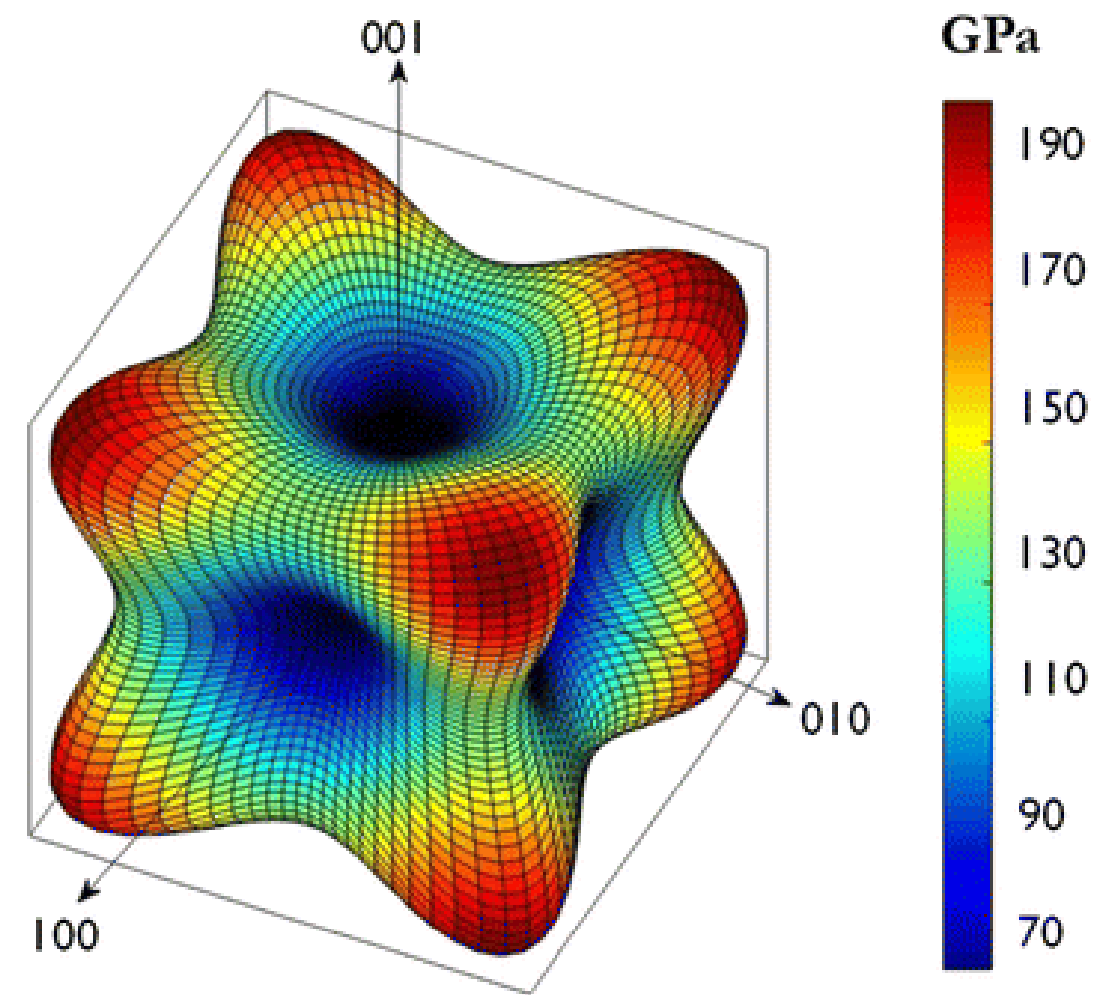
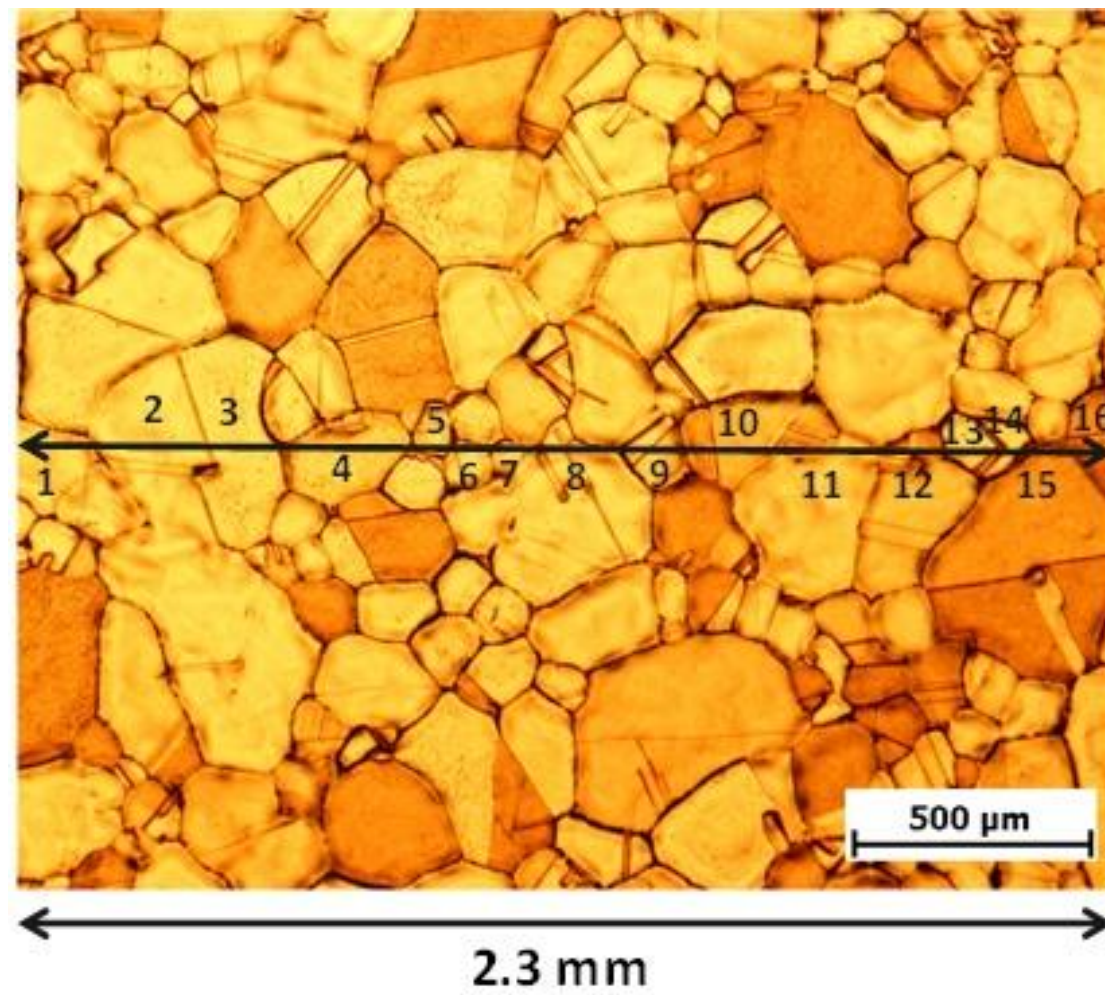
# DISTORTIONS STUDY

## Coneness study (Hannah Binney)

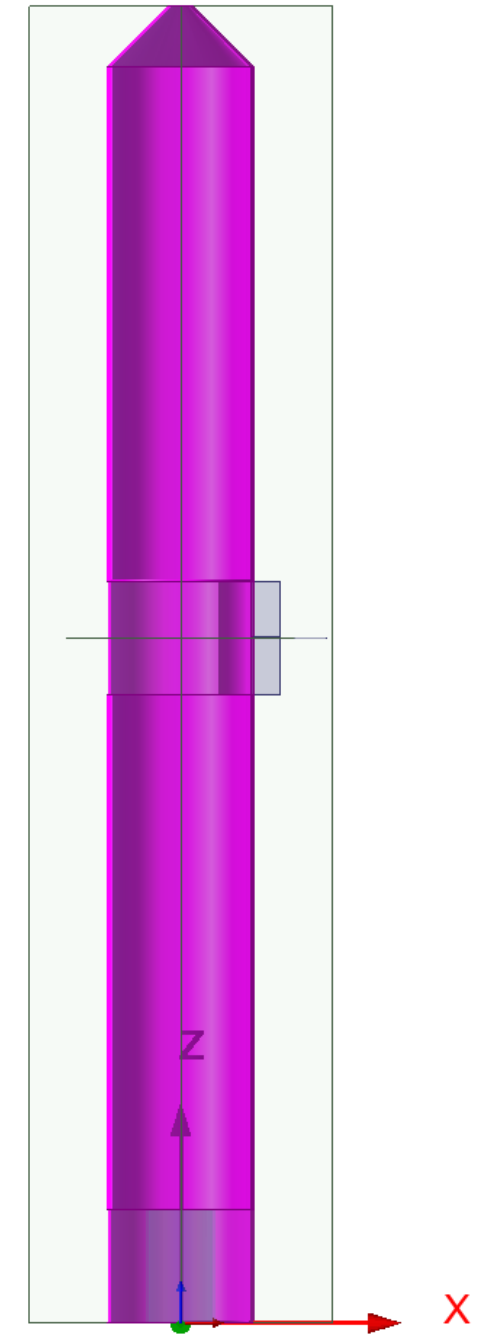
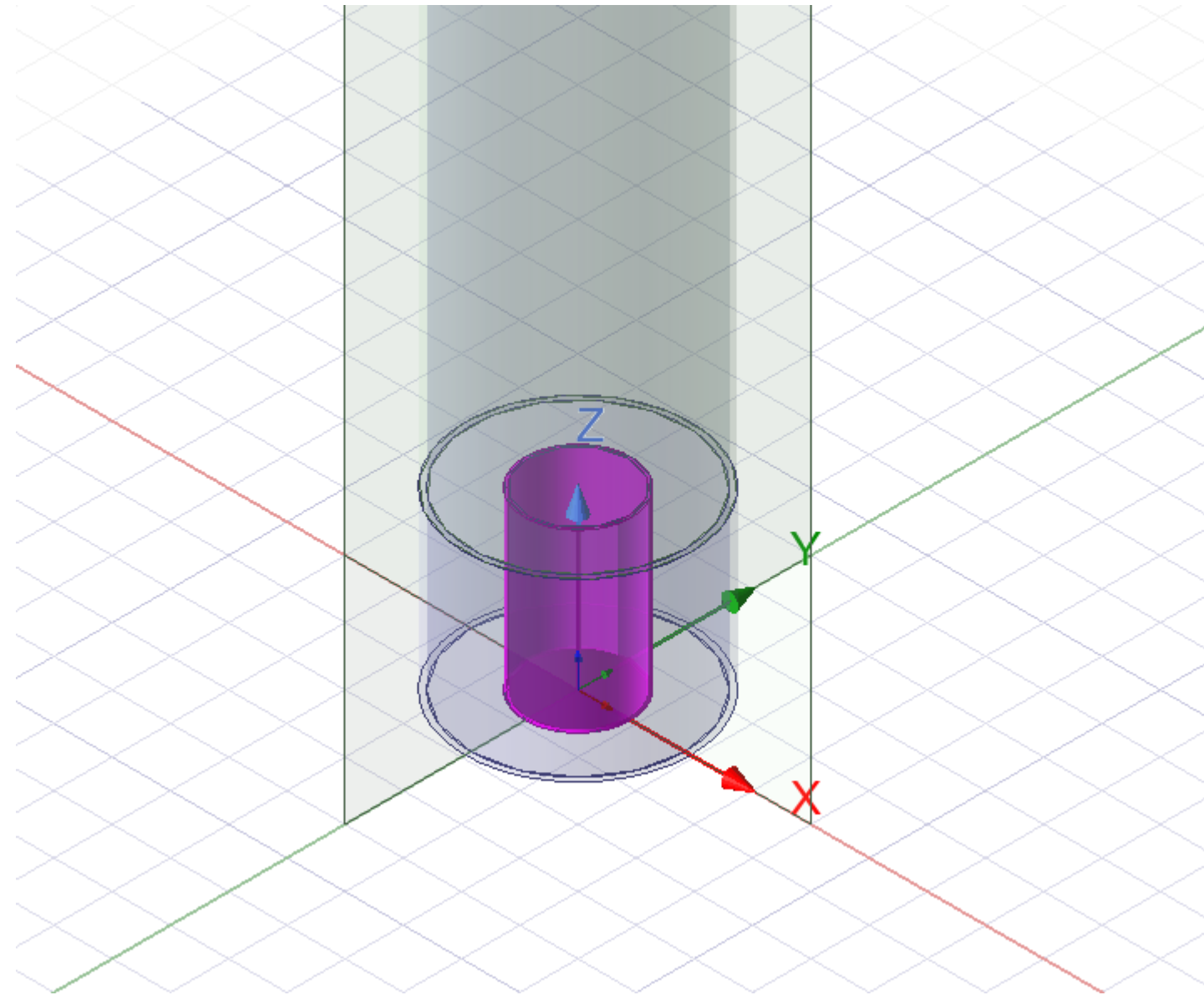




# MATERIAL STUDY



# ENDCAP TERMINAL LENGTH STUDY



OTHER



# COLLABORATION MEETUP TEXAS



THE UNIVERSITY OF TEXAS  
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# WIKIPEDIA ARTICLE

## Draft:Project 8

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- **Warning:** The page [Project 8](#) redirects to [Project 8 \(disambiguation\)](#). Please ensure it is not a copy or that this page is located to the correct title.

**Project 8** is an international collaboration of physicists intending to measure the absolute mass of the [neutrino](#)<sup>[1]</sup> with a sensitivity of approximately 40 meV. <sup>[2][3][4]</sup>

The experiment measures the [beta decay](#) of tritium. The energy spectrum of [beta-decay](#) electrons depends on the mass of the [electron antineutrino](#). A non-zero neutrino mass will distort the shape of the highest-energy part of the energy spectrum.<sup>[5]</sup> Project 8 relies on [cyclotron radiation](#) from single electrons produced in [beta decay](#) in order to measure their energy, a method dubbed **CRES** (**C**yclotron **R**adiation **E**mission **S**pectroscopy). The cyclotron radiation is captured using a [microwave waveguide](#) (as in the first demonstration) or a [resonant cavity](#) (as considered for future phases<sup>[6]</sup>). This method was successfully demonstrated in Phase I of Project 8, marking the first measurement of cyclotron radiation from a single electron.<sup>[7]</sup>

The beta decay source for the 40 meV experiment is planned to be atomic [tritium](#). This provides higher precision than molecular tritium since an isolated atom has no [rotational](#) or [vibrational](#) states that can take up some of the decay's energy.<sup>[8]</sup>

Tritium beta decay has been used by a number of previous experiments, the current generation of which is [KATRIN](#). its design uses a large spectrometer which would need to be enlarged to implausible proportions to materially improve its sensitivity. CRES is therefore a more promising method for a tritium-based next-generation direct neutrino-mass experiment. <sup>[9]</sup> Project 8 was mentioned in the The 2023 Long Range Plan for Nuclear Science from the Nuclear Science Advisory Committee (NSAC) of the [United States Department of Energy](#), which described the status of the field as follows:<sup>[10]</sup>

Any experiment that follows KATRIN will need two new technologies: (1) a scalable electron spectroscopy technique to measure the tritium decay spectrum and (2) a tritium source consisting of atoms rather than the more natural molecular form of this hydrogen isotope.

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Width

Standard

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