XLS Linearizer Frequency Comparison

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XLS Linearizer Status and Updates,
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Outline

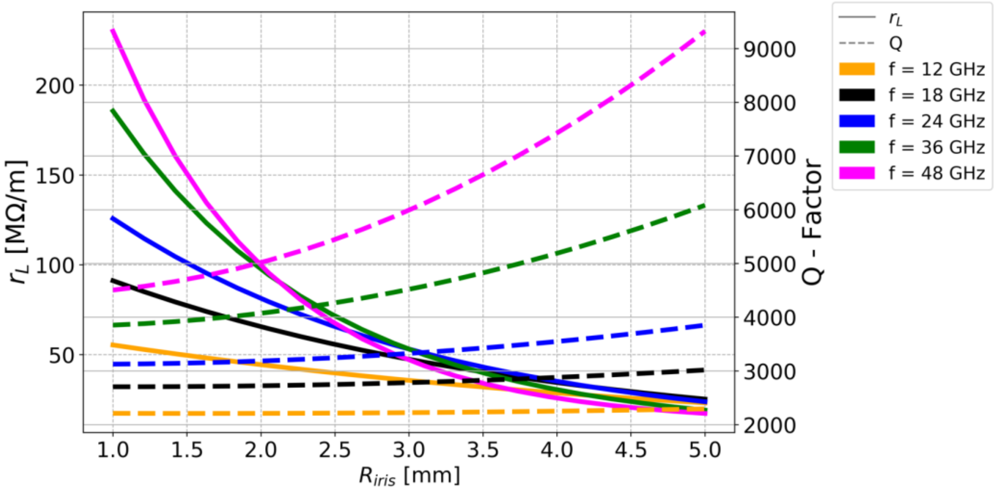
- Considerations.
- Figures of Merit.
- Power and gains.
- Summary.

Considerations

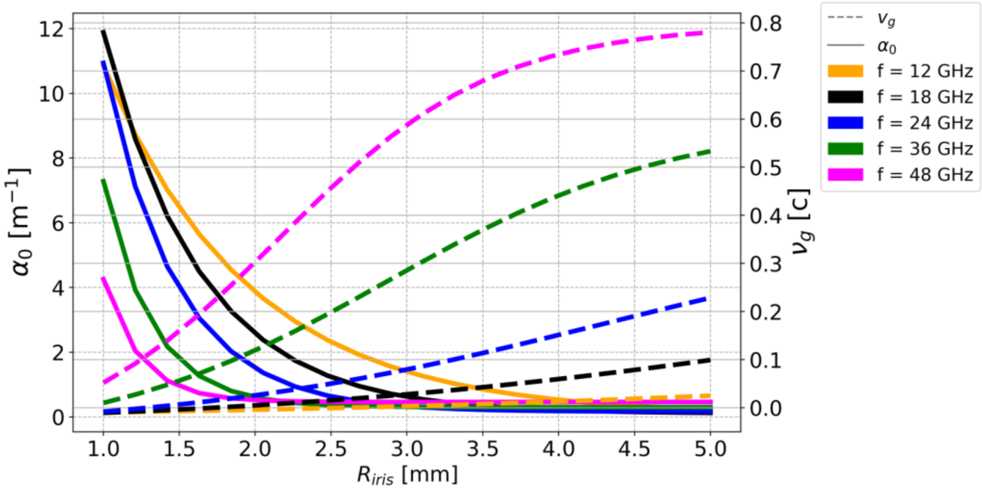
- I have used the simulation data for the Ka-band and the following simple scaling laws:
  - $L_{cell}(f_2) = \left({}^{f_1}/_{f_2}\right) \cdot L_{cell}(f_1).$
  - $Q_0(f_2) = \sqrt{{}^{f_2}/_{f_1}} \cdot Q_0(f_1).$
  - $R_s(f_2) = \sqrt{{}^{f_2}/_{f_1}} \cdot R_s(f_1).$
  - $v_g(f_2) = \left({}^{f_2}/_{f_1}\right) \cdot v_g(f_1).$
  - $\alpha_0(f_2) = \sqrt{\left({}^{f_2}/_{f_1}\right)^3} \cdot \alpha_0(f_1).$
  - $R_{iris}(f_2) = \left({}^{f_1}/_{f_2}\right) \cdot R_{iris}(f_1).$
- Then I did curve fits and extrapolations, when needed, to aide the comparison.

Figures of Merit

Shunt Impedance and Q_0



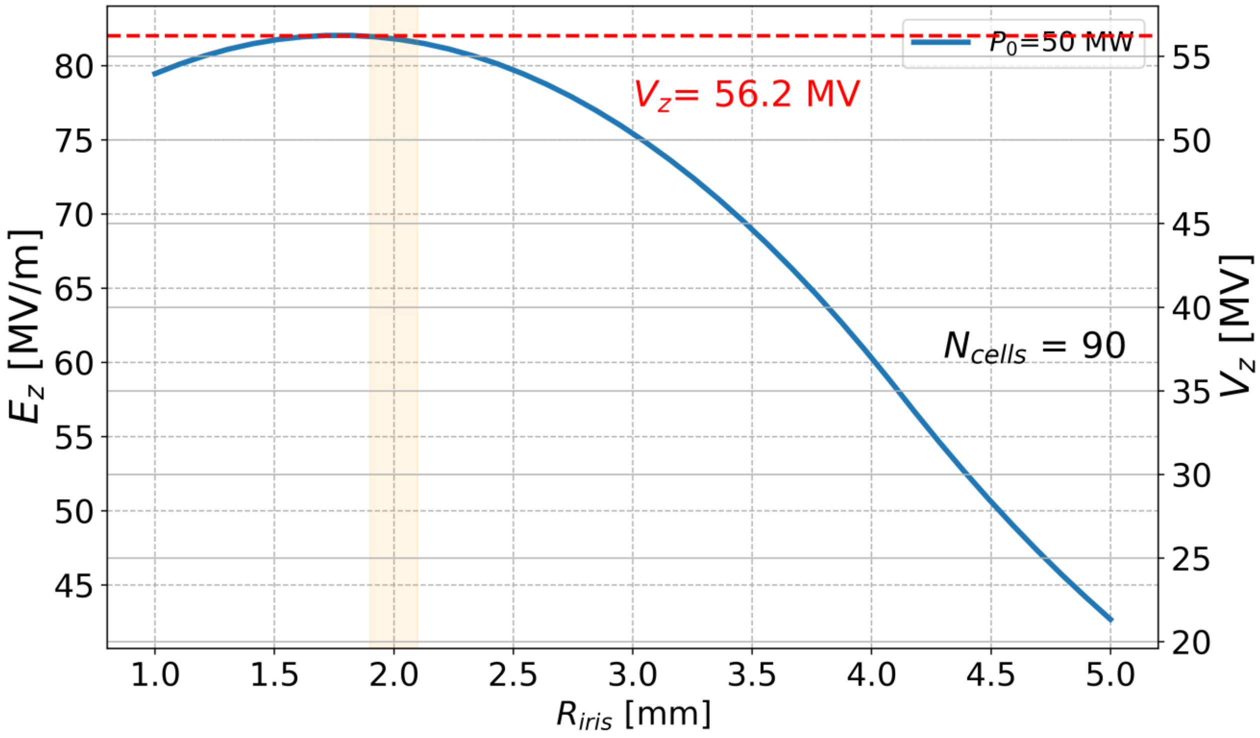
v_g and Attenuation Factor



- At low apertures (≤ 2.0mm) higher freqs. show more desirable numbers, as expected.
- At around 3.5mm, lower freqs. start to show better shunt impedance than the highest freqs.
- Higher freqs. maintain lower attenuation and higher group velocity along the range.

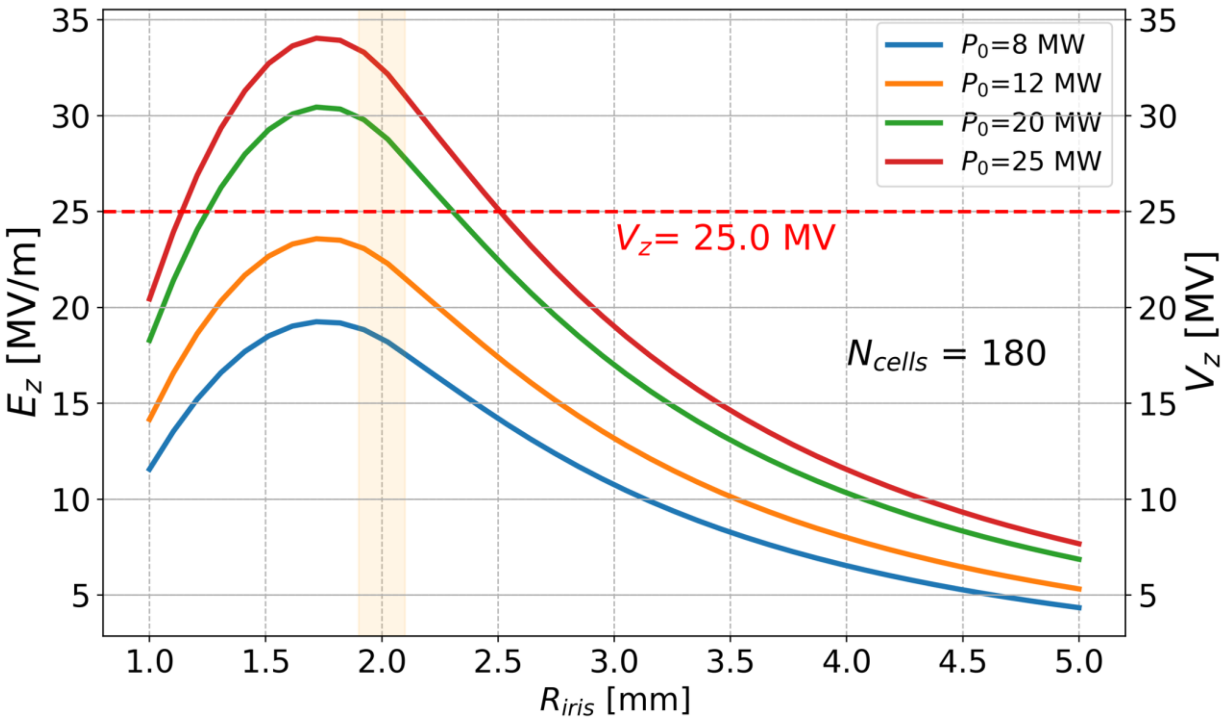
Power Requirements and Gains

12 GHz and 0.5m active length



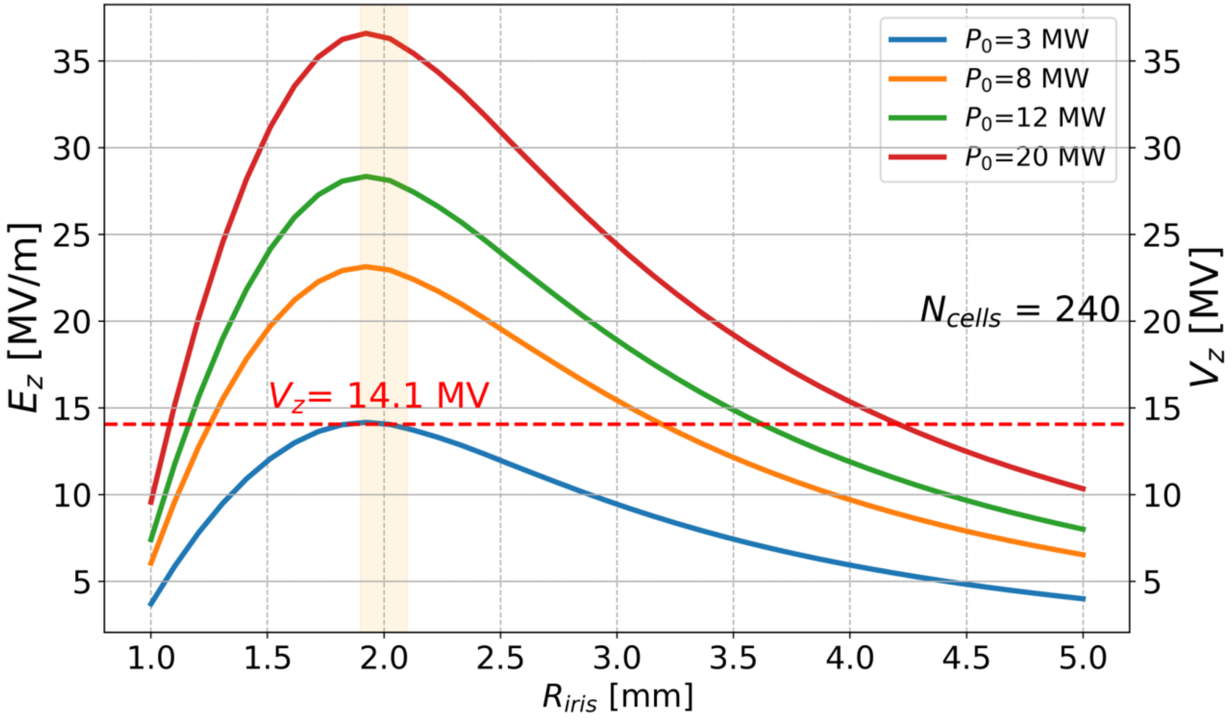
- A half meter long structure will need about 50MW to reach the goal.

18 GHz and 1m active length



- To 1st order, $\varsigma = h^2 \times Voltage$ is our figure of merit, so in principle:
  - The higher harmonic, the lesser the needed voltage.

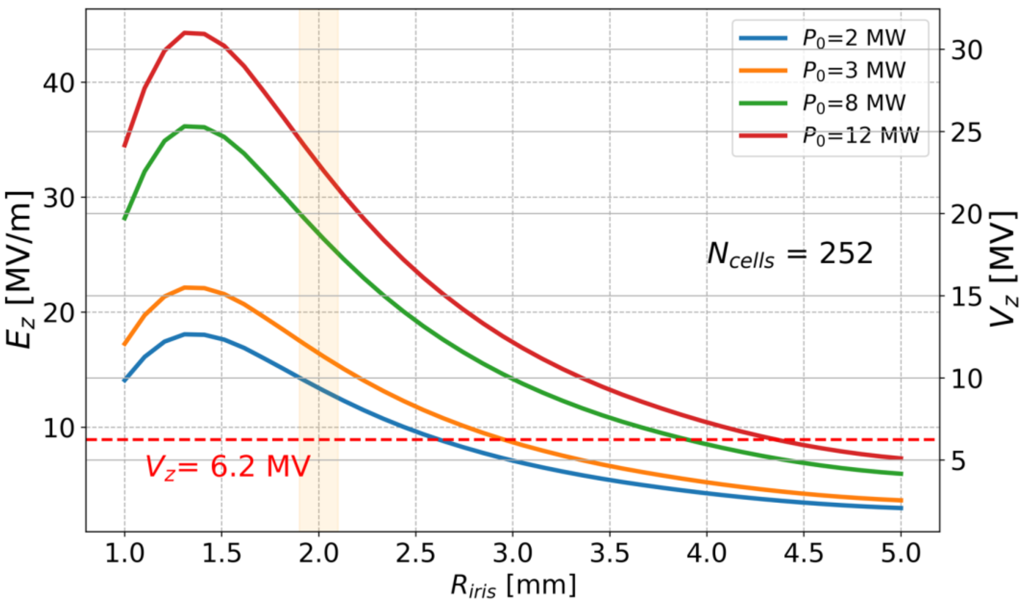
24 GHz and 1m active length



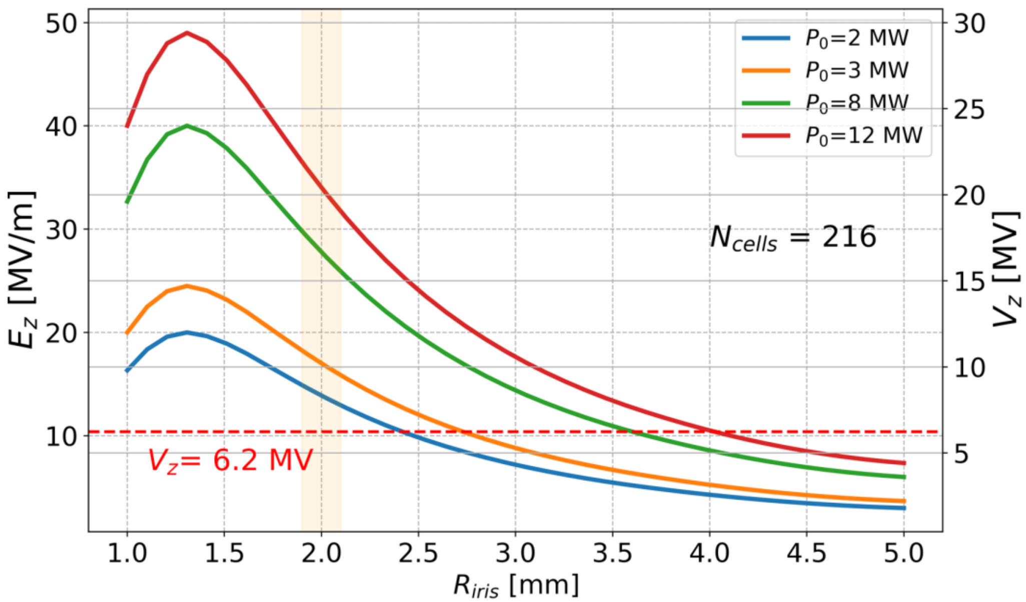
- Fairly long structure but provides enough voltage for ~6 MW.
  - There is room to further shorten the structure for a higher input power.

36 GHz

0.7m active length



0.6m active length

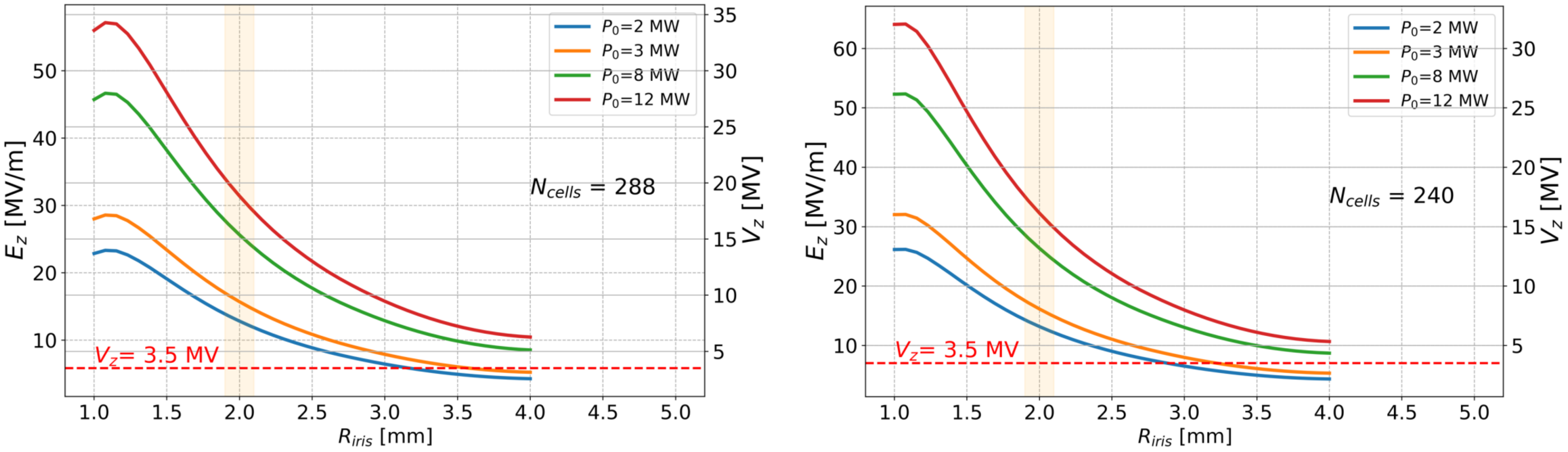


- Still room to shorten further the structure.

48 GHz

0.6m active length

0.5m active length



- Similarly to the 36GHz there still room to shorten further the structure

Summary

- Keeping a 2.0 mm iris radius, some candidates:
  - 12 GHz, 1m long @~50MW.
  - 18 GHz, 1.0m long @~15MW.
  - 24 GHz, 1.0m long @~3MW.
  - 36 GHz, room for <0.6m long @3MW.
  - 48 GHz, room for <0.5m long @2MW.
- Keeping in mind that for the gyro-klystrons:
  - @36 GHz, with a 3MW output.
  - @48 GHz, with a 2MW output.

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Compact

Thank you!

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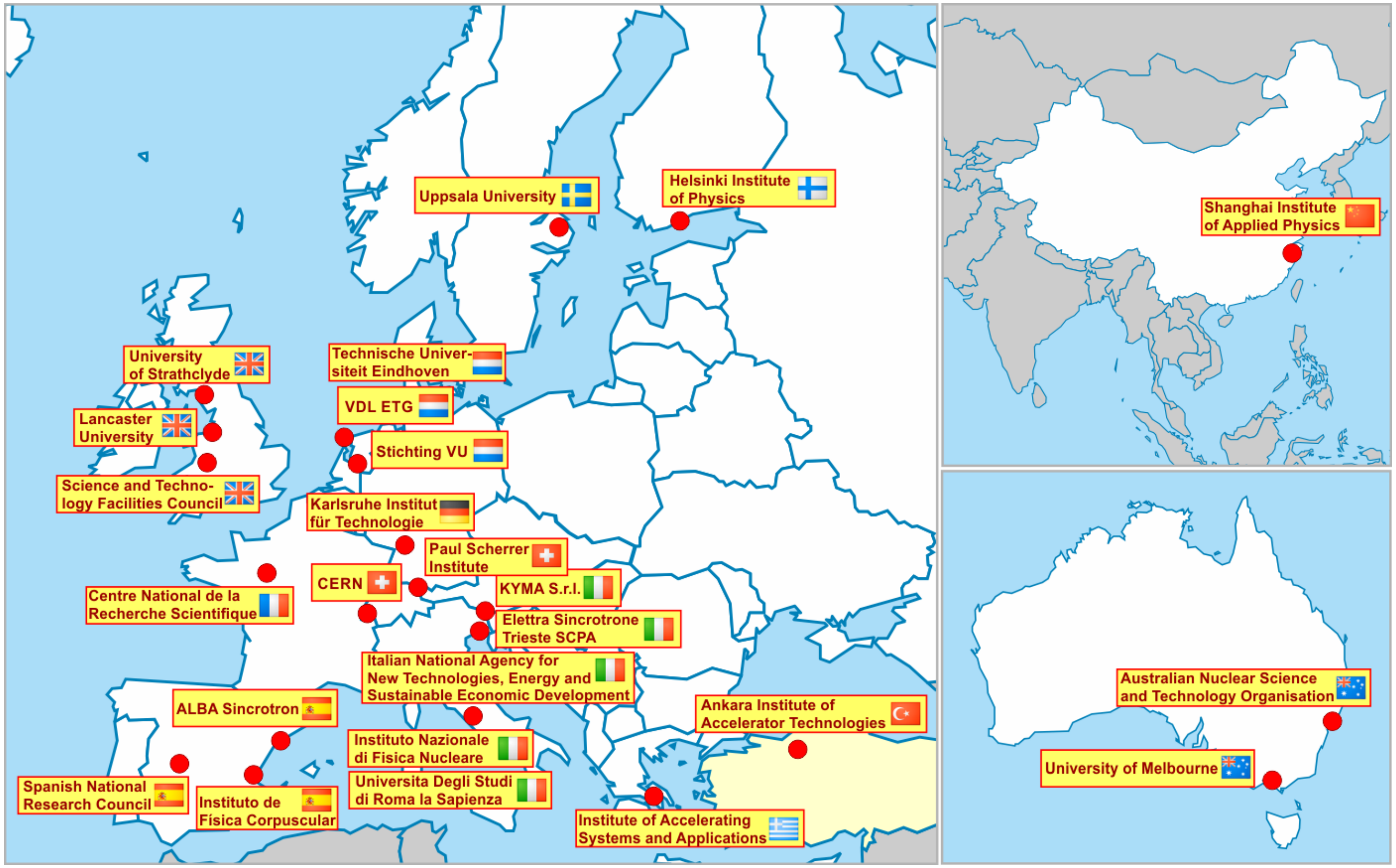

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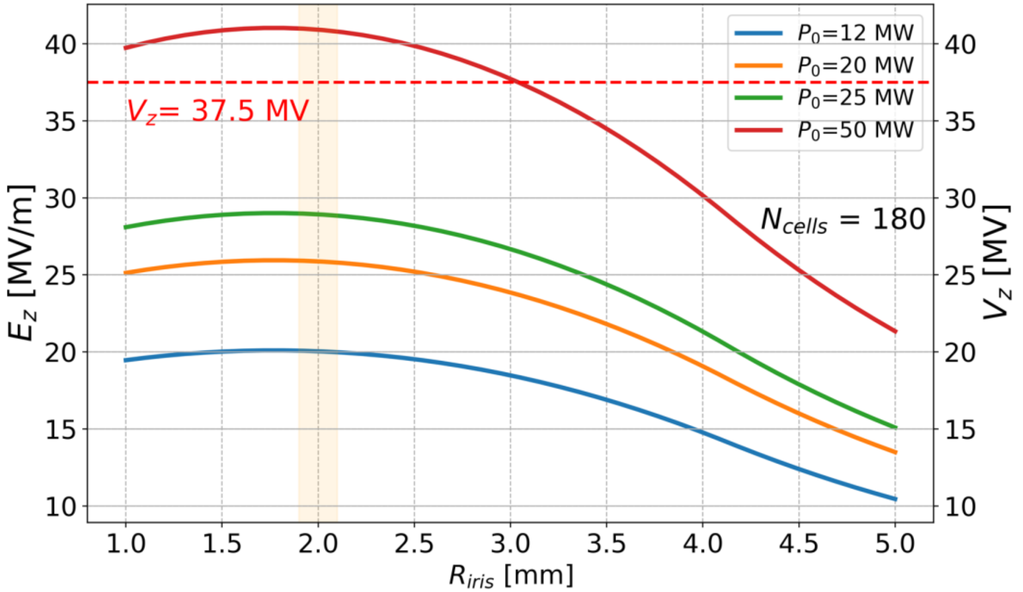
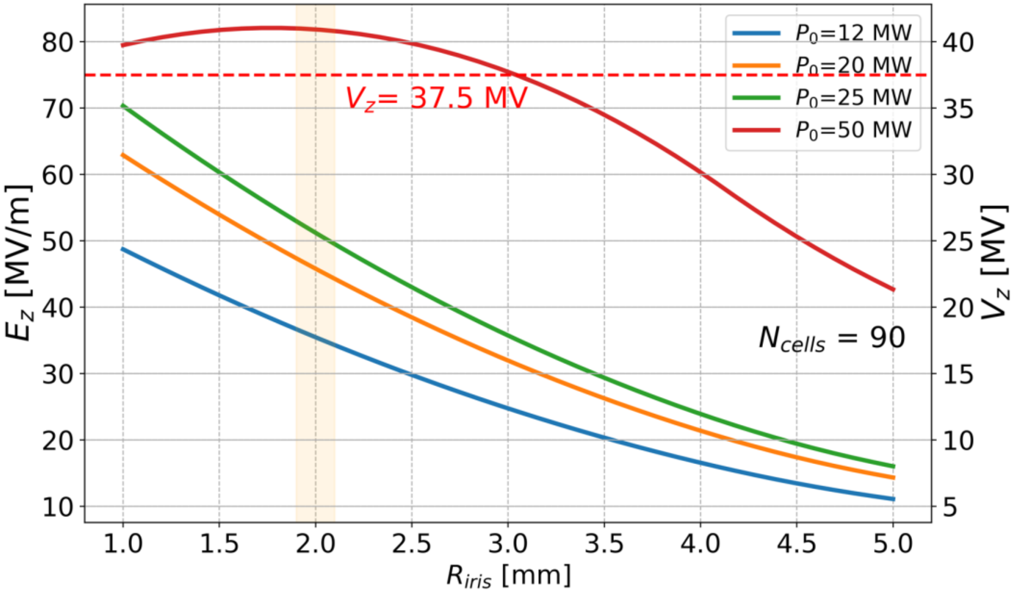
12 GHz

1m active length



0.5m active length



- Structures longer than 0.5m alleviate the high gradients but don’t reduce the power need.
- A half meter long structure will need about 40MW to reach the goal.
  - A 3mm iris radius and 50MW could also work.
  - Disregard values R_{iris} <1.5mm due to a poor extrapolation.