



**TÉCNICO** LISBOA

# FIRST PRINCIPLES STUDY OF TOPOLOGICAL INVARIANTS OF WEYL POINTS IN MAGNETIZED PLASMA

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# GREEN'S FUNCTION FORMALISM

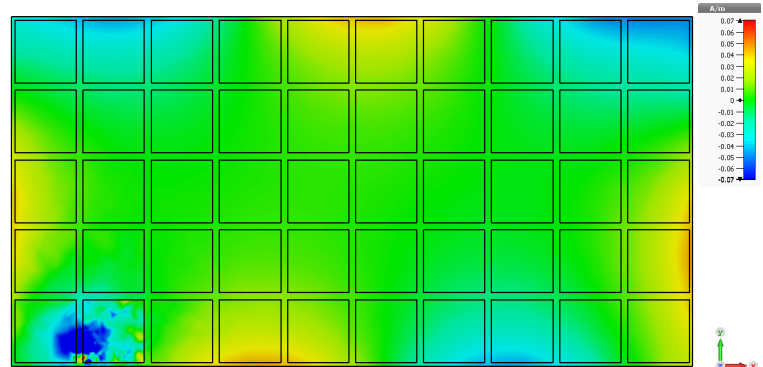
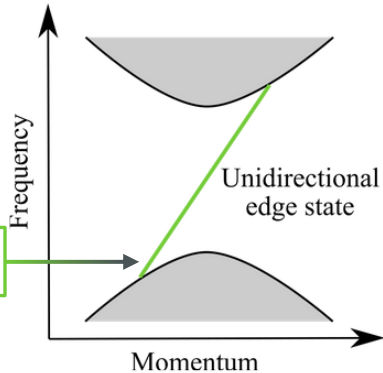
- Gap Chern number:

2D

$$C_{gap} = \frac{i}{(2\pi)^2} \int d^2\mathbf{k} \int_{\omega_{gap}-i\infty}^{\omega_{gap}+i\infty} d\omega \text{Tr}\{\partial_1 \hat{L}_{\mathbf{k}} \cdot \mathcal{G}_{\mathbf{k}} \cdot \partial_2 \hat{L}_{\mathbf{k}} \cdot \mathcal{G}_{\mathbf{k}}^2\}$$

- Photonic Green's function:

$$\mathcal{G}_{\mathbf{k}} = i(\hat{L}_{\mathbf{k}} - \omega I)^{-1}$$



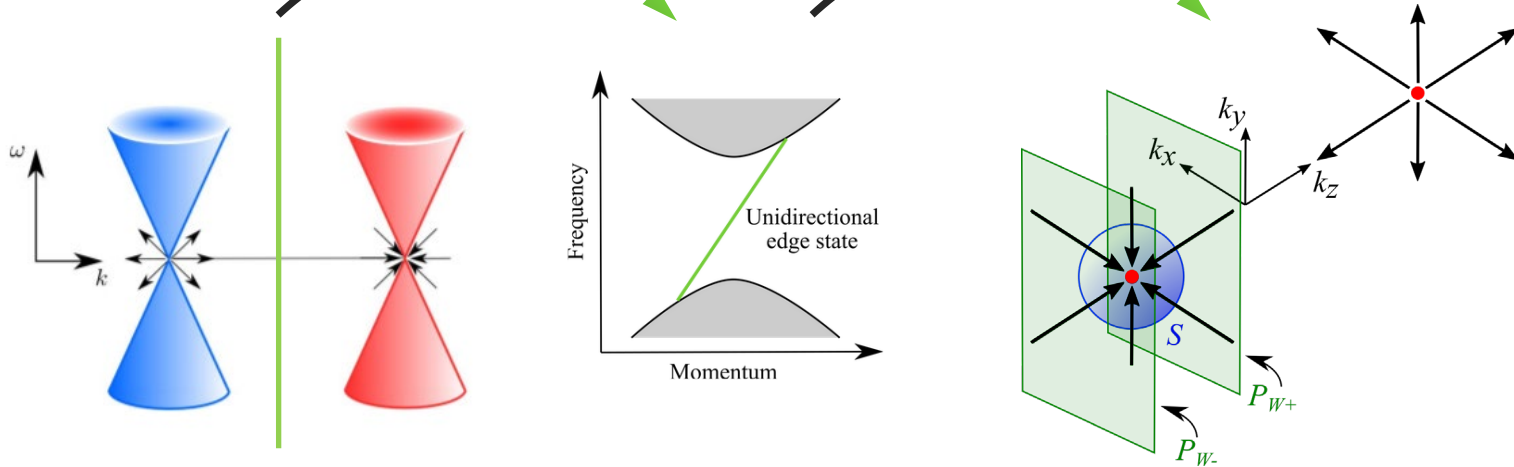
# WEYL POINTS

3D

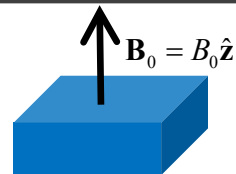
○ Weyl point's chirality is given by:

$$C_W = \frac{i}{(2\pi)^2} \int dS \hat{\mathbf{n}} \cdot \int_{\omega_{gap}-i\infty}^{\omega_{gap}+i\infty} d\omega \text{Tr}\{[\partial_2 \hat{L}_k \cdot \mathcal{G}_k \cdot \partial_3 \hat{L}_k + \partial_3 \hat{L}_k \cdot \mathcal{G}_k \cdot \partial_1 \hat{L}_k + \partial_1 \hat{L}_k \cdot \mathcal{G}_k \cdot \partial_2 \hat{L}_k] \cdot \mathcal{G}_k^2\}$$

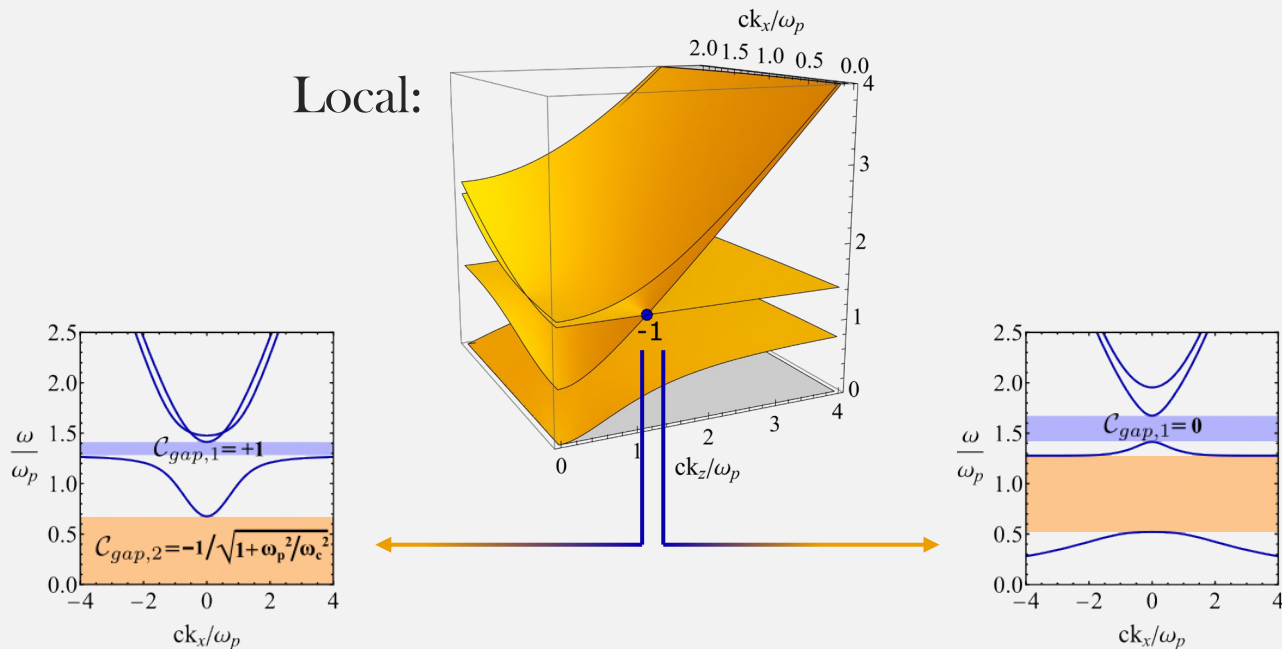
$$C_W = C_{gap}(P_{W+}) - C_{gap}(P_{W-})$$



# MAGNETIZED PLASMA



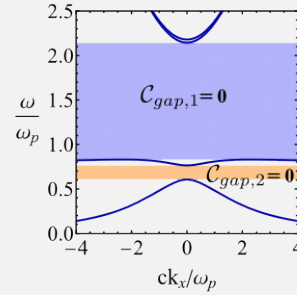
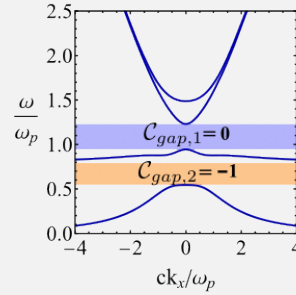
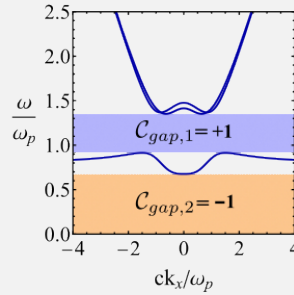
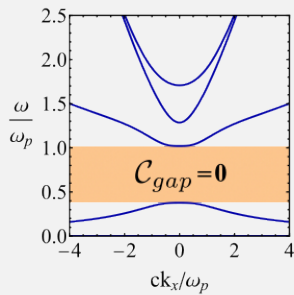
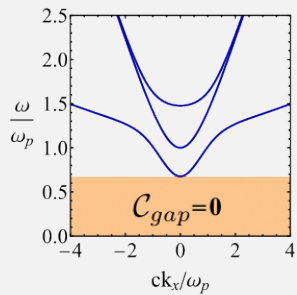
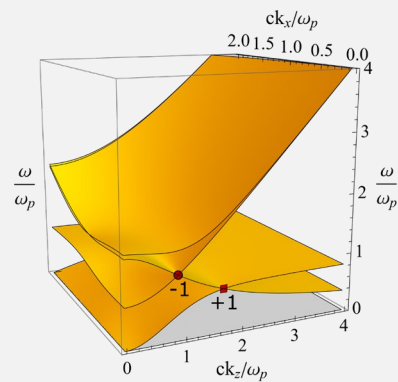
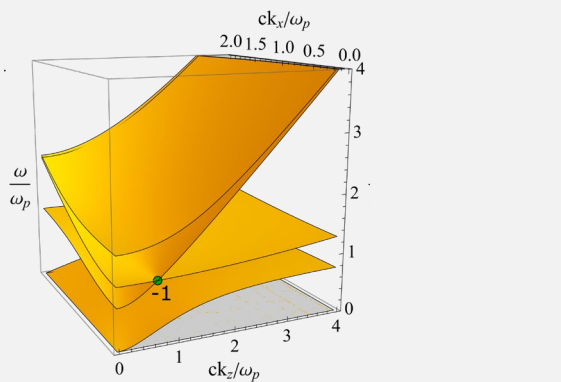
- The Weyl points arise at the crossing between a flat longitudinal mode and a transverse mode:



# NONLOCAL MAGNETIZED PLASMA

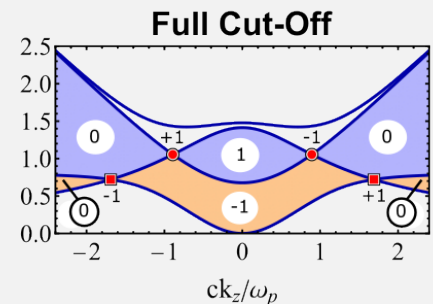
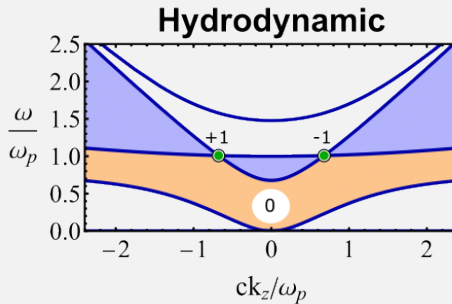
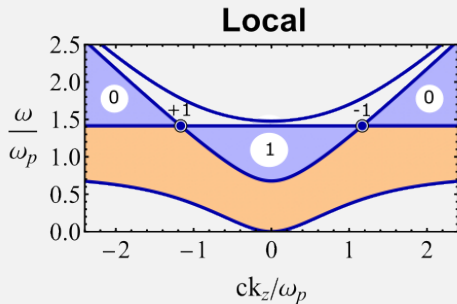
## Hydrodynamic

## Full Cut-Off



# CONCLUSIONS

- Generalized the Green's function formalism to compute topological invariants in 3D media.
- We consider dispersion and nonlocality.
- 3D approach can compute chirality without full band gaps.
- Between Weyl point pairs, gap topology is non-trivial and trivial outside.





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