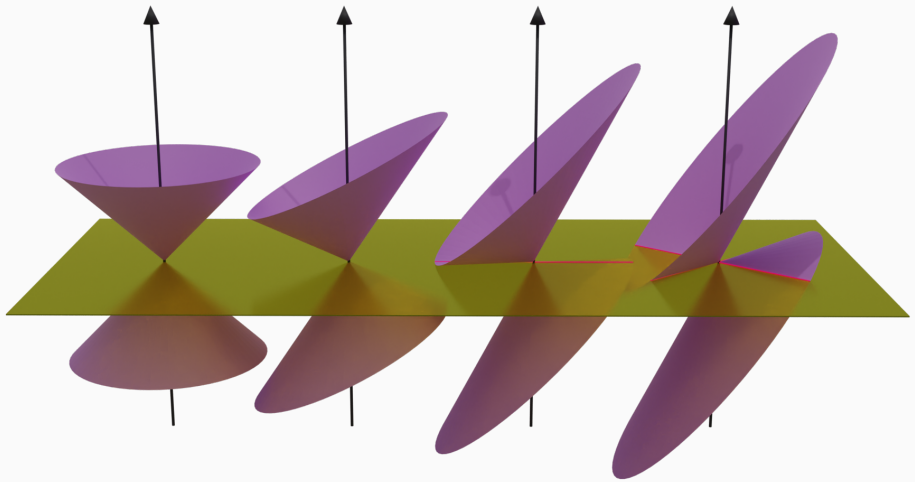
Master thesis presentation

Thorvald M. Ballestad

03. June 2022



Background

Conformal anomaly in massless QED

The massless Dirac equation

$$\bar{\psi} i \not{\partial} \psi = 0. \tag{1}$$

Conformal anomaly in small perturbation limit

$$g^{\mu\nu} = \eta^{\mu\nu} + \delta g^{\mu\nu}. \tag{2}$$

The Dirac cone Hamiltonian

$$H_D = v_F s \boldsymbol{p} \boldsymbol{\sigma}. \tag{3}$$

Our work

Linear response and Luttinger's method

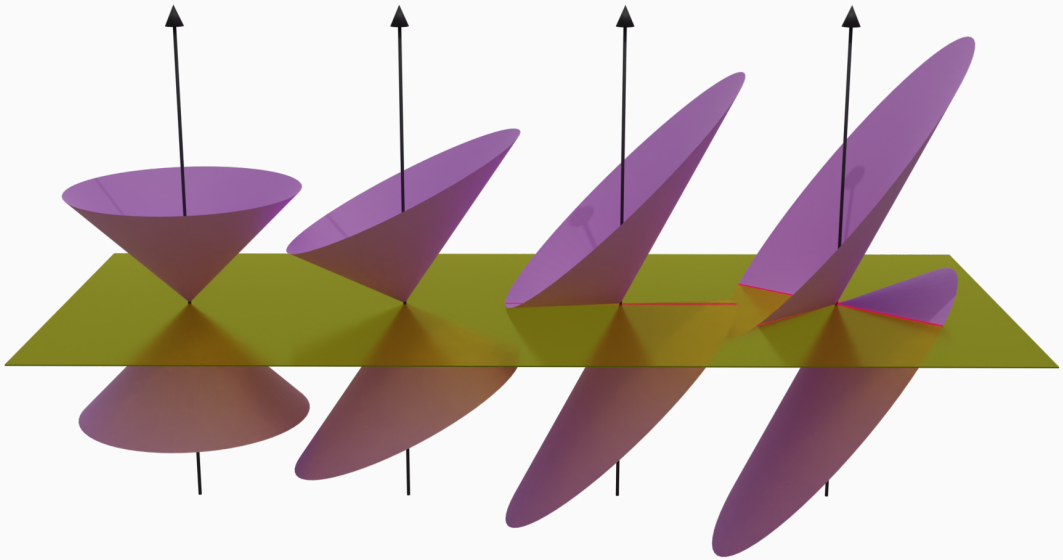
Temperature pertupation ∇T and gravitational potential ψ

$$\nabla\psi + \frac{\nabla T}{T} = 0. \tag{4}$$

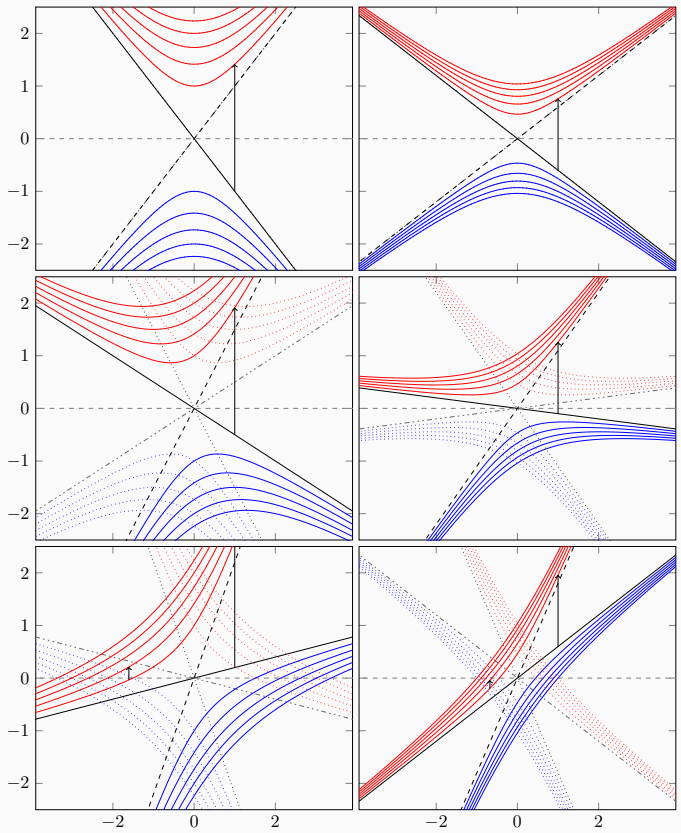
Linear response (Kubo)

$$\langle J \rangle (t, \boldsymbol{r}) = i v_F \int \mathrm{d}t' \mathrm{d}\boldsymbol{r}' \int_{-\infty}^{t'} \mathrm{d}t'' \Theta(t - t') \times \left\langle \left[\boldsymbol{J}^i(t, \boldsymbol{r})), T^{j0}(t'', \boldsymbol{r}') \right] \right\rangle \frac{\partial'_j T(t', \boldsymbol{r}')}{T(t', \boldsymbol{r}'} \tag{5}$$

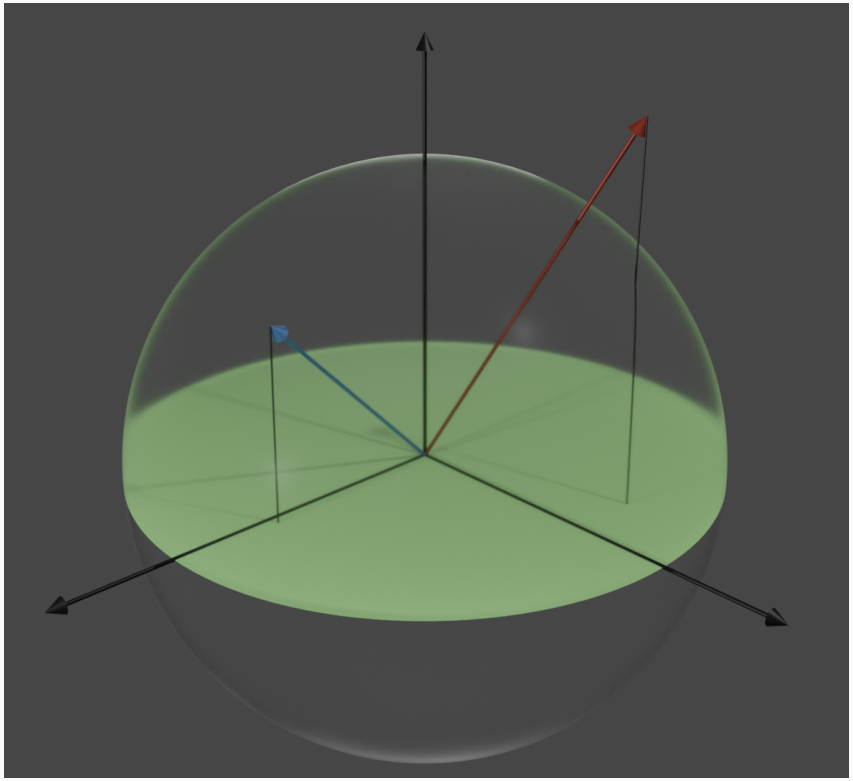
Type-I and Type-II



Landau levels



Type-I and Type-II



Proposition

The modulus of the *tilt vector* $\boldsymbol{t}$ separates Type-I from Type-II, with Type-II having $t > 1$.

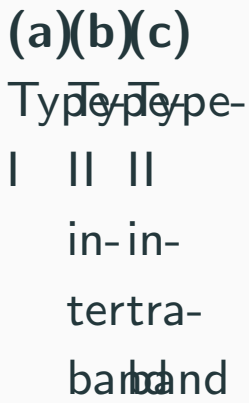
Collapse of LLs for perpendicular tilt.

Result

The response can be directly tuned by the tilt parameter t.

Perpendicular tilt

Parallel tilt



Thank you!