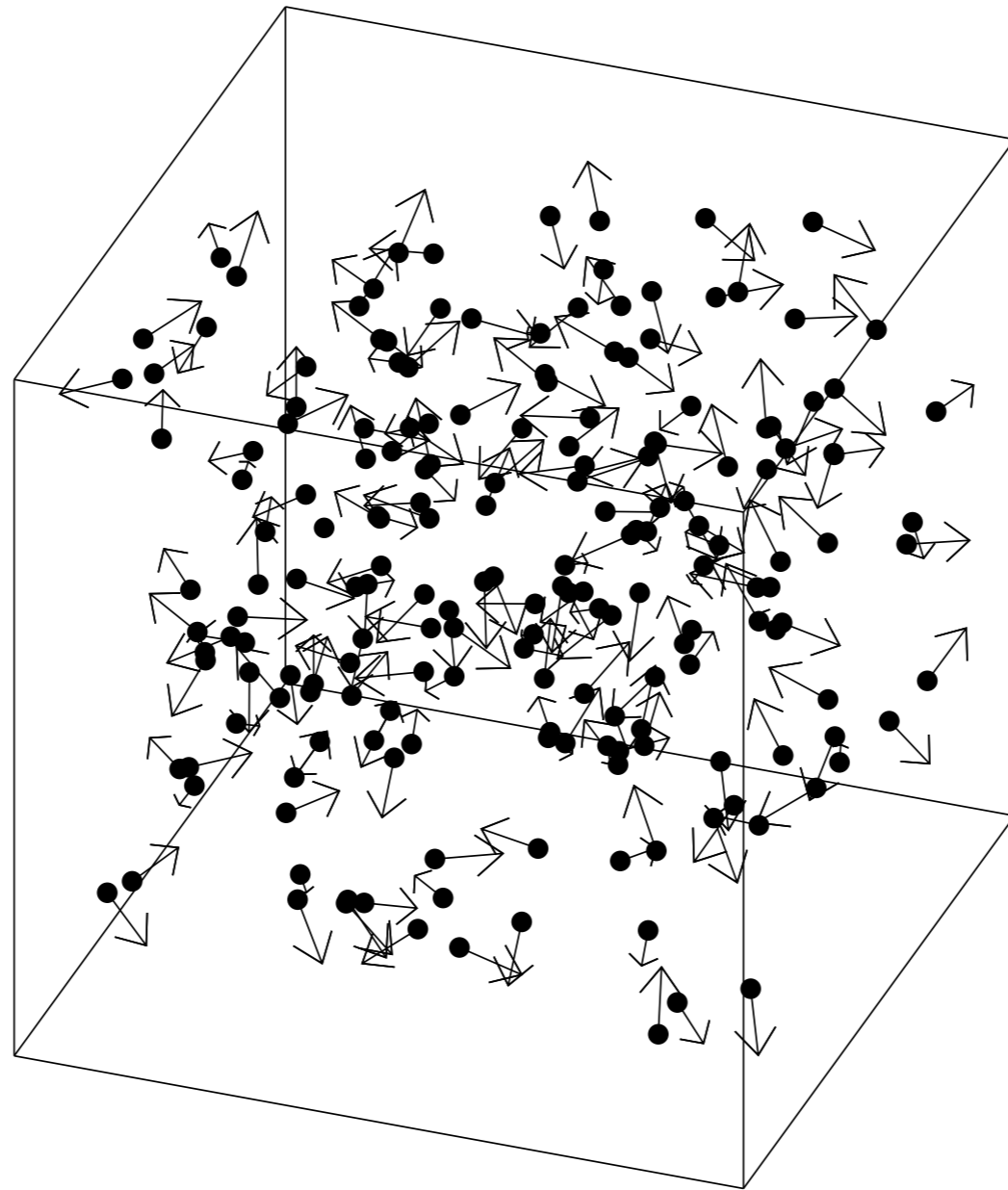
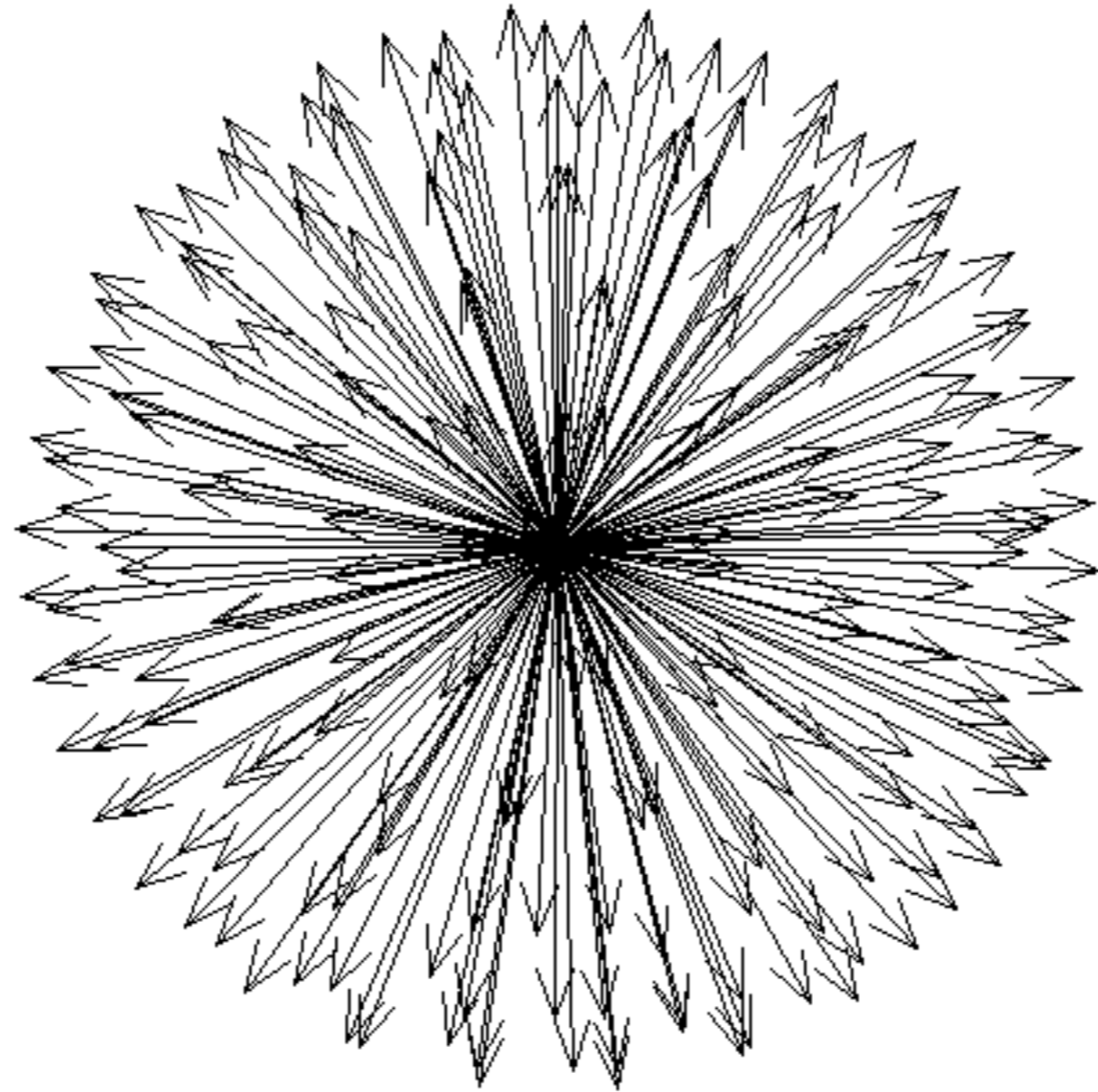


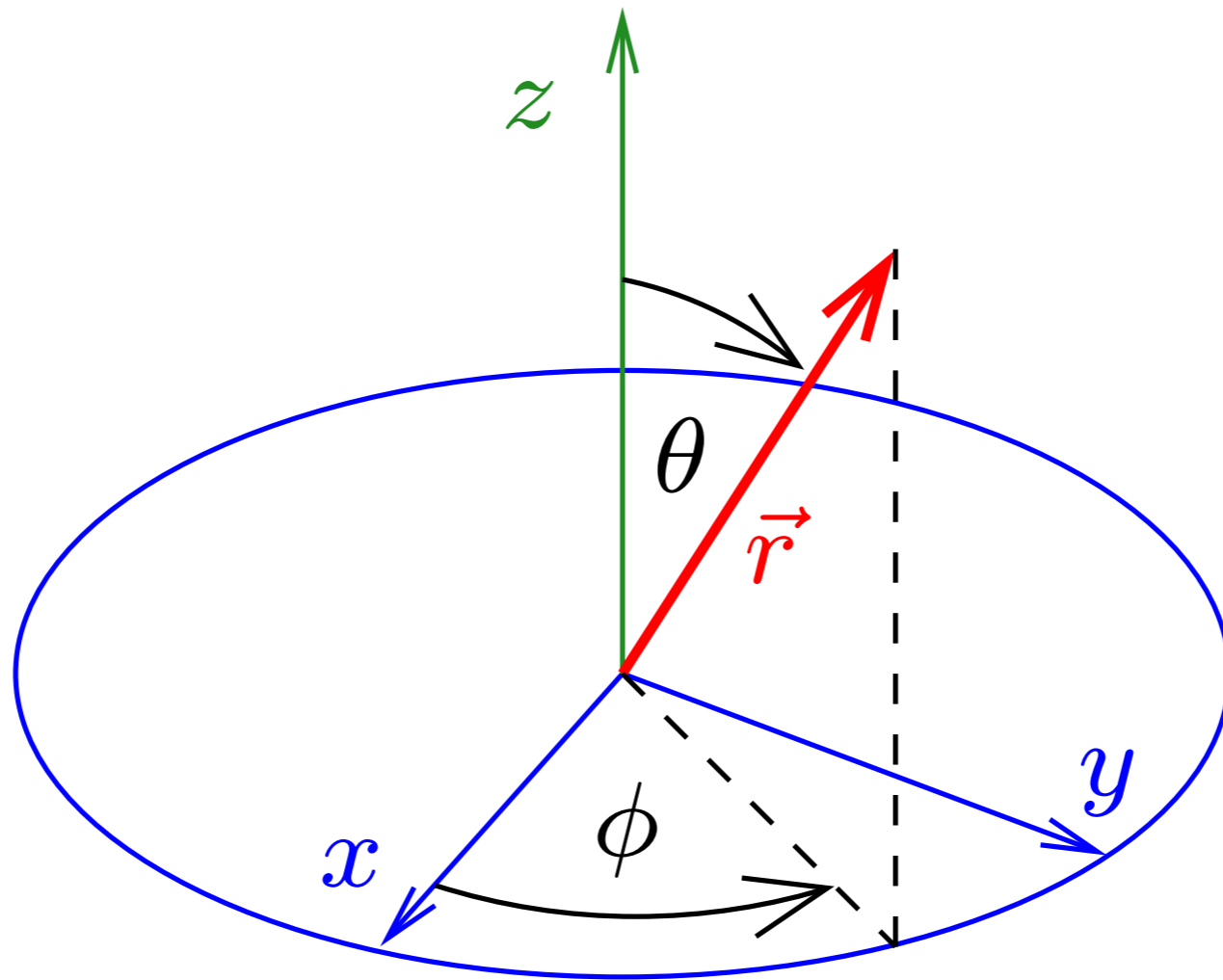
# LECTURE 2

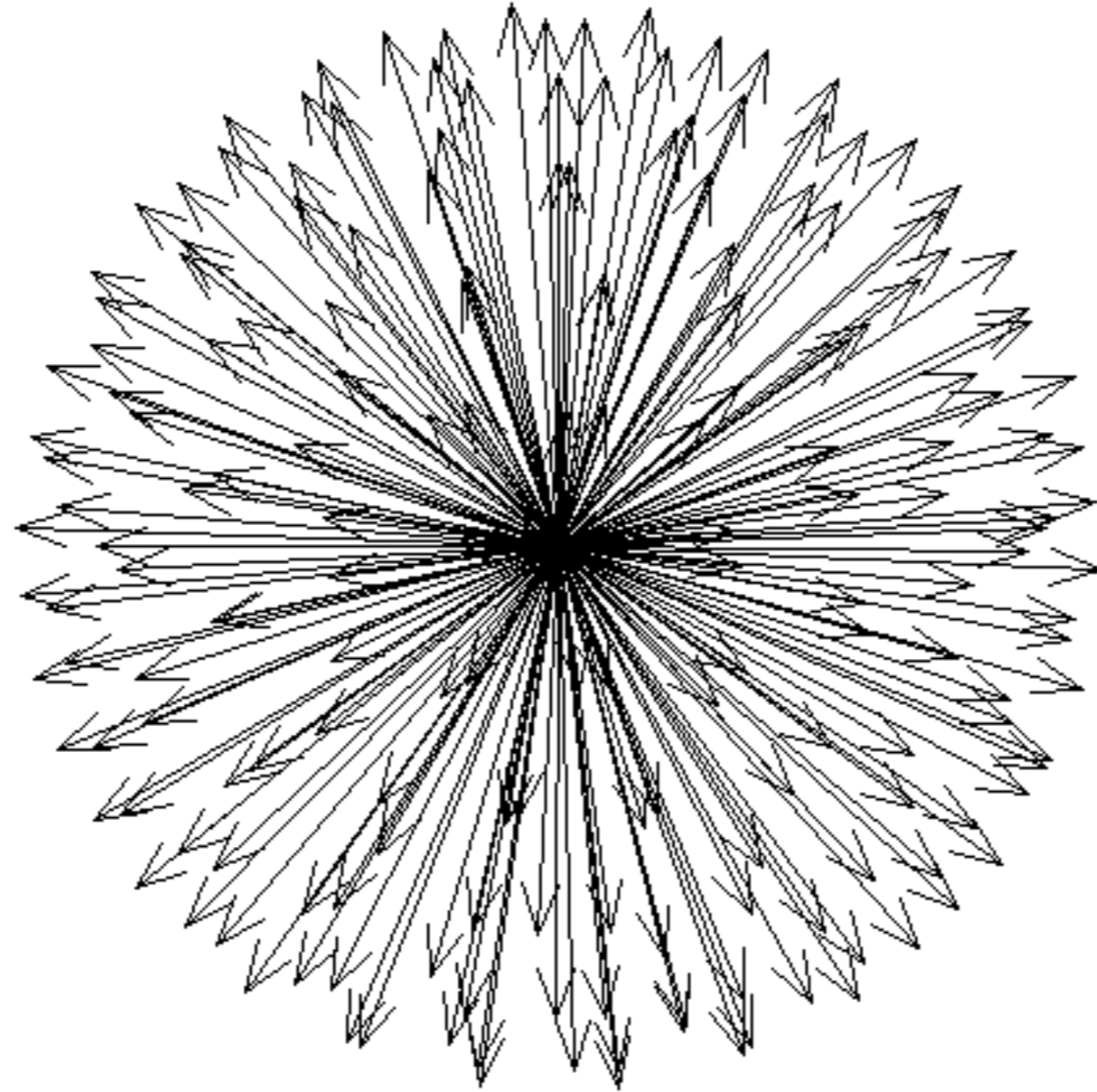


$$\vec{M} = (\vec{\mu}_1 + \vec{\mu}_2 + \vec{\mu}_3 + \vec{\mu}_4 + \vec{\mu}_5 + \vec{\mu}_6 + \dots) / V \quad \text{Magnetization}$$

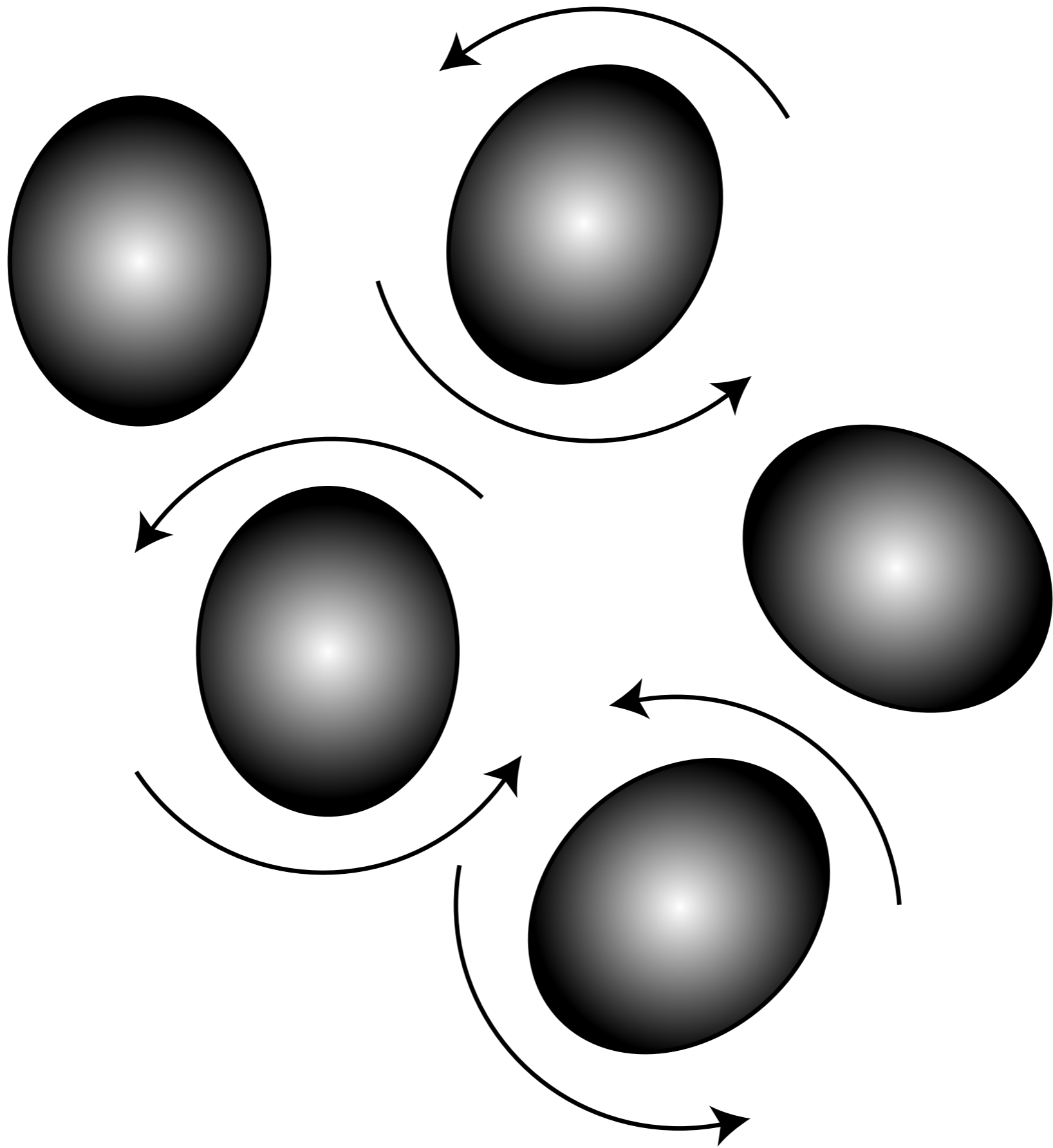


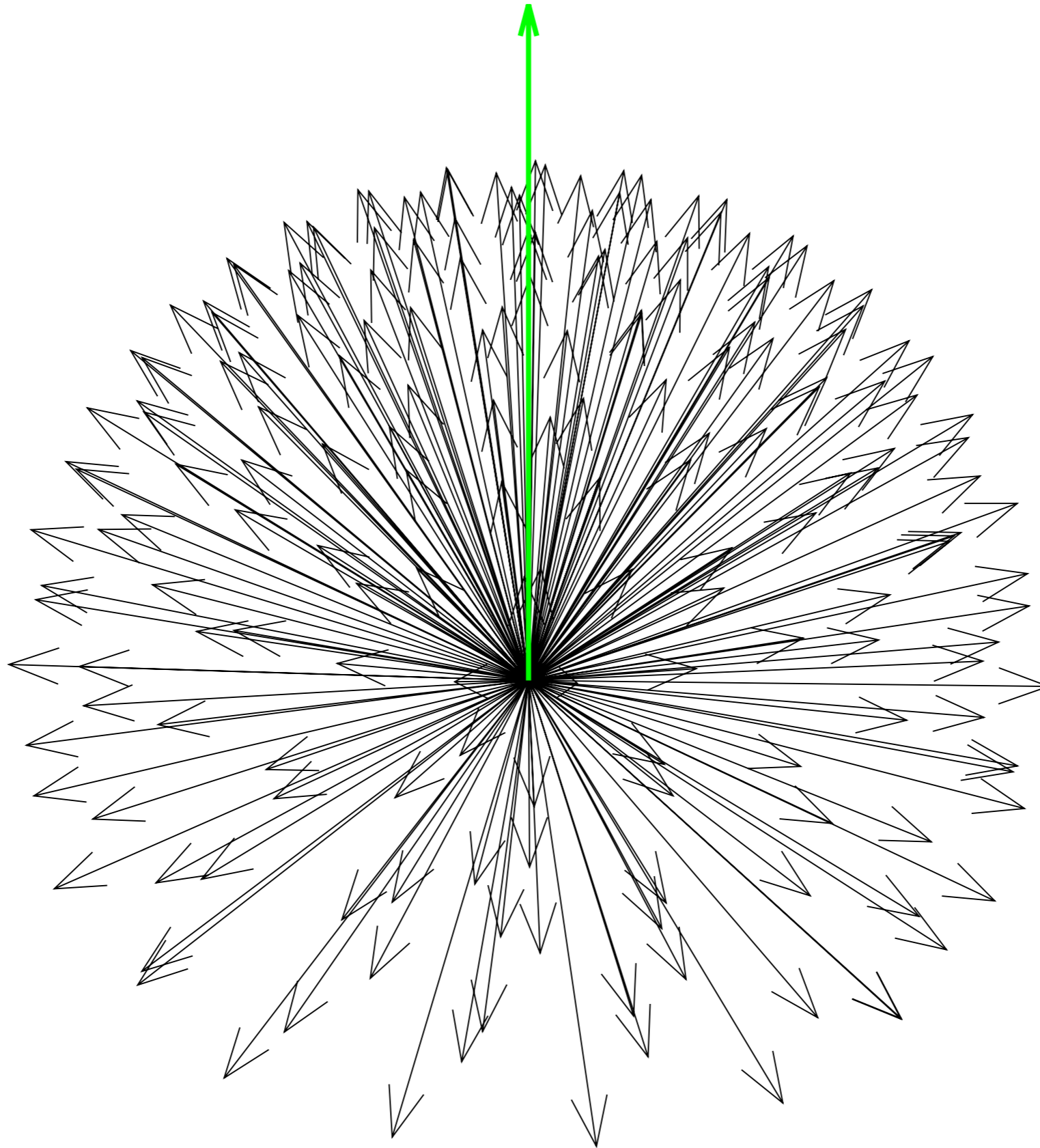
# Spherical coordinates





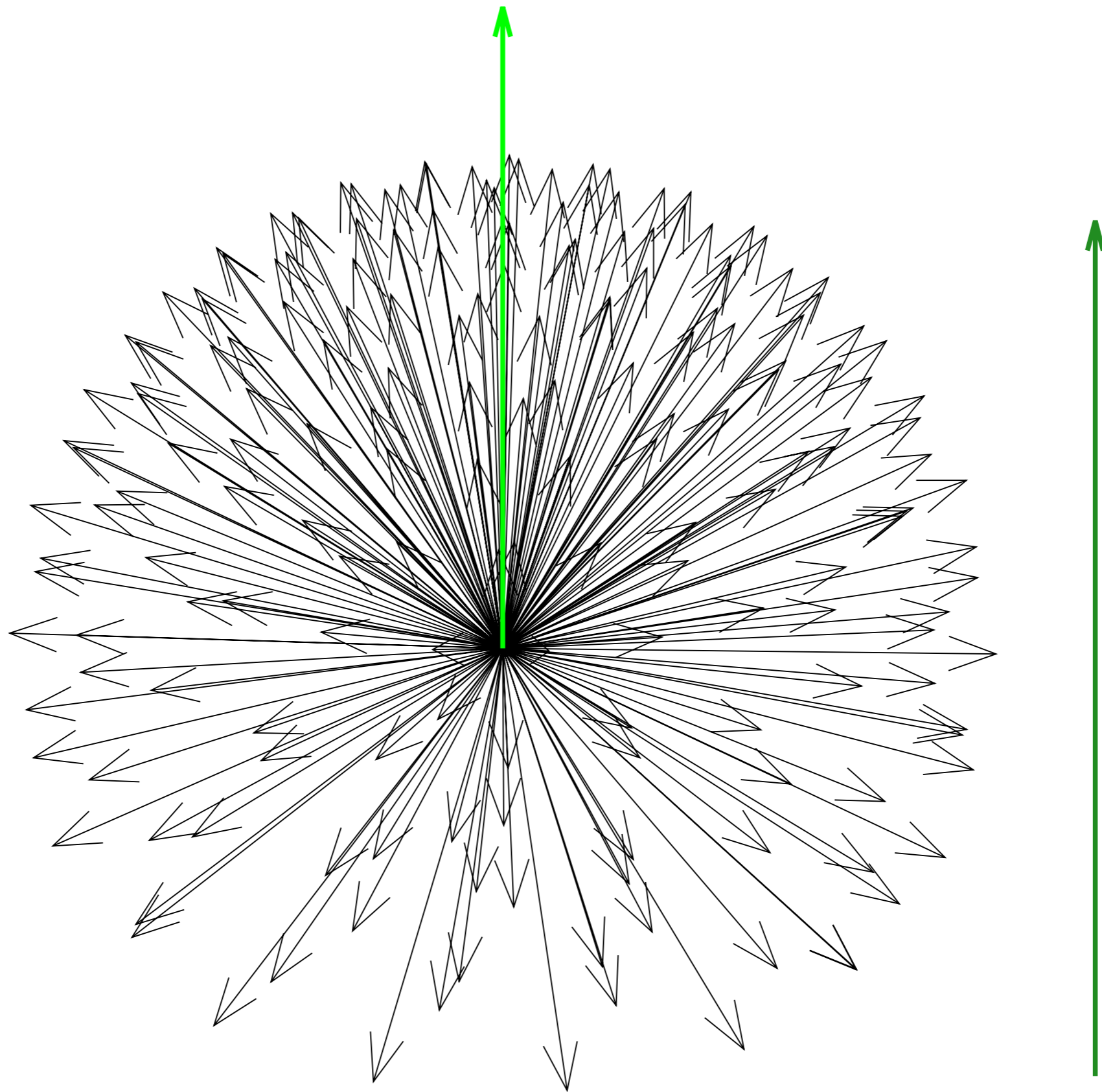
Magnetic moments in magnetic field

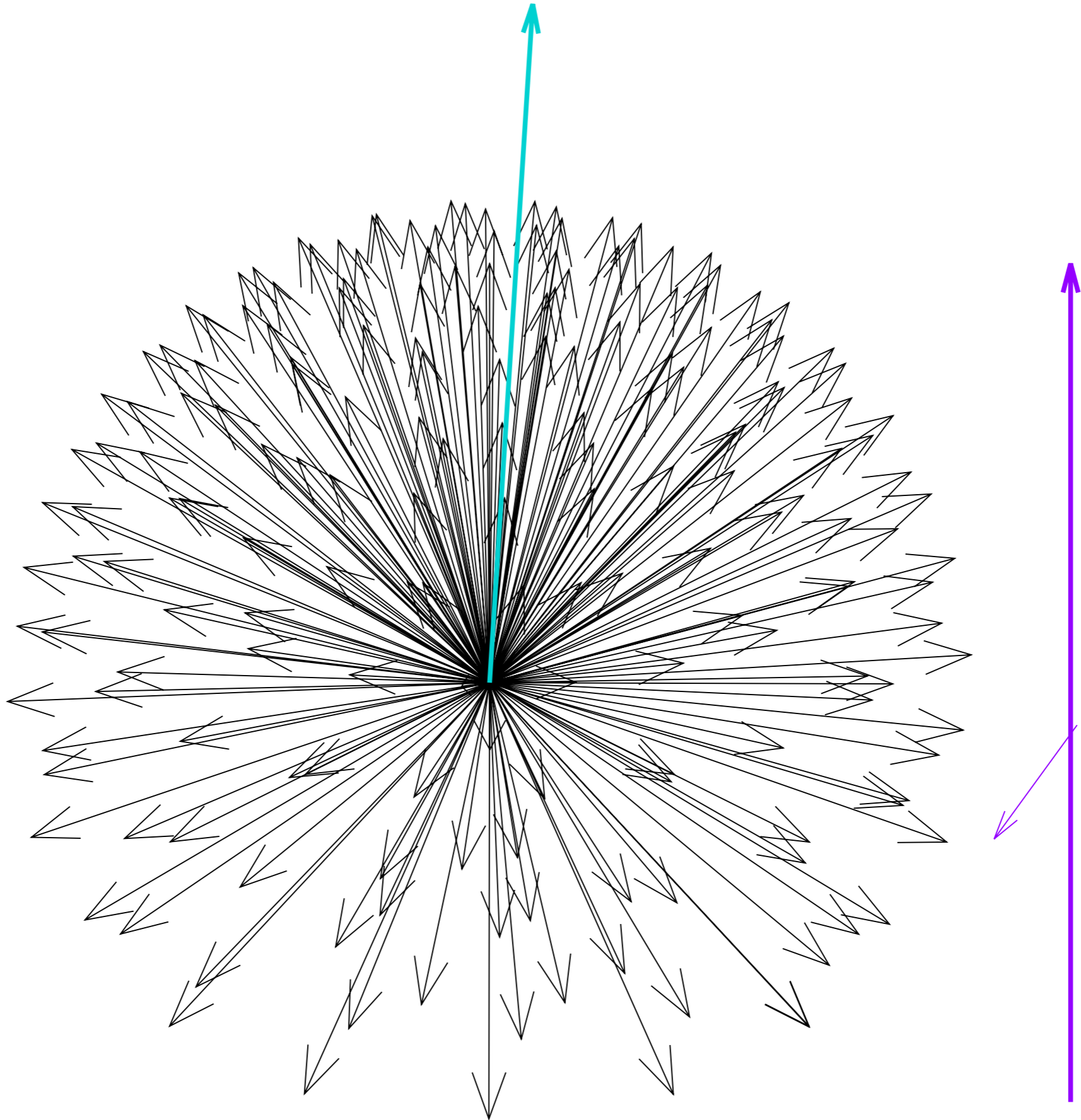


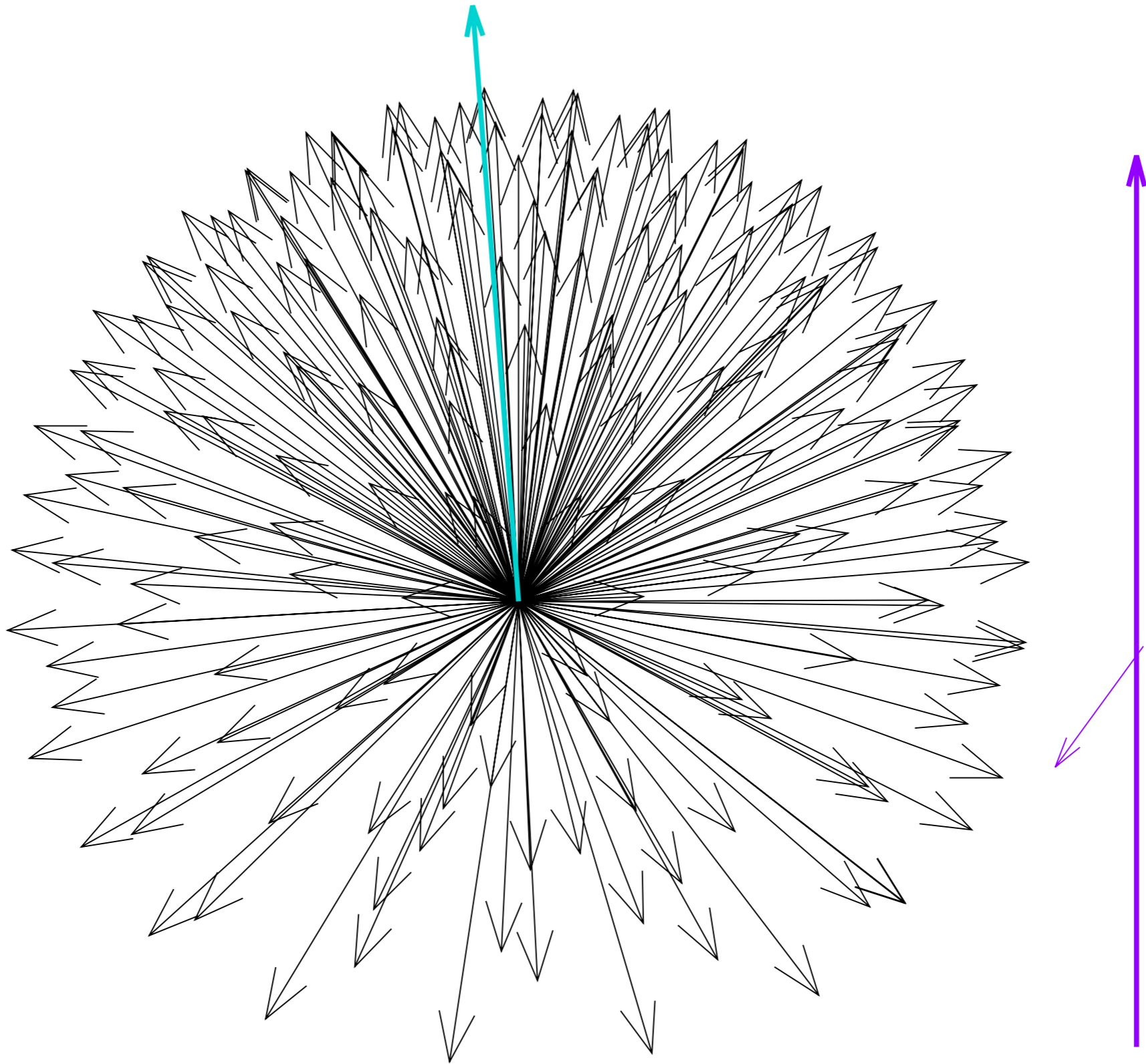


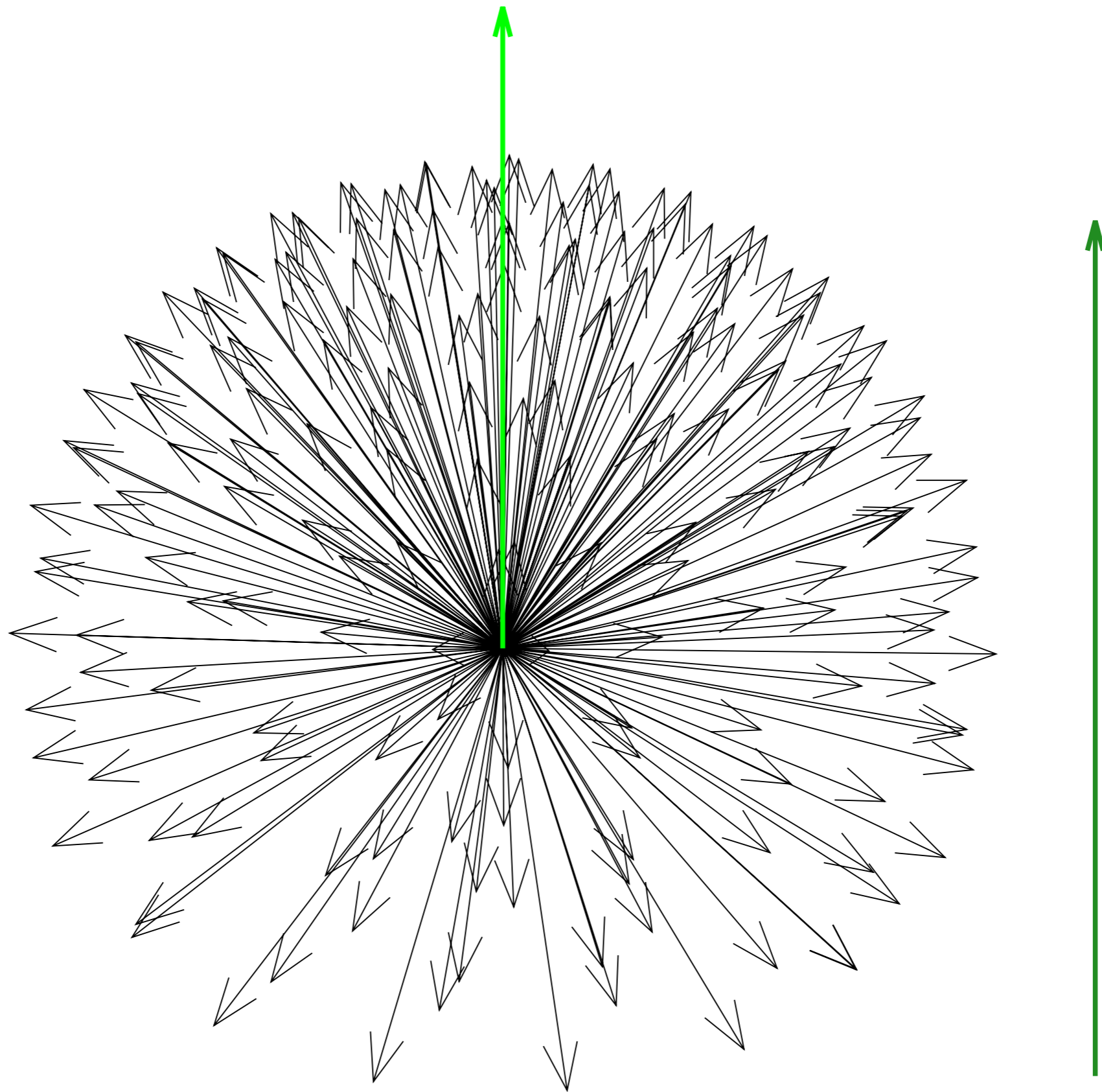


Longitudinal polarization

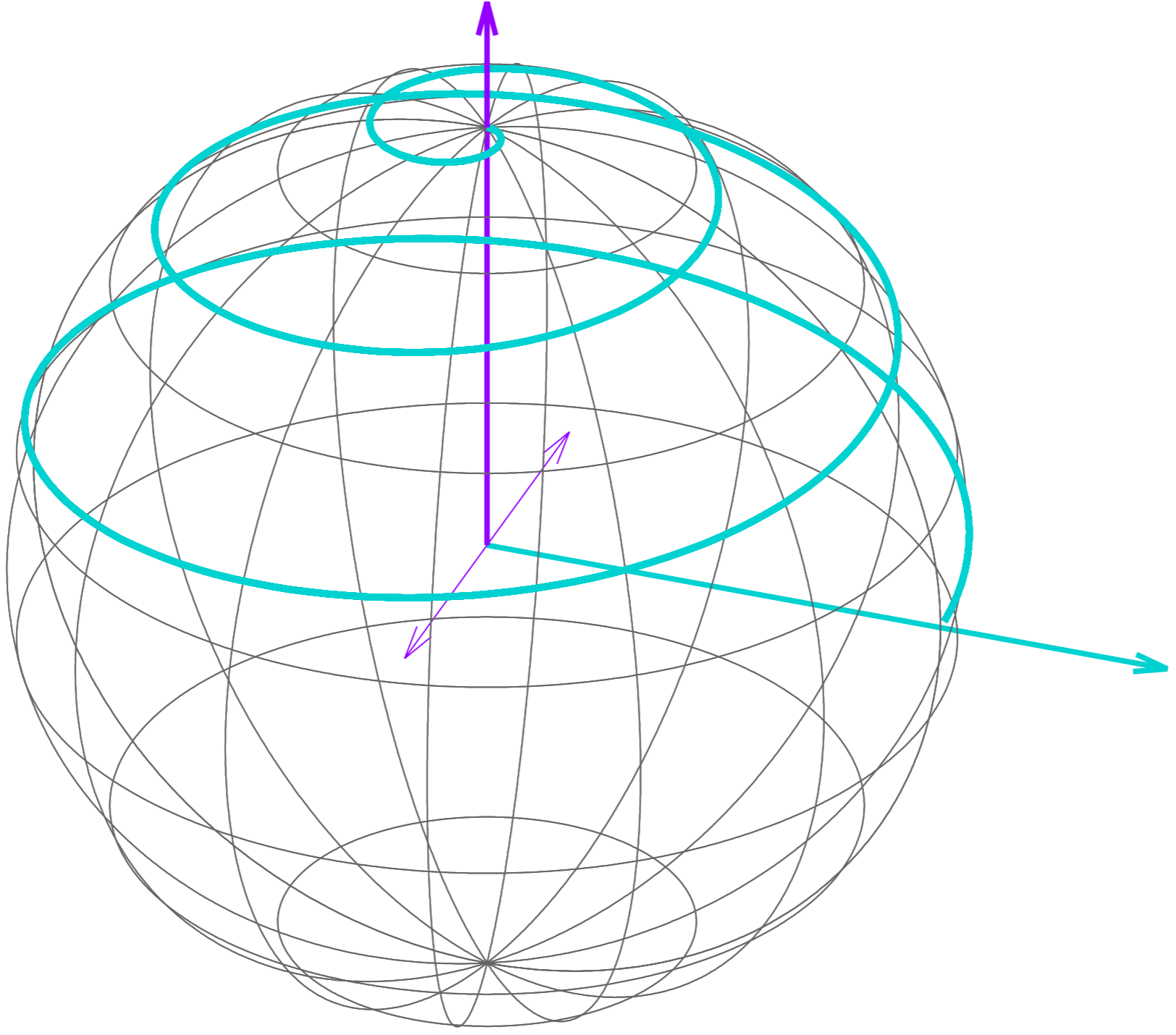


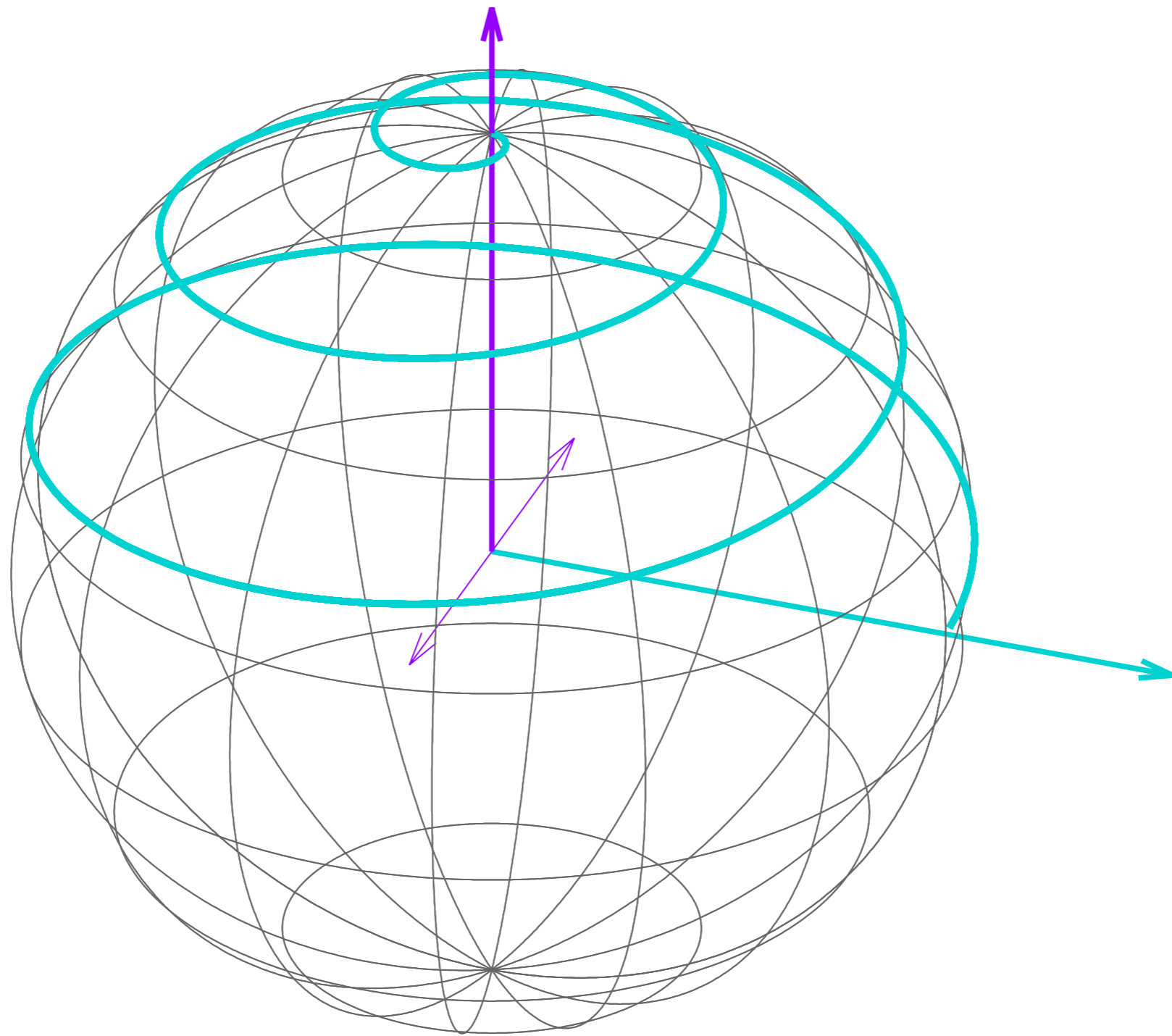




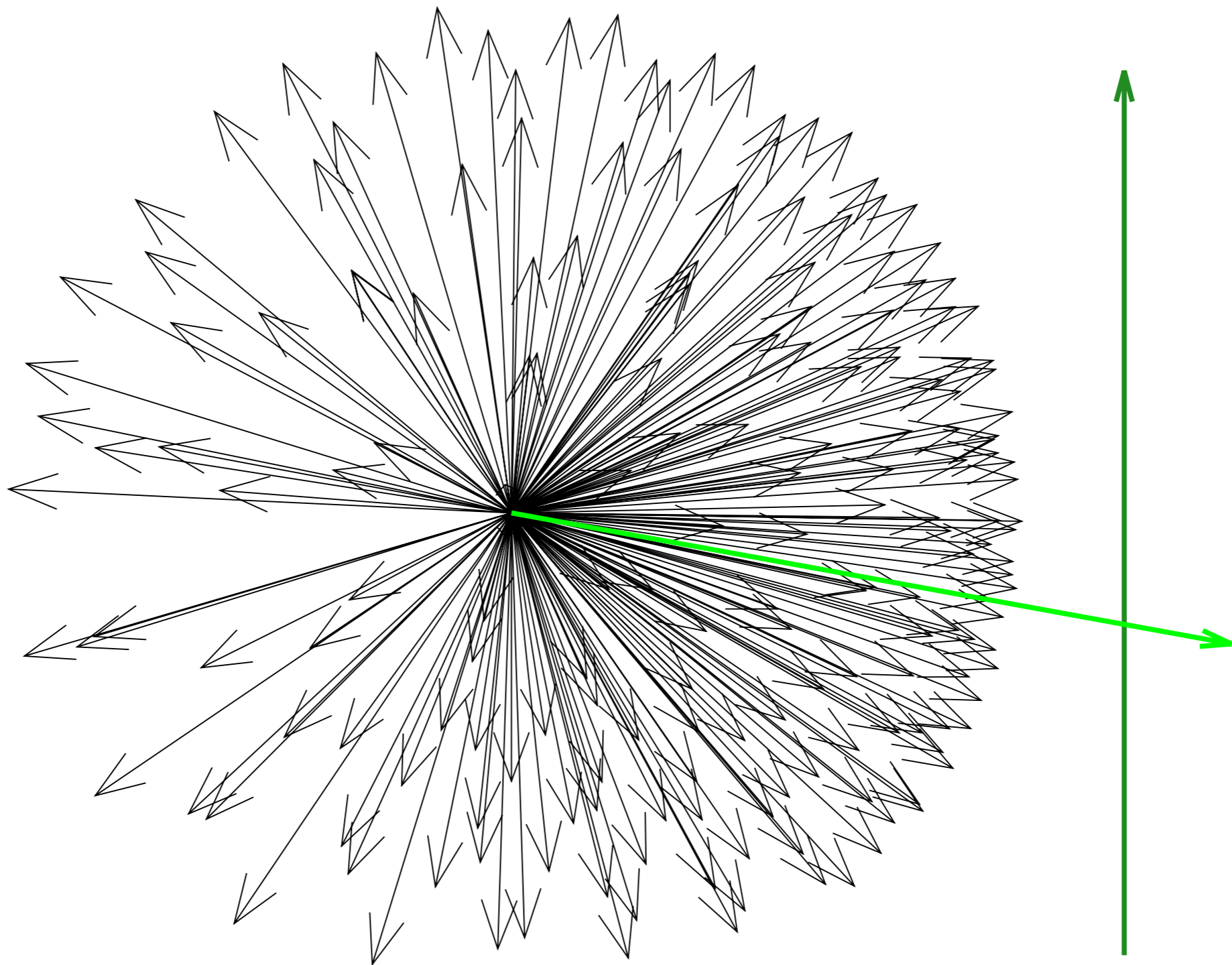


Flipping magnetization

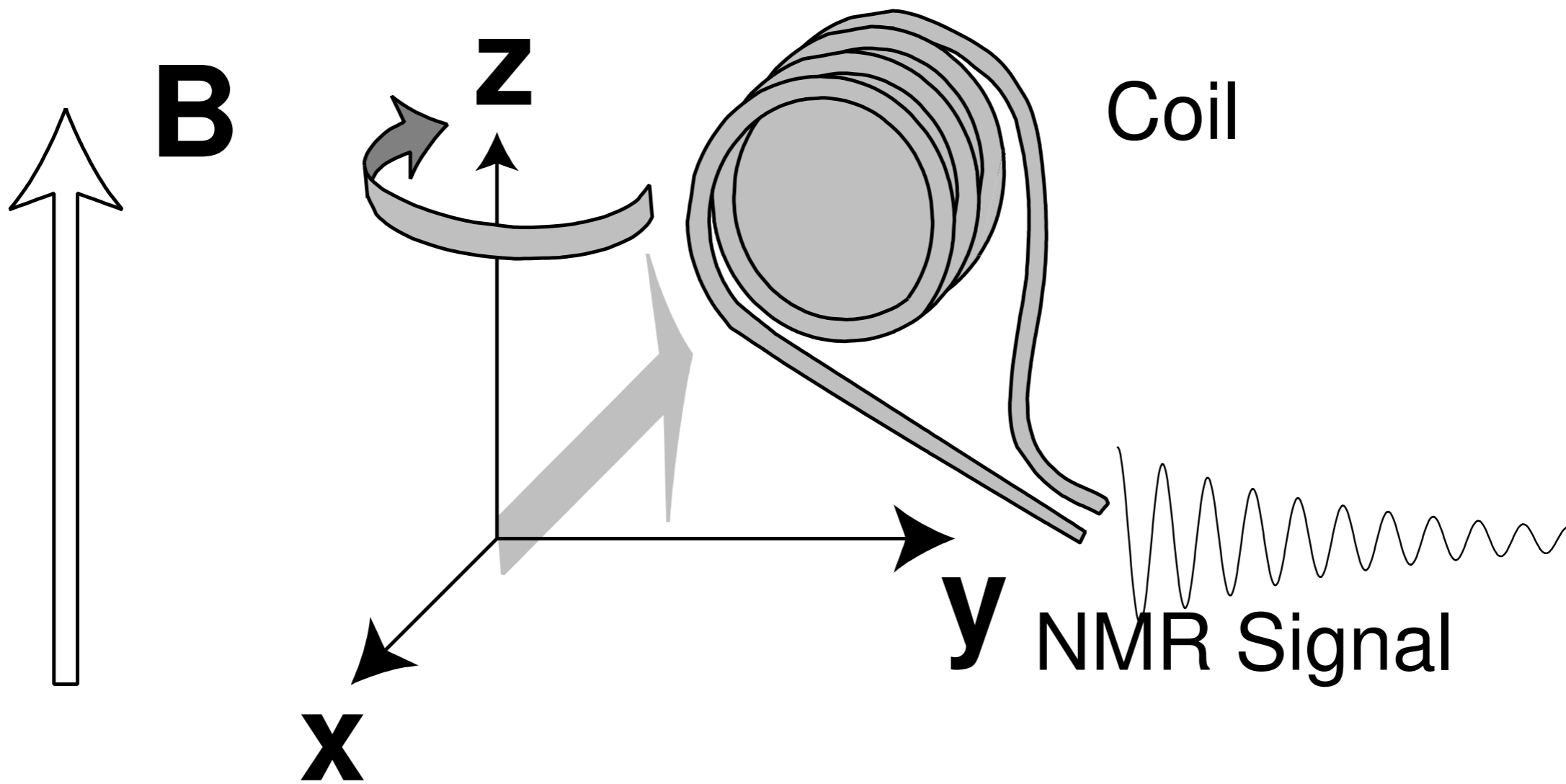


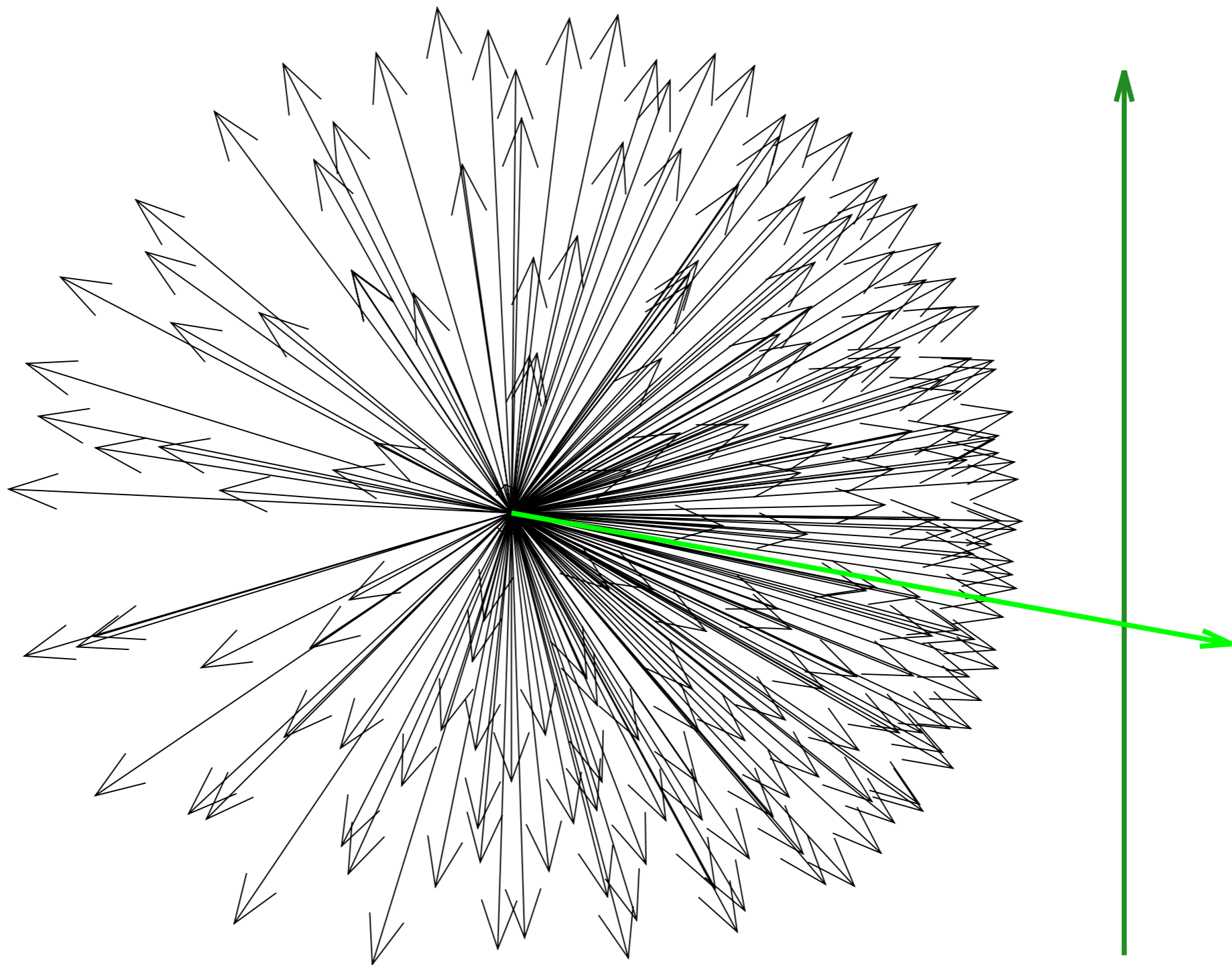


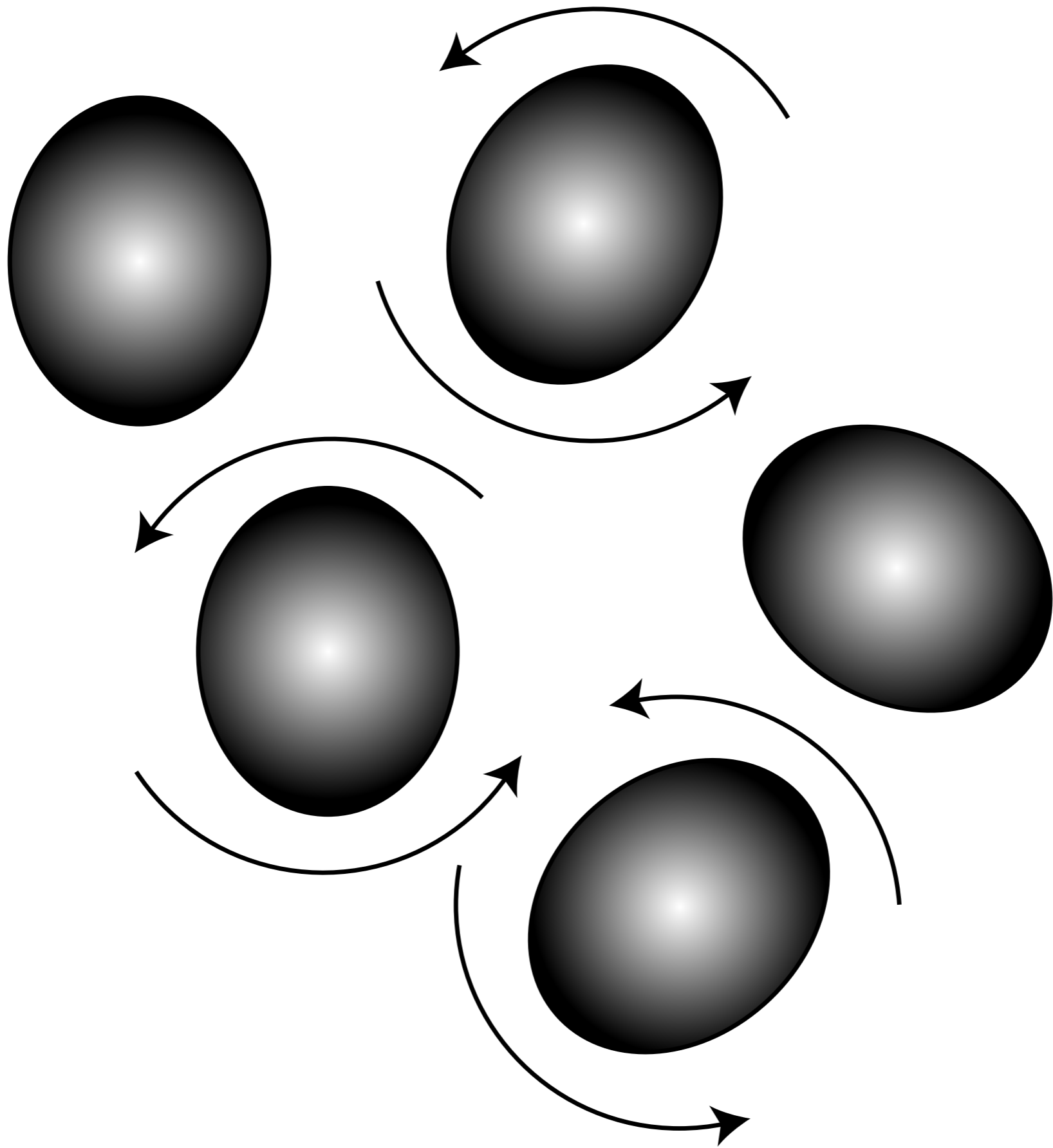


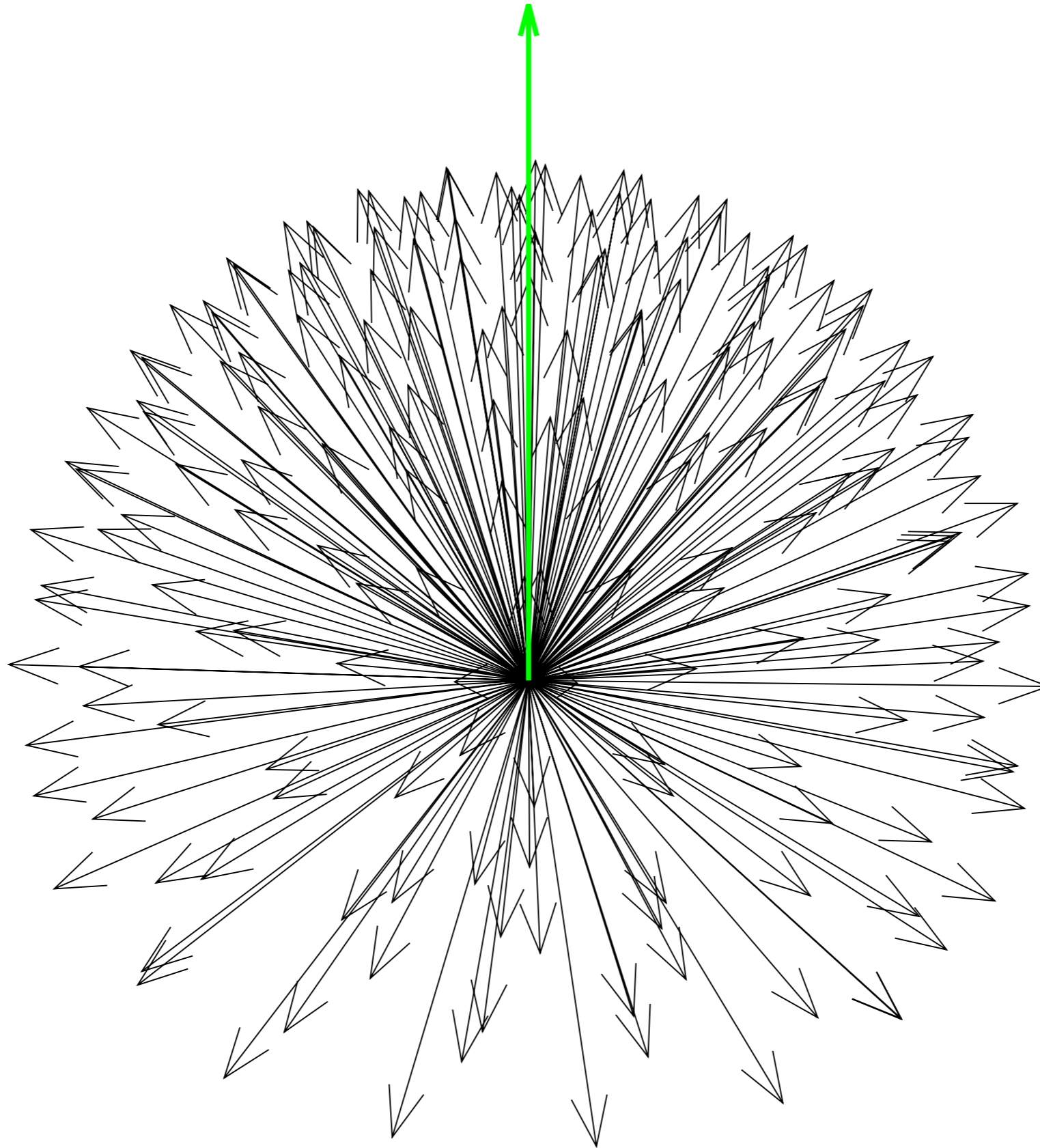


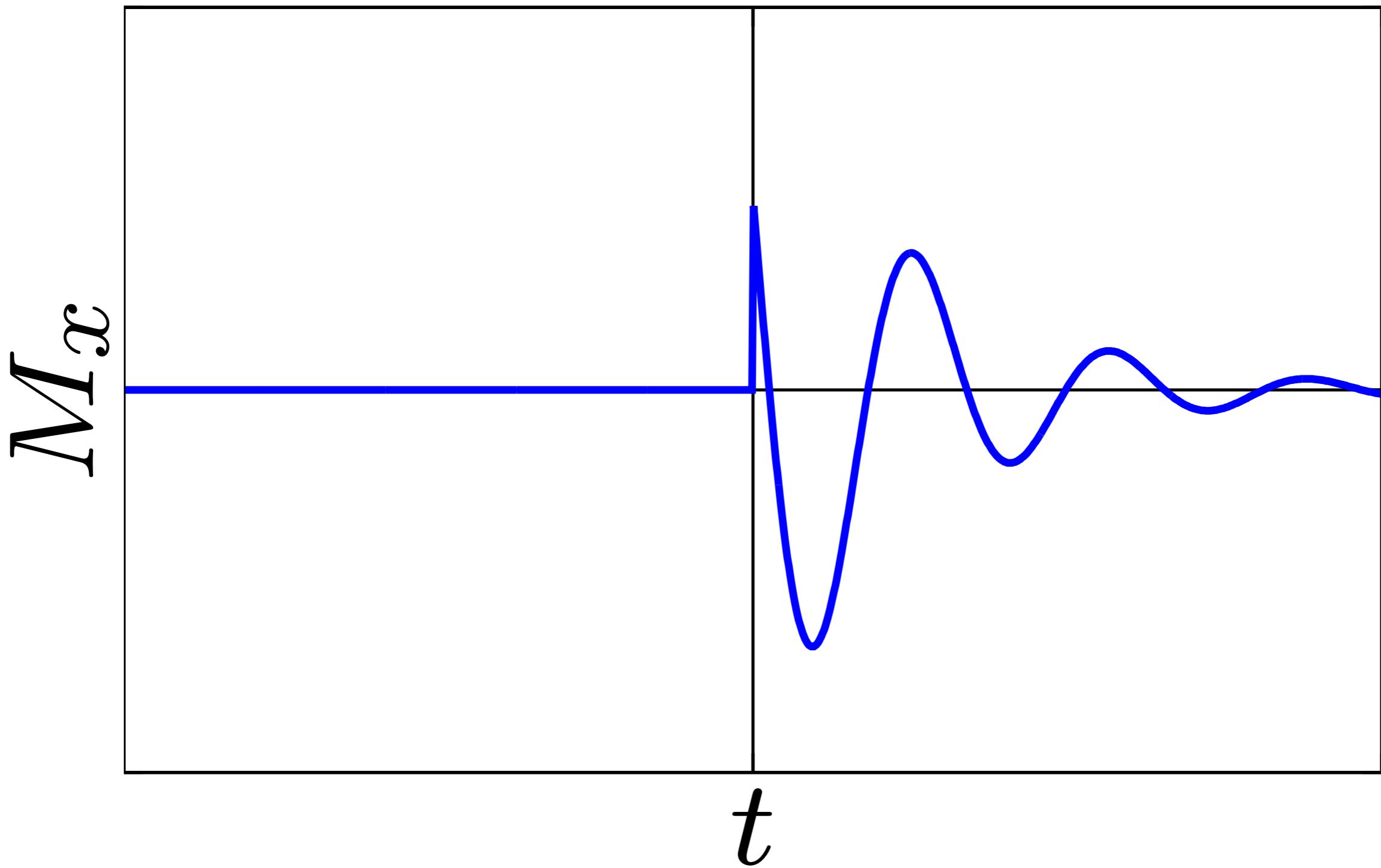
Transverse polarization

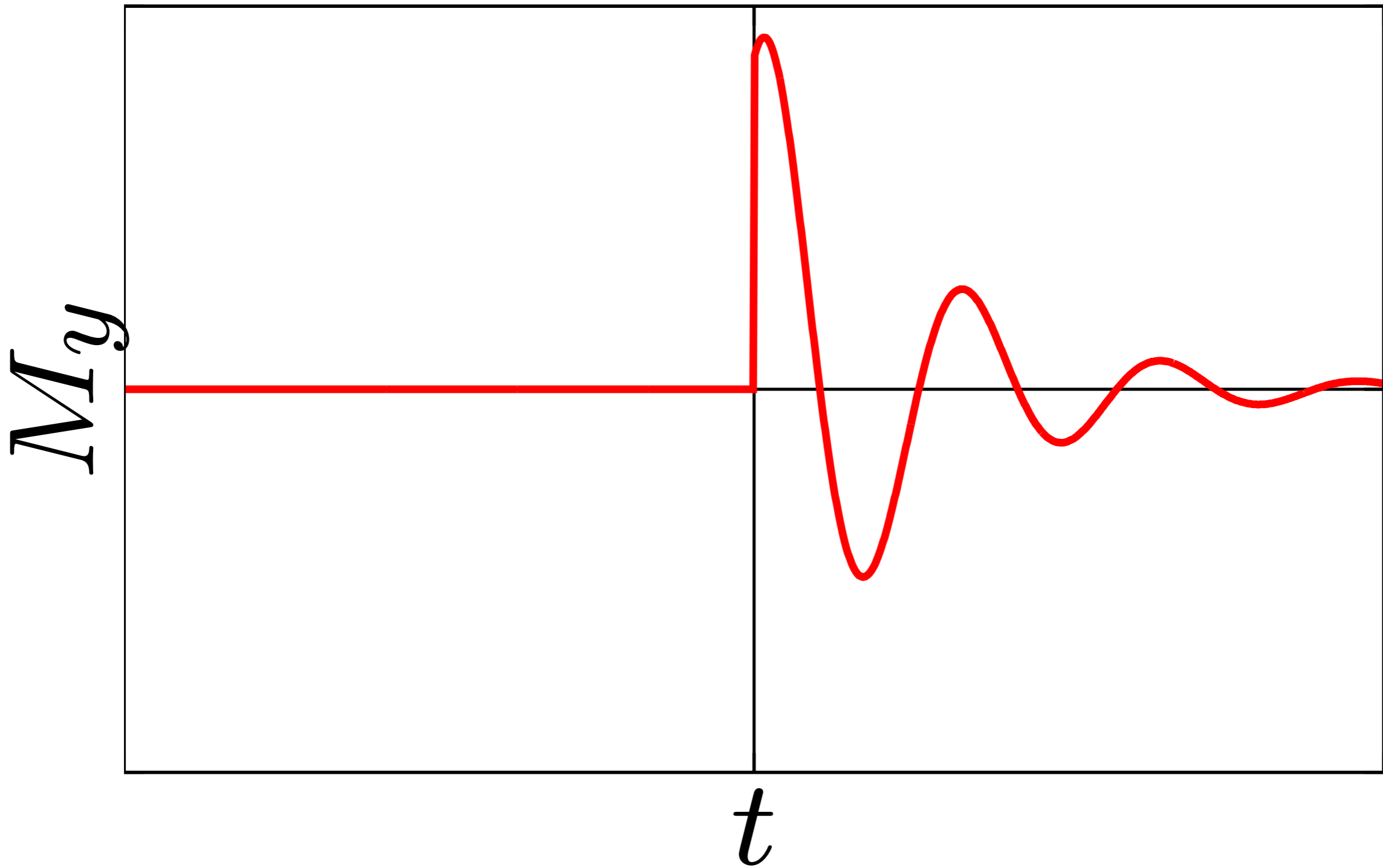




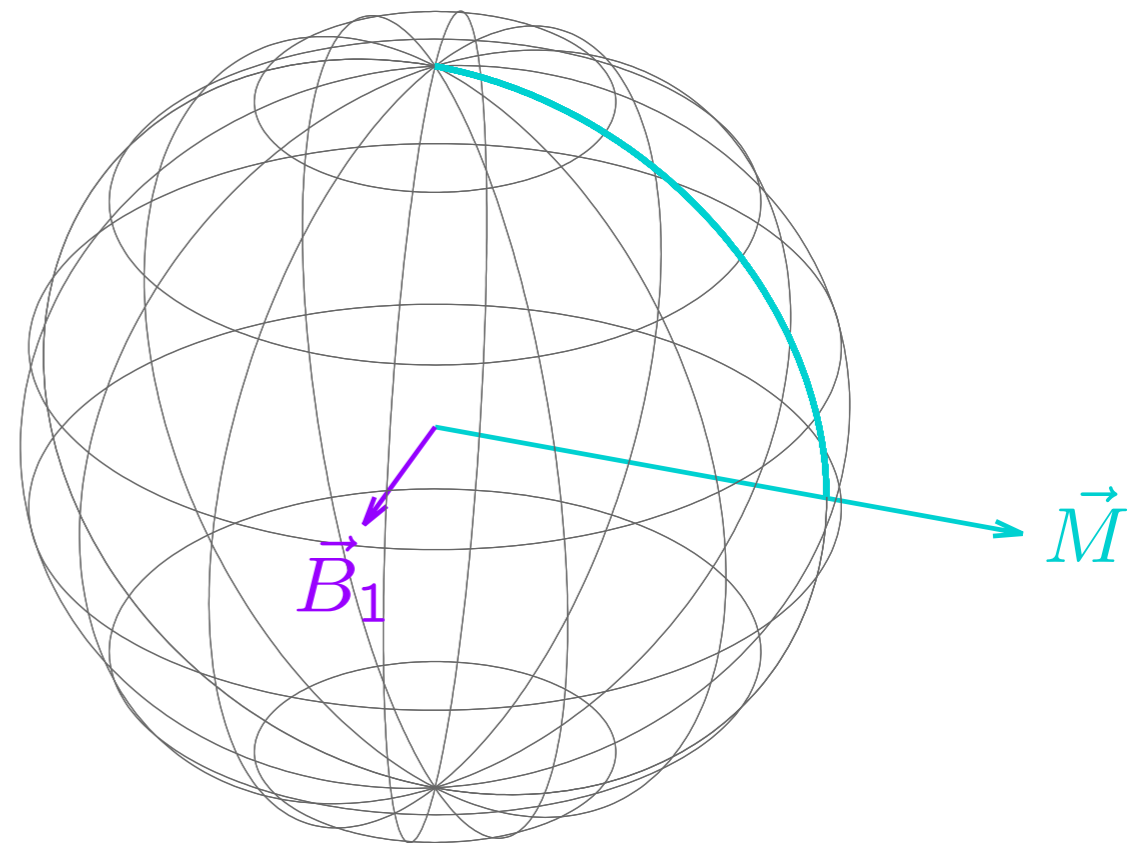
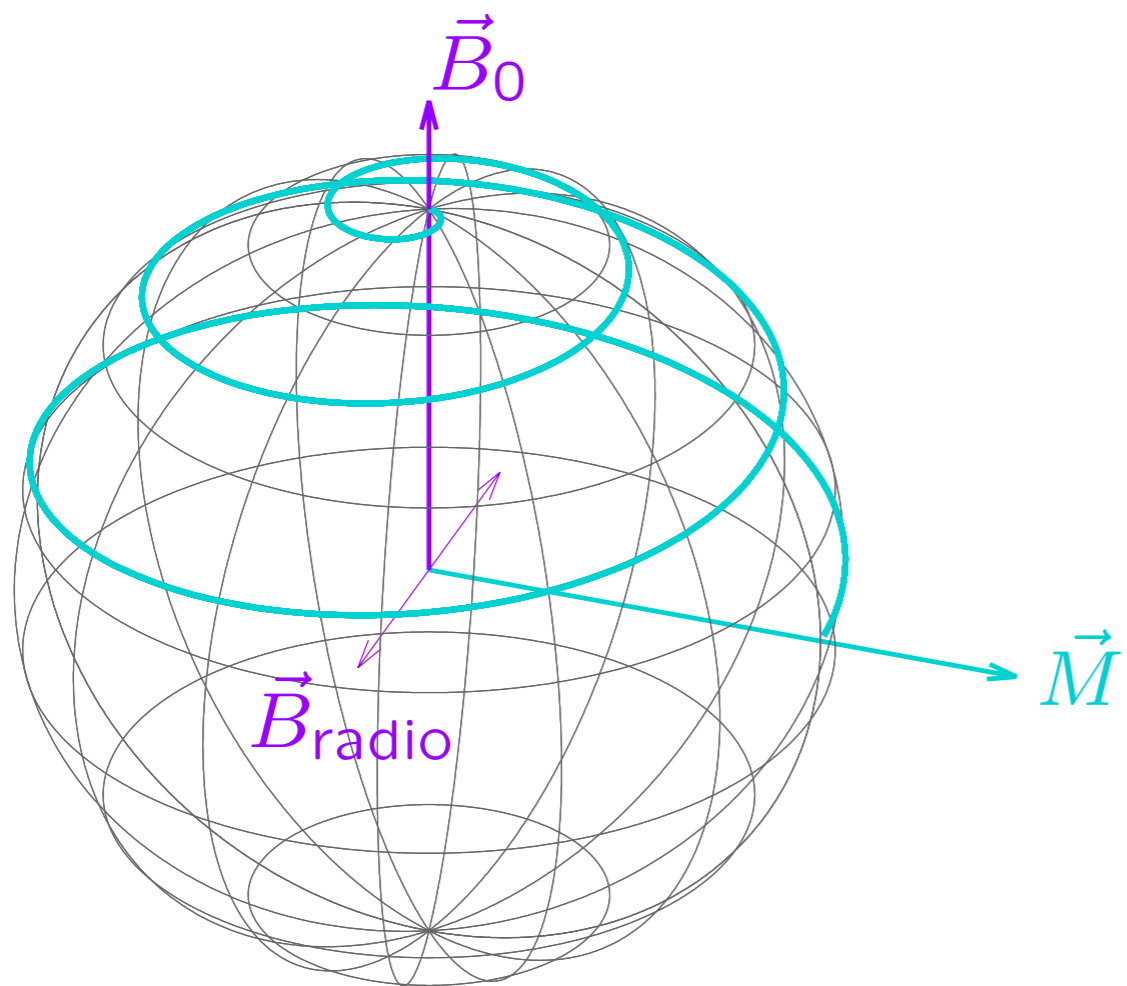


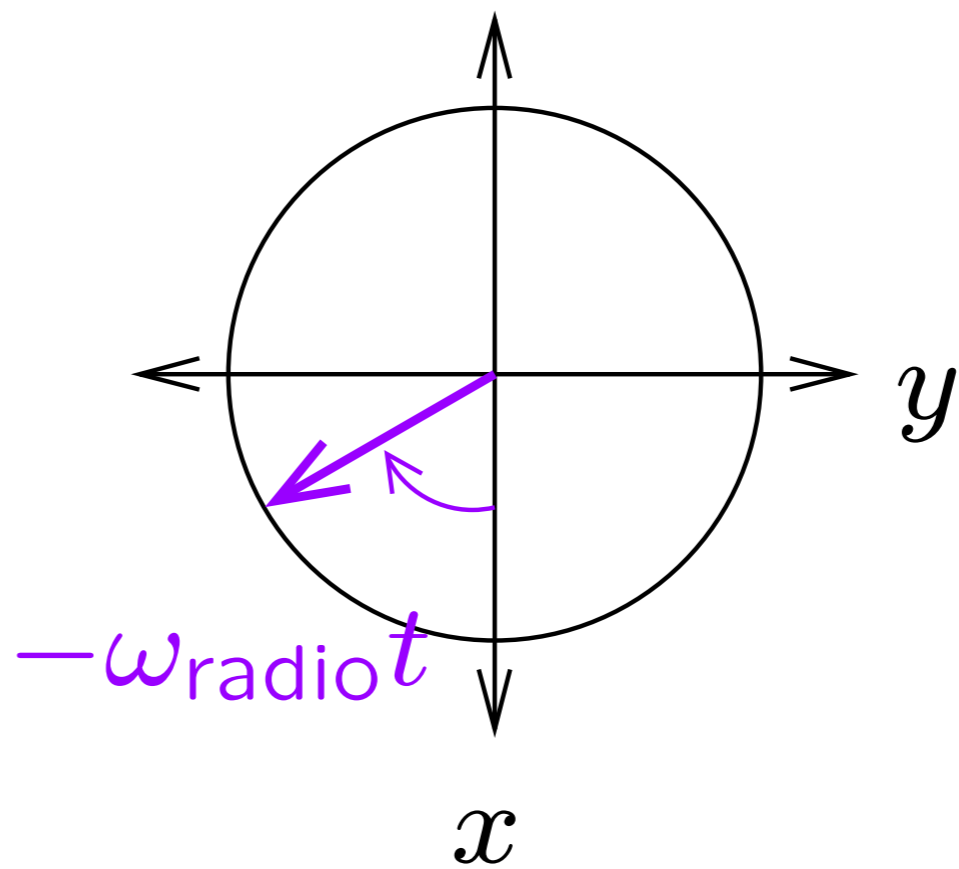
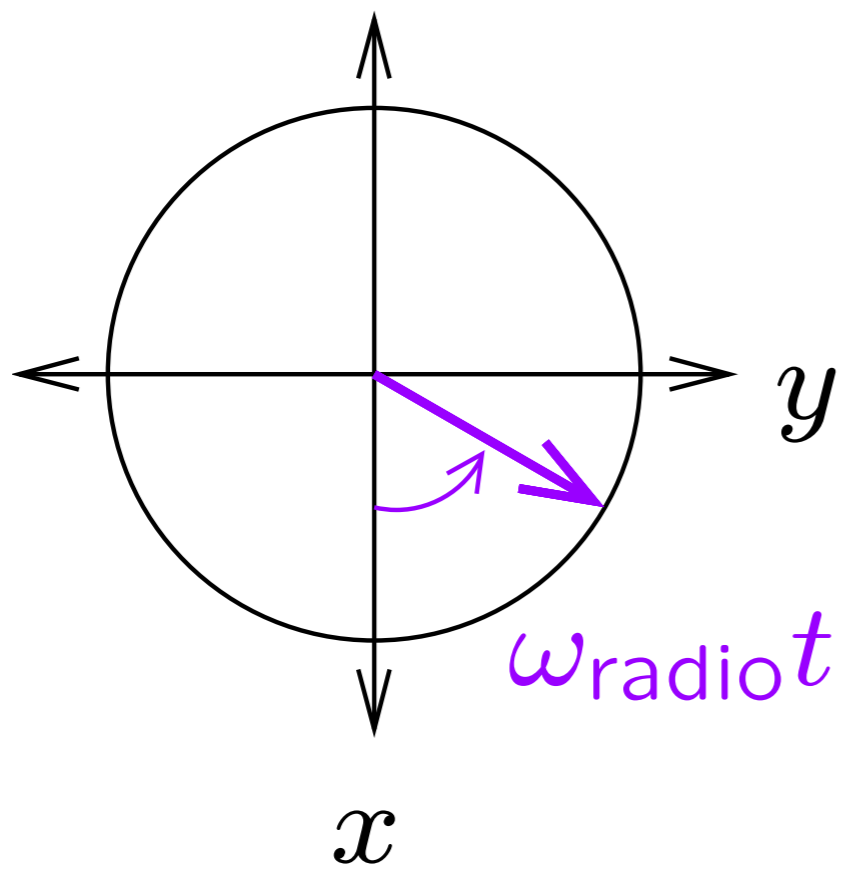


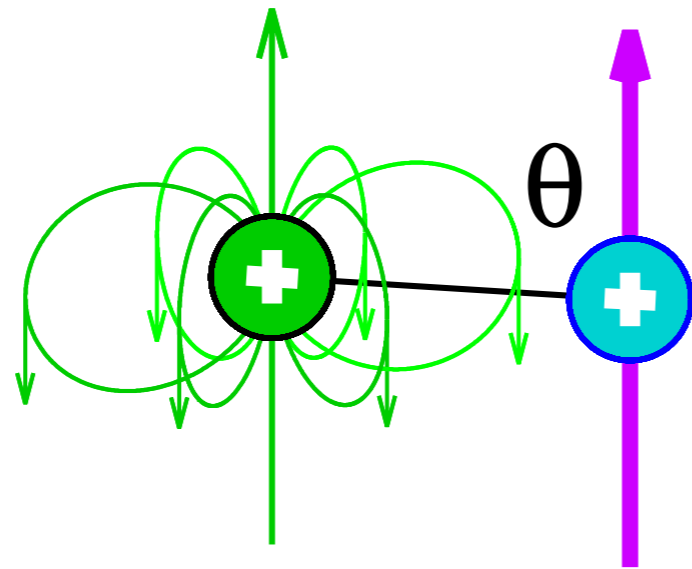


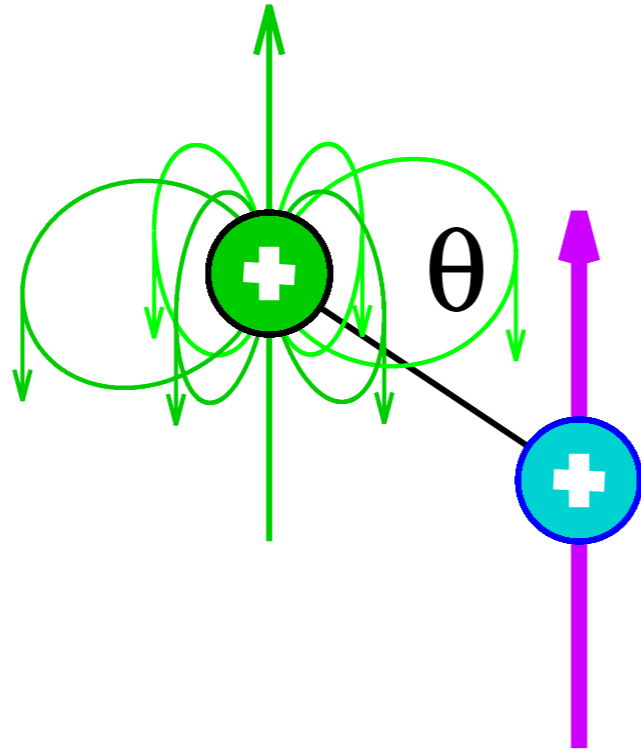


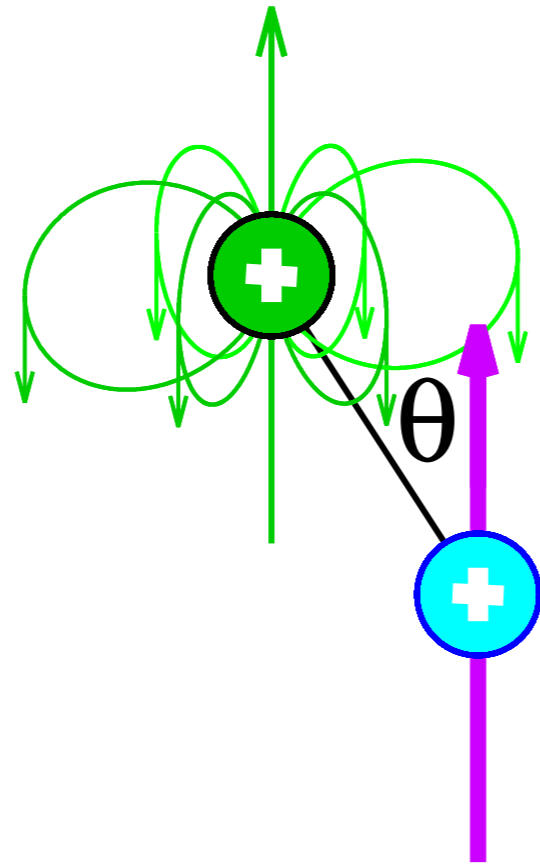


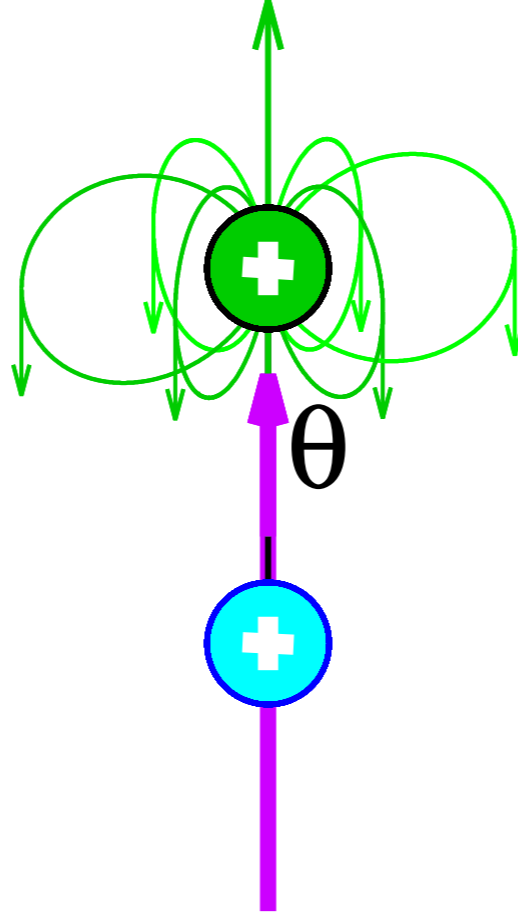


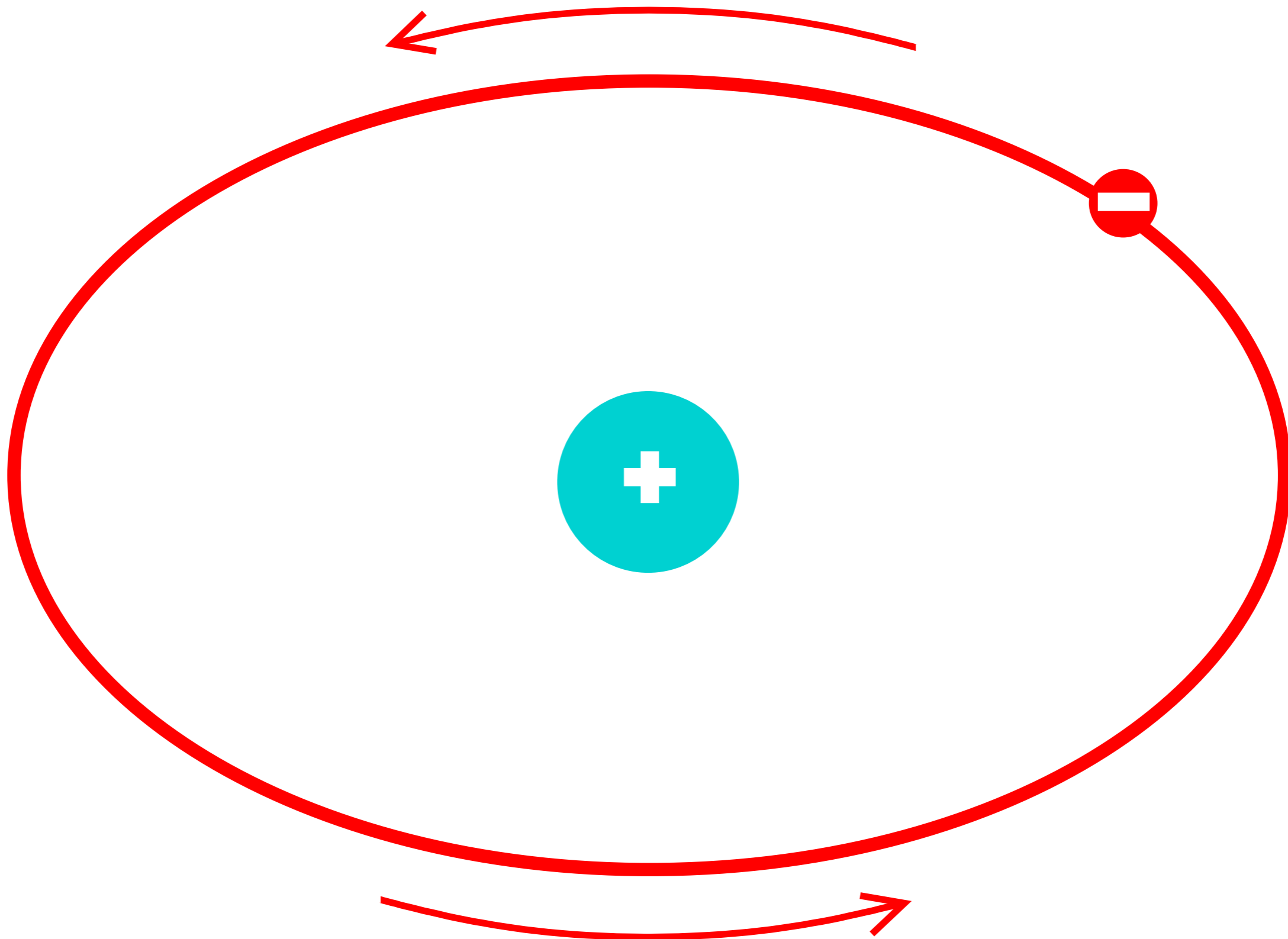


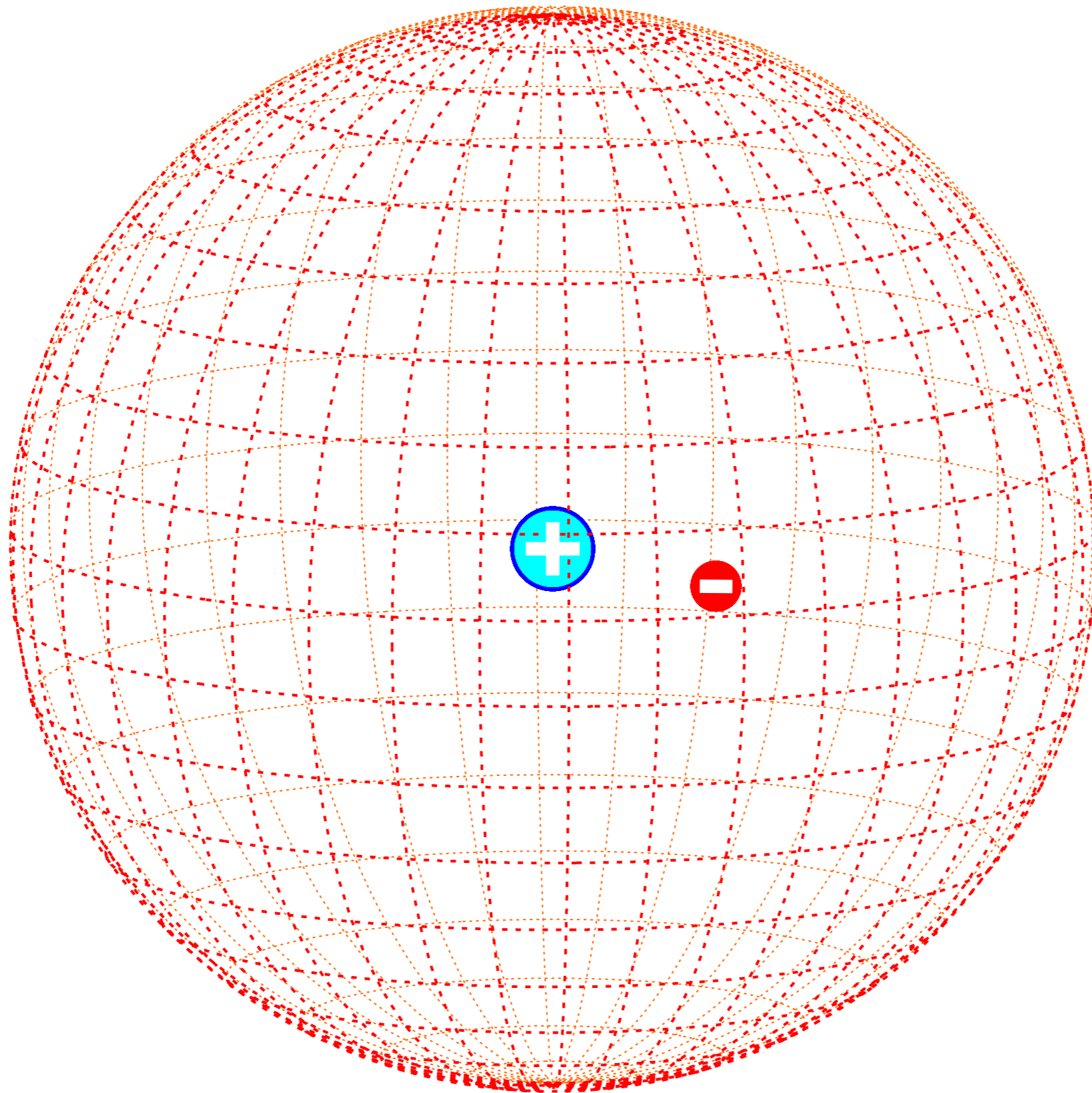




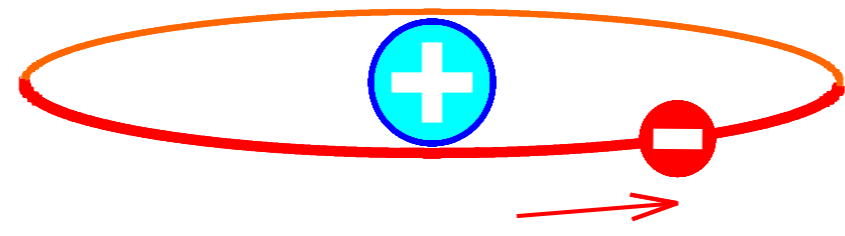


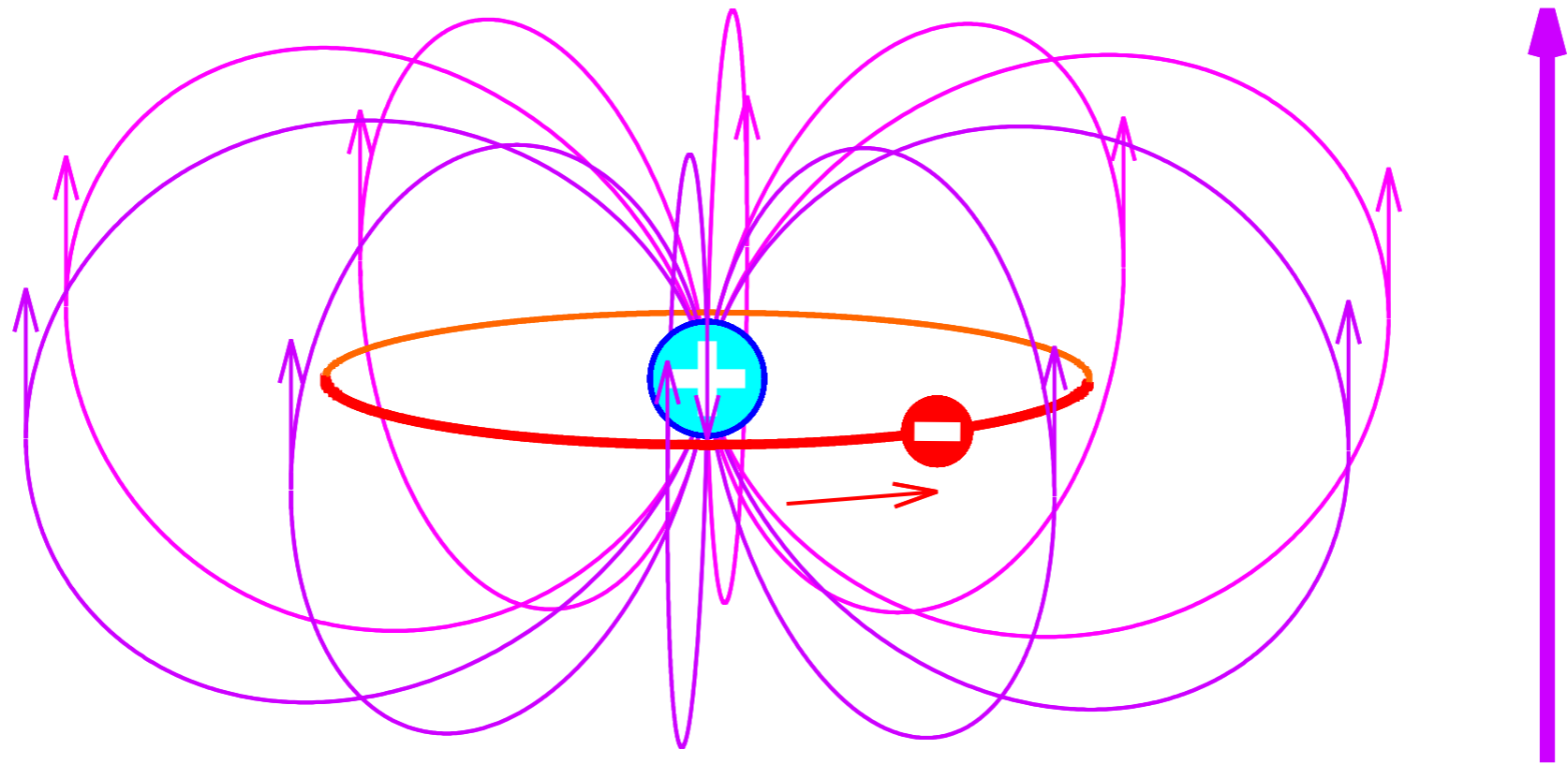


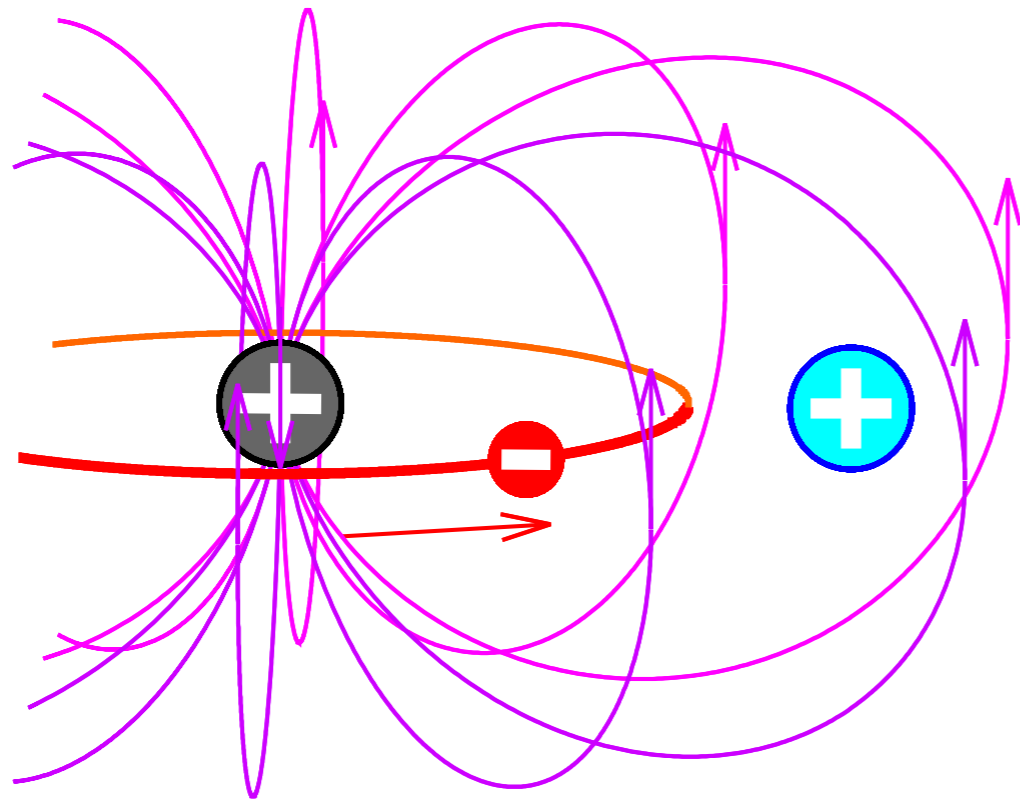


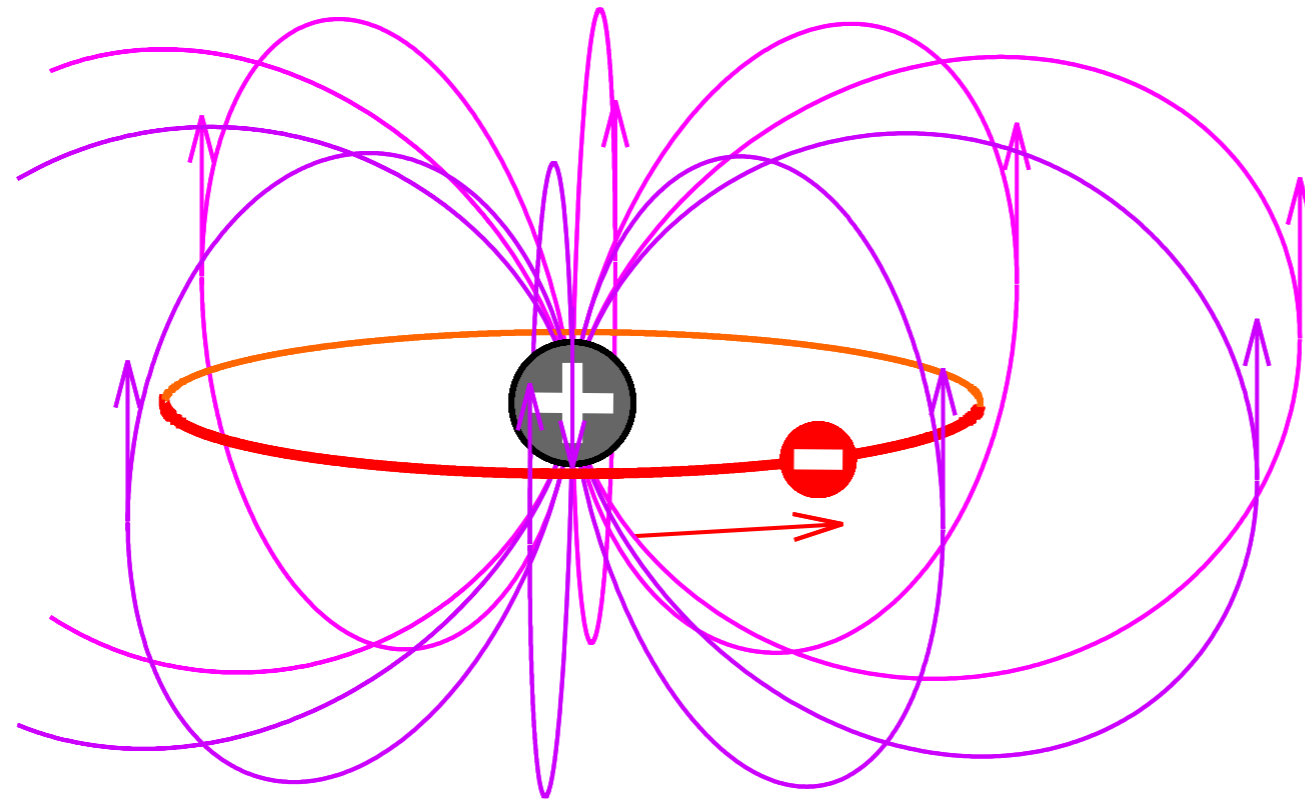


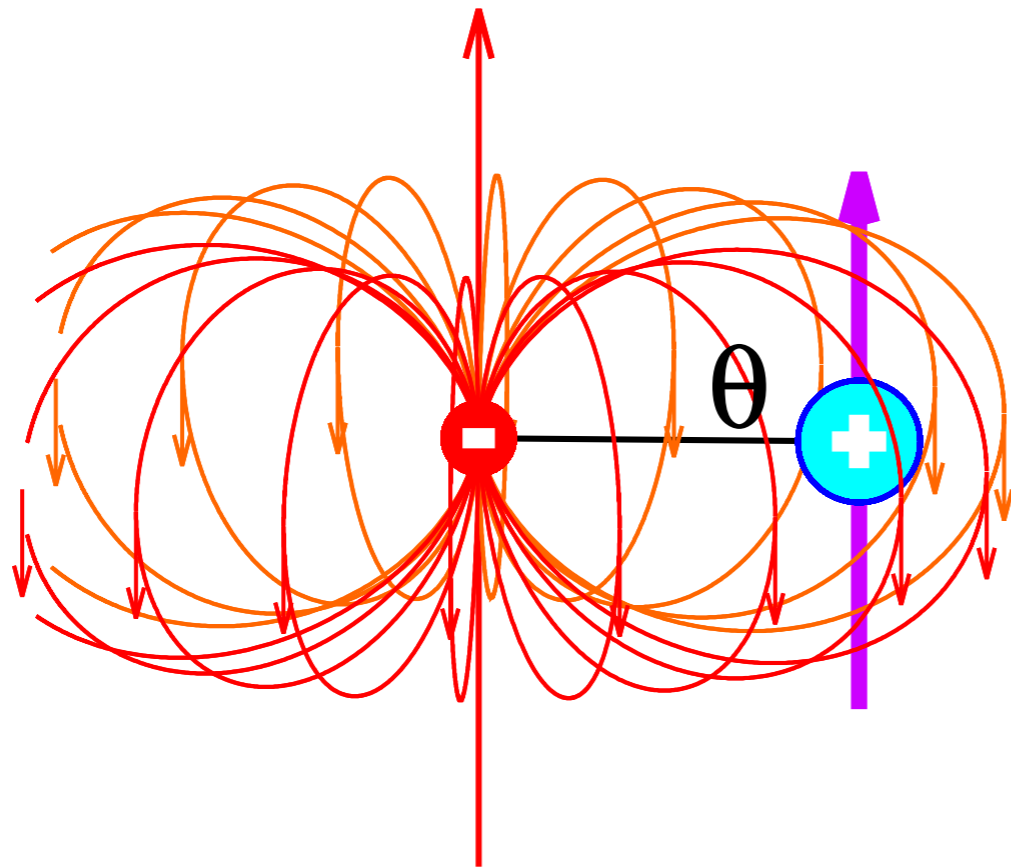


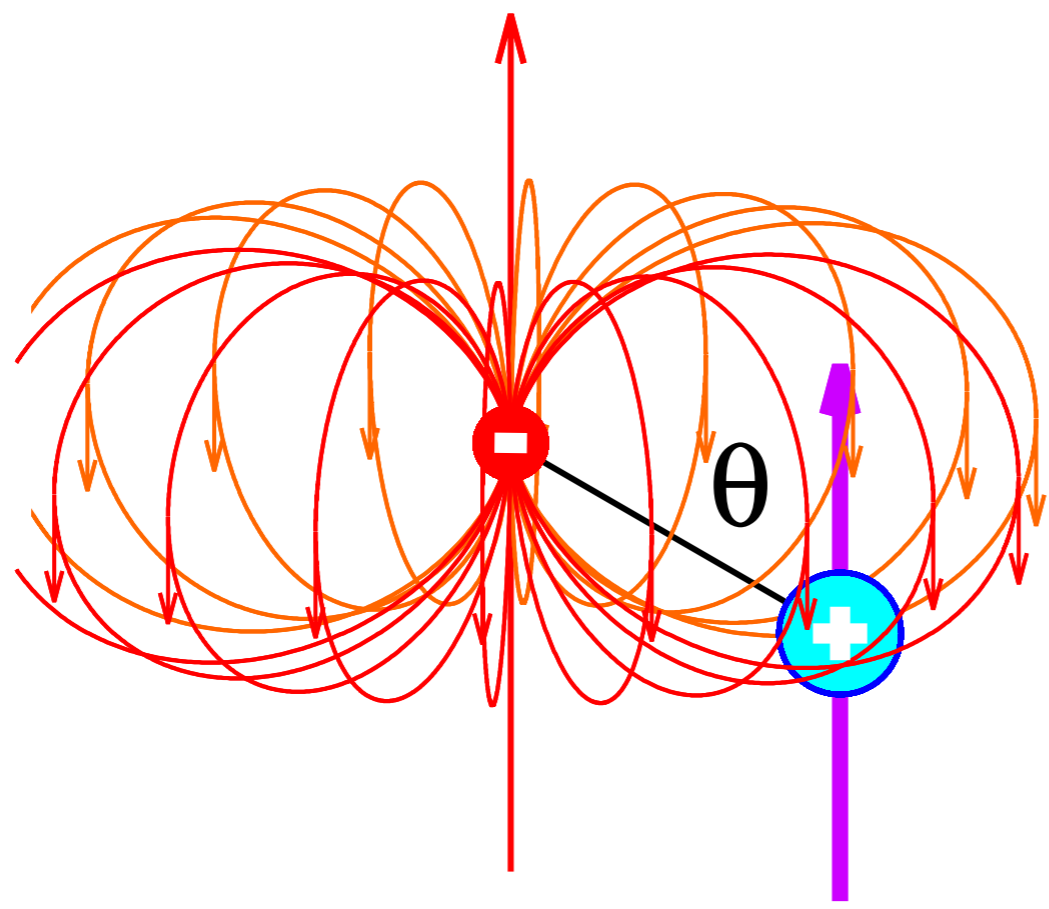


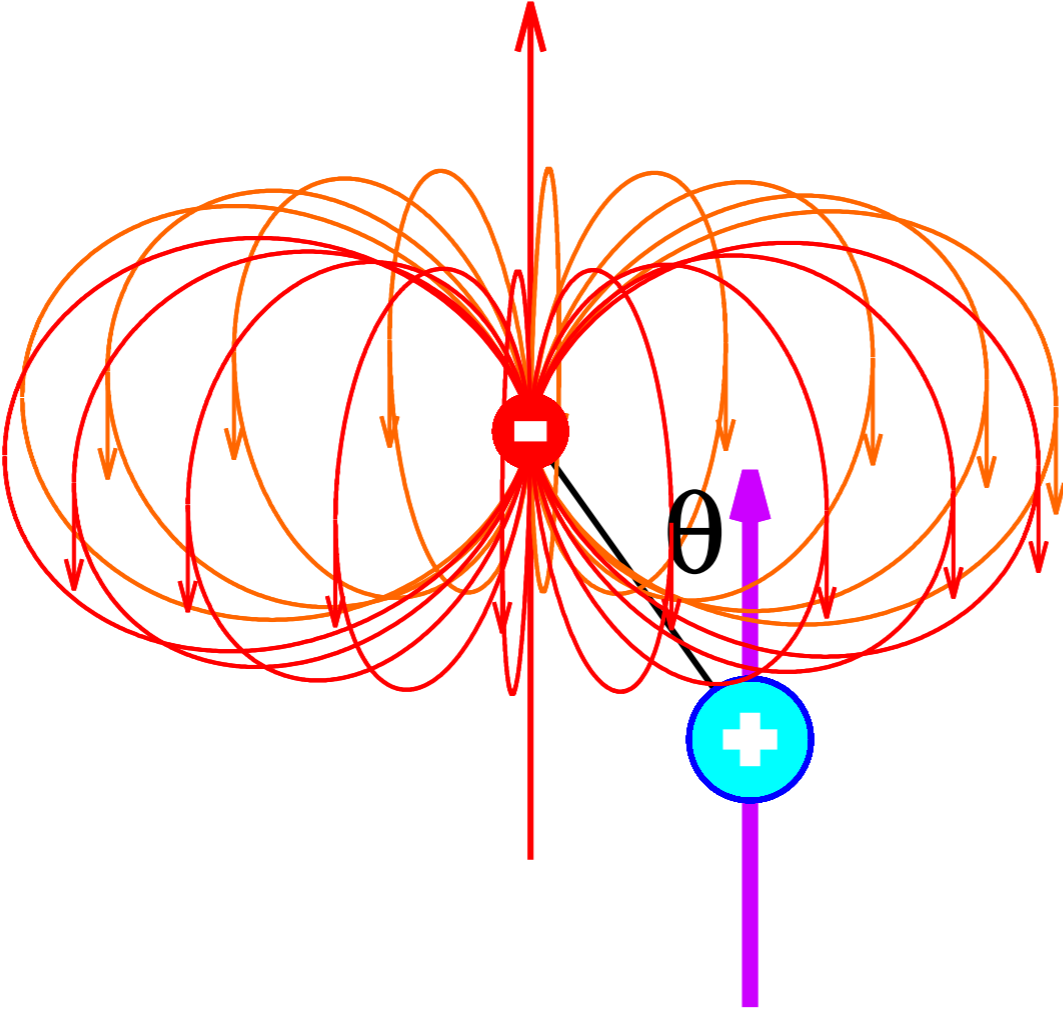


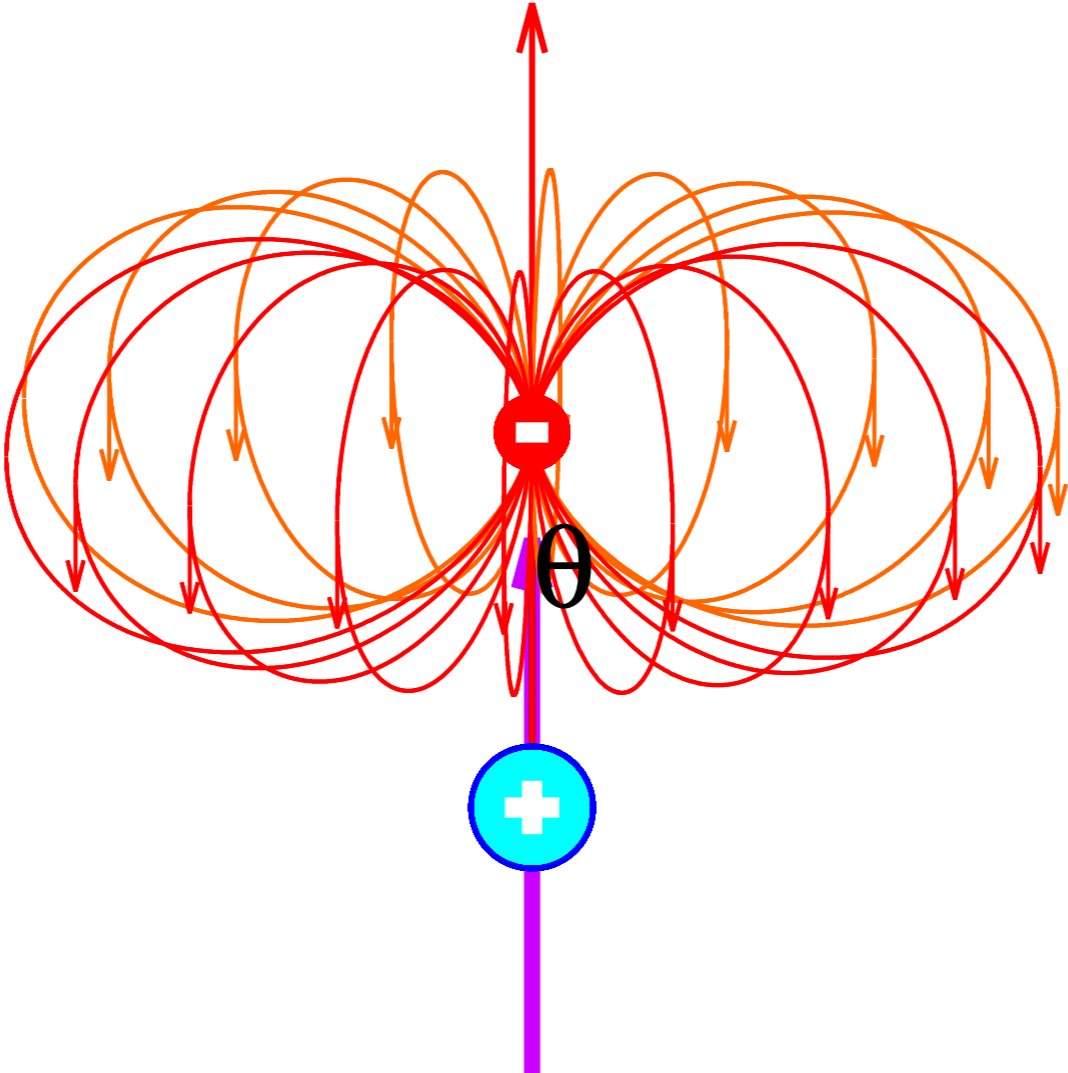




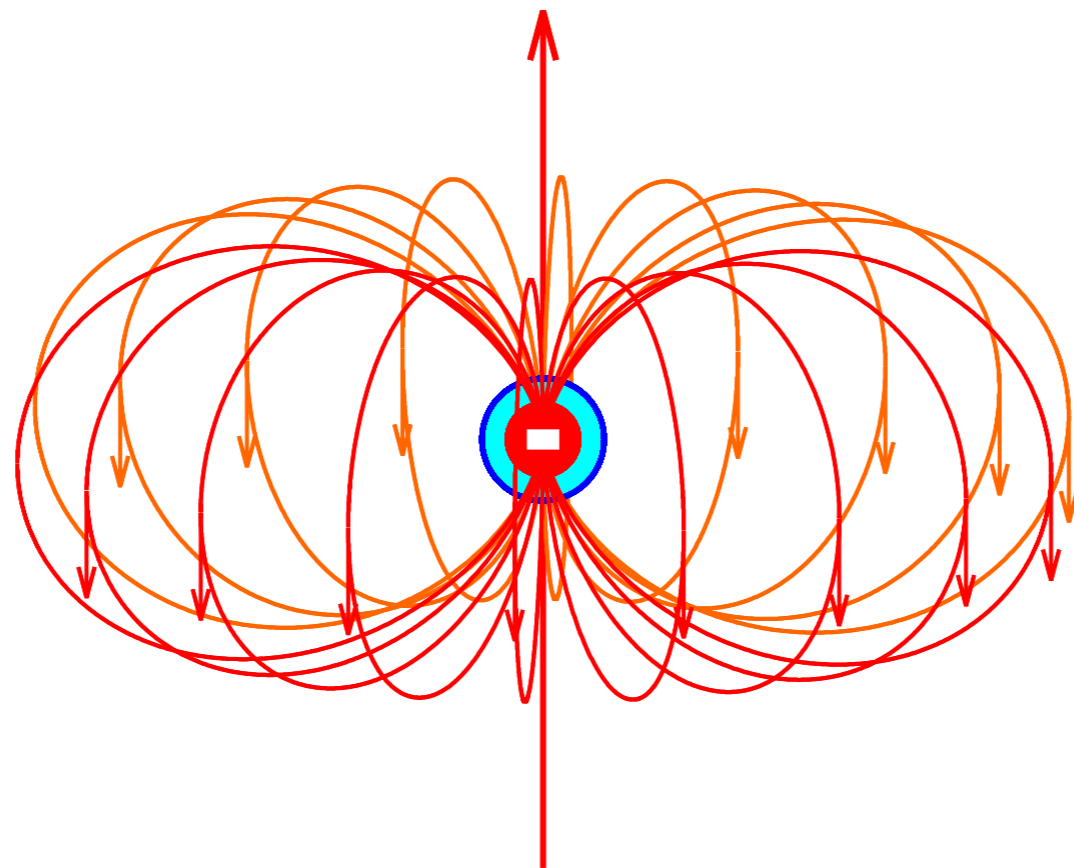




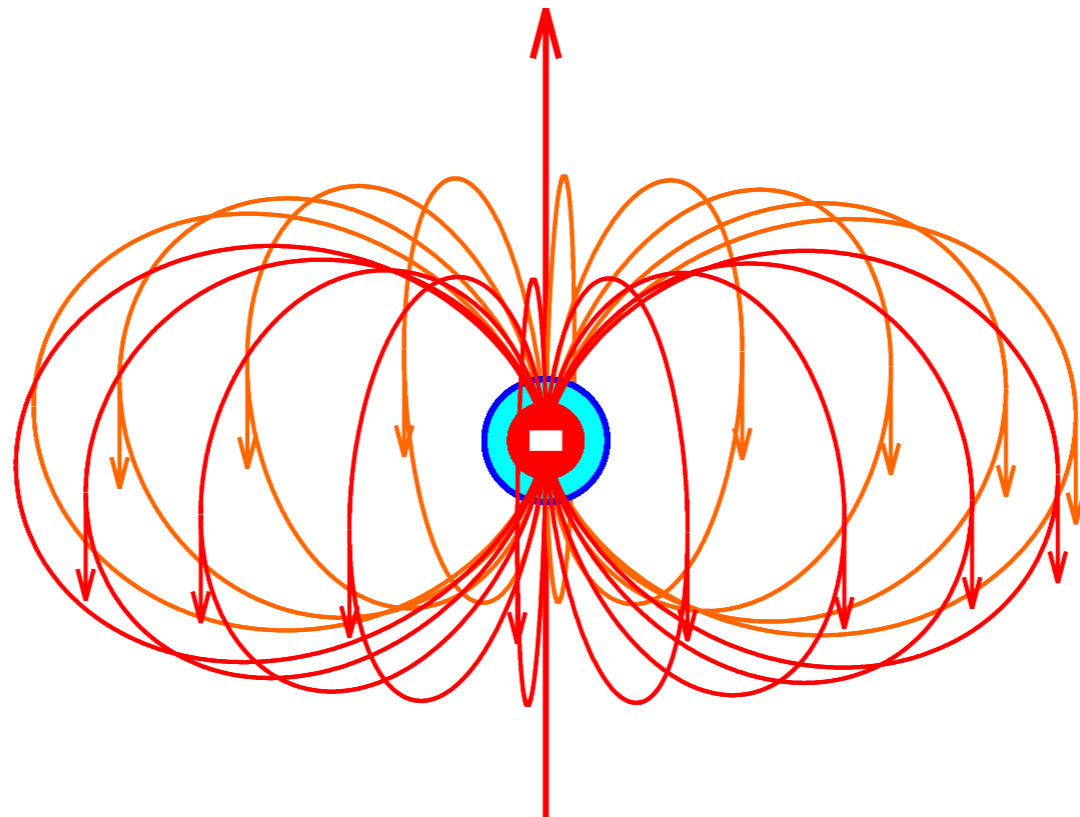


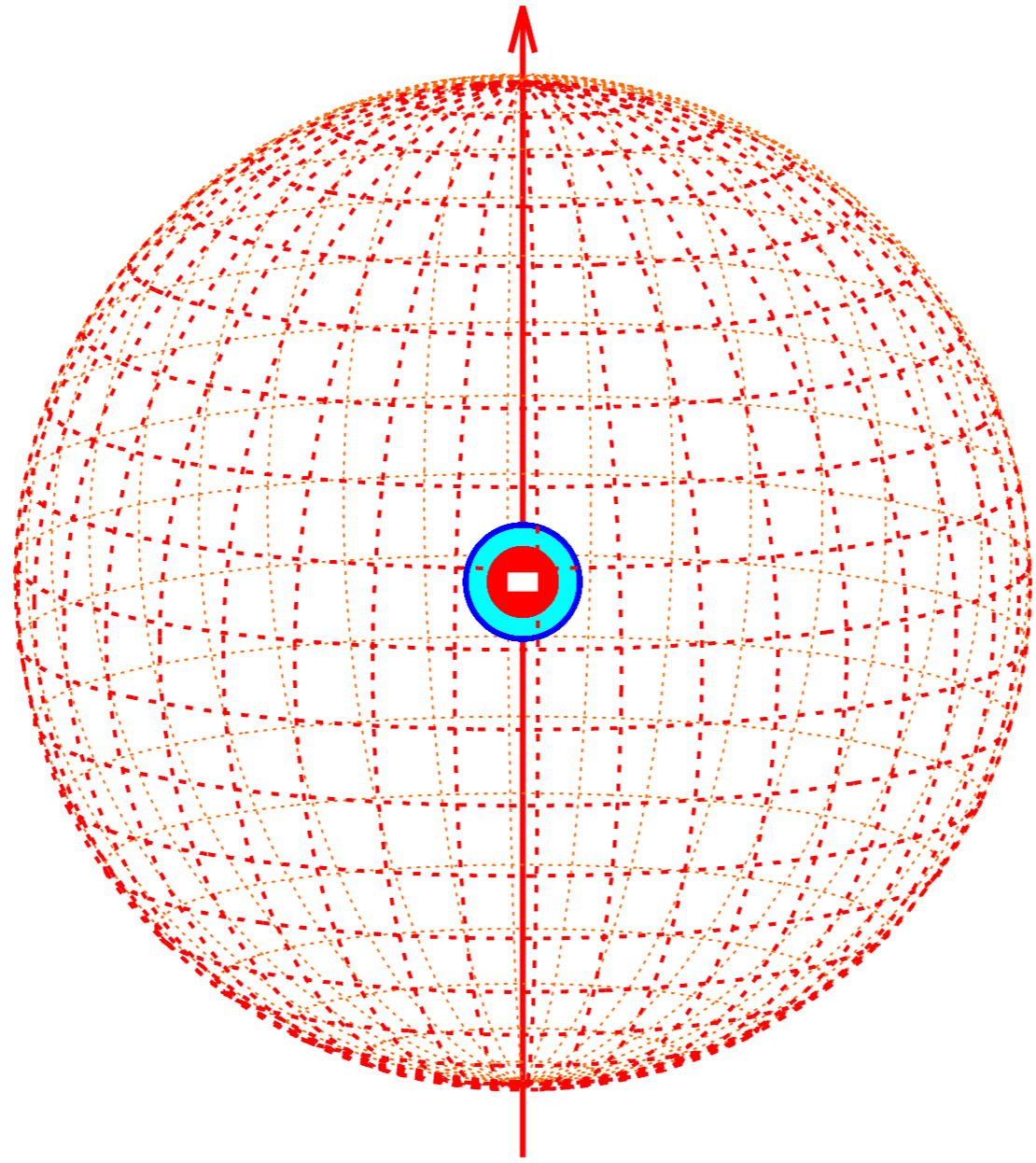


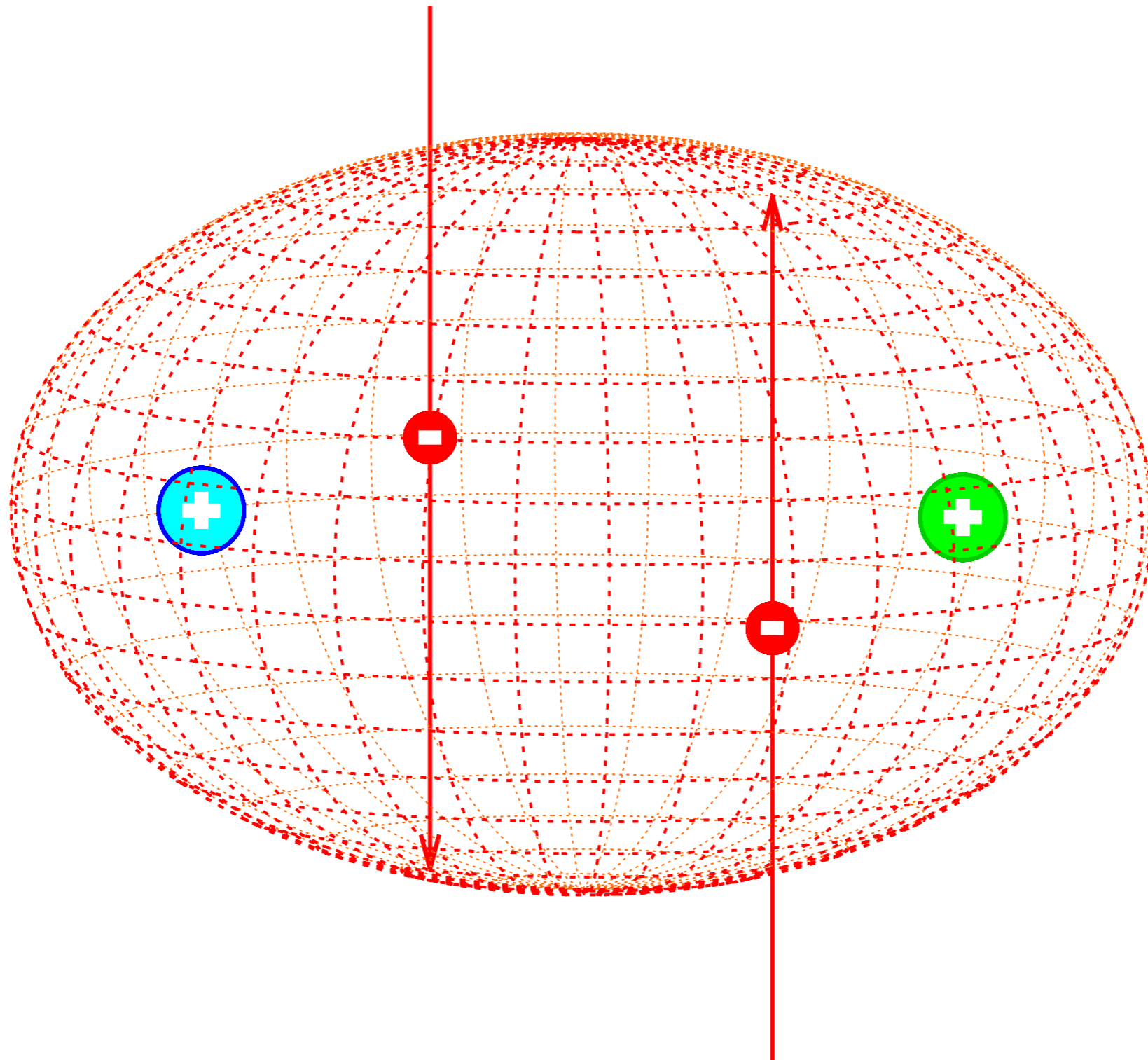


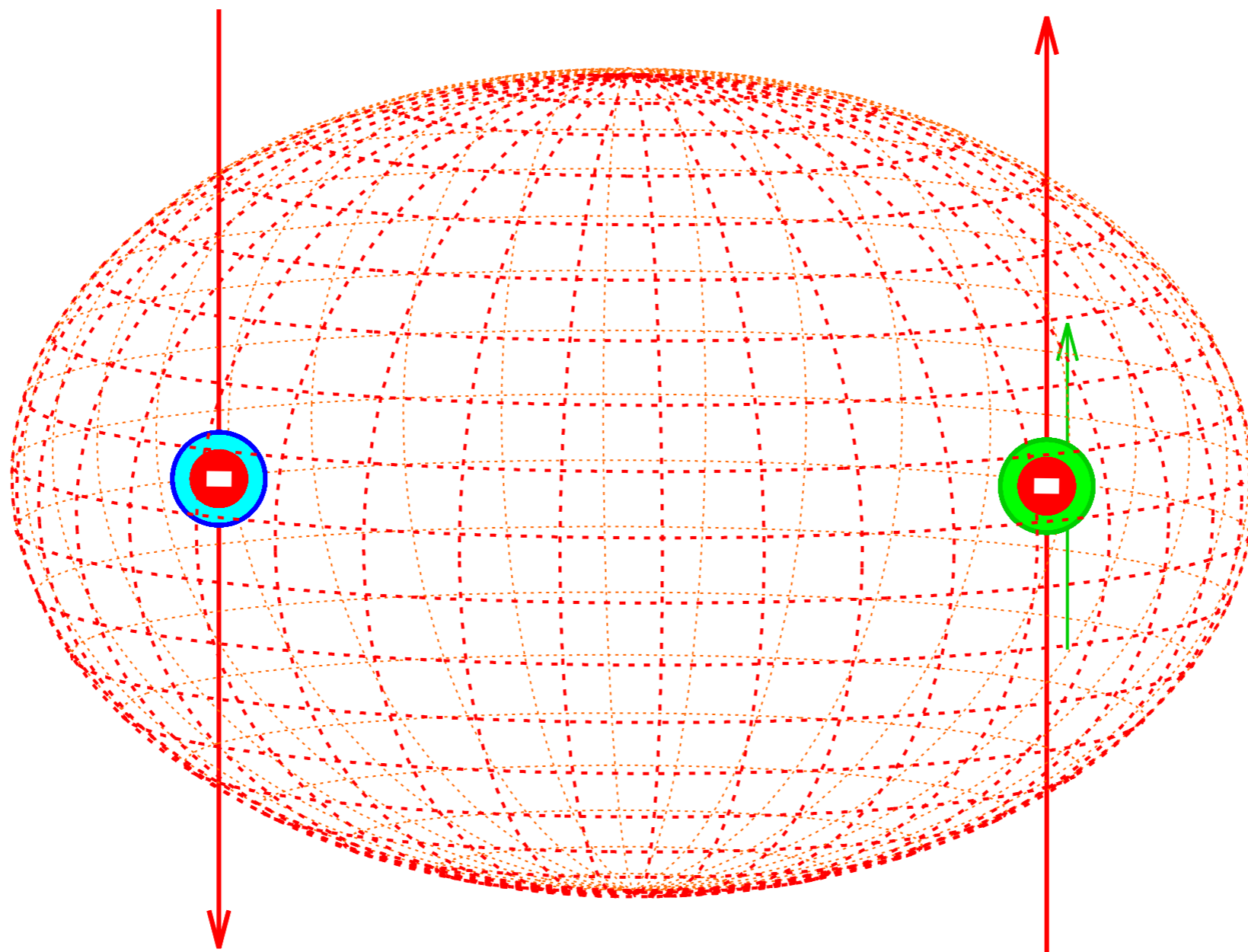


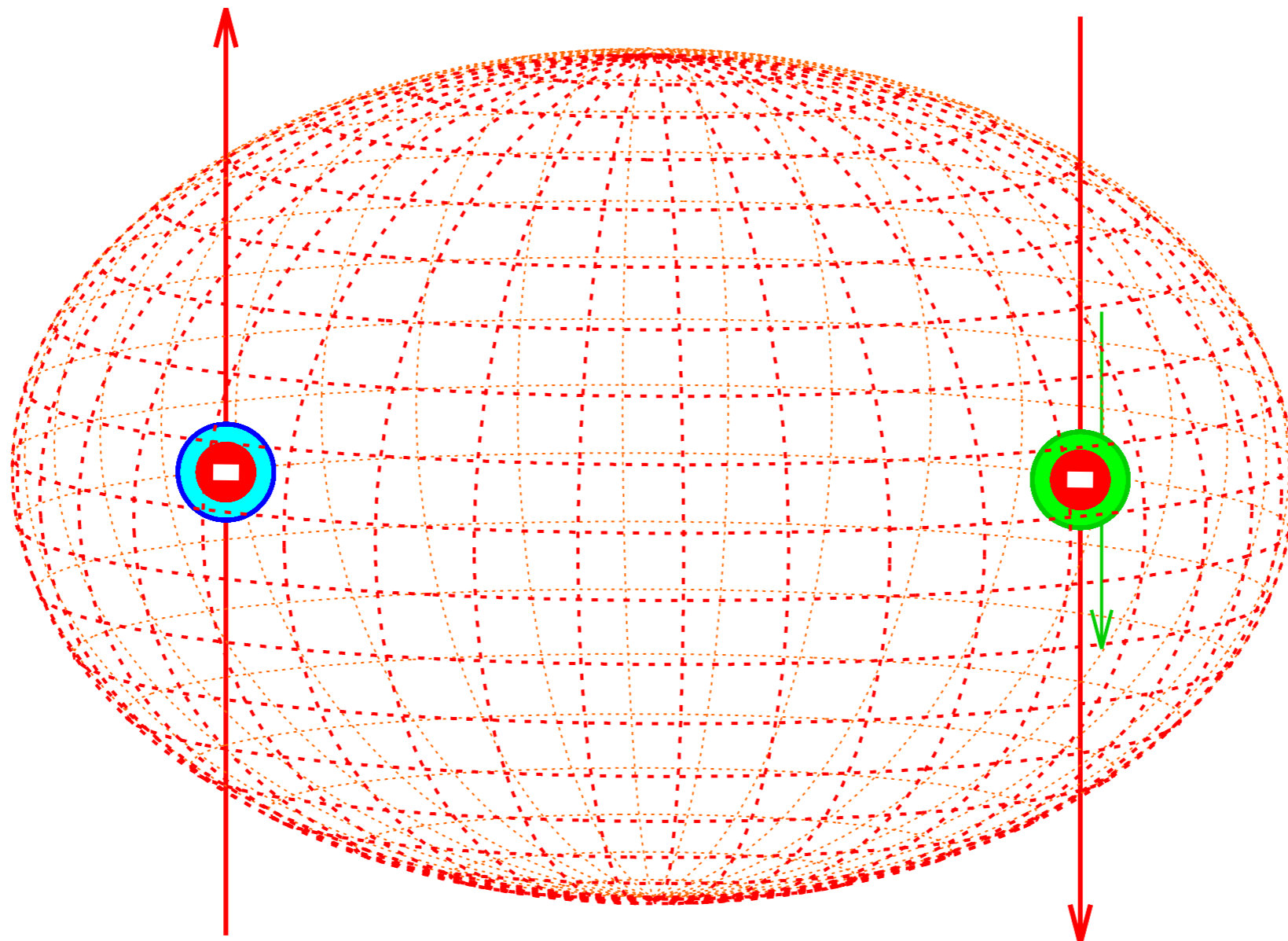
$$E = -\vec{\mu}_{\text{electron}} \cdot \vec{\mu}_{\text{nucleus}} \cdot P(\text{electron at nucleus})$$





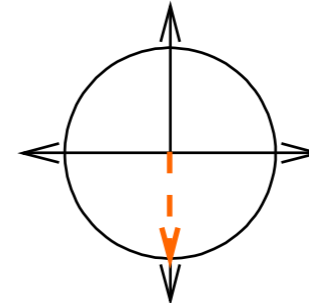
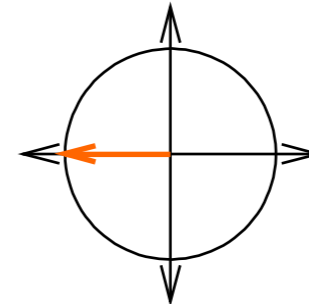
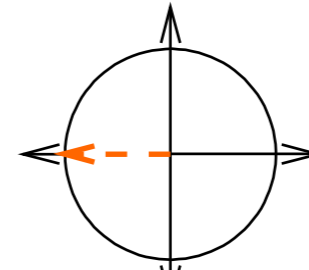
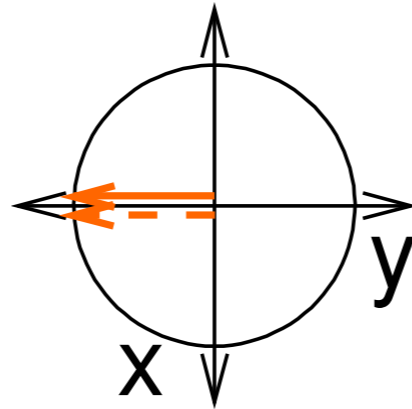
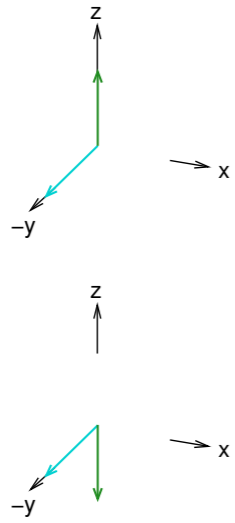




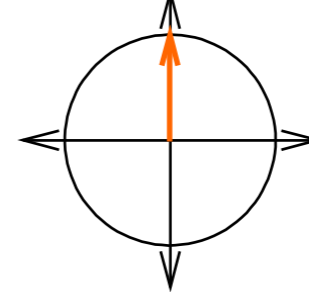
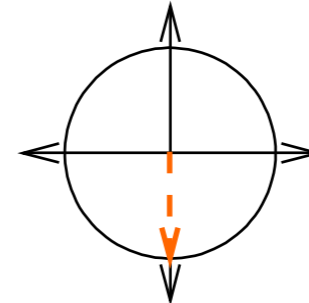
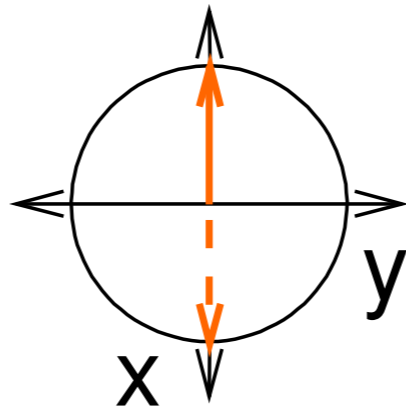
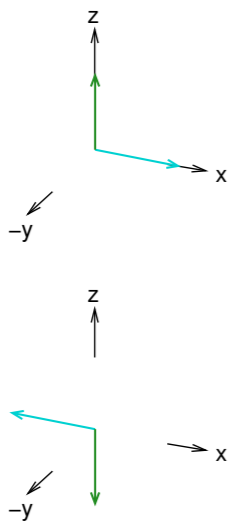


Coherence depicted as polarizations depicted as arrows decomposed arrows

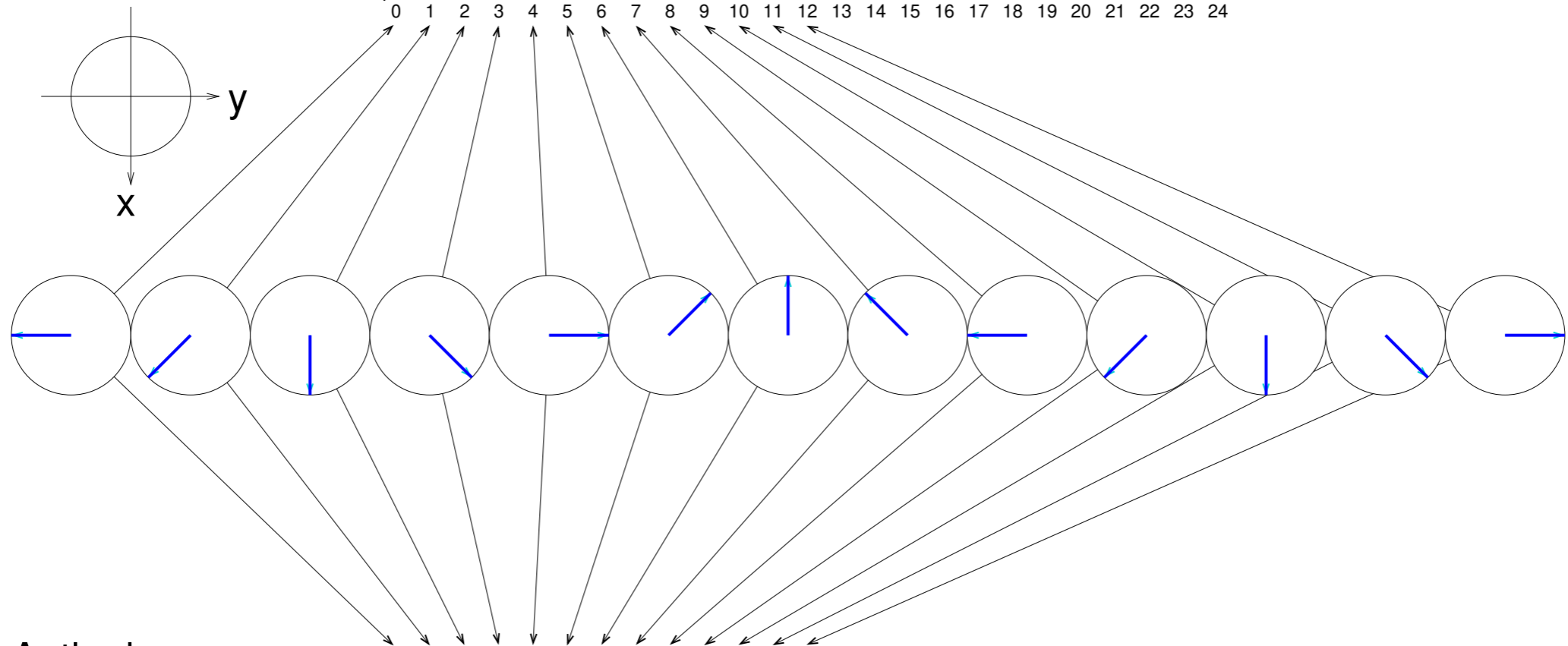
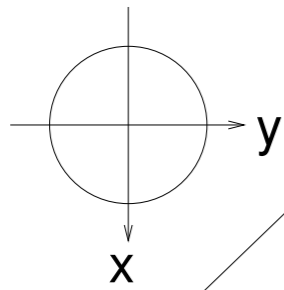
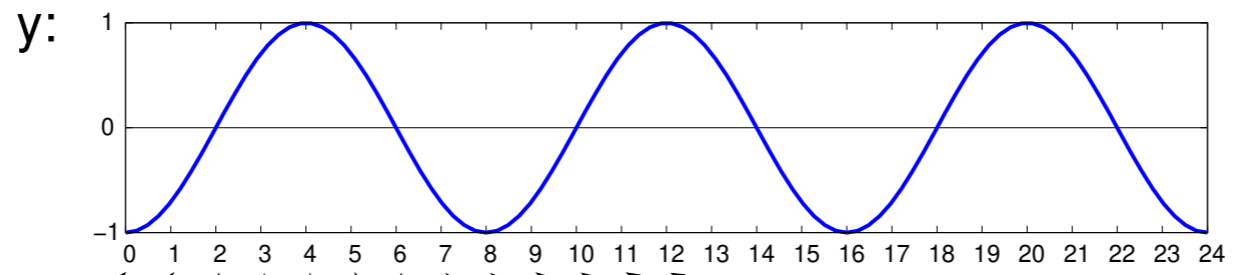
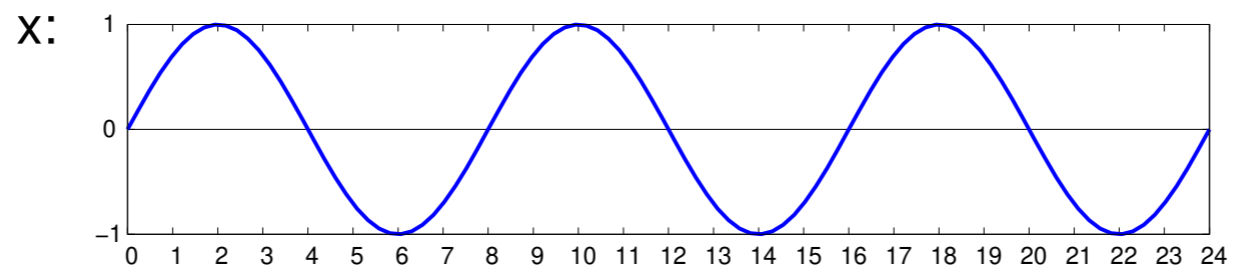
In-phase



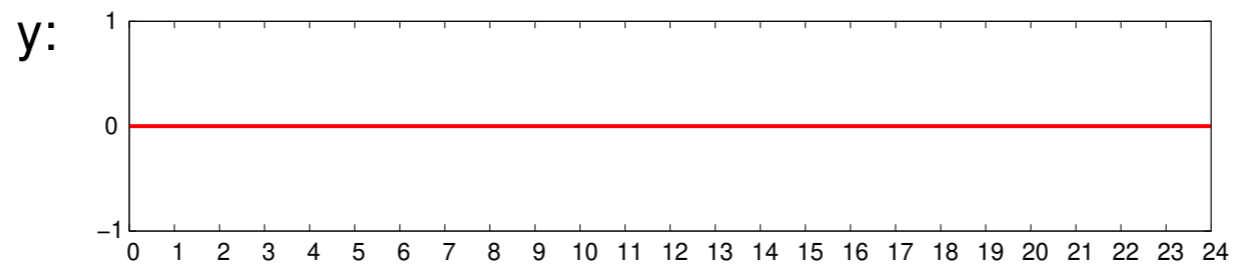
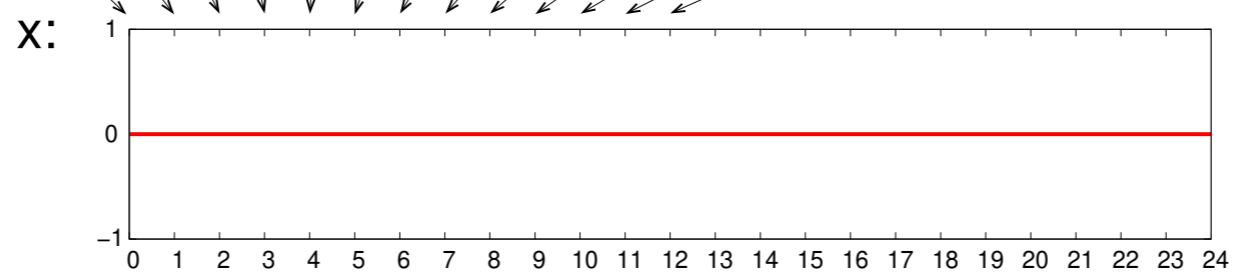
Anti-phase



In-phase:

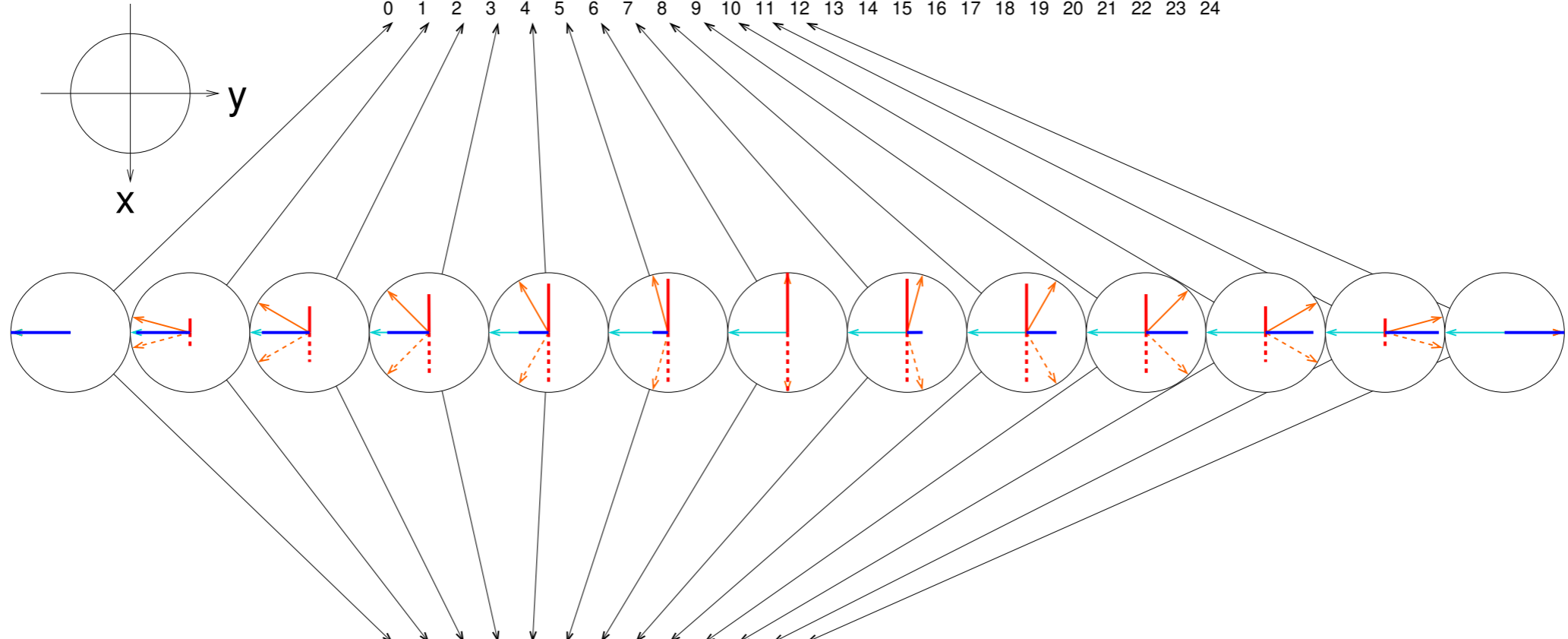
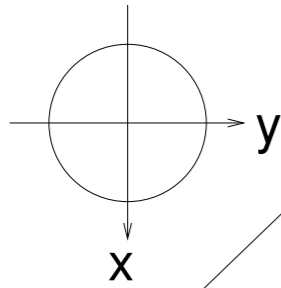
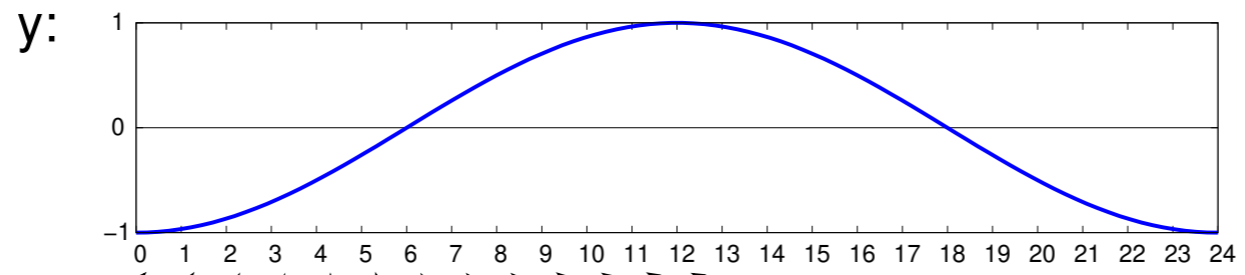
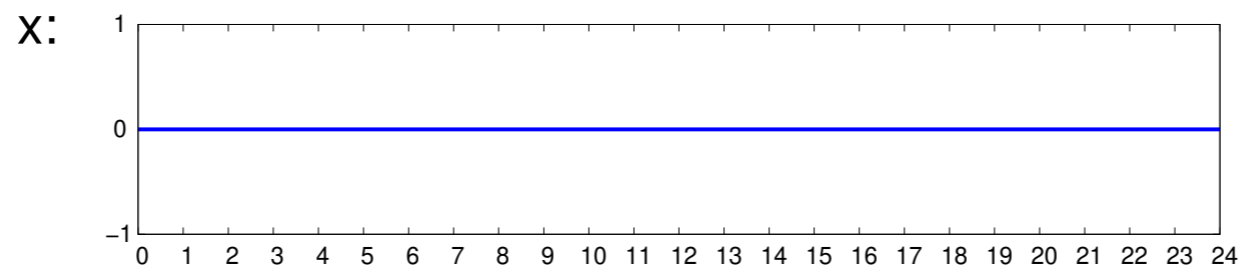


Anti-phase:

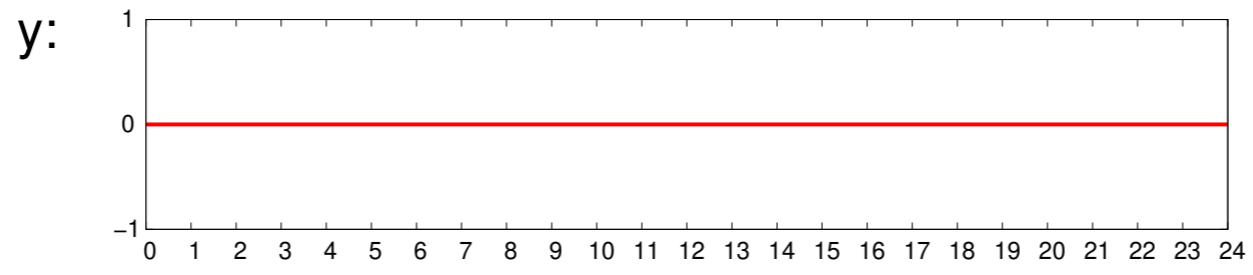
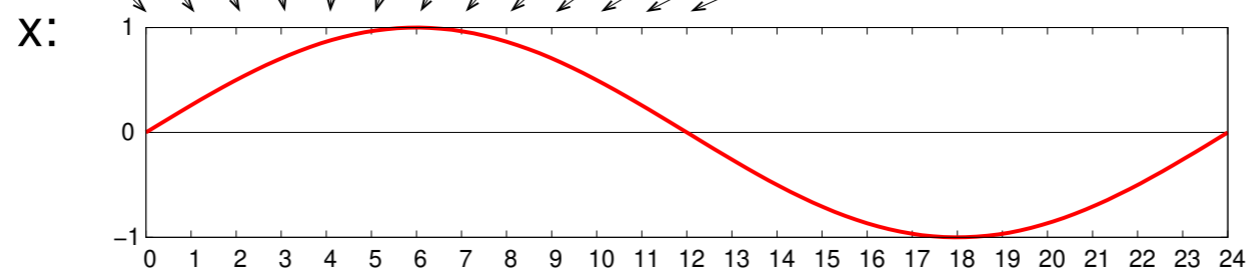




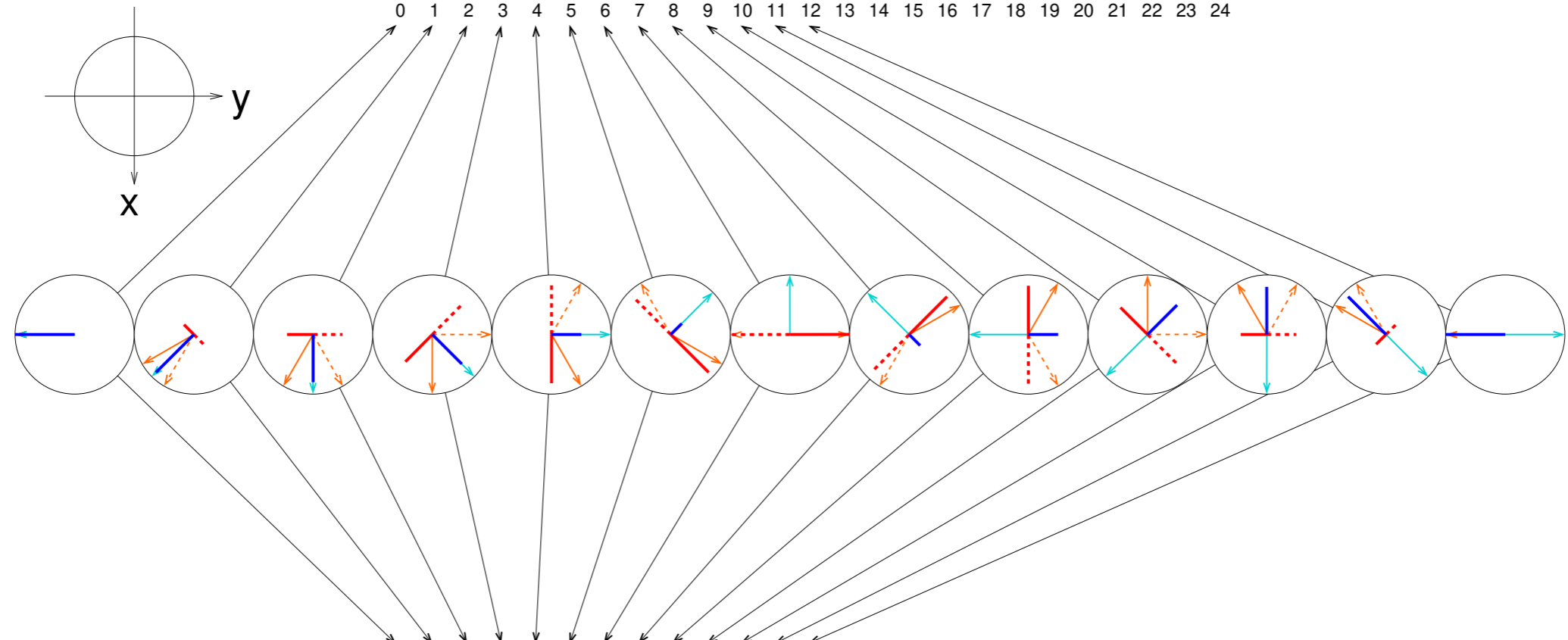
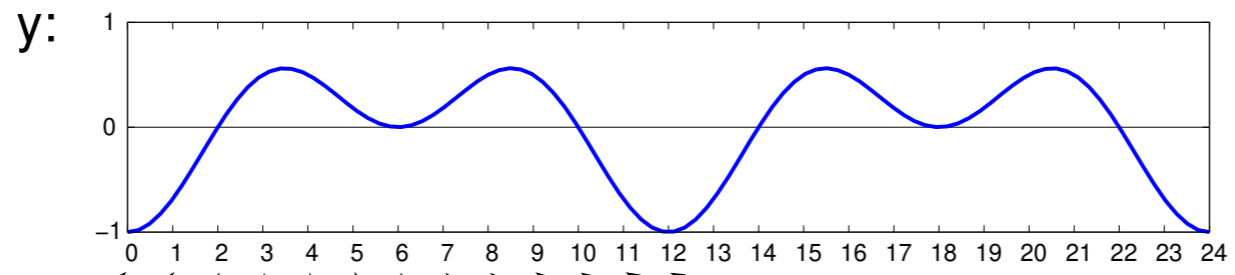
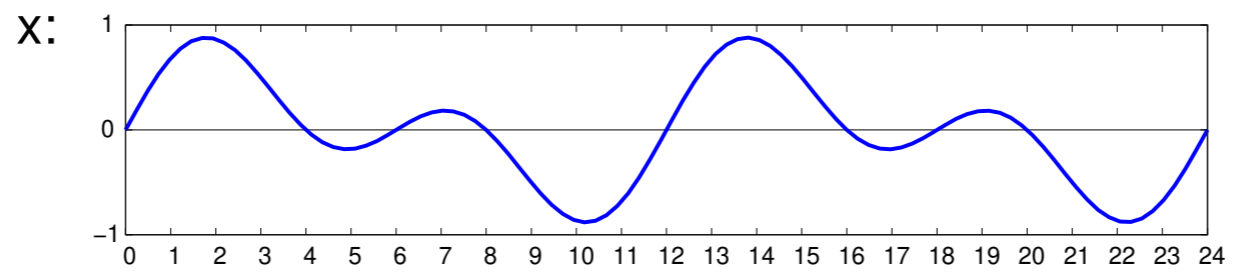
In-phase:



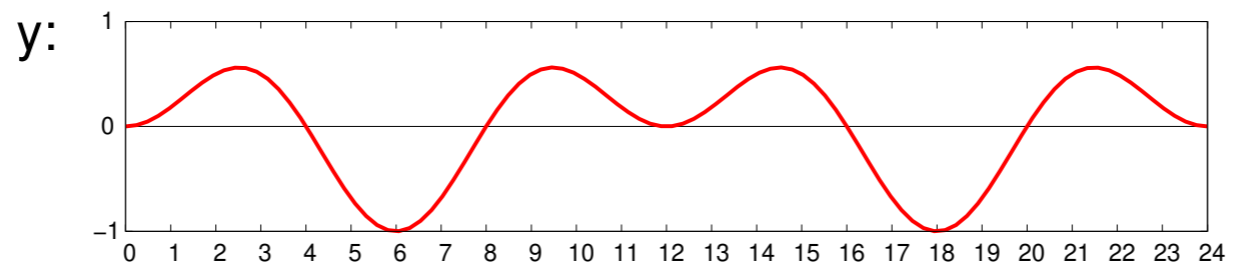
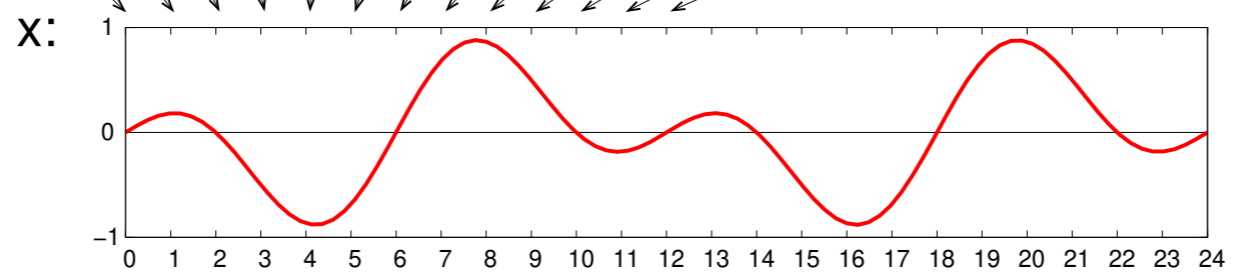
Anti-phase:

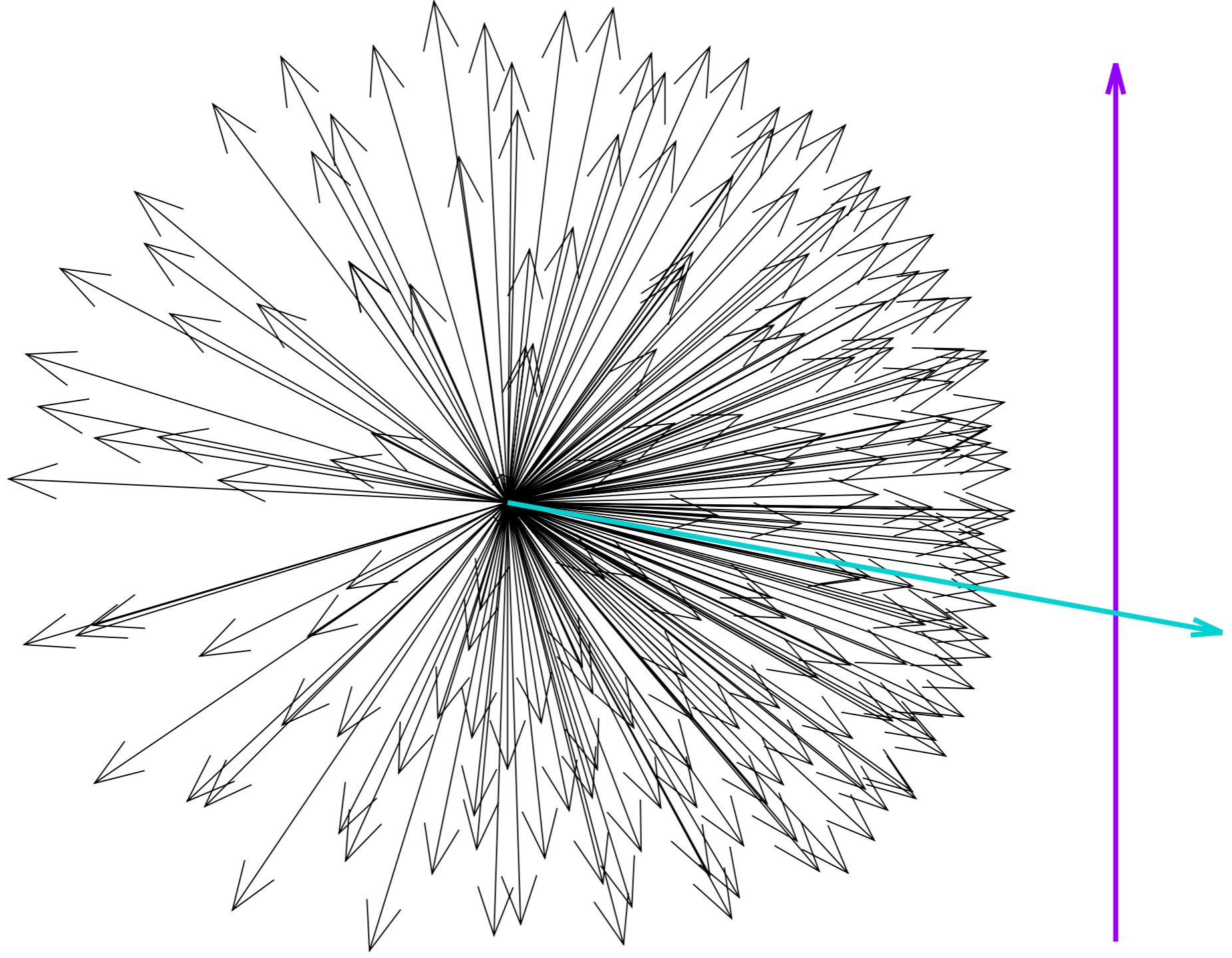


In-phase:

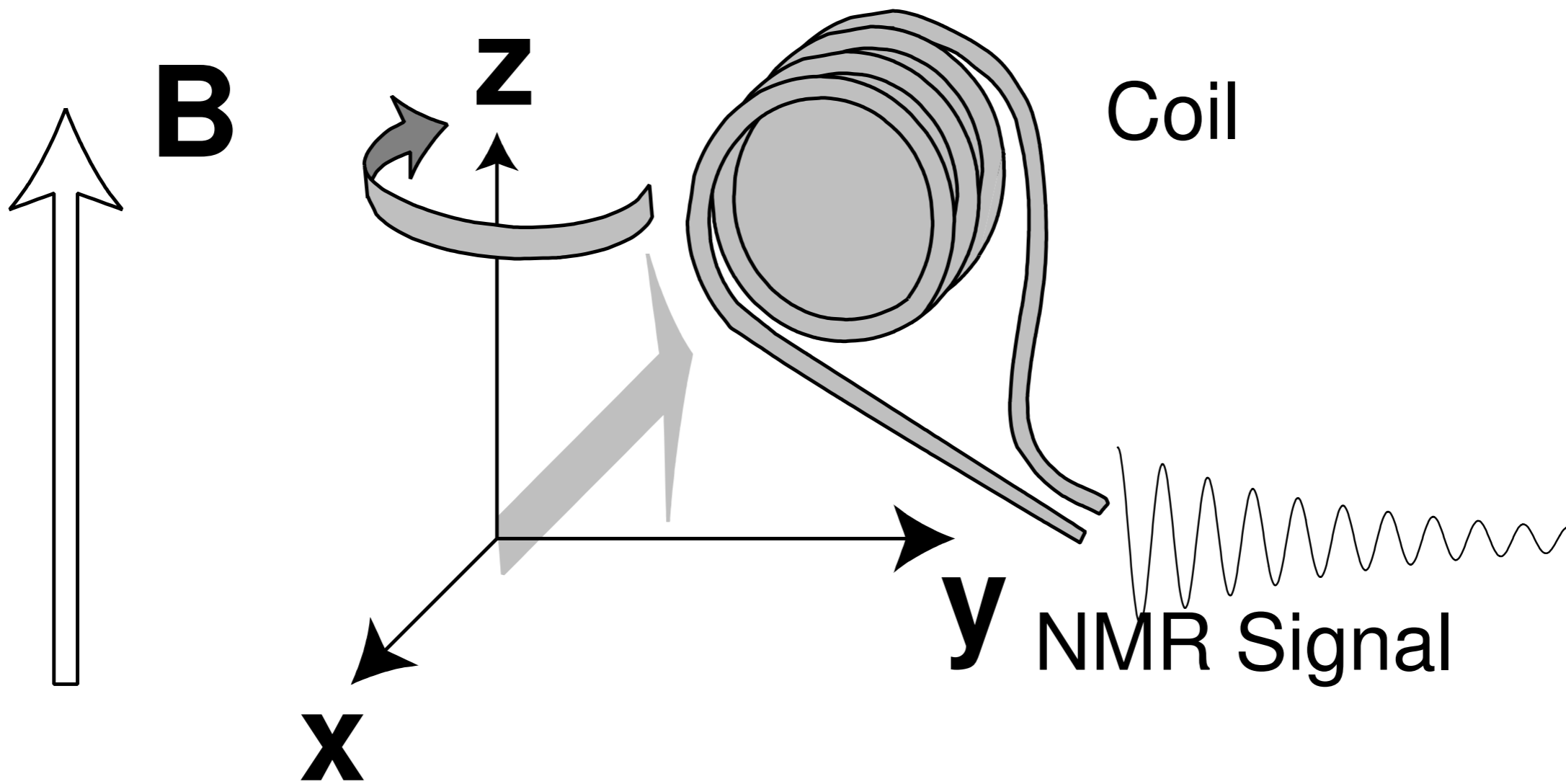


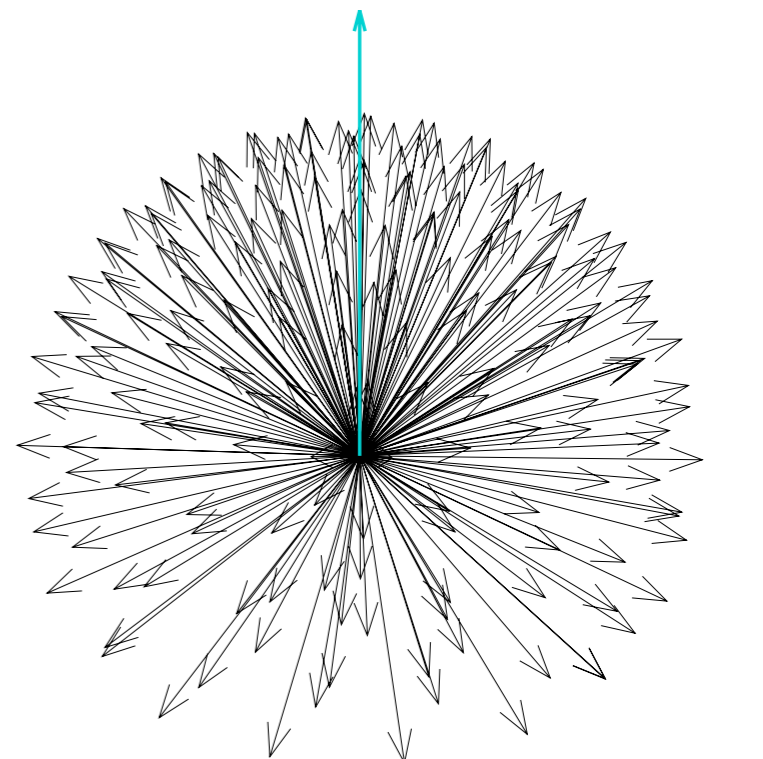
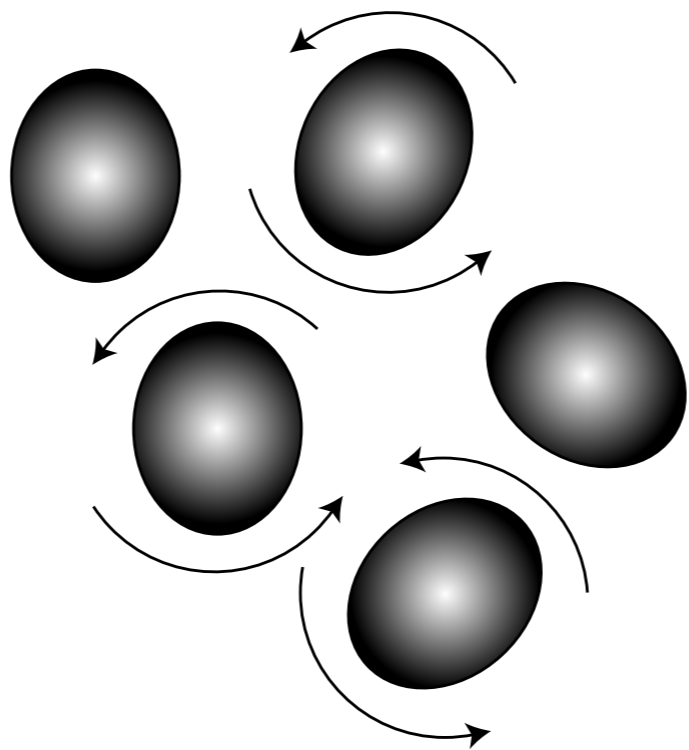
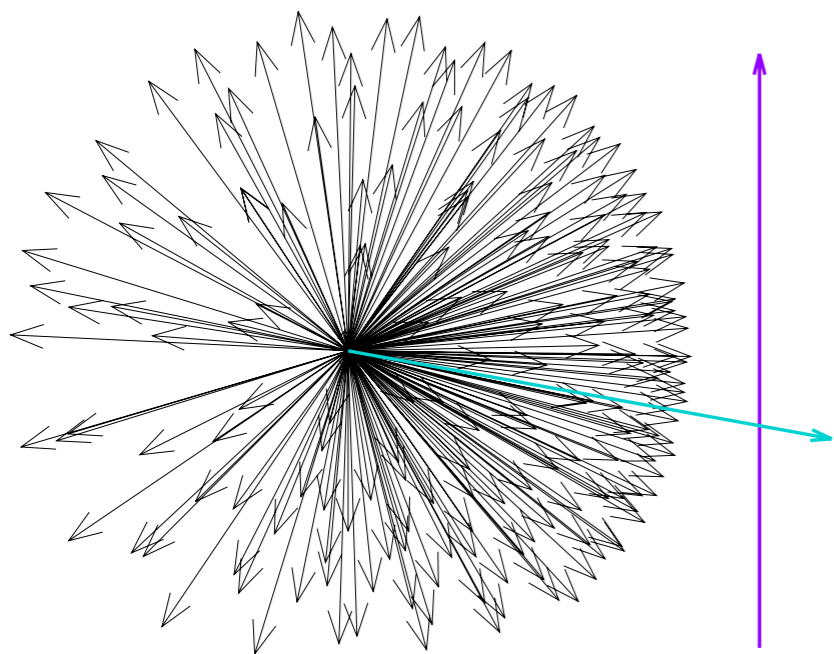
Anti-phase:

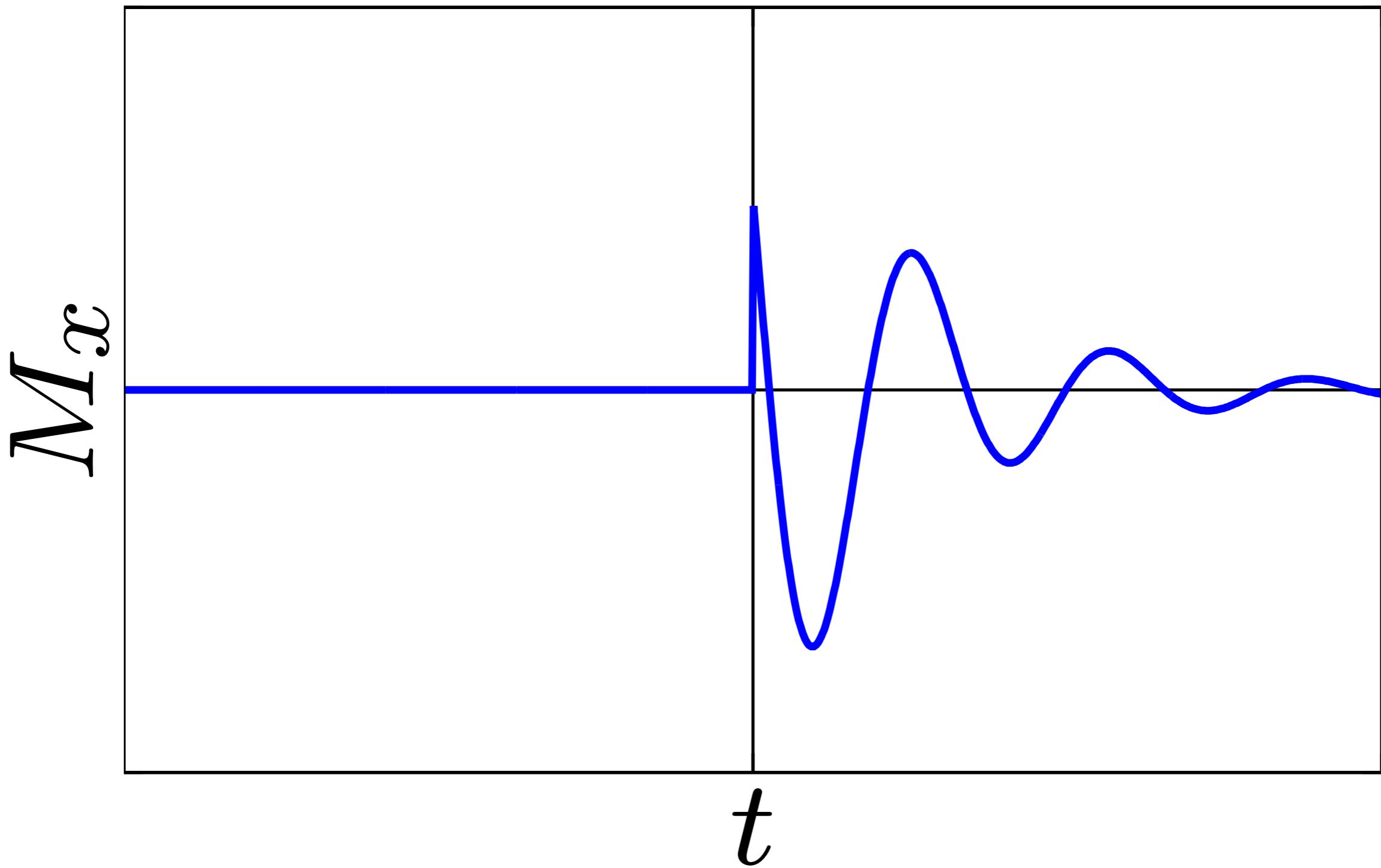


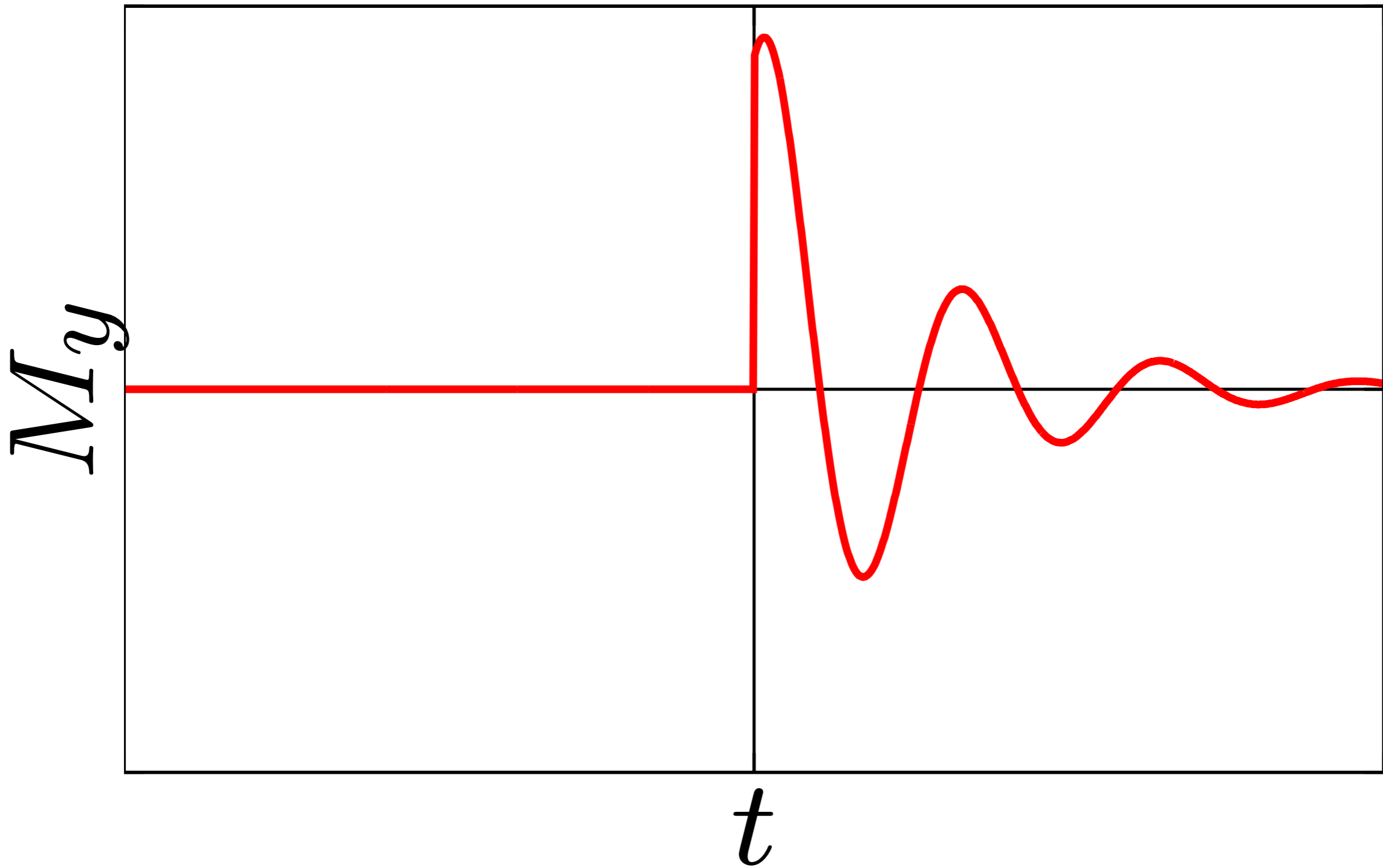


Transverse polarization



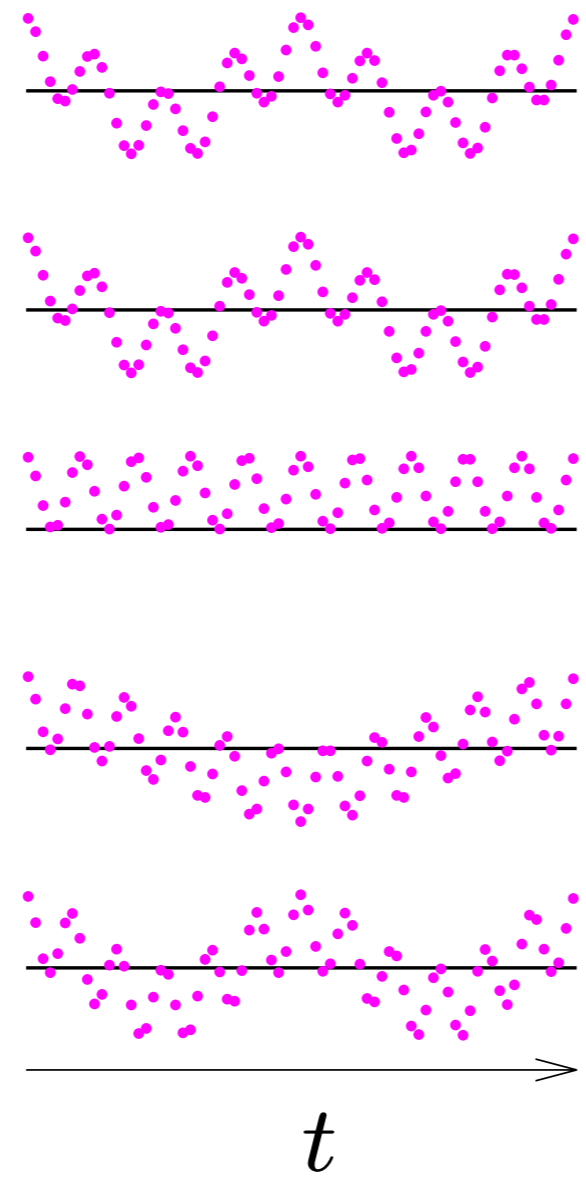
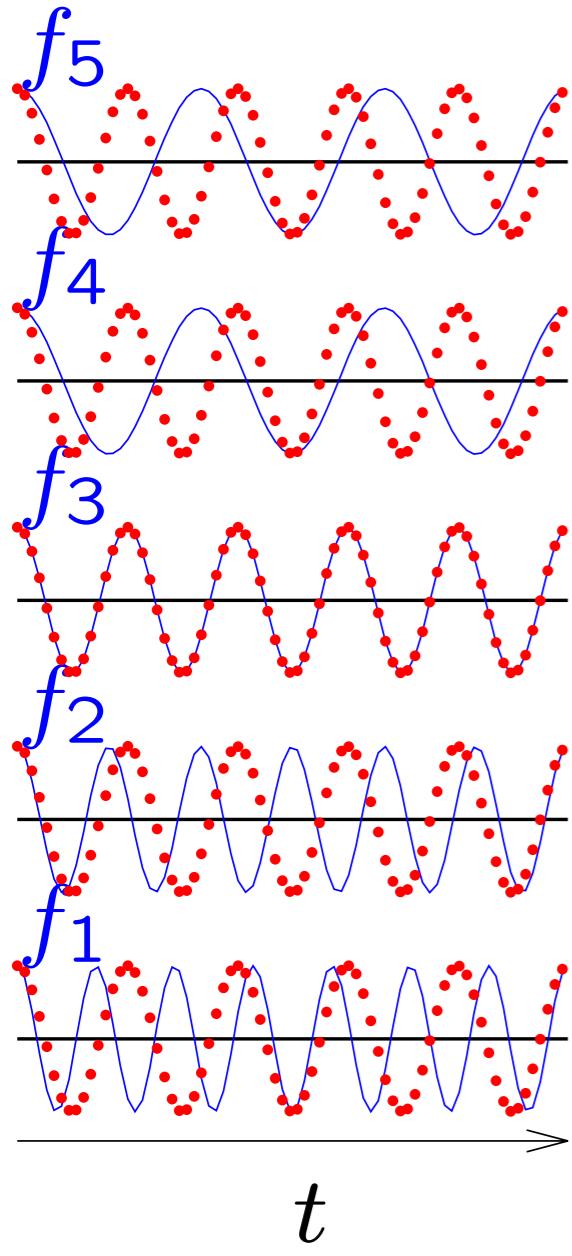
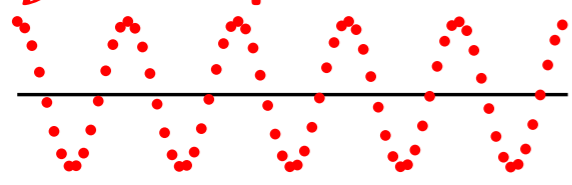








$\nu = ?$



$\Sigma = 0$

$\Sigma = 0$

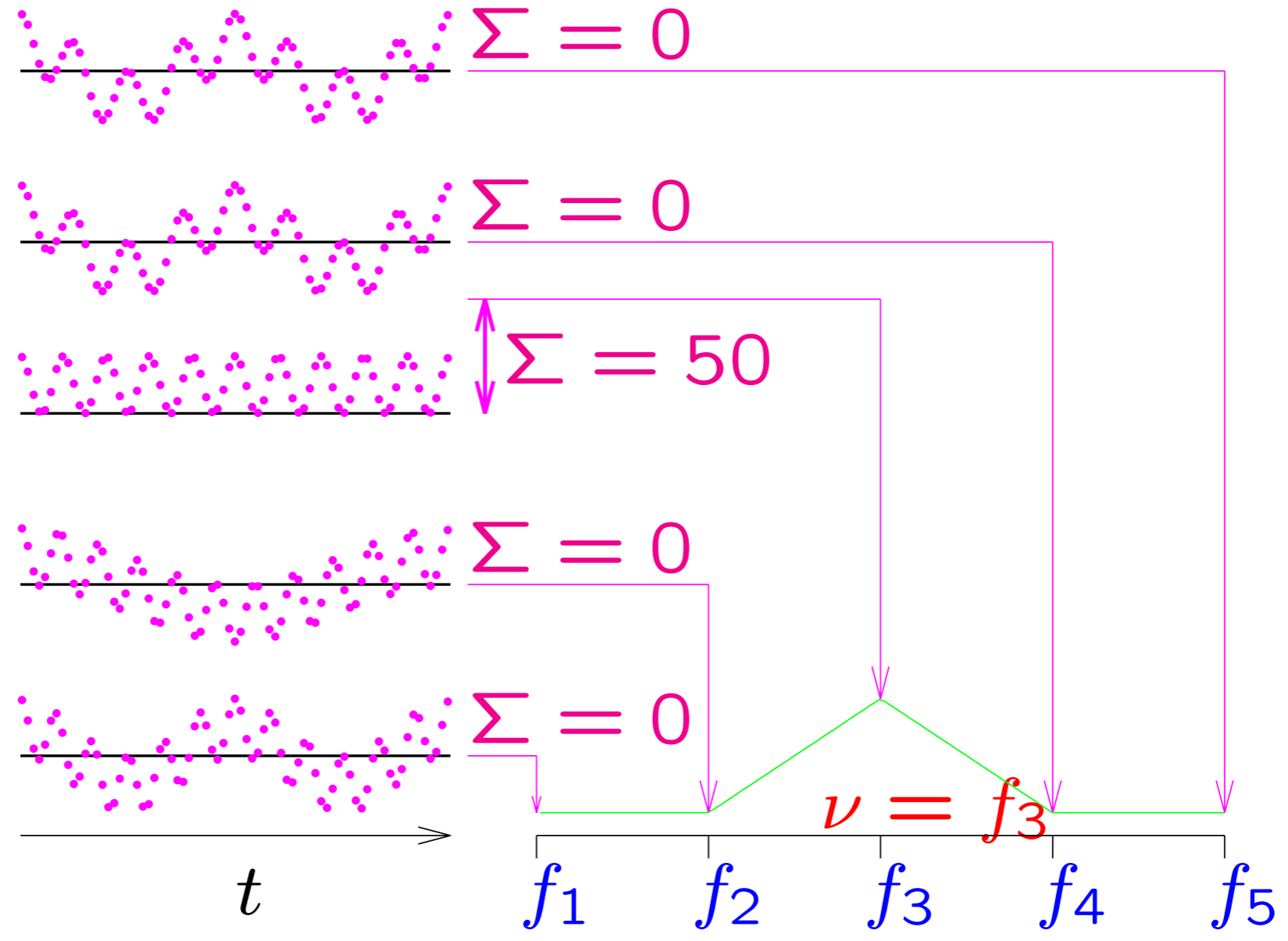
$\Sigma = 50$

$\Sigma = 0$

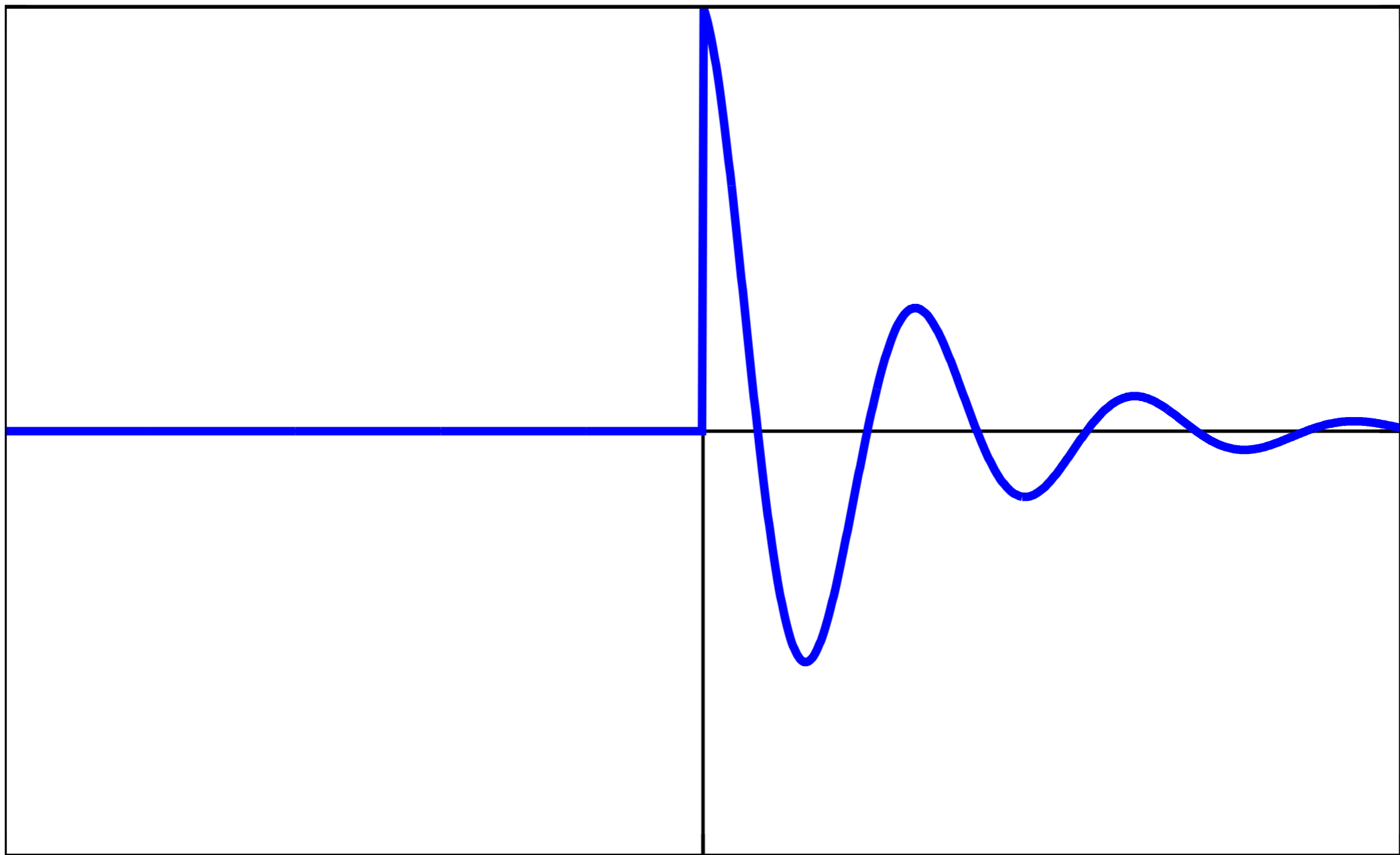
$\Sigma = 0$

$f_1$   $f_2$   $f_3$   $f_4$   $f_5$

$\nu = f_3$

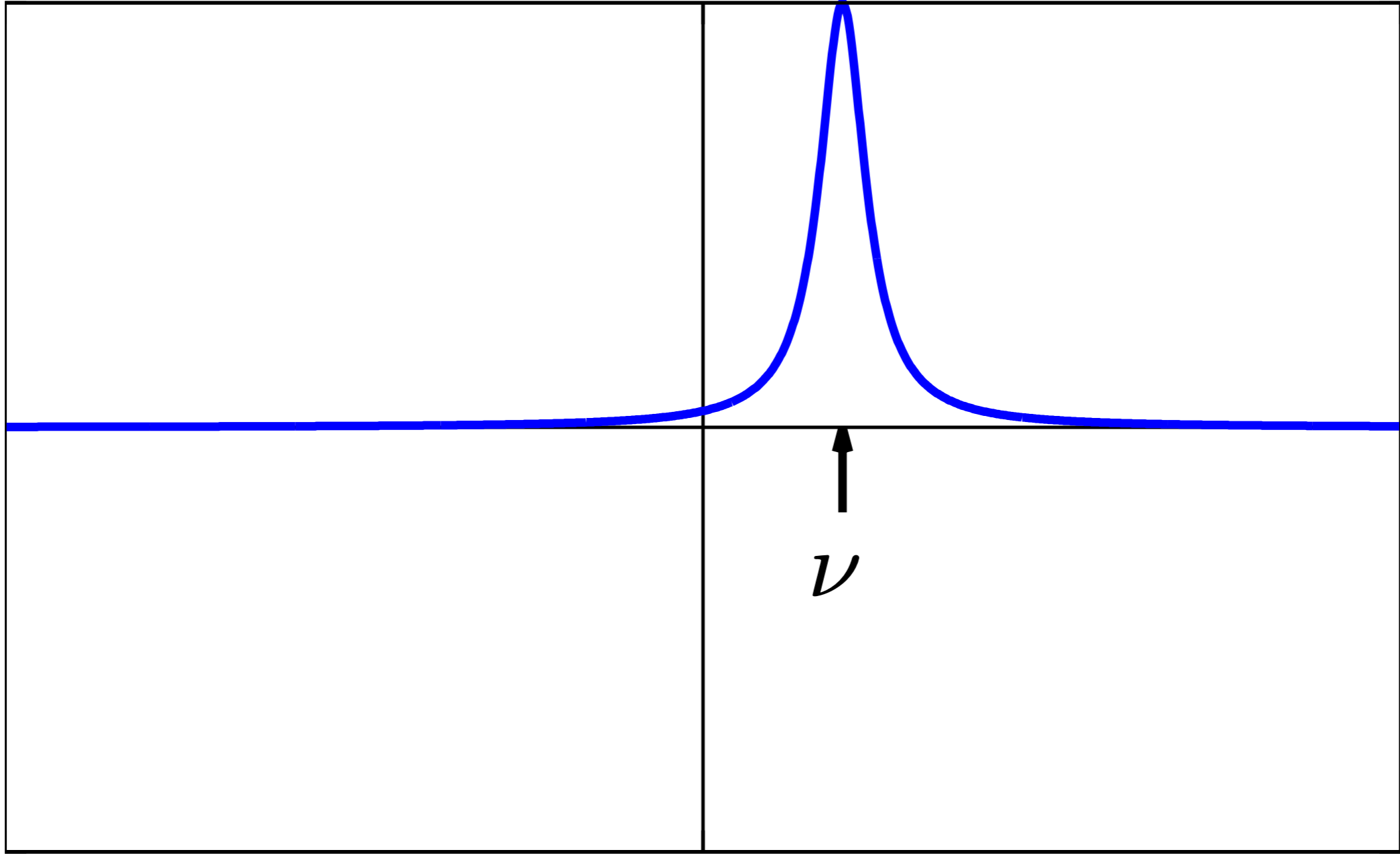


Signal intensity



$t$

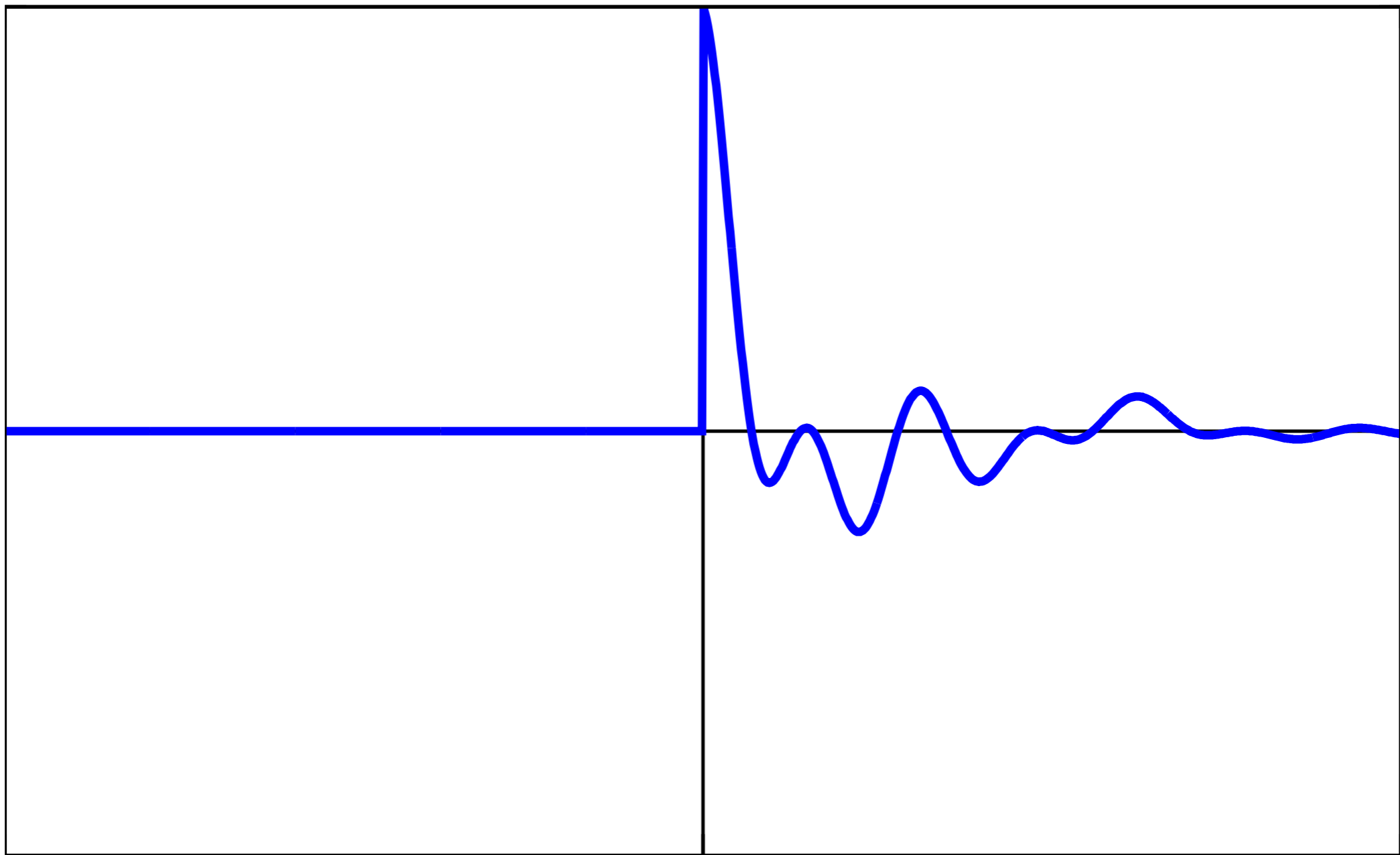
Spectrum intensity



$f$

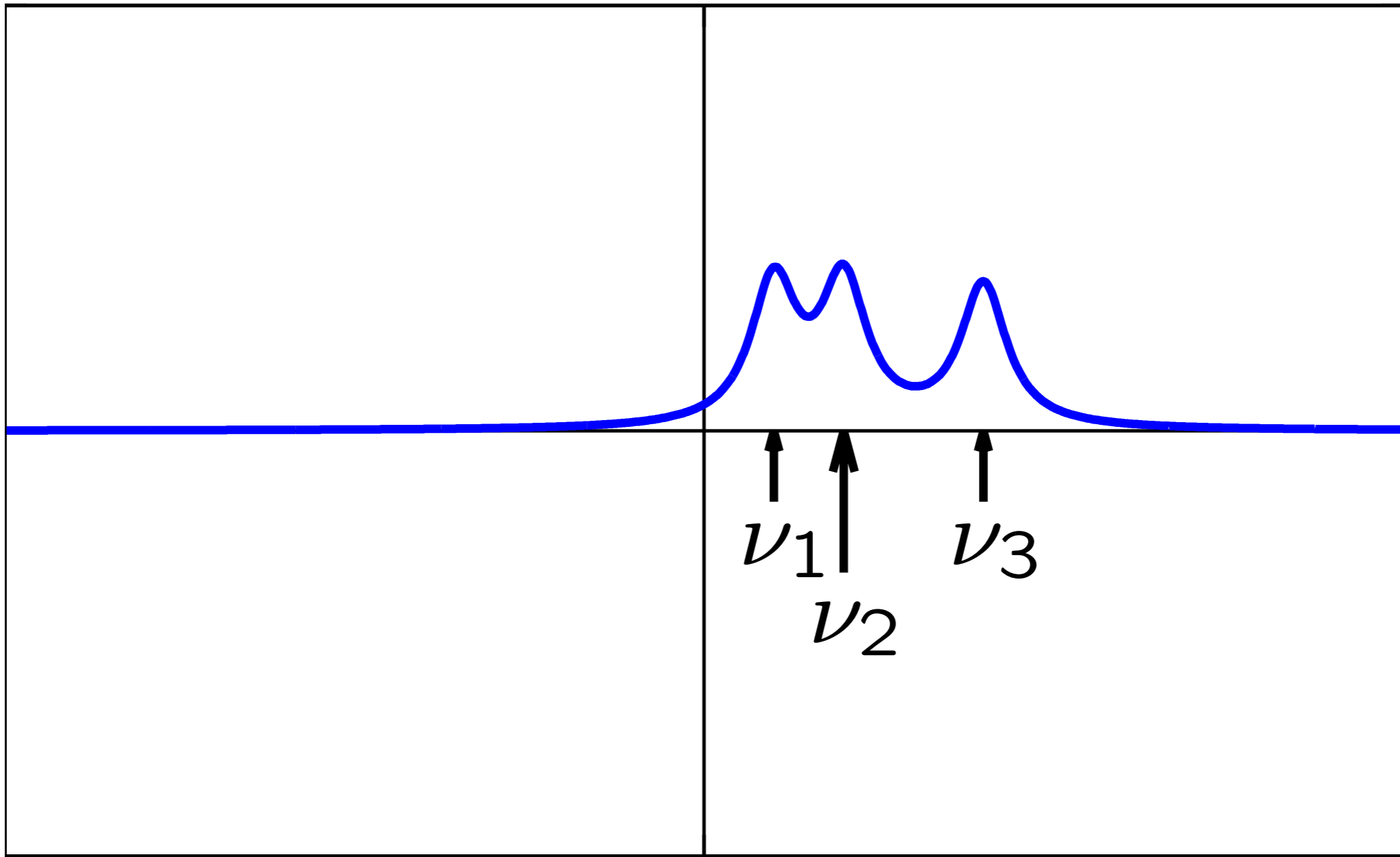
$\nu$

Signal intensity



$t$

Spectrum intensity

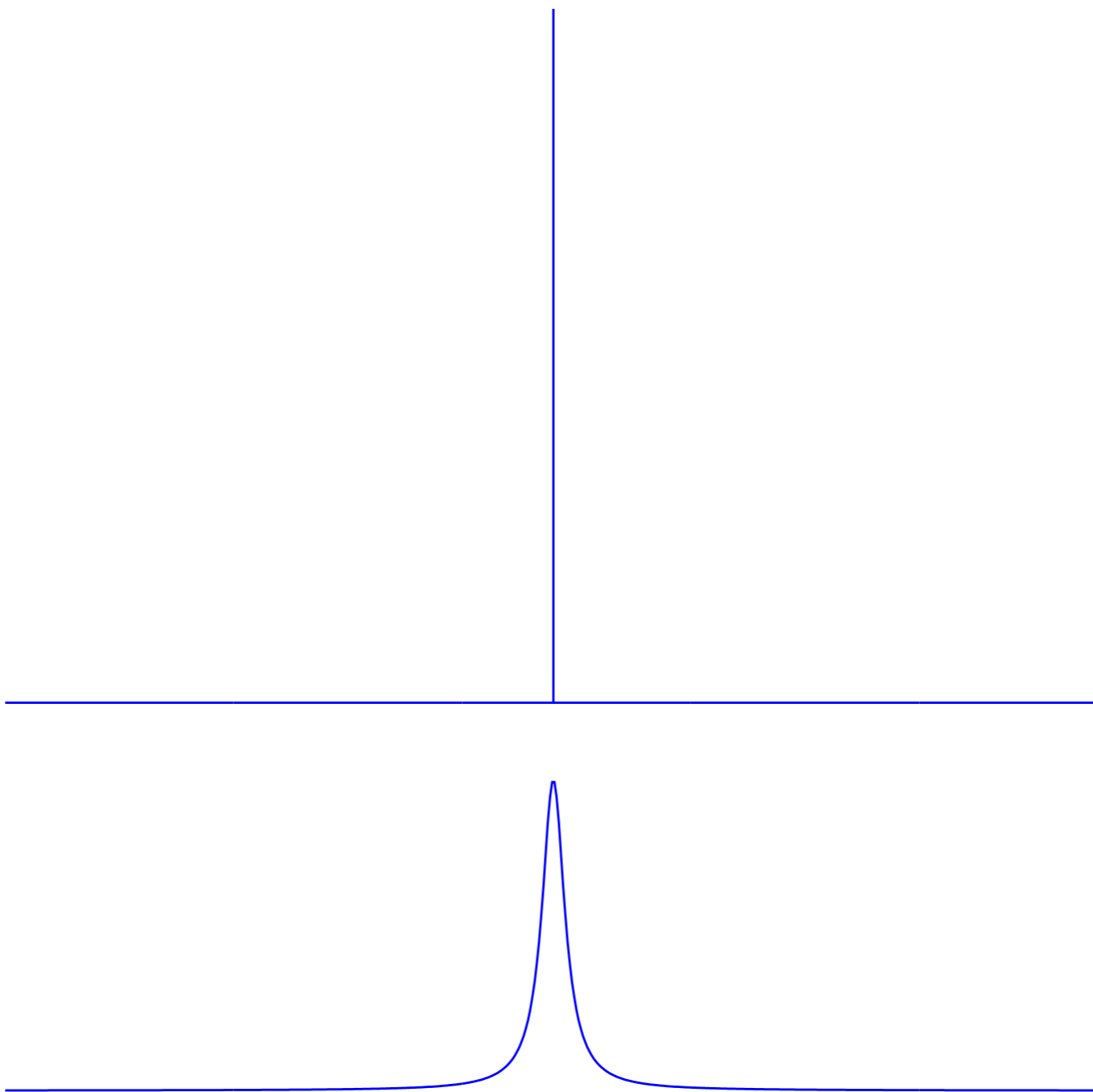


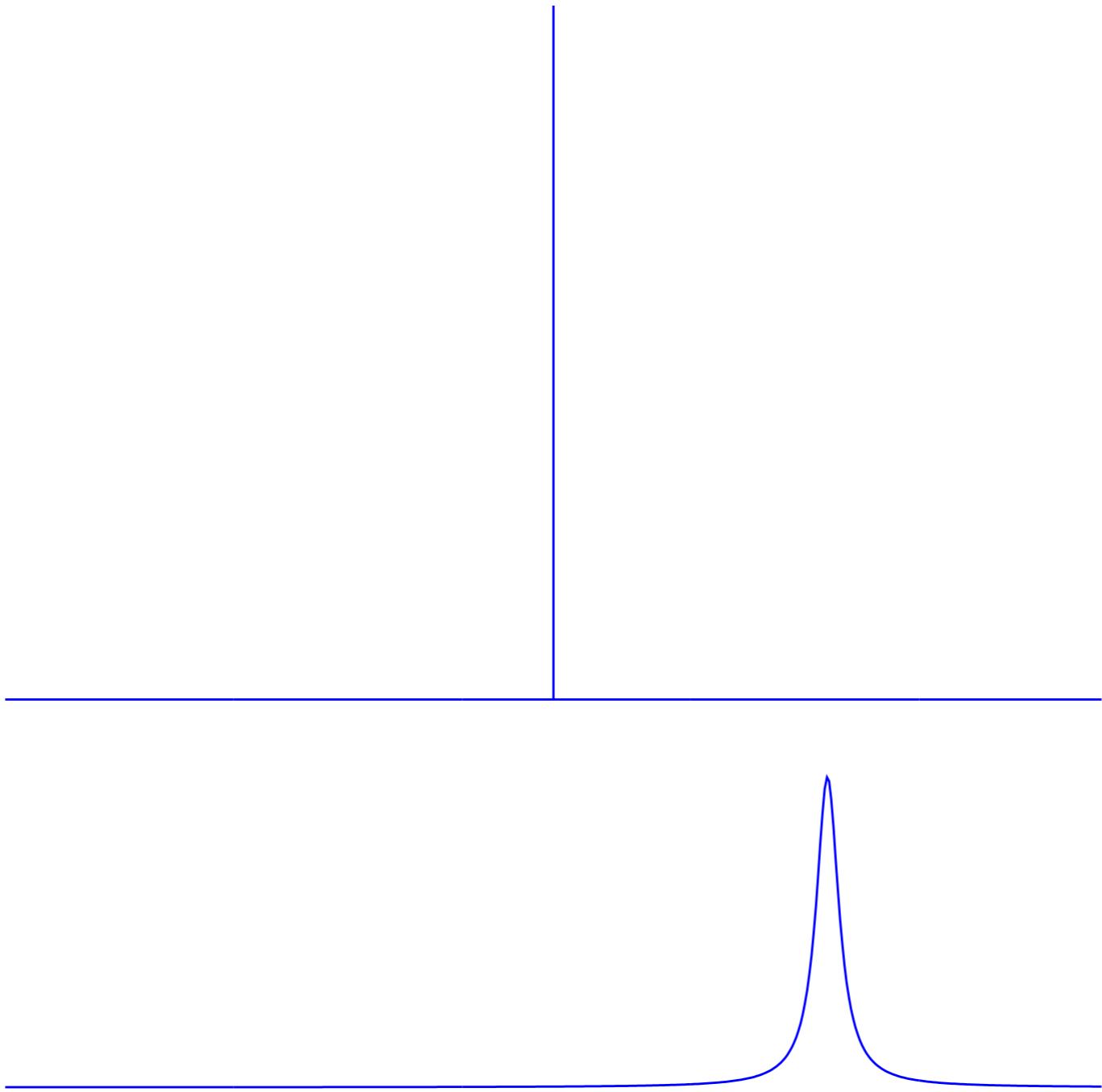
$f$

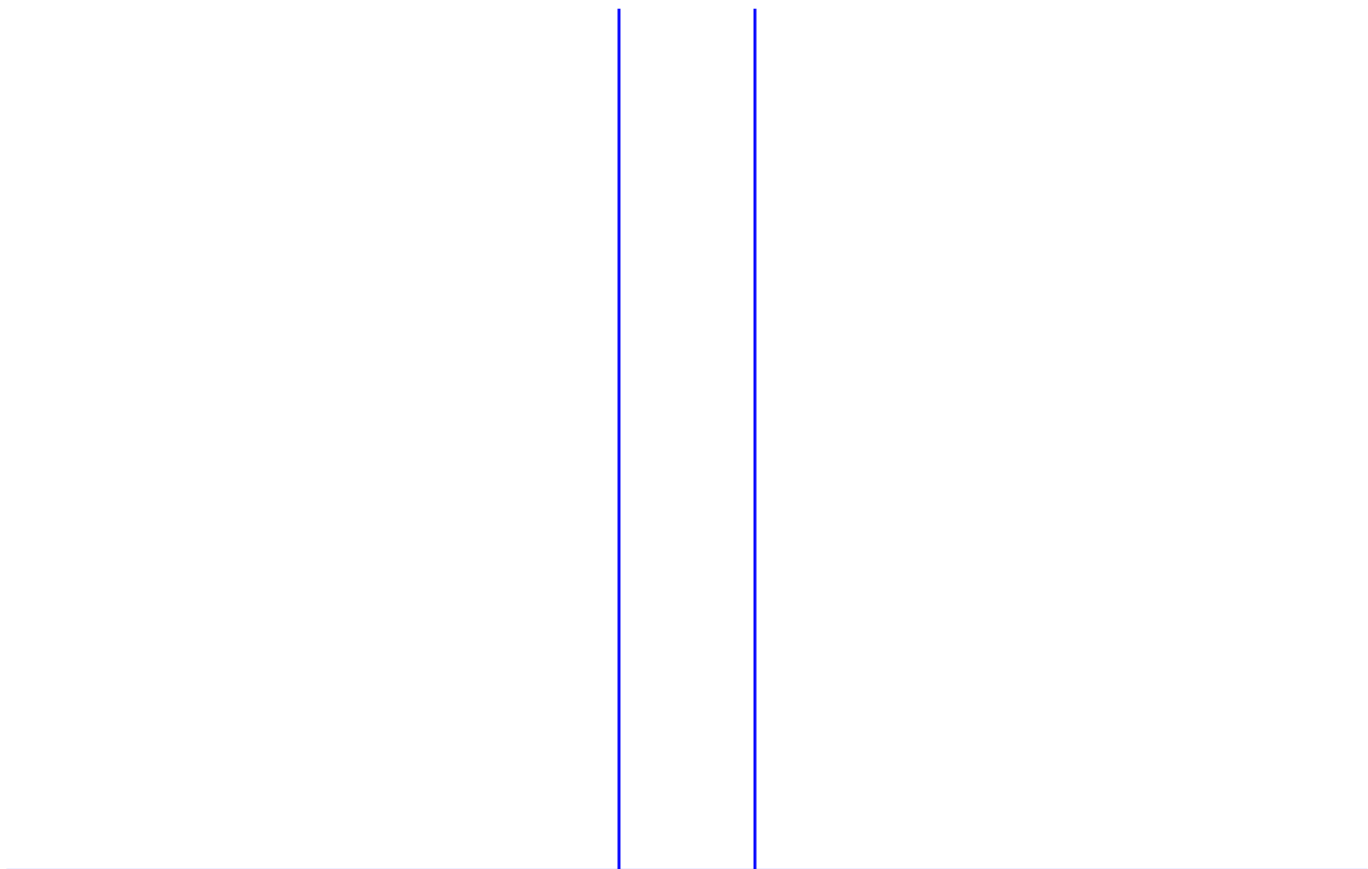
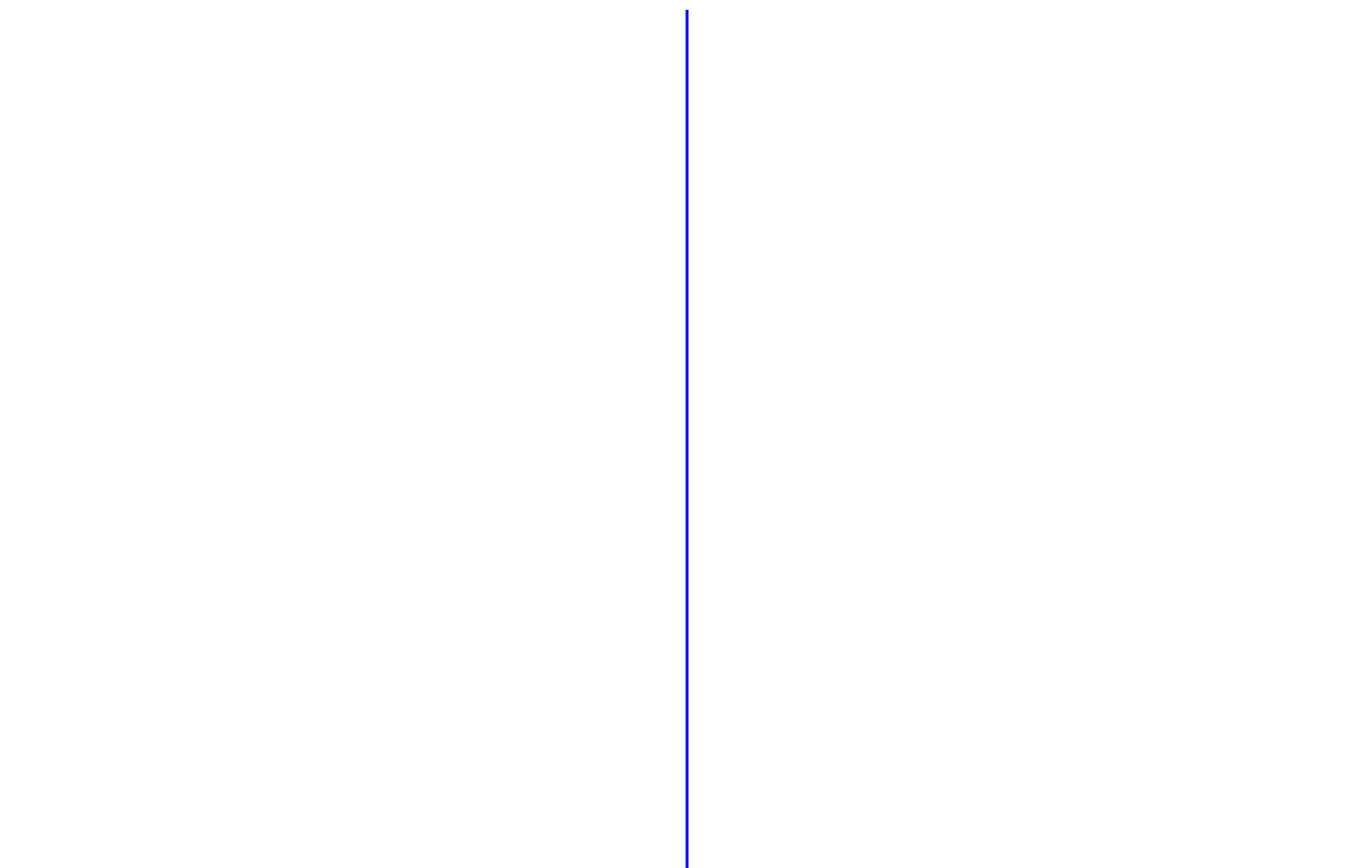
$\nu_1$

$\nu_2$

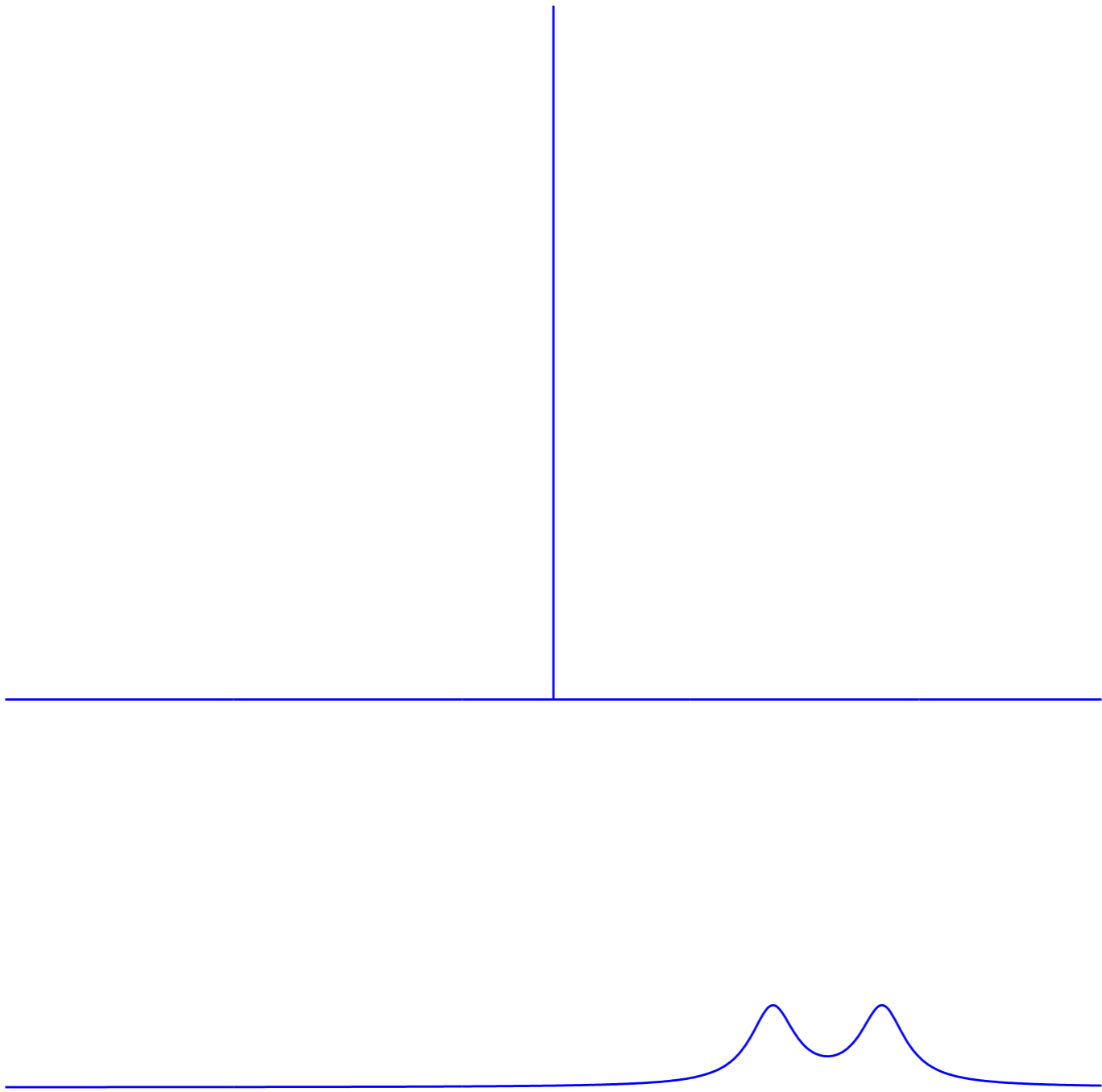
$\nu_3$







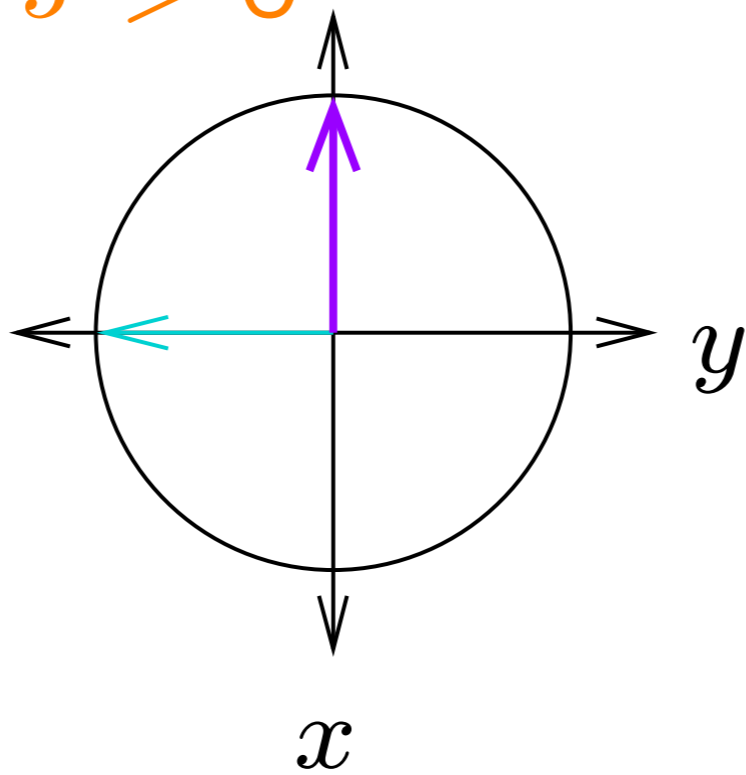




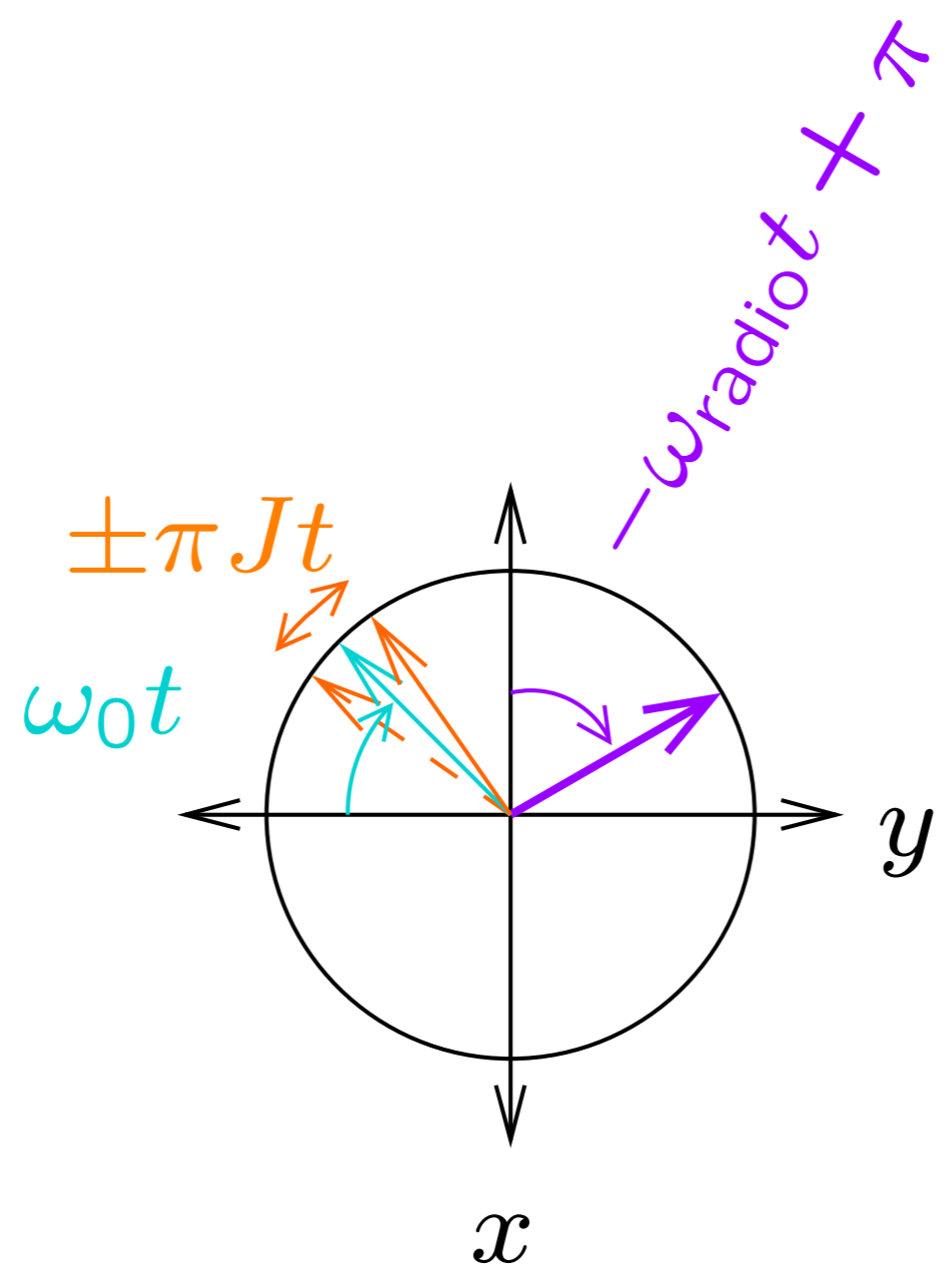
$$\gamma > 0, \Omega > 0$$

$$J > 0$$

$$t = 0$$

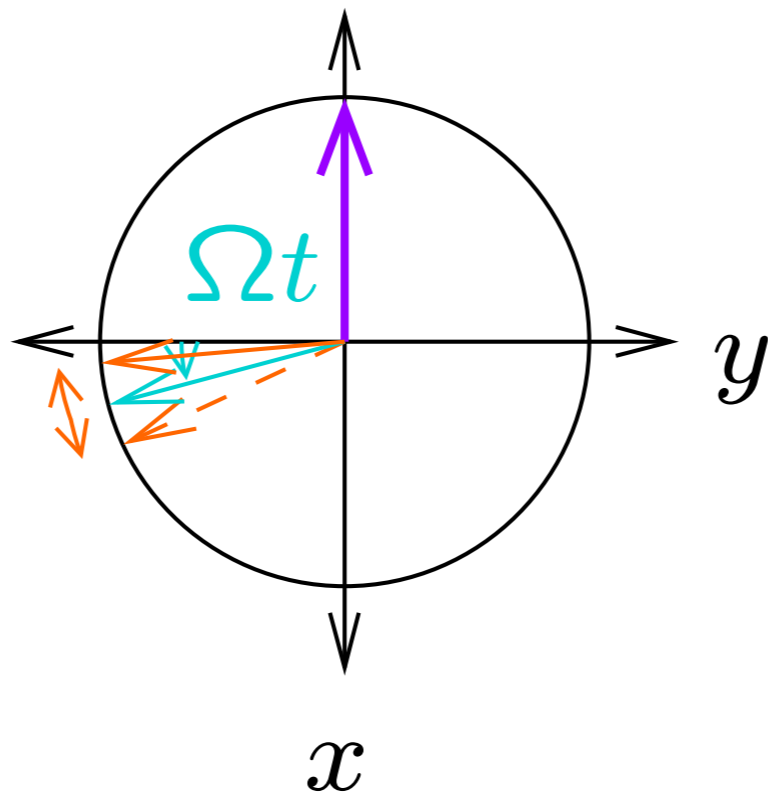


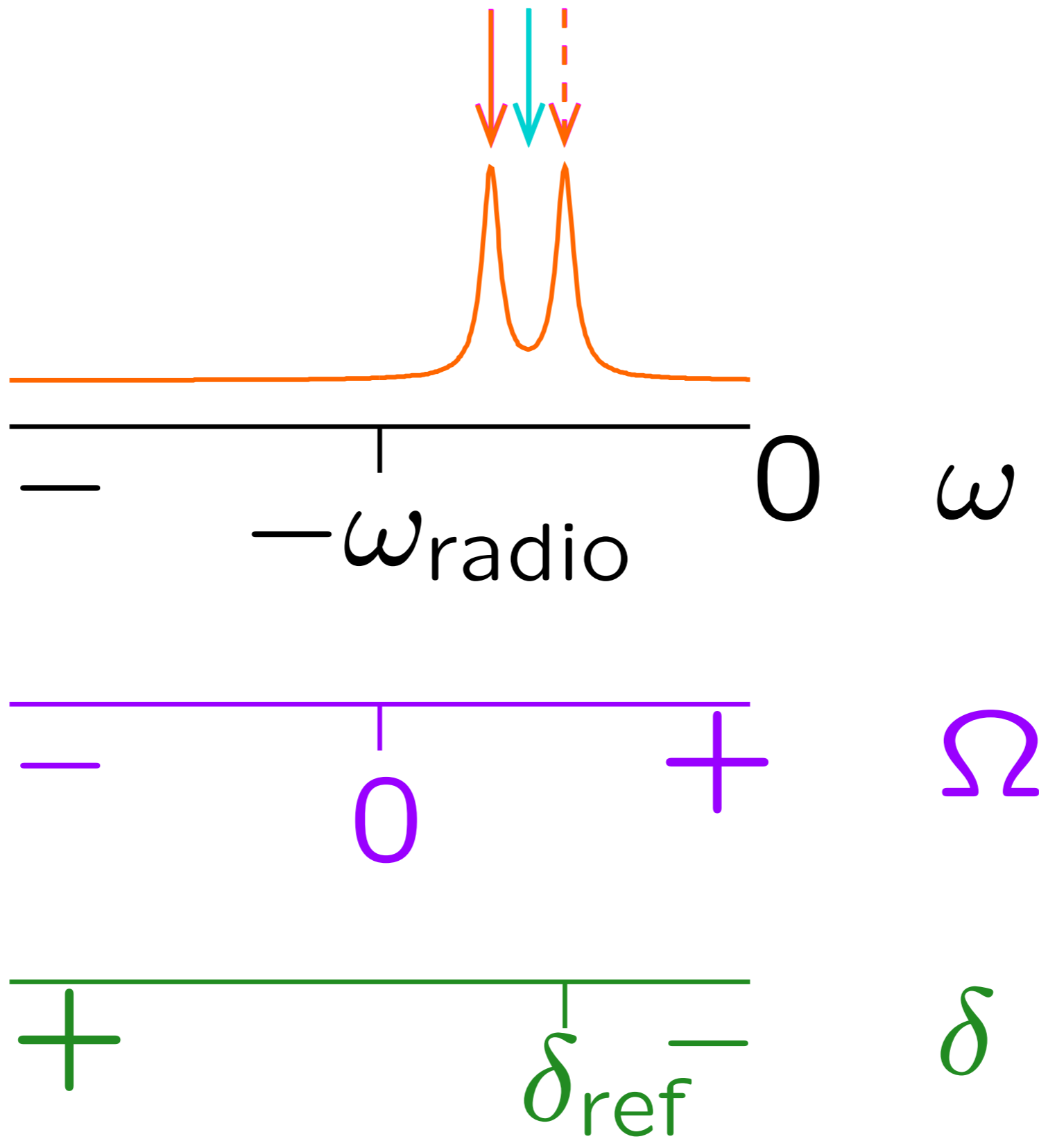
$t > 0$



$t > 0$

$\pm \pi J t$



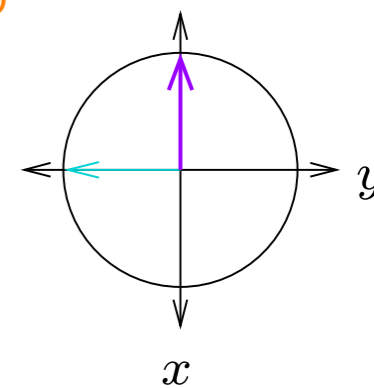
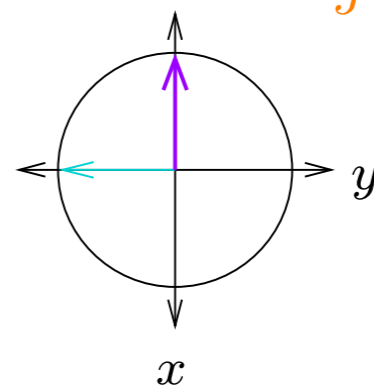
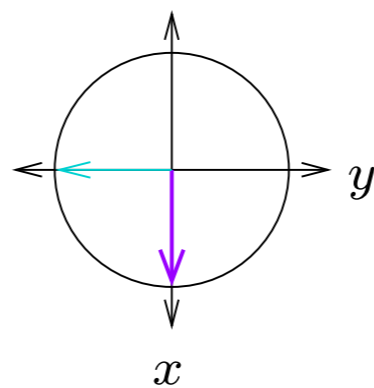
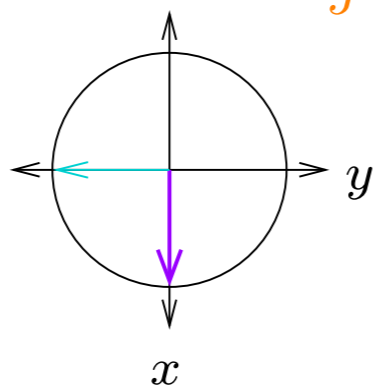


$\gamma < 0, \Omega < 0$        $\gamma < 0, \Omega > 0$        $\gamma > 0, \Omega < 0$        $\gamma > 0, \Omega > 0$

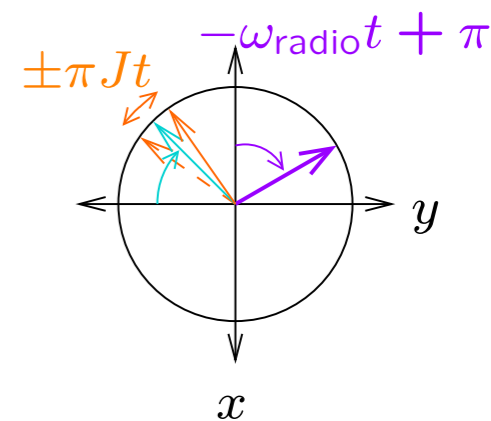
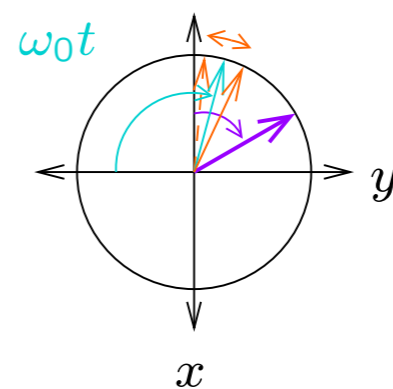
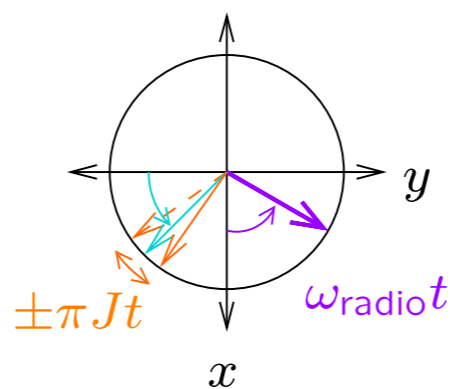
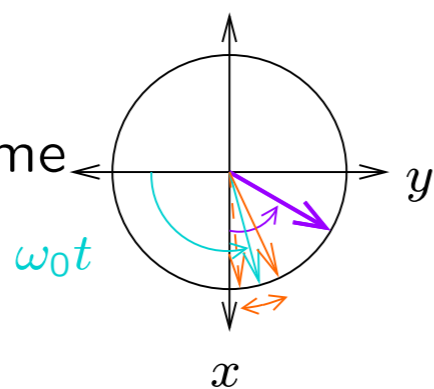
$J < 0$

$J > 0$

$t = 0$



Laboratory frame  
 $t > 0$



Rotating frame  
 $t > 0$

