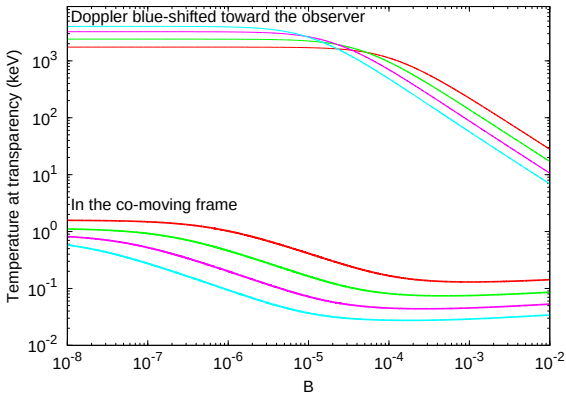
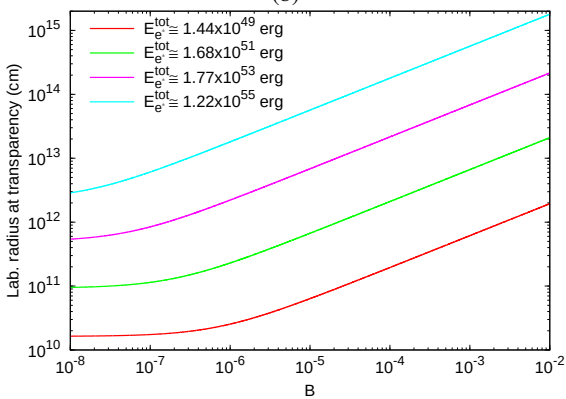
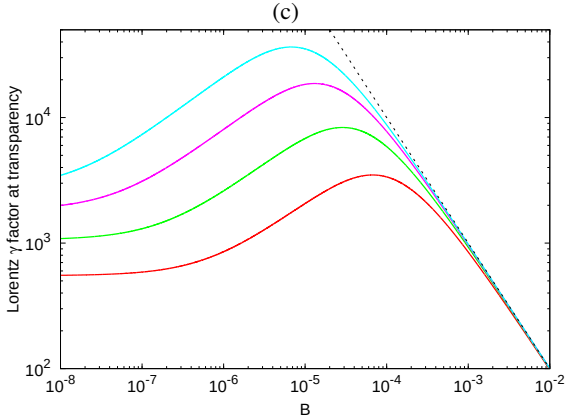
(a)


Doppler blue-shifted toward the observer
In the co-moving frame
Temperature at transparency (keV)
B

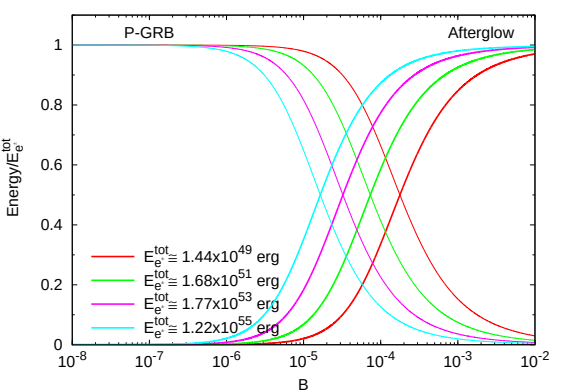
(b)


$E_{e^-}^{tot} \cong 1.44 \times 10^{49}$ erg
$E_{e^-}^{tot} \cong 1.68 \times 10^{51}$ erg
$E_{e^-}^{tot} \cong 1.77 \times 10^{53}$ erg
$E_{e^-}^{tot} \cong 1.22 \times 10^{55}$ erg
Lab. radius at transparency (cm)
B

(c)


Lorentz γ factor at transparency
B

(d)


P-GRB
Afterglow
$E_{e^-}^{tot} \cong 1.44 \times 10^{49}$ erg
$E_{e^-}^{tot} \cong 1.68 \times 10^{51}$ erg
$E_{e^-}^{tot} \cong 1.77 \times 10^{53}$ erg
$E_{e^-}^{tot} \cong 1.22 \times 10^{55}$ erg
Energy/E_e^{tot}
B