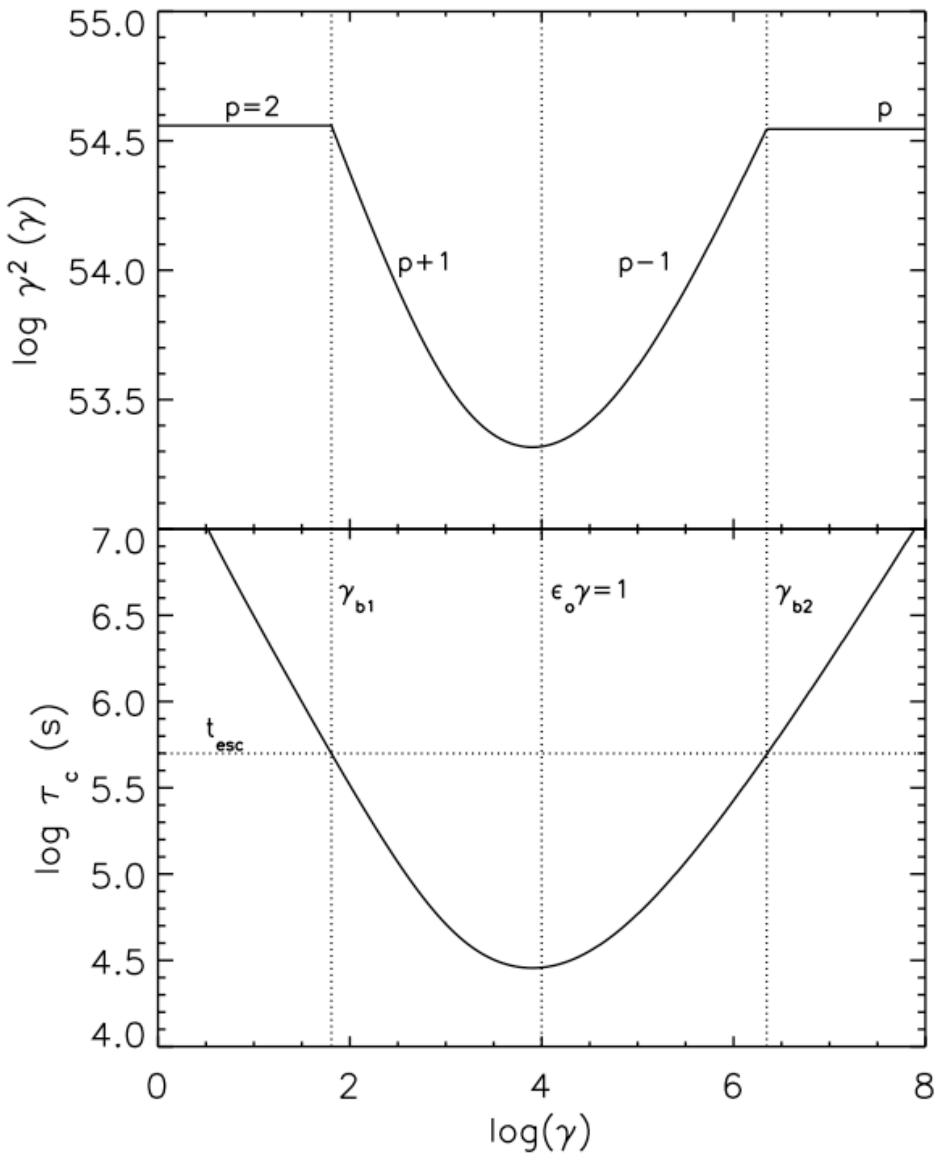
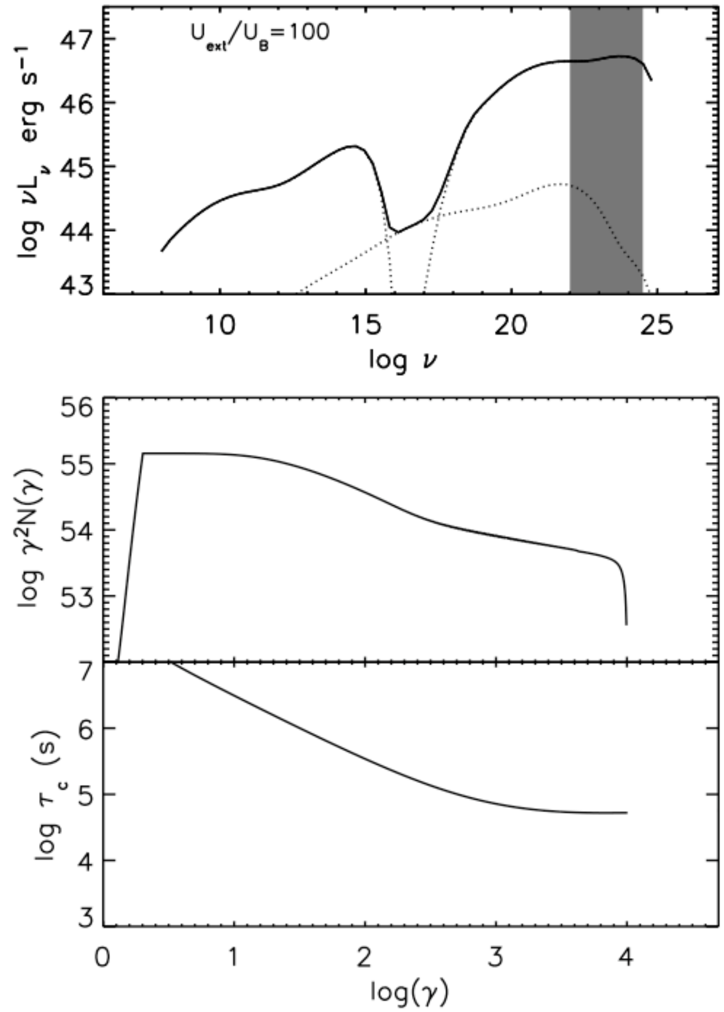
Cooling on photons with dimensionless energy $\epsilon=10^{-4}$ .Upper panel: the steady state electron distribution in a source with escape time t_{esc}. Note the expected cooling break by one at ~ $\gamma=100$. The electron distribution enters the Klein-Nishina regime at $\gamma\sim1/\epsilon\sim10^4$ and because the cooling rate goes from γ^2 to log γ, the electron distribution hardens by 2. As the cooling time $\tau=\gamma/(d\gamma/dt)$ (lower panel) now increases with γ, at $\gamma\sim10^{6.5}$ the cooling time becomes longer than the escape time



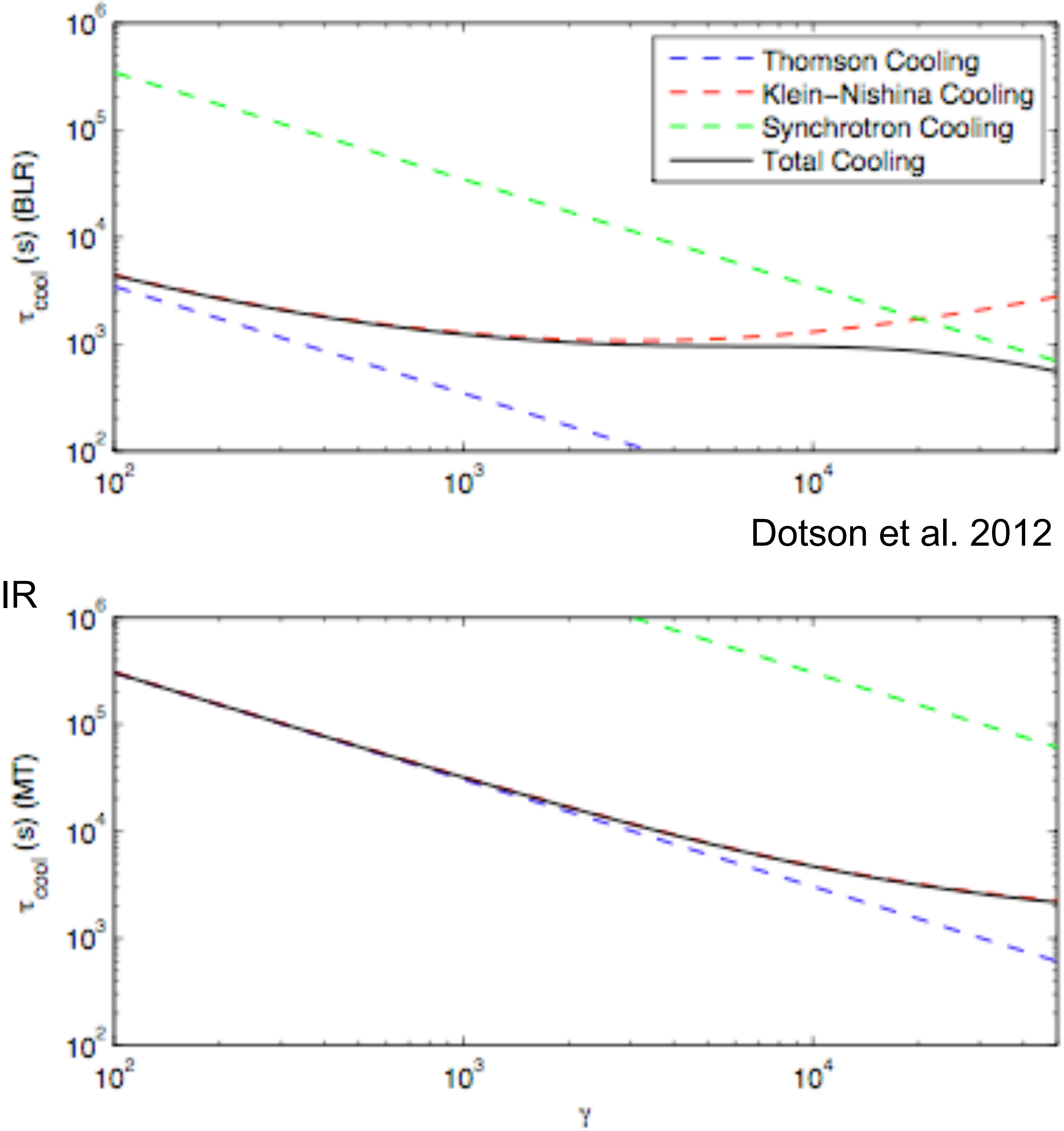
A model high Compton dominance blazar inside the broad line region. Upper panel: the SED. Middle panel the electron distribution. Lower panel: the electron cooling time (G06). Note how the cooling time flattens for $\gamma \sim 10^3$-10^4 and how the electron distribution hardens at $\gamma \sim 10^3$. This is manifested in the synchrotron SED with a bump. In the Compton component, the reduced emissivity in the KN regime is compensated by the hardening of the electron distribution, resulting to a flat spectrum.

These spectral signatures should be observed if the acceleration mechanism provides a simple power law and if emission takes place inside the BLR.

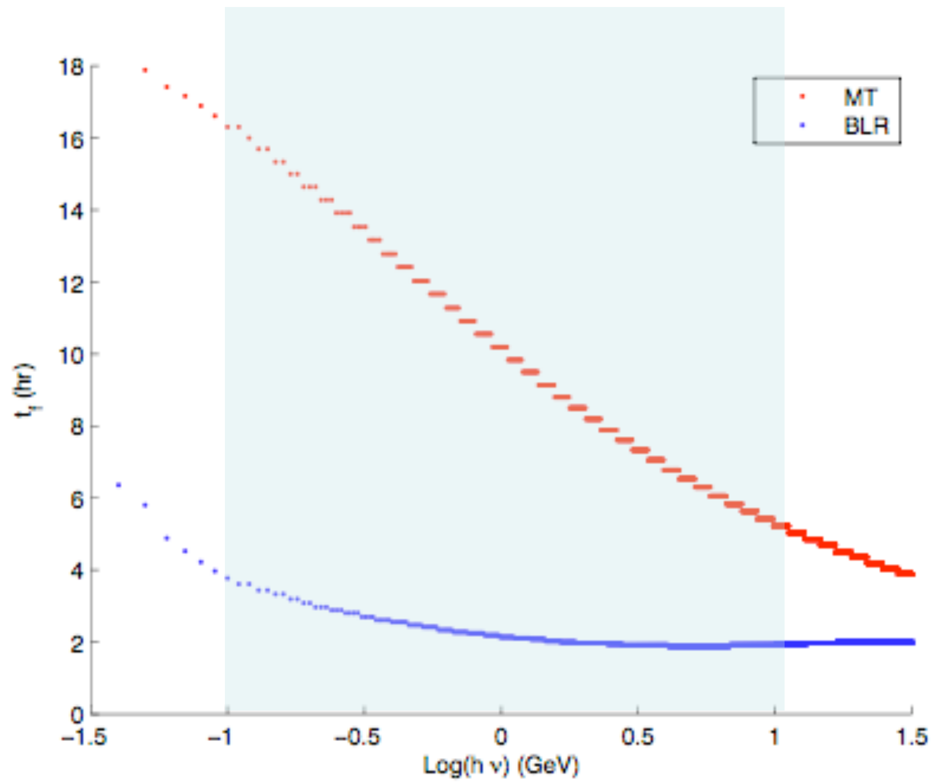


A detailed view of cooling times for cooling in the BLR versus cooling in the molecular torus.

The difference is due to the energy difference of the seed Photons, UV for the BLR and IR for the molecular torus.

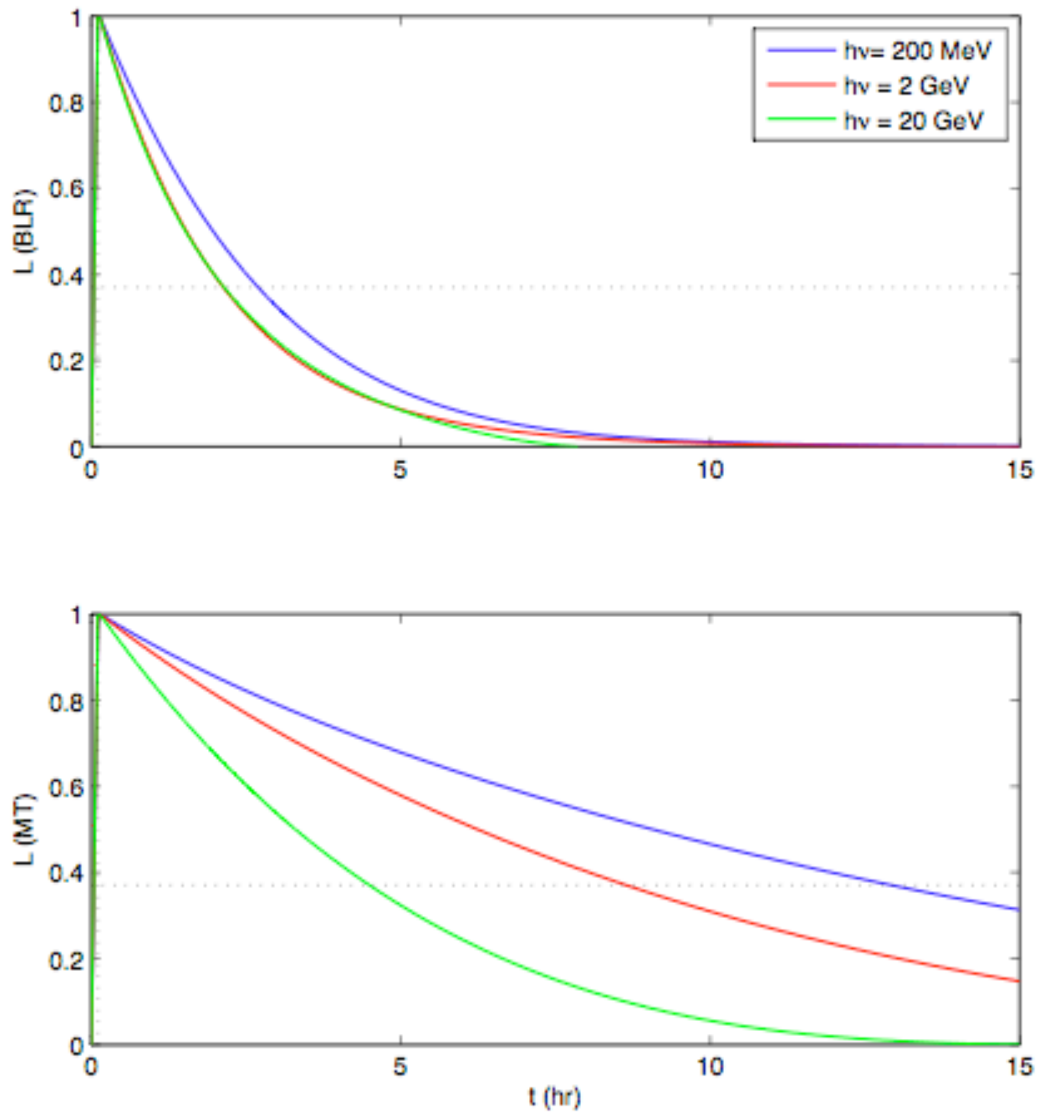


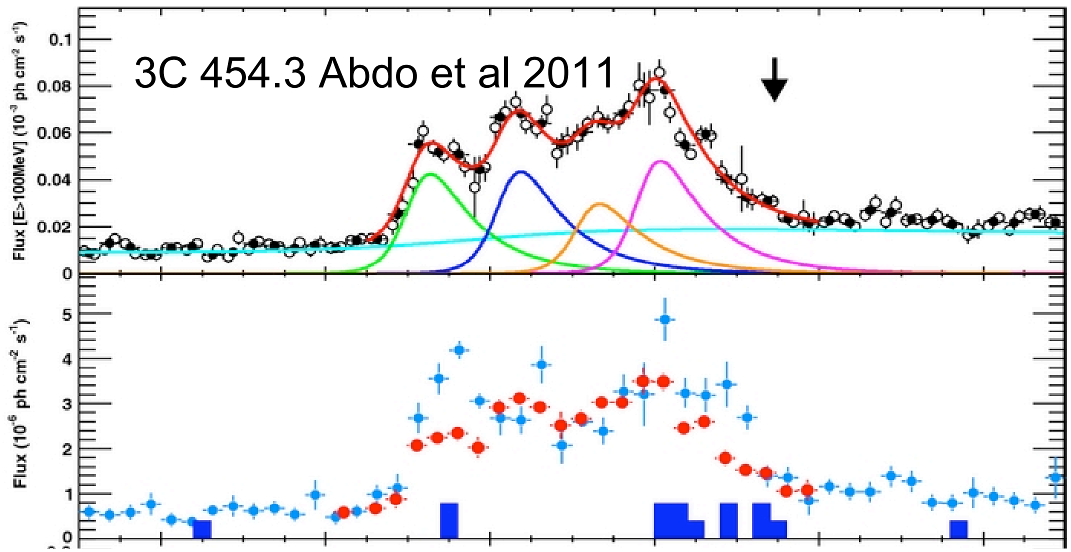
Dotson et al. 2012



Cooling times as a function of observed energy for cooling in a typical BLR and molecular Torus environment. Notice that in the Fermi band (shaded) the BLR cooling is faster and almost achromatic while the molecular torus cooling is slower and energy dependent with shorter cooling times at higher energies.

Model light curves in three characteristic energies for cooling in the BLR (top) and molecular torus (bottom).
Note again that the BLE cooling is faster and almost achromatic, while the molecular torus cooling is slower and energy dependent.





Will we be able to use this diagnostic? We will need bright and fast flares like the one shown here, the brightest observed so far. The decay time of the total flux (upper panel) is about 15 hours. In the lower panel the decay time for 100 meV < E < 1 GeV is plotted in red, and the flux above 1 GeV is plotted in blue, with the blue squares used for those few photons with E>10 GeV (the arrow in the upper panel shows the highest energy photon at 31 GeV). From visual inspection There does not seem to be a strong energy dependence of the decay timescale. A quantitative confirmation will have implications for the γ-ray emission site distance from the black hole.