Decaying particles and the reionization history of the Universe

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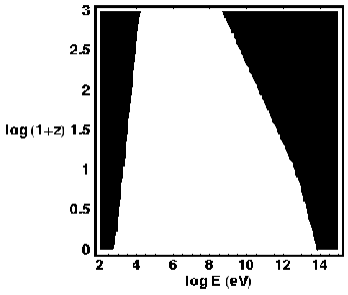
Motivations

- High redshift reionization required by the TP WMAP CMB power spectrum (τ= 0.17)
- Decaying particles may provide partial reionization at high redshift, therefore alleviating the problems of models with low small scale power (WDM, running spectral index…).

Channels for the decay

- Photons
- electrons
- other ($\mu,\tau,\pi\ldots$)
- The reionization path depends on the specific decay process in hand, but still general questions may be asked.

Chen & Kamiokowski 03



The neutrino decay model

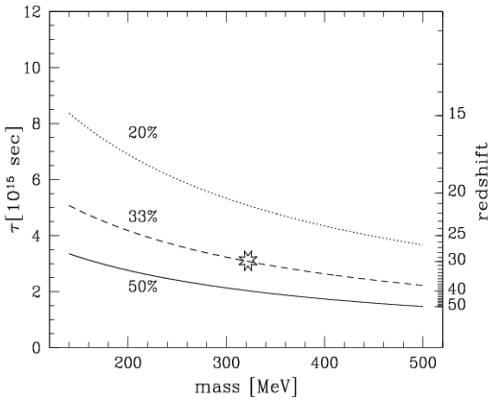
Hansen & Heiman 03

$$\nu \longrightarrow \pi + e$$

Inverse Compton	$e + \gamma \longrightarrow e + \gamma$
Photoionization	$H + \gamma \longrightarrow H^+ + e^-$
Collisional ionization	$H + e^- \longrightarrow H^+ + e^- + e^-$

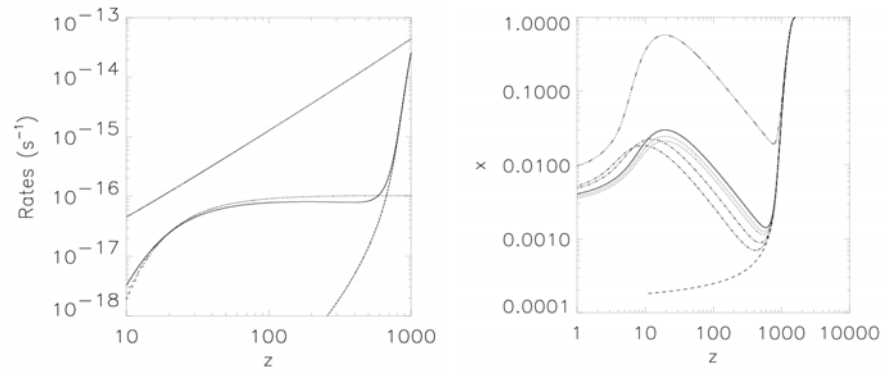
- Electrons trigger reionization via inverse Compton on CMB photons, which then photoionize H atoms. Photo-elecrons then ionize via collisions with atoms.

Neutrino model parameters

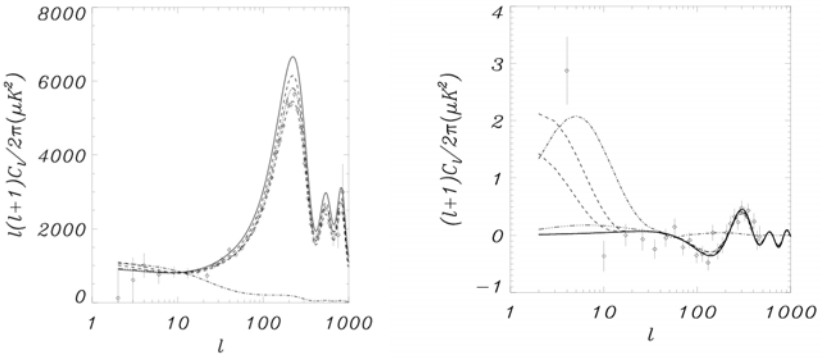


- neutrino mass m_ν = 140-500 MeV ,
- Ee = 0 -180 MeV.
- time decay: $\tau_{15} = \tau / 10^{15}$ s = 2–10
- abundance: $\Omega\nu = 10^{-9}$

Reionization history

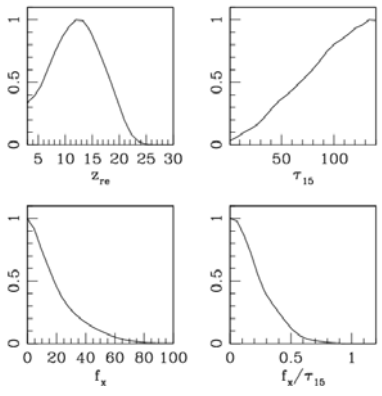


Power spectra



- High reionization from decay particles produce a too high optical depth and a too weird TP spectrum
- High-z reionization from stars still needed

Constraints from CMB



- Long lifetimes favoured
- limit on the decay particles abundance
- limit on the decay rate at high redshift
- other reionization sources at high redshift still needed

Conclusions

- Decaying particles are now constrained by the γ and X--ray background, and the CMB.
- High level of reionization from decaying particles is excluded by CMB data
- Alternative (or standard?) reionization sources at high redshift is still needed.
- The implied “y” distortion parameter is too low to be observed.