Reionization and Dark Matter

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Focus week on on Indirect Dark Matter Search
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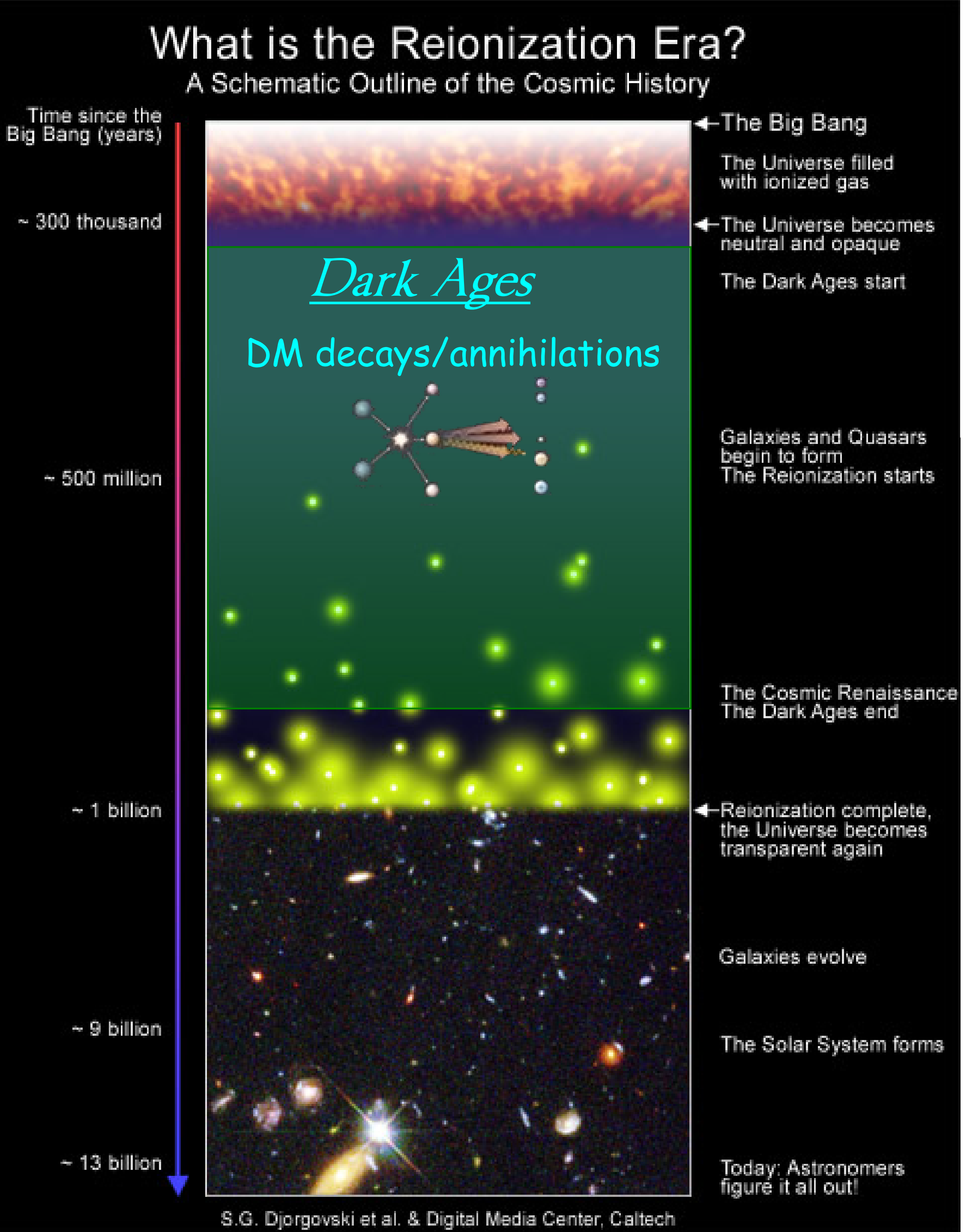
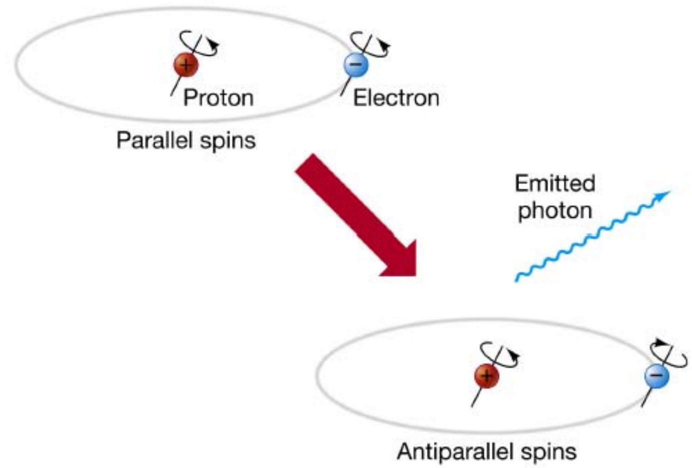


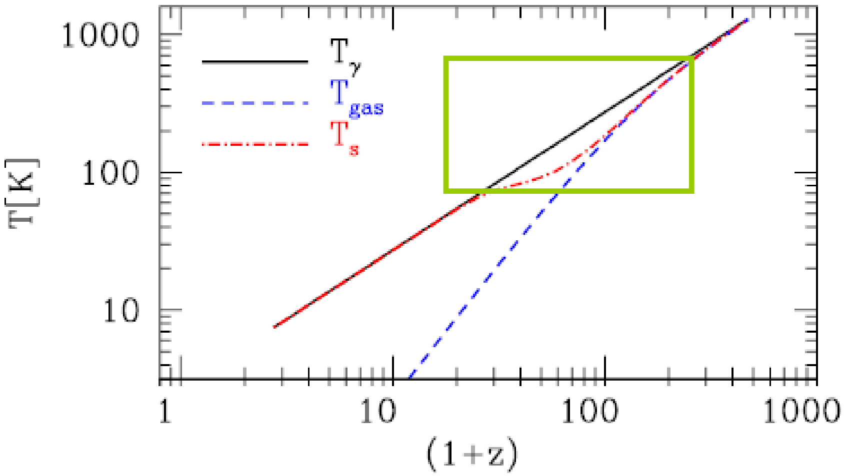


–Visualization of the two energy states of the ground level of neutral hydrogen, in which the electron has its spin either parallel or anti-parallel to that of the proton.

–The parallel state has an energy higher by ~ 5.9×10^{-6}eV, so a transition to the anti-parallel state results in the emission of a HI 21 cm photon

–Future radio interferometers such as LOFAR, MWA, SKA will probe directly the physics of the Dark Ages via HI 21 cm observations

DM decays/annihilations can leave an observable trace on the Dark Ages high-z IGM



$$T_S = \frac{T_{CMB} + y_\alpha T_k + y_c T_k}{1 + y_\alpha + y_c}$$

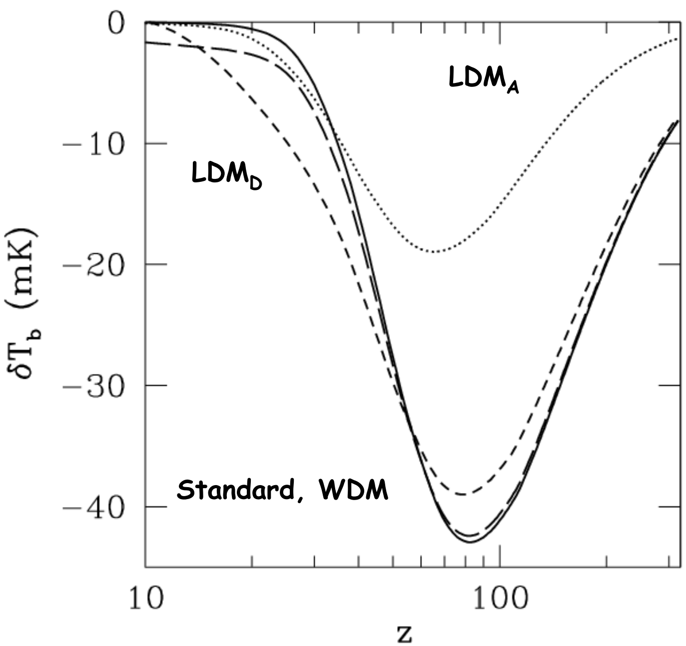
$$\delta T_b \simeq \frac{T_S - T_{CMB}}{1+z}\tau$$

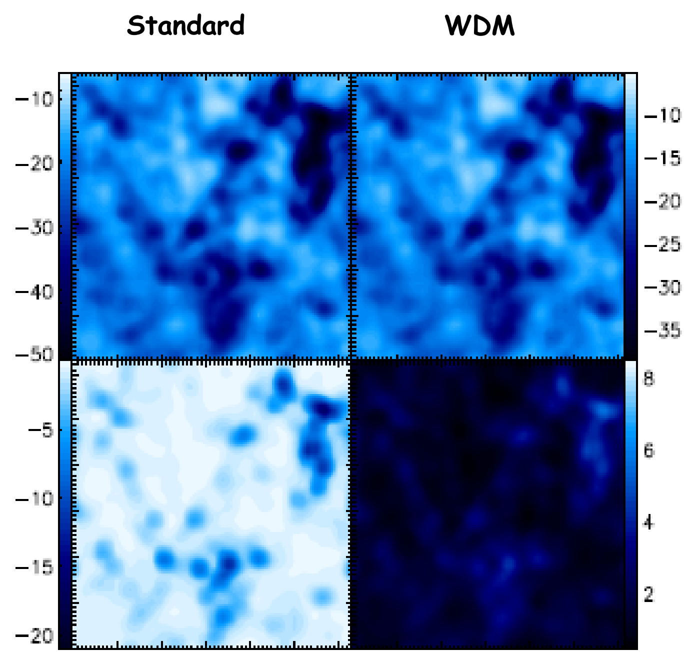
$$\tau \simeq \frac{3c^3 h_p A_{10}}{32\pi k_B \nu_0{}^2 T_S H(z)} \mathcal{N}_{\mathrm{HI}}$$

DM decays/annihilations can affect the thermal and ionization evolution of the IGM

→ Solve eqs. describing redshift evolution of x_e, T_k, J_α

→ Compute new values of δT_b





Differential brightness temperature, δT_b [mK]

Particle energy cascade in the intergalactic medium (astro-ph0911.1125)

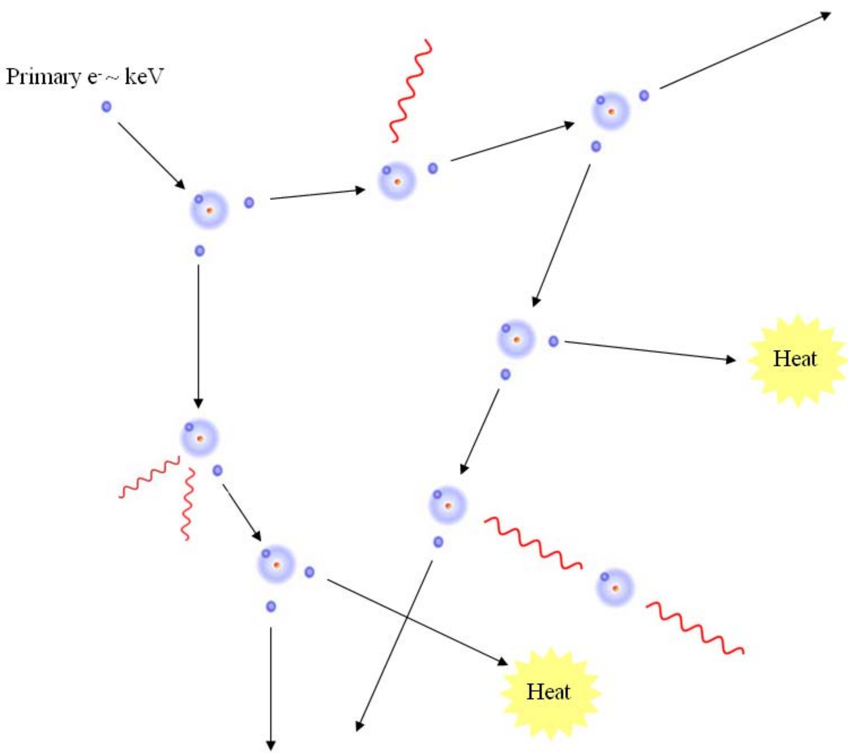
Valdés & Ferrara, 2008 | Valdés, Evoli C. & Ferrara A., 2009

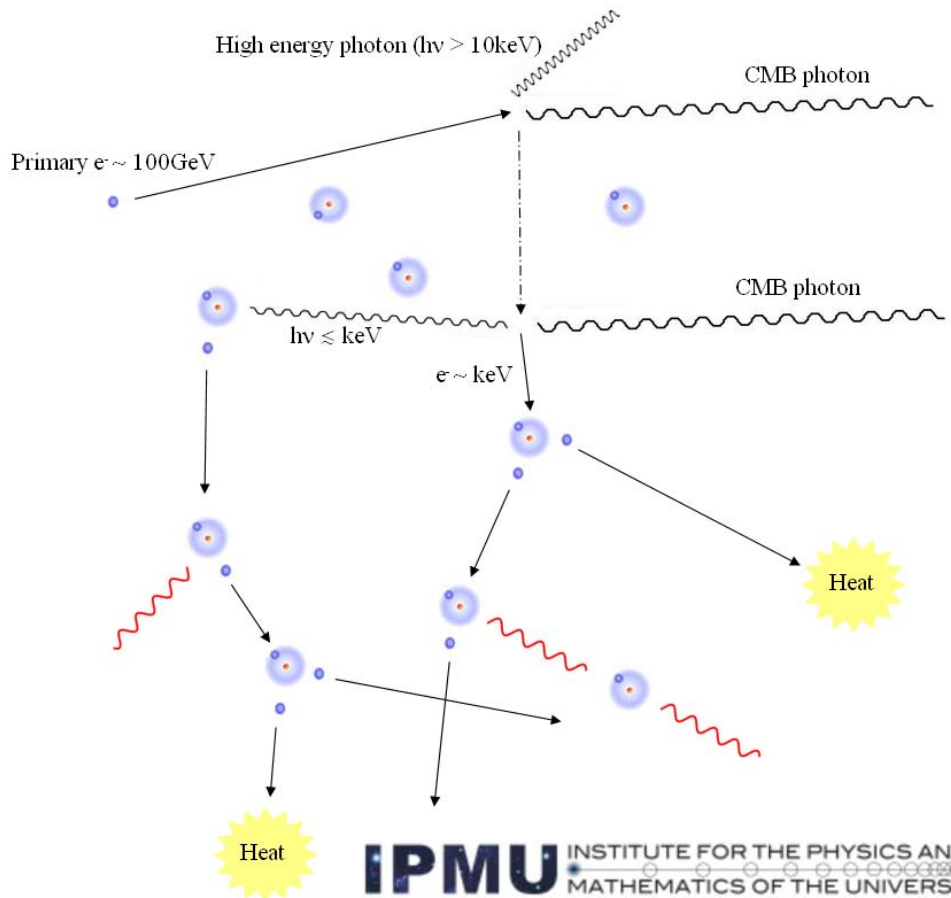
MEDEA - Monte Carlo Energy DEposition Analysis: repeated random sampling of the relevant physical quantities and processes, i.e. *cross-sections and interaction probabilities* to follow the evolution of a relativistic electron up to 1 TeV (previous works did up to 10 keV)

LE
- (I) H, He, HeI ionization
- (II) H, He *excitation*
- (III) *Collisions with thermal electrons*
- (IV) *Recombinations*

HE
- (V) *Bremsstrahlung*
- (VI) *Inverse Compton*

→ Ensemble of secondary photons and electrons which can interact further with the gas. Start with one particle → end up with many!





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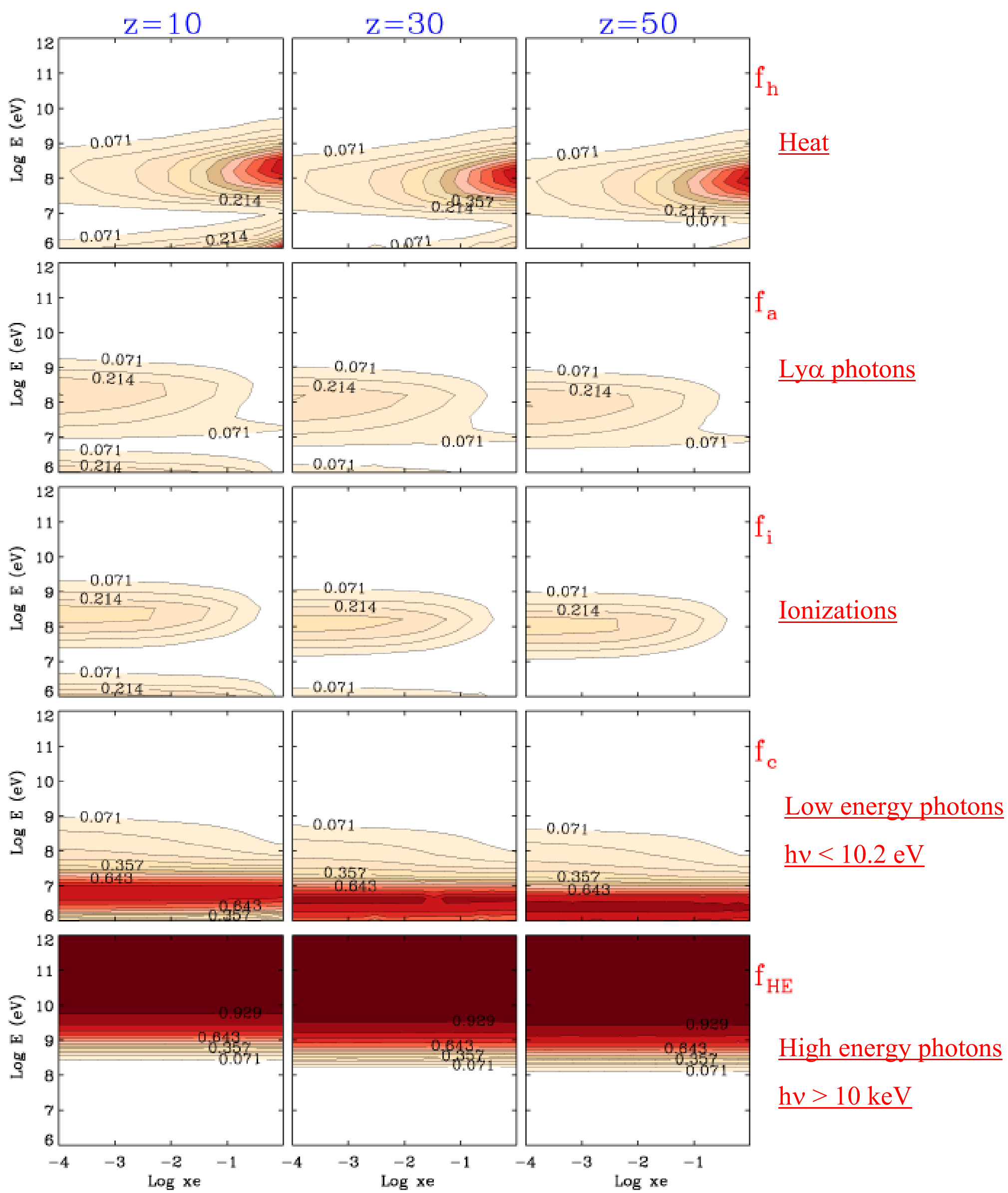
MEDEA results



- f_h heating grows with x_e
- f_i , f_a , f_h present a "double peak", with very low values for 10 MeV… f_c absorbs ~ 80% of the energy!
- f_{HE}, f_c independent from x_e vary slow with z
- f_{HE} dominant over 1 GeV