Astrophysical signatures of warm dark matter

Antonella Garzilli

with: Alexey Boyarsky, Oleg Ruchayskiy, Andrii Magalich, Christoph Weniger





UNIVERSITY OF AMSTERDAM





Universiteit Leiden

COLD DARK MATTER: the particles were produced/decoupled non-relativistically

WARM DARK MATTER: particles were created/decoupled relativistic, became non-relativistic in the radiation-dominated epoch



Moore, Maccio' et al



For the purpose of this talk: Warm dark matter is any dark matter model that predicts less power below a certain scale than CDM does

Some WDM candidates:

- Sterile Neutrinos
- ultralight axions

ETHOS model



Antonella Garzilli - University of Amsterdam and Leiden University

Warm Dark Matter and Sterile Neutrinos

(Laine & Shaposhnikov 2008)



Observables of matter power spectrum at small scales

halo number counts (related to missing satellites and

too big to fail)



- measure matter power spectrum directly (Lya)
- distribution of matter inside halos (cores vs cusps) debatable, see (Governato and Maccio' 2016)

Intergalactic medium

EAGLE: Evolution and Assembly of GaLaxies and their Environments

The evolution of intergalactic gas. Colour encodes temperature

z = 19.8 t = 0.2 Gyr L = 25.0 cMpc

Simulation by the EAGLE collaboration Visualisation by Jim Geach & Rob Crain

(Schaye et al 2015)

Previous constraints on WDM from the Lyman-α forest



WDM or IGM temperature?





- in CDM power spectrum is expected to grow with k
- in BOSS like data there is no cutoff, consistent with CDM
- in high resultion data we go to smaller scales, power spectrum starts to decays— This is what we expected from WDM

Sterile neutrinos





- The intergalactic medium at high redshift is most promising probe of WDM
- We are studying the Lyman-alpha forest for producing new robust limits
- it is impossible to put bounds on WDM from the HIRES and MIKE data before we confirm experimentally what is the origin of the cut off. May be we have discovered WDM already! Antonella Garzilli - University of Amsterdam and Leiden University