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Cosmological constraint on mass of neutrino

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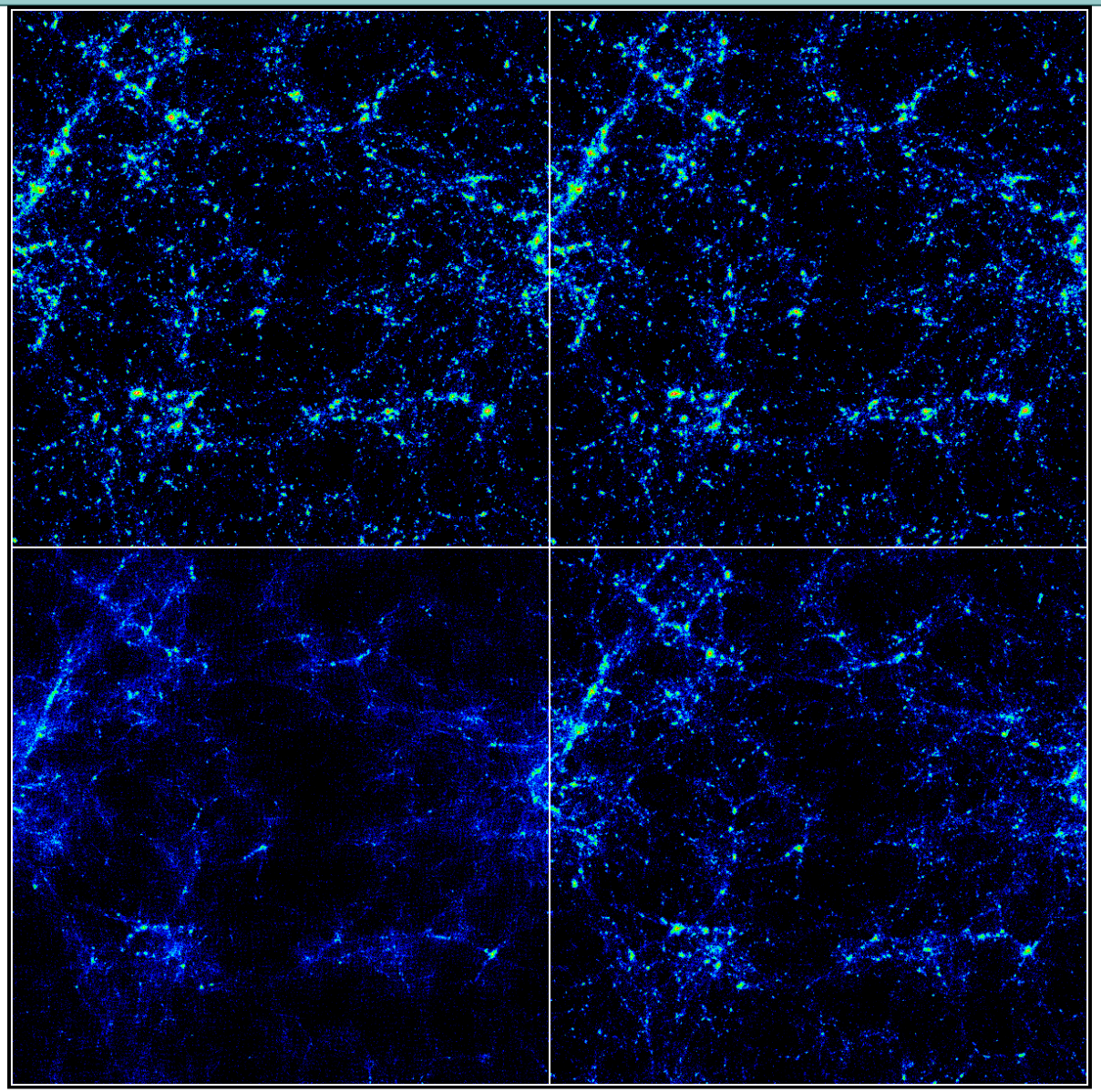
Topics:

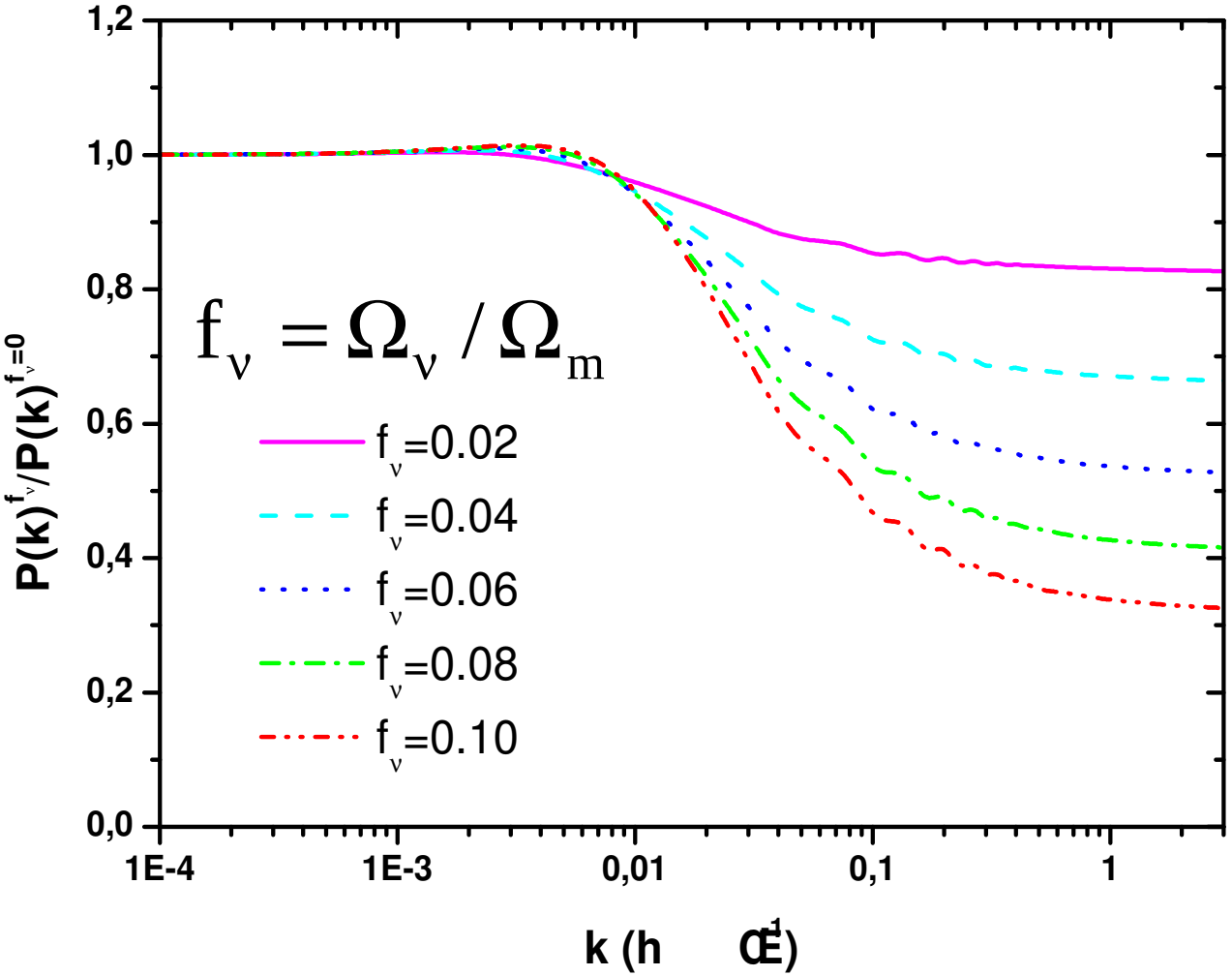
- Impact of massive neutrino on LSS and P(k)
- Used observational data (*CMBA* and *GC*)
- Space of cosmological parameters
- Statistics
- Our result
- Comparison with other results
- Conclusion

Impact of massive neutrino: LSS



Ma ’96

Impact of massive neutrino: P(k)

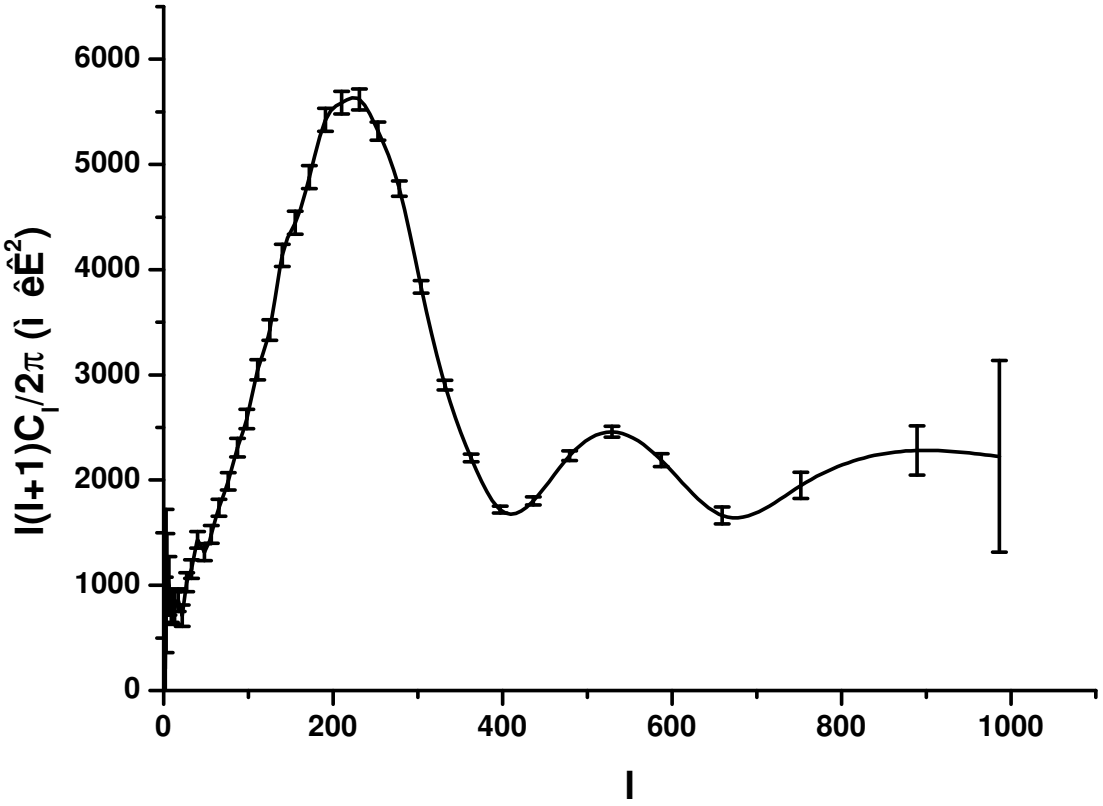


$$\Omega_\nu \cong \frac{\Sigma m_\nu}{94 h^2\ \mathrm{eV}}$$

for $m_\nu \approx 1$ eV
and $h \approx 0.7$
$\Omega_\nu \approx 0.02$

Observational data (CMB)

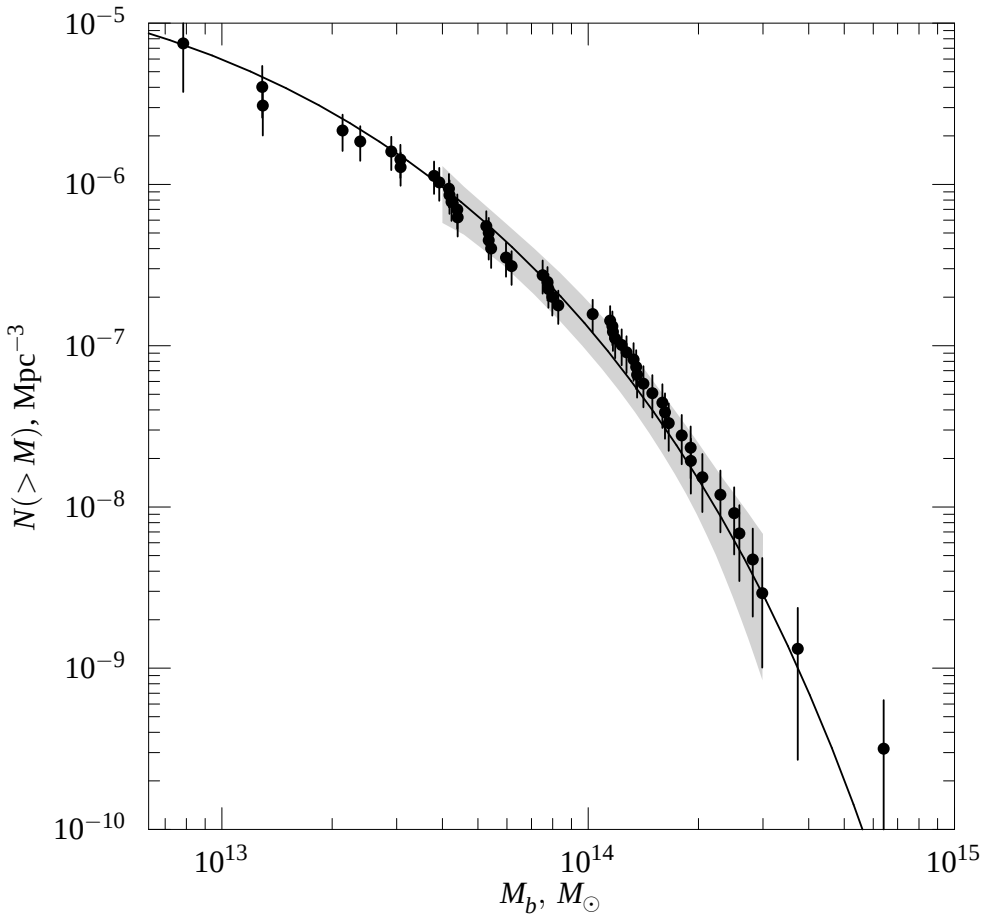
- CMB anisotropy 3 year WMAP temperature spectrum for $2 < \ell < 1000$



Observational data (GC)

- Integral mass function of galaxy clusters - 42 X-ray clusters from ROSAT catalog (Voevodkin, Vikhlinin, 2004).

  Masses of clusters are calculated assuming the universal fraction of baryons in the Universe



Space of cosmological parameters

- Spatially-flat LCDM model ($\Omega_{tot} = 1$)
- Matter density: Ω_m = **0.2 – 0.36**, step 0.01
- Dimensionless Hubble constant (H_0=100 **h** km/s/Mpc):

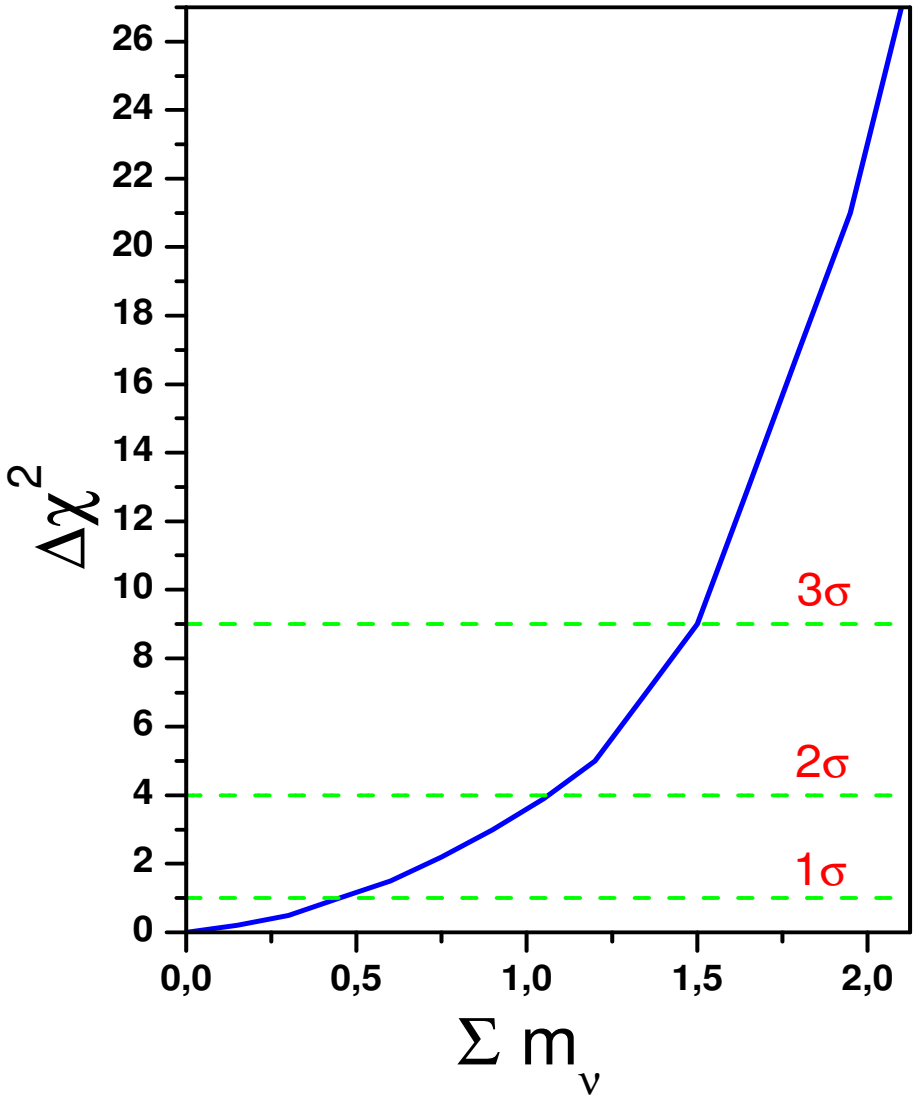
  h = 0.65 – 0.85, step 0.01
- Scale-free spectrum of density perturbations with slope: **n = 0.96 – 1.02**, step 0.01
- N_ν=3, $\mathbf{m_e}$=$\mathbf{m_\nu}$=$\mathbf{m_\tau}$ = **0, 0.05 – 0.7**, step 0.05;
- Cosmological density of baryons: Ω_b $\mathbf{h^2}$ = **0.023**

Total number: 37485 models

Statistics

- Calculations are based on CAMB code
- $\chi^2 = \chi^2_{CMB} + \chi^2_{GC}$ with 999 + 42 - 4 = 1037 degrees of freedom
- $\chi^2_{min} = 1092$
- Result is presented for the quantity $\Delta\chi^2_\nu = \chi_\nu{}^2 - \chi_{min}{}^2$ which is χ^2 distributed with one degree of freedom

Our result


26
24
22
20
18
16
14
12
10
8
6
4
2
0
$\Delta\chi^2$
3σ
2σ
1σ
0,0
0,5
1,0
1,5
2,0
$\Sigma\, m_\nu$

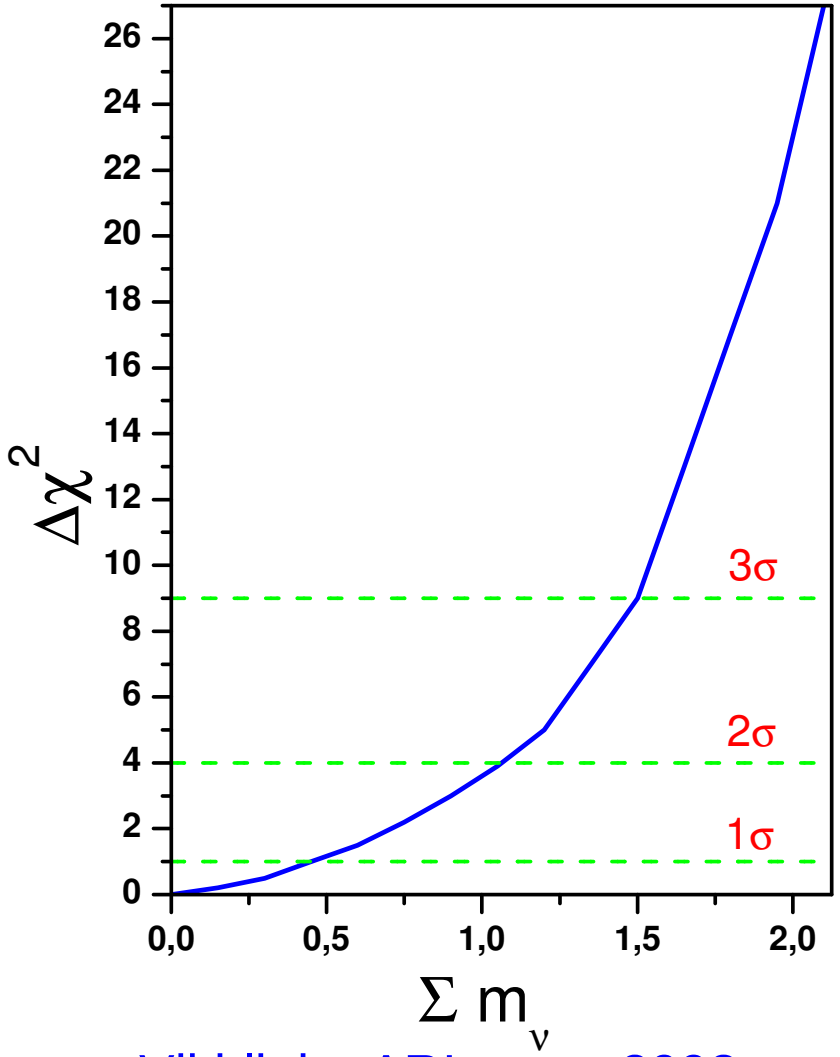
Comparison with other results

Observational data set	*Authors*	Σm_ν*(95%)*
N(z)	Kahniashvili et al., 05	**< 2.4 eV**
WMAP3	Kristiansen et al., 06	**< 1.57 eV**
WMAP5	Dunkley et al, 08	**< 1.3 eV**
WMAP3 + N	**Malinovskii et al., 08**	**< 1.05 eV**
WMAP3+SDSS	Tegmark et al., 06	**< 0.9 eV**
WMAP5+SNIa +BAO	Komatsu et al., 08	**< 0.61 eV**
WMAP3+SNIa +SDSS+Lya	Goobar et al. 06	**< 0.35 eV**
WMAP3+SNIa+SDSS+Lya+BAO	Seljak et al., 06	**< 0.17 eV**

Conclusion

New independent constraint for the sum of masses of three species of neutrino:

$\Sigma\, m_\nu < 1.05$ eV (CL 95%).



Malinovskii, Voevodkin, Lukash, Mikheeva, Vikhlinin, ARLetters 2008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