Spectral equivalence for dDE models

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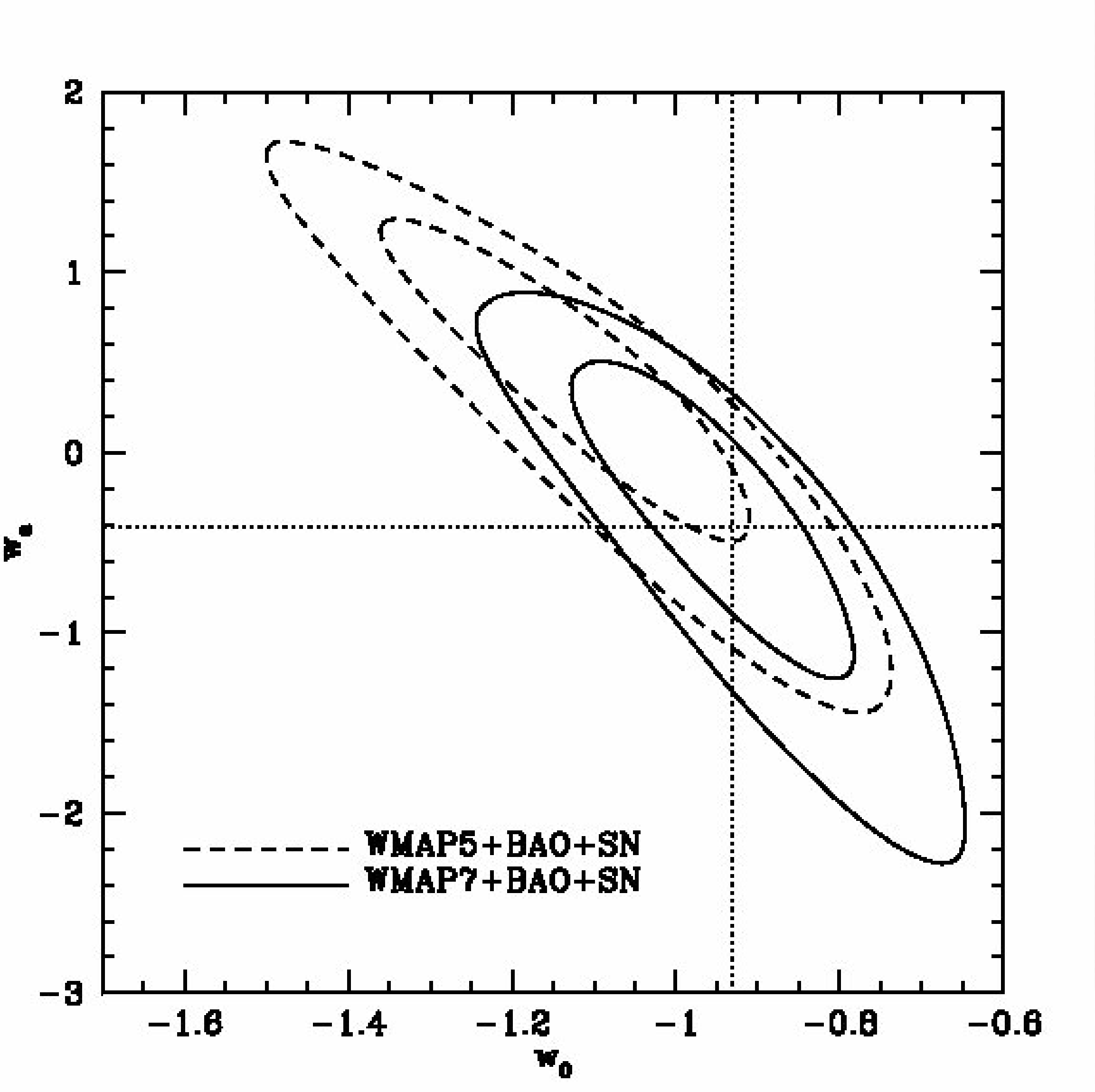
Time dependent equation of state – Weak lensing



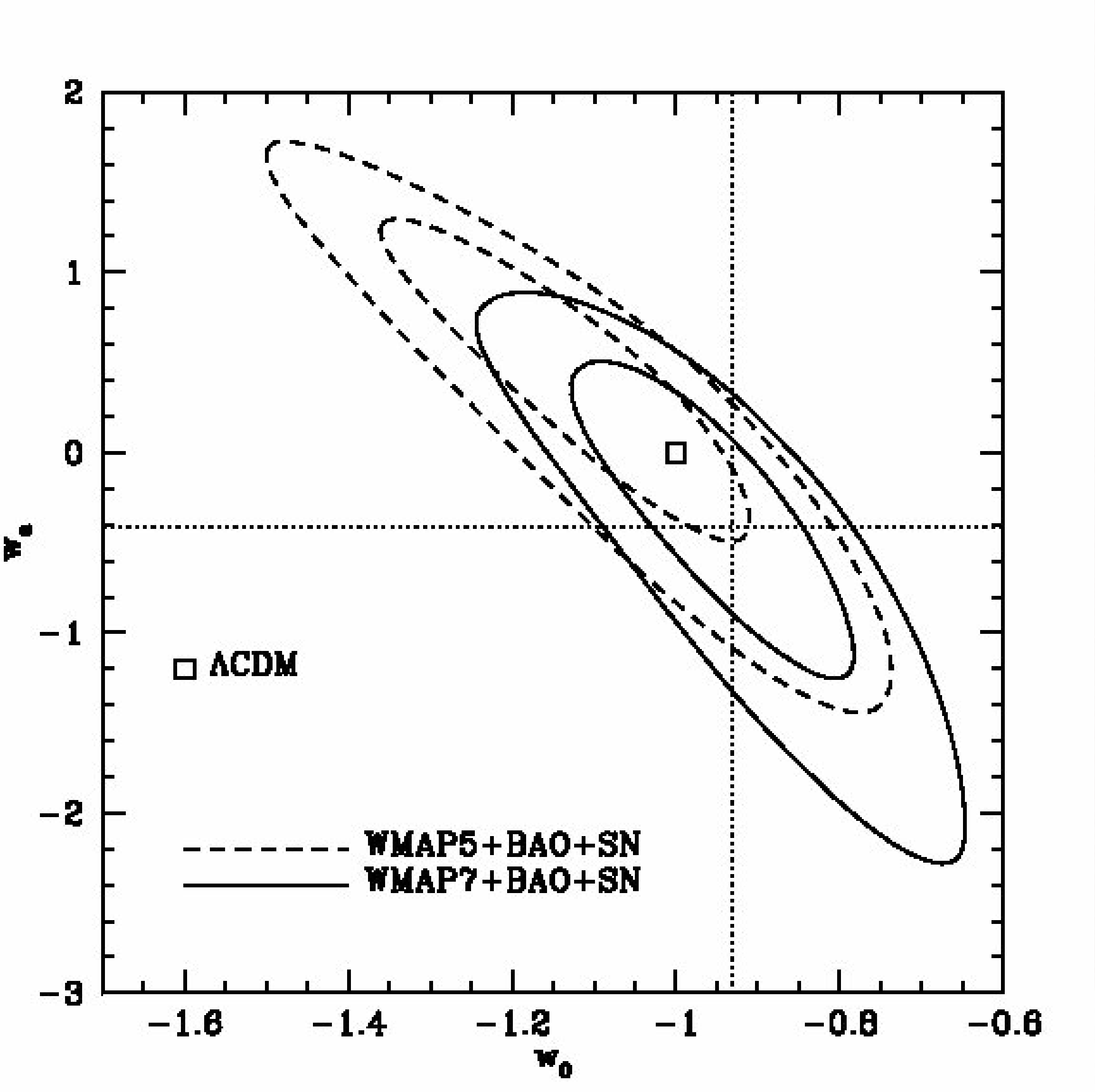
different cosmologies
predict different histories
for structures formation

weak lensing will discriminate
power spectra P(k,z) ~**1% !!!**
(Huterer & Takada 2005)

how to predict accurately P(k,z) to compare models with next data?

$w(a)=w_0+w_a(1-a)$

Time dependent equation of state – Weak lensing



different cosmologies predict different histories for structures formation

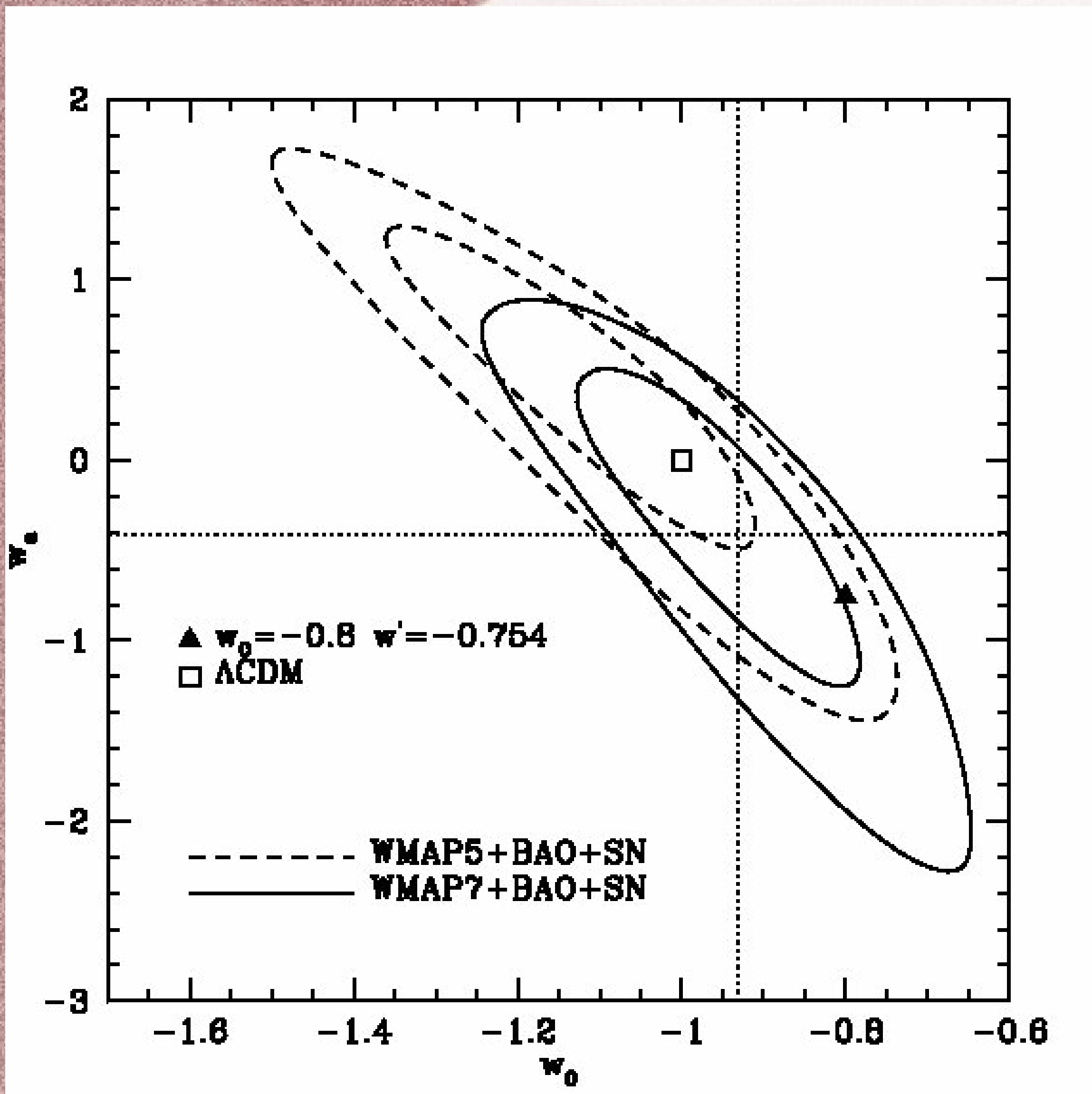
weak lensing will discriminate power spectra P(k,z) **> 1% !!!** (Huterer & Takada 2005)

how to predict accurately P(k,z) to compare models with next data?

Halofit provide an analytical expression for ΛCDM ~ 3% until k~3 h Mpc^{-1} (Smith at al. 2003)

$w(a)=w_0+w_a(1-a)$

Spectral equivalence: dDE vs ΛCDM



$\sigma_8=\sigma_8'$ (linear fluctuations)

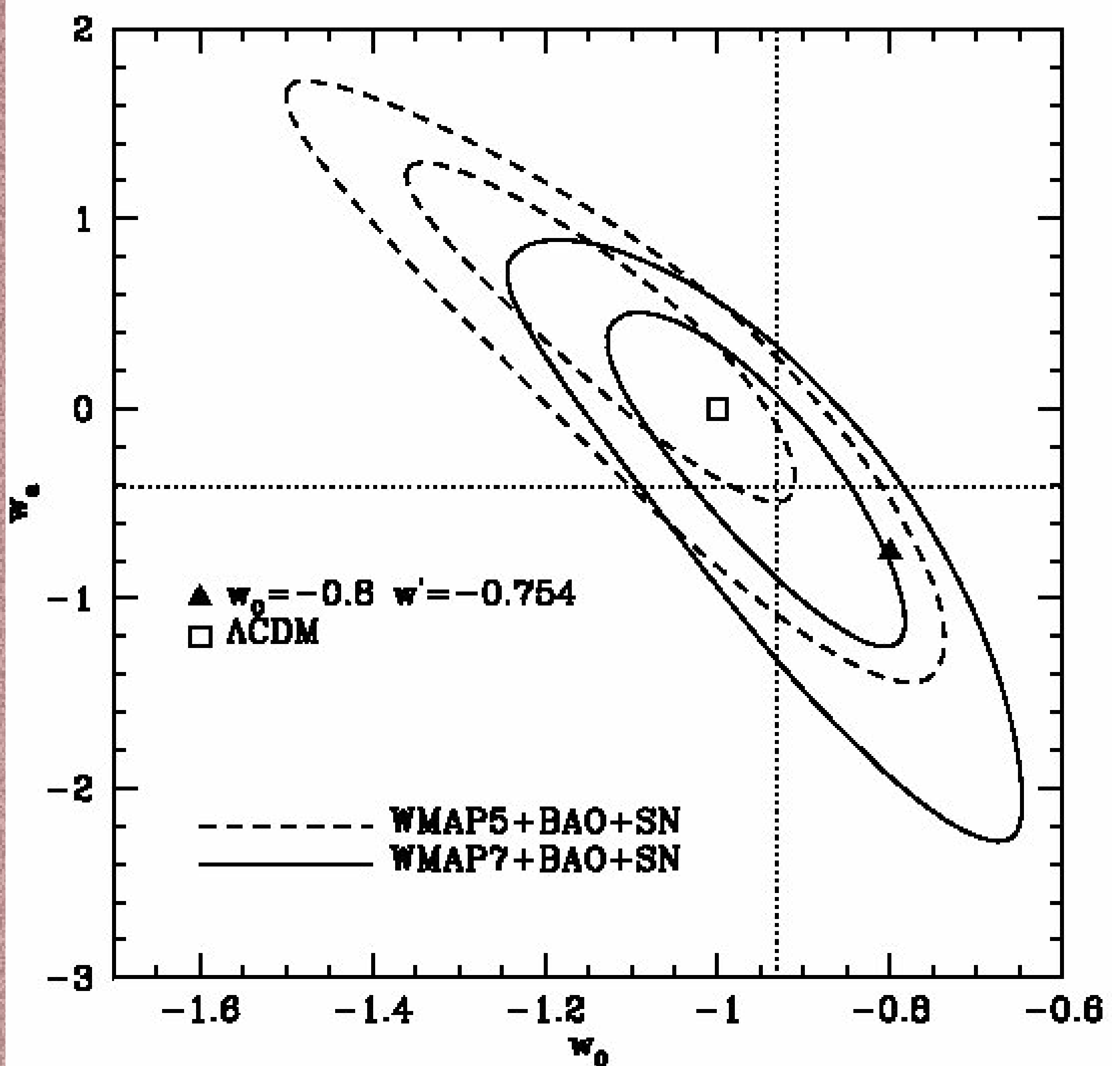
$\Omega_m h^2=\Omega_m' h'^2$(BAO)

$d_{LSB}=d_{LSB}'$ (conformal time)

$h_0=h_0'$

$\Omega_{m0}=\Omega_{m0}'$

Spectral equivalence: dDE vs ΛCDM



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$\Omega_m h^2 = \Omega_m' h'^2$ (BAO)

tuning:

$d_{LSB} = d_{LSB}'$ (conformal time)

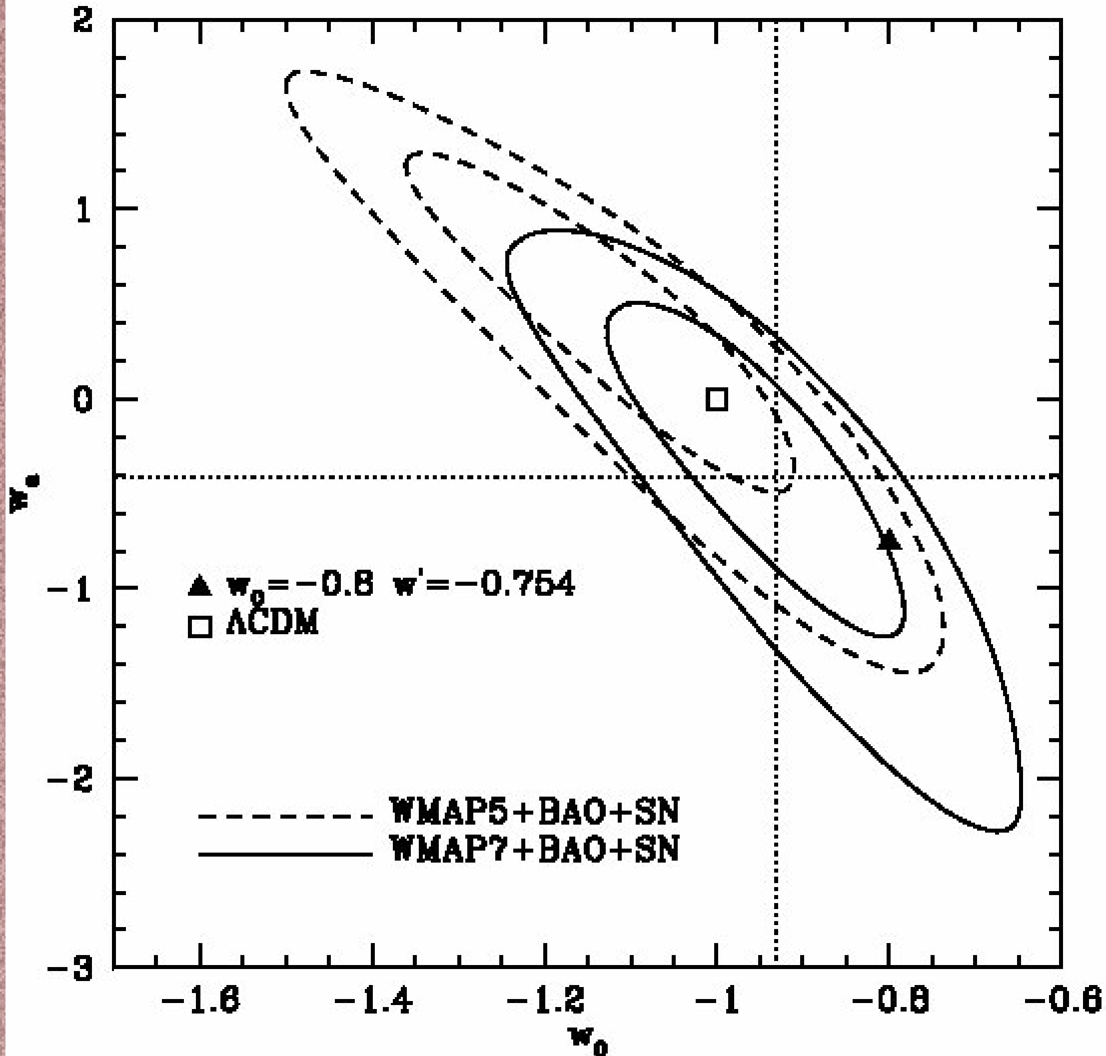
varying h (so Ω_m)

$h_0 \neq h_0'$

$\Omega_{m0} \neq \Omega_{m0}'$

(Linder & White 2006)

Spectral equivalence: dDE vs w=const



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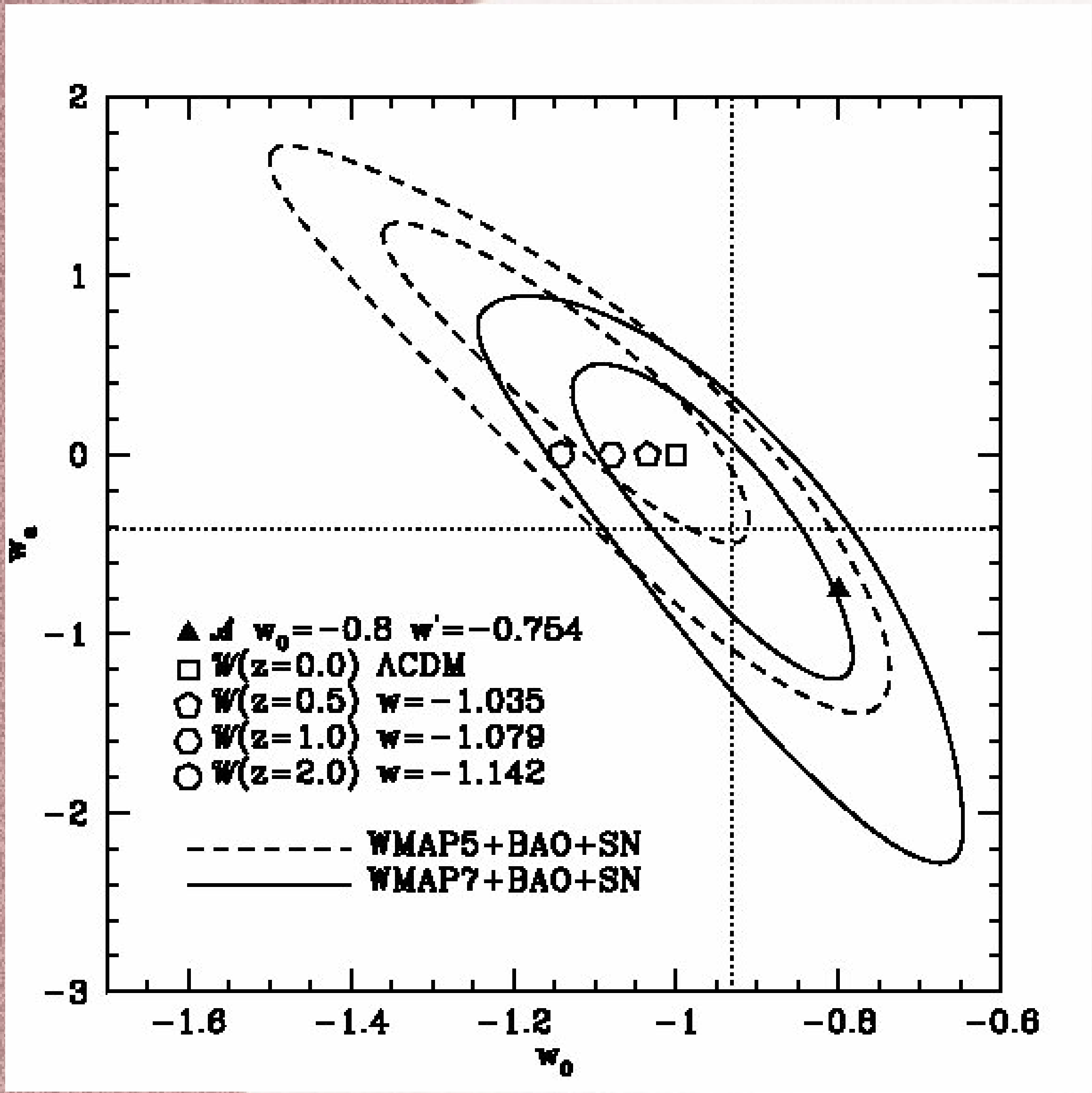
varying w=const

$h_0 = h_0'$
$\Omega_{m0} = \Omega_{m0}'$

(Francis, Lewis & Linder 2007)

ok for z=0 (<1%)
does not work for z>0 (>1%)

Spectral equivalence: dDE vs w=const



$\sigma_8(z)=\sigma_8'(z)$ (linear fluctuations)

$\Omega_m h^2=\Omega_m' h'^2$ (BAO)

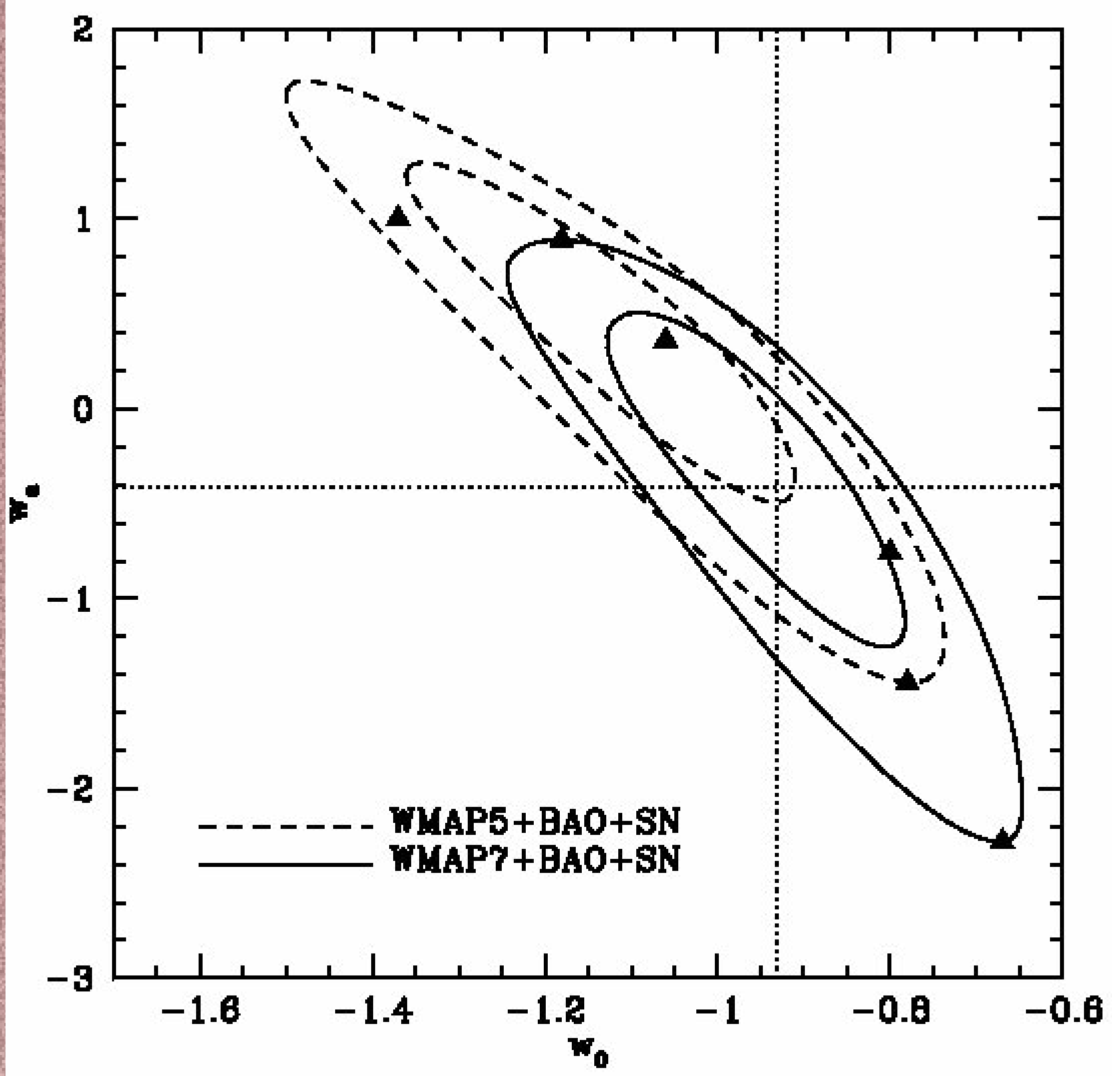
tuning:
$d_{LSS}(z)=d_{LSS}'(z)$ (conformal time)
varying w=const **at different z**

$h_0=h_0'$
$\Omega_{m0}=\Omega_{m0}'$

(Casarini, Maccio' & Bonometto 2009)

ok for every redshift

Spectral equivalence: dDE vs w=const



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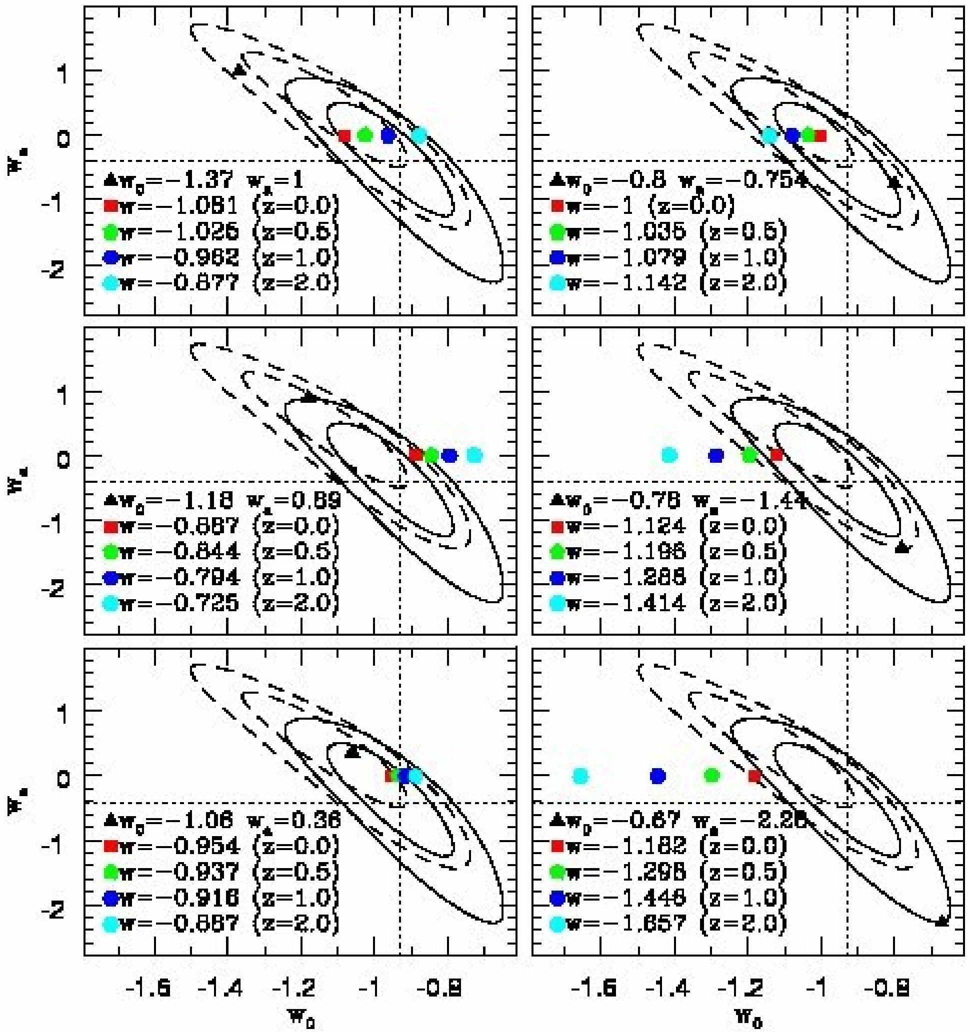

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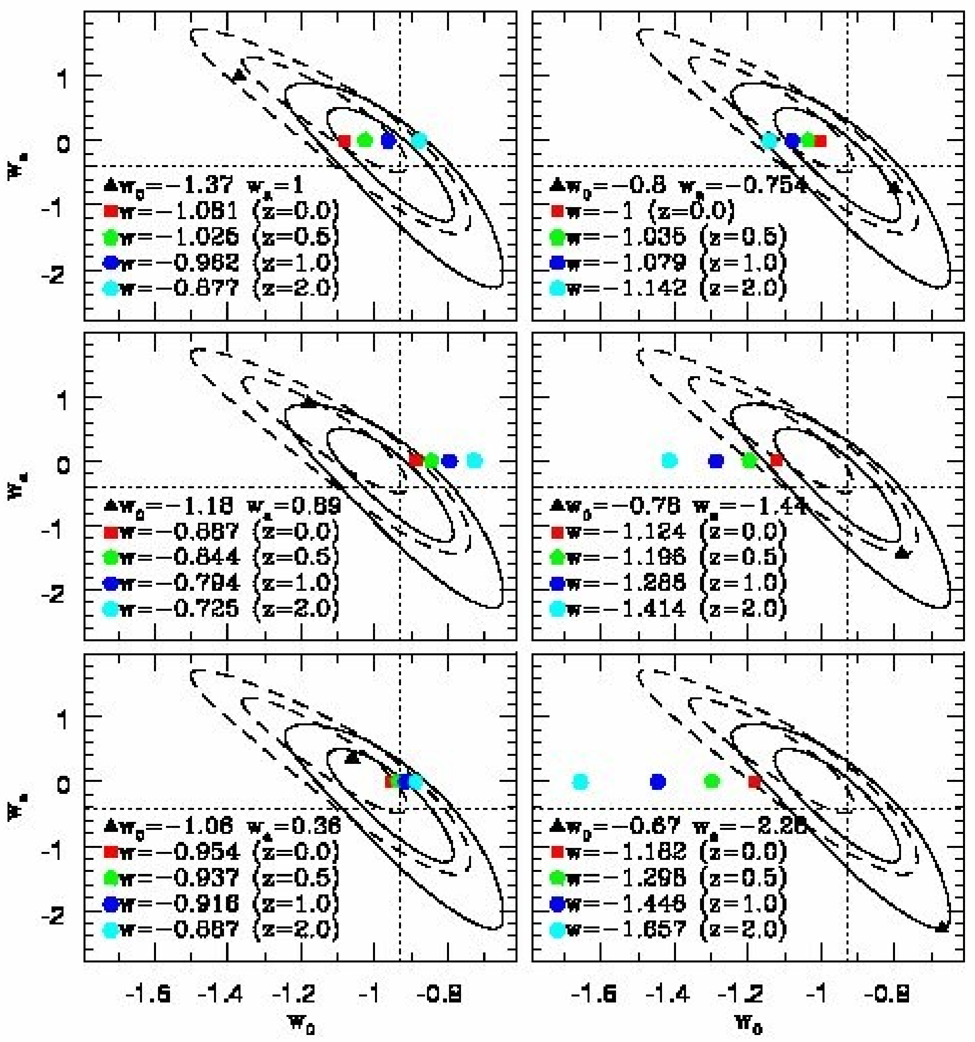
Non linearity – N-body simulations



$w(a)=w_0+w_a(1-a)$

$h_0=0.7$

$\Omega_m=0.274$

$\Omega_{de}=0.726$

$n_s=0.96$

$\sigma_8=0.81$

$L_{box}=256$ Mpc h^{-1}

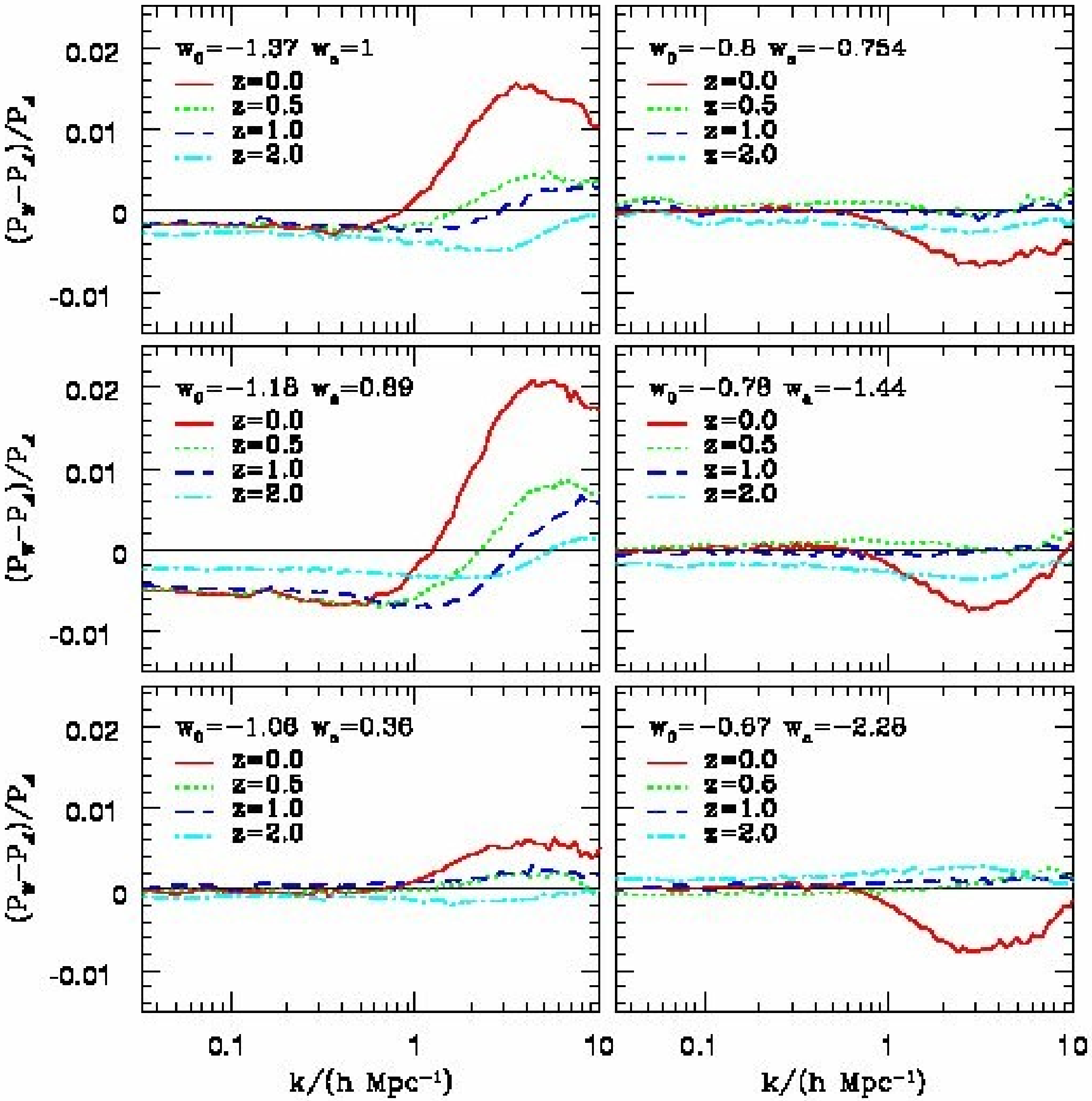
$N_{pat}=256^3$

$K_{max}\sim 10$ h Mpc^{-1}

$m_{pat}=7.61\ 10^{10}\ M_s h^{-1}$

PKDGRAV (Stadel 2001)

Spectral equivalence: dDE vs w=const



$\sigma_8(z)=\sigma_8'(z)$ (linear fluctuations)

$\Omega_m h^2=\Omega_m' h'^2$ (BAO)

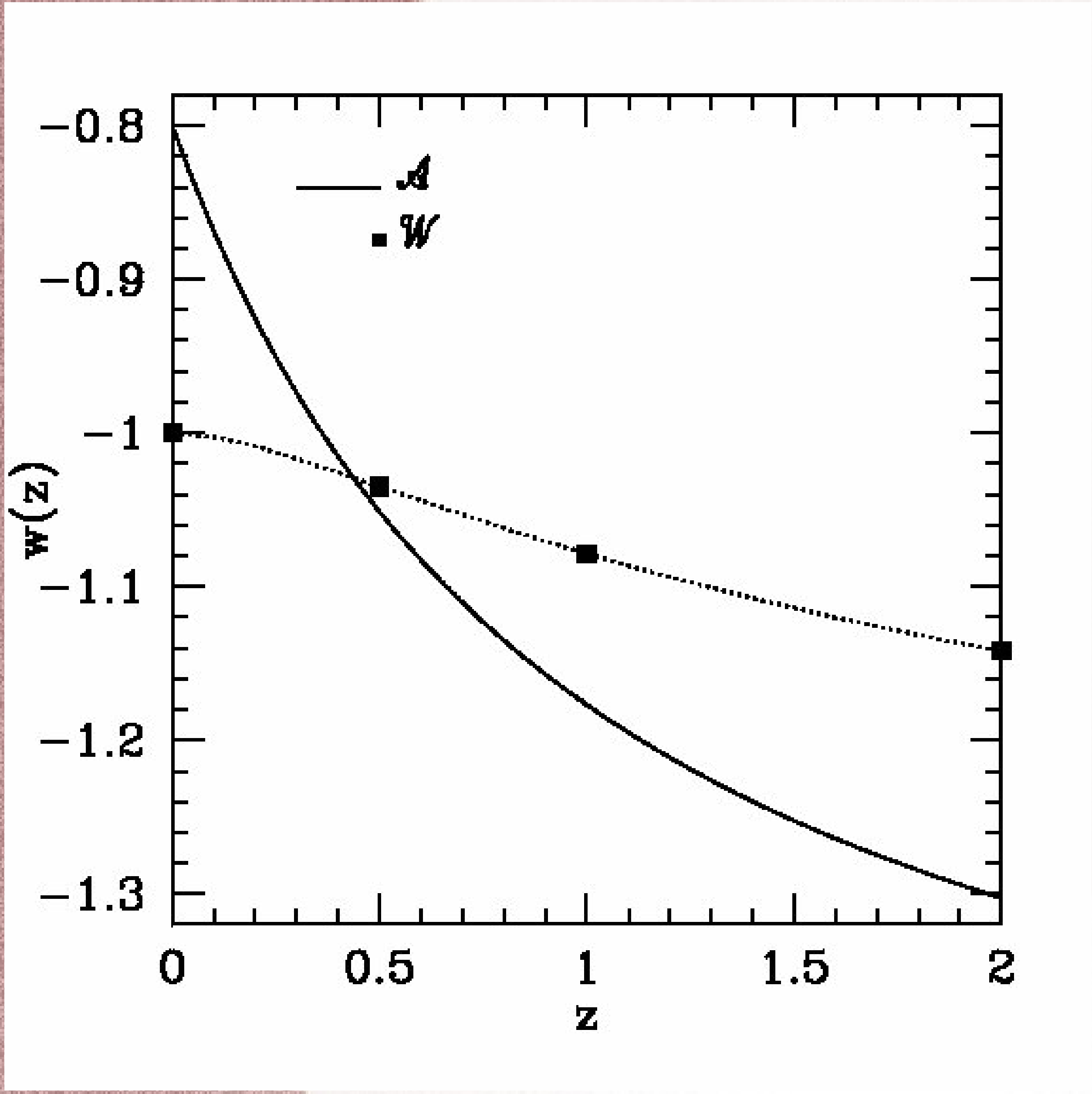
tuning:
$d_{LSB}(z)=d_{LSB}'(z)$(conformal time)
varying w=const at different z

$h_0=h_0'$
$\Omega_{m0}=\Omega_{m0}'$

supercluster scale:
-equivalence at ~ 0.001%!!

cluster scale:
-conformal time ≠ physical time
-equivalence at ~0.01%
-what happens with baryons?

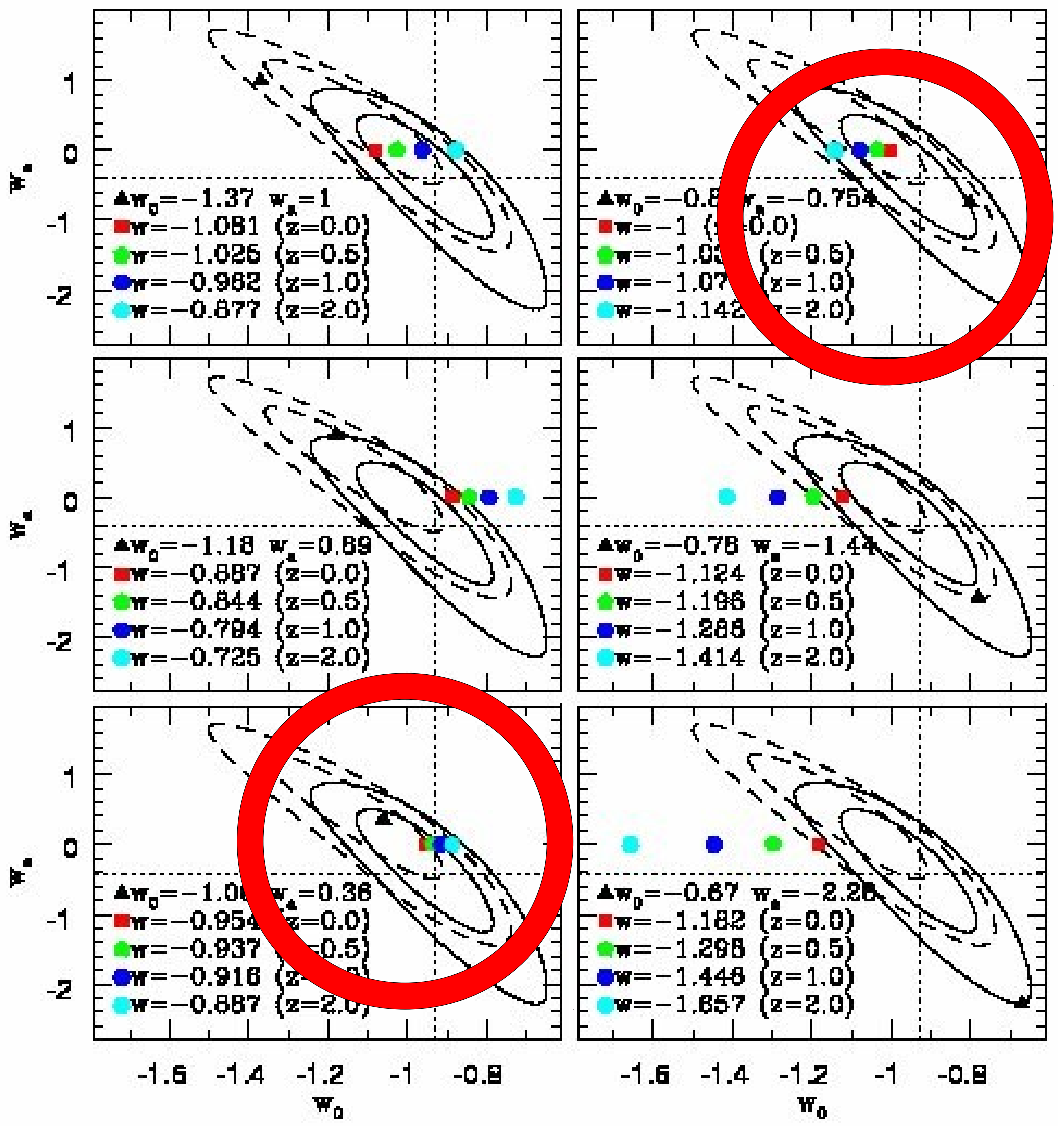
Spectral equivalence: dDE vs w=const



w(z)≠w'(z)!!!

bias for experiments!

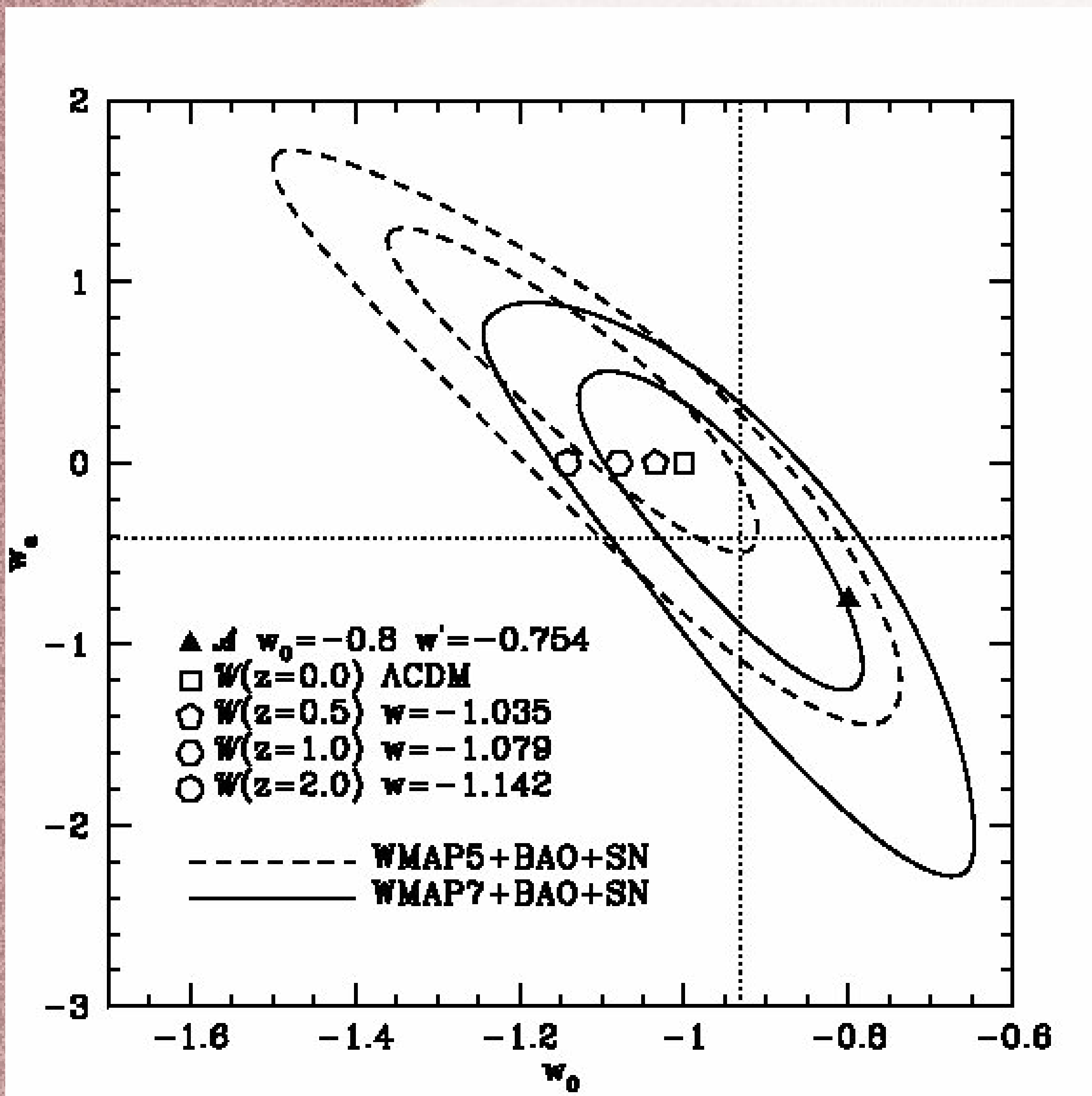
Spectral equivalence: dDE vs w=const



w'(z) closer than w(z)

bias for experiments!

Cluster scale – Hydro simulations



$w(a)=w_0+w_a(1-a)$

$h_0=0.7$

$\Omega_c=0.228$ $\Omega_b=0.046$

$\Omega_{de}=0.726$

$n_s=0.96$

$\sigma_8=0.81$

L_{box} =256 (64*) Mpc h^{-1}

$N_{part}=256^3$

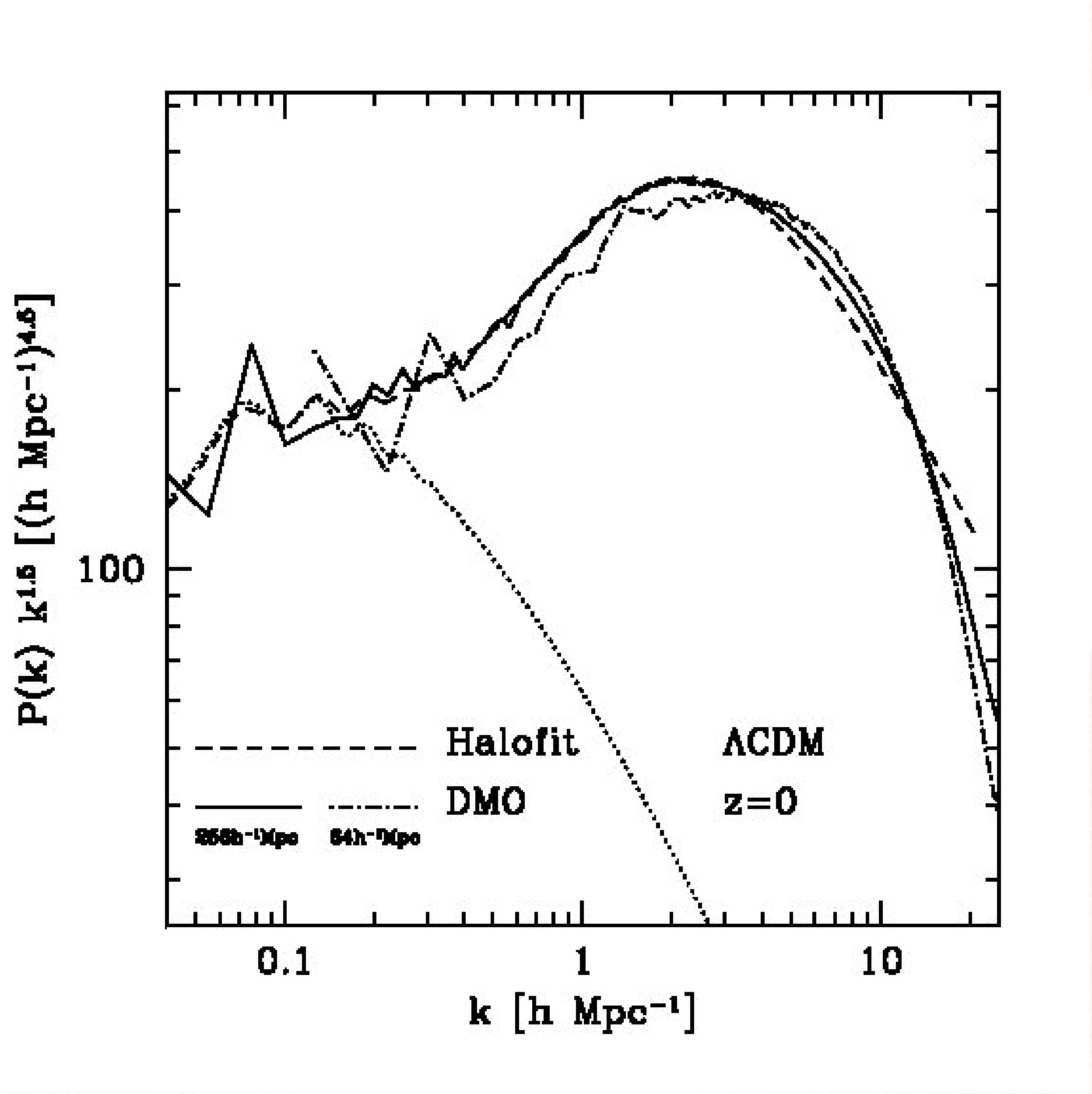
$m_{part\text{-}c}=6.33\ 10^{10}\ M_s h^{-1}$

$m_{part\text{-}b}=1.28\ 10^{10}\ M_s h^{-1}$

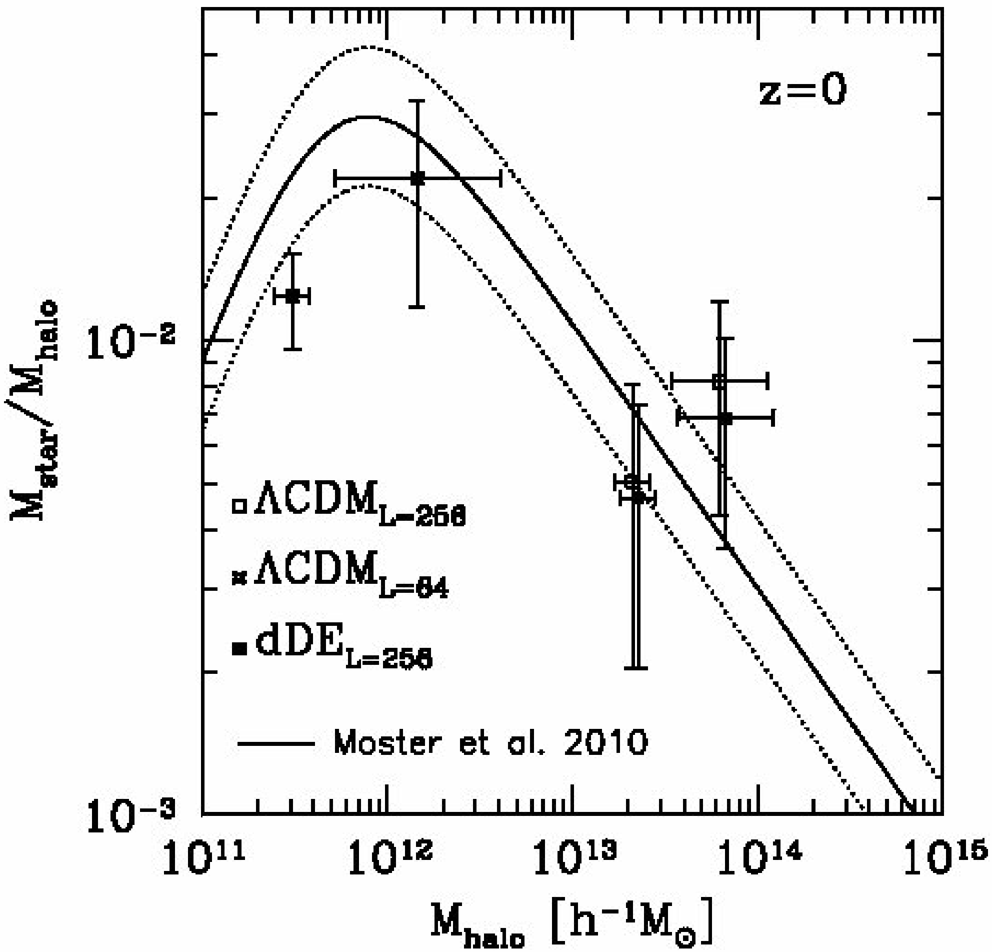
GASOLINE (Wadsley et al 2001)

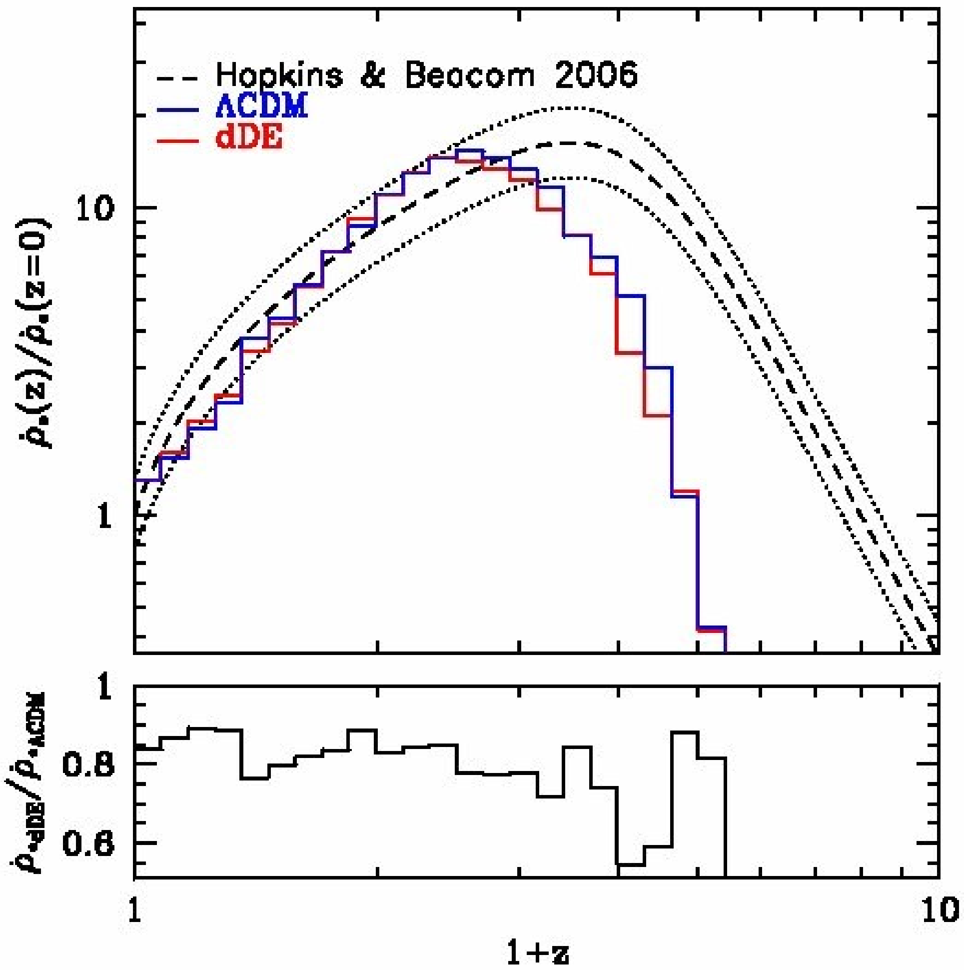
*only for ΛCDM

Sample variance vs resolution - P(k)



Sample variance vs resolution - Star formation



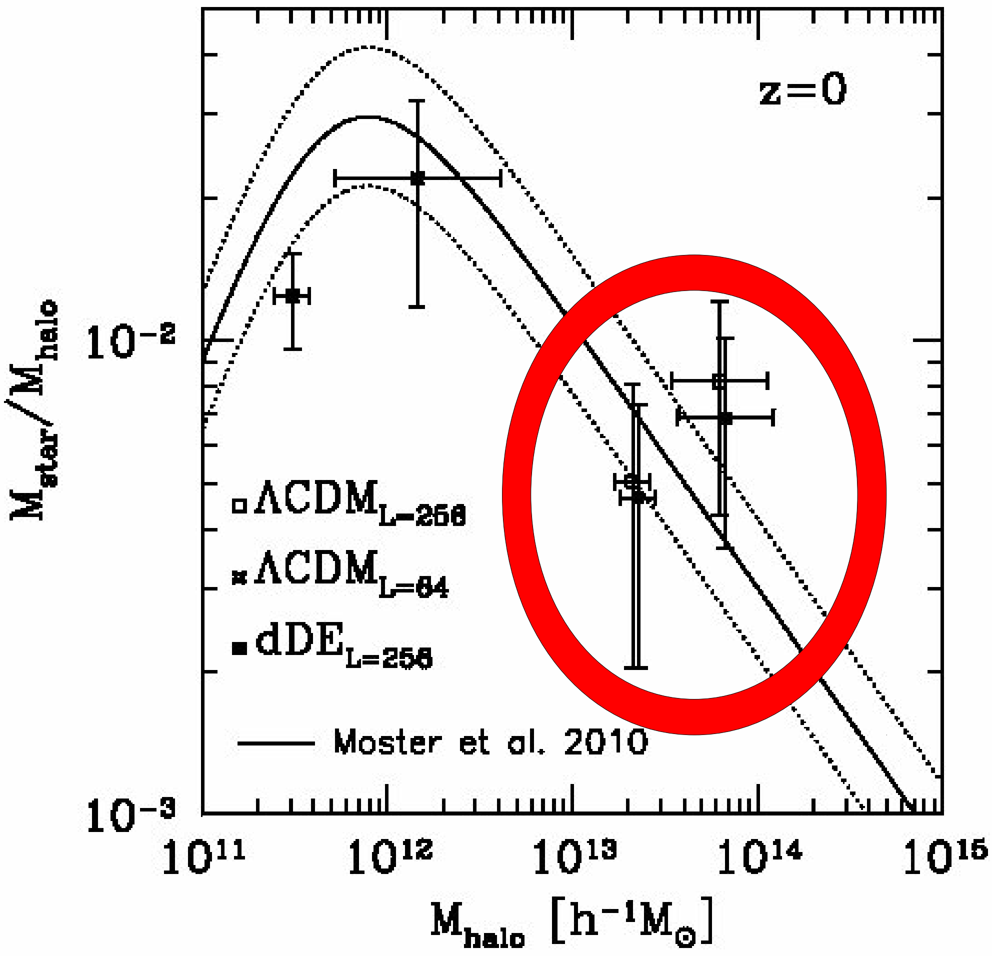


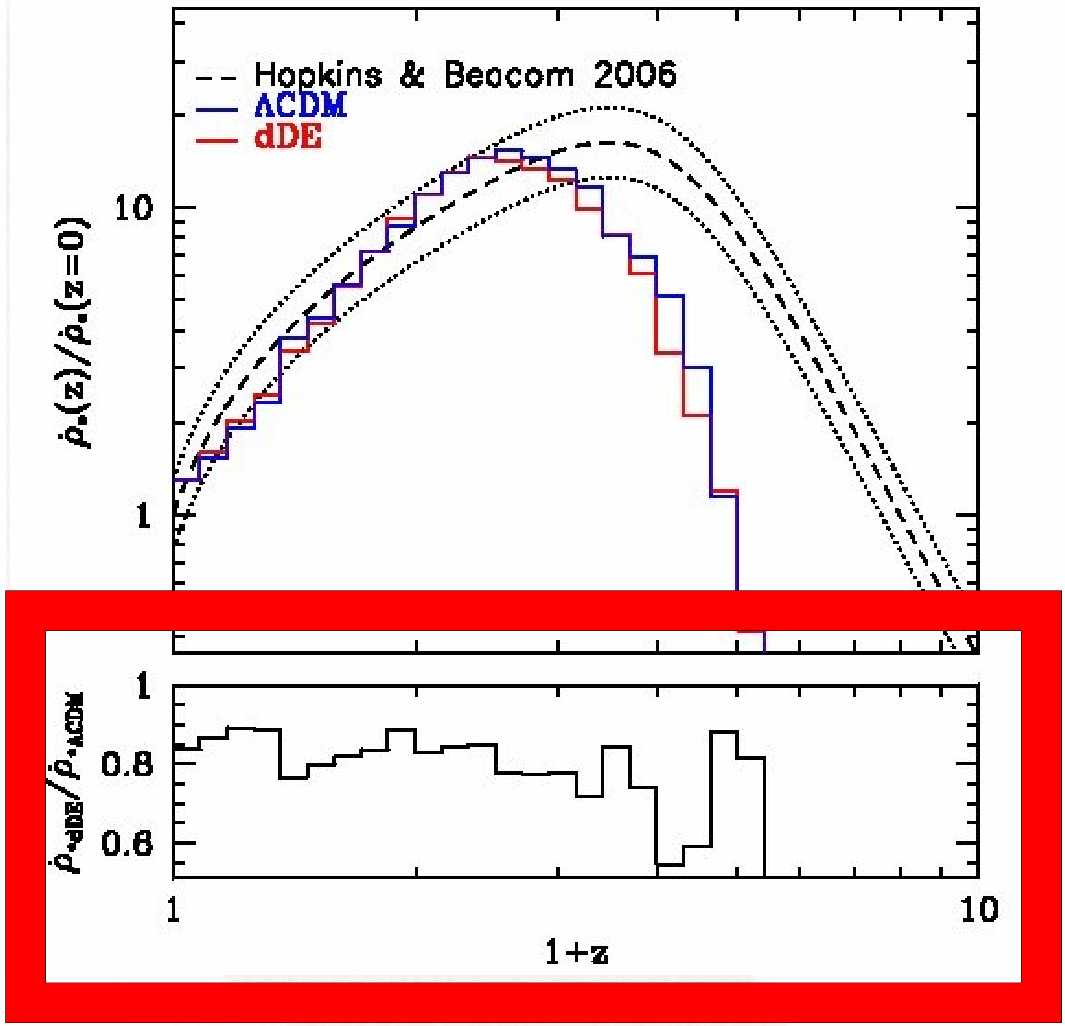
fair star fraction in halos

small halos missed

resolution good enough for our purpose

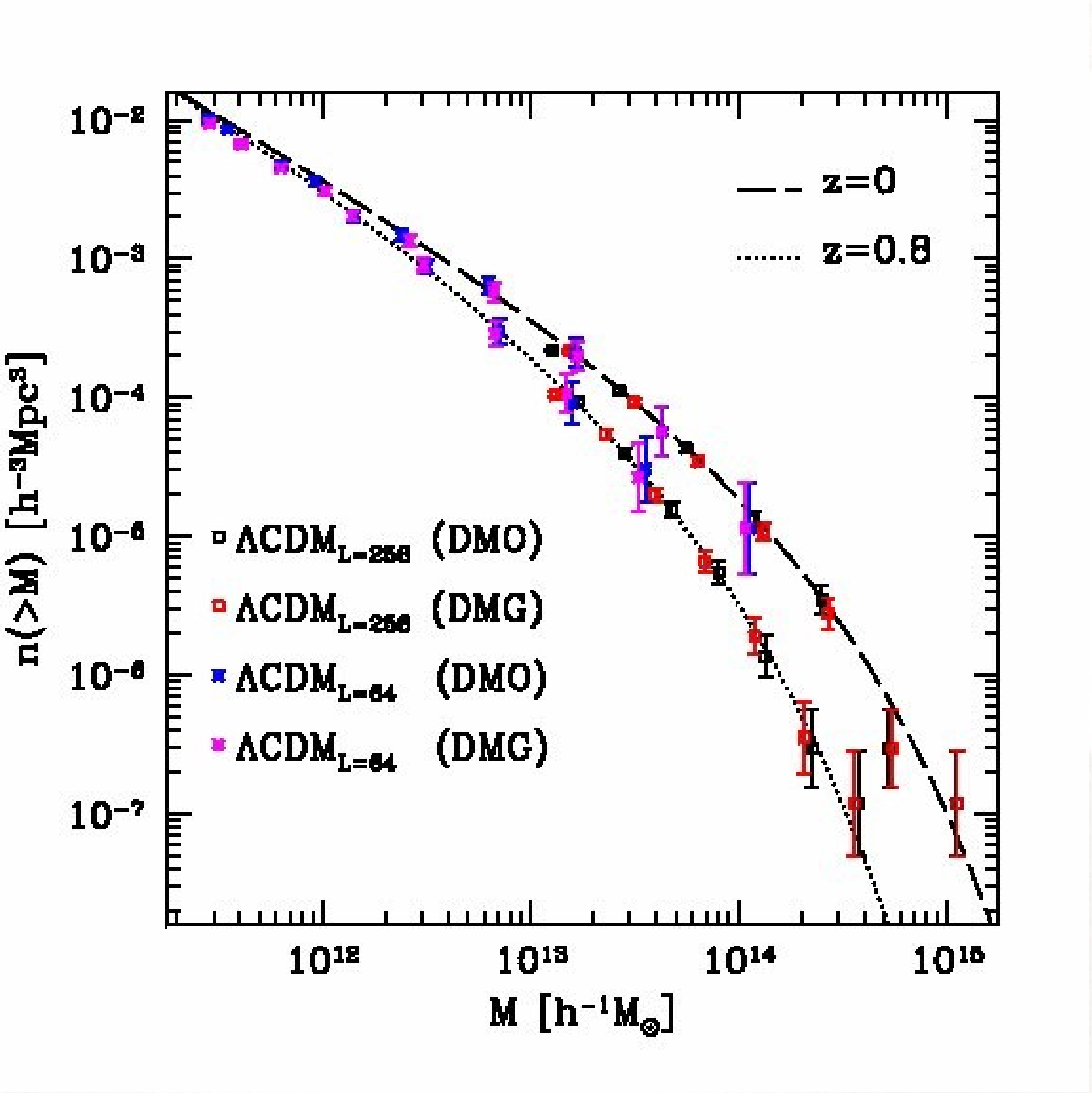
Sample variance vs resolution - Star formation



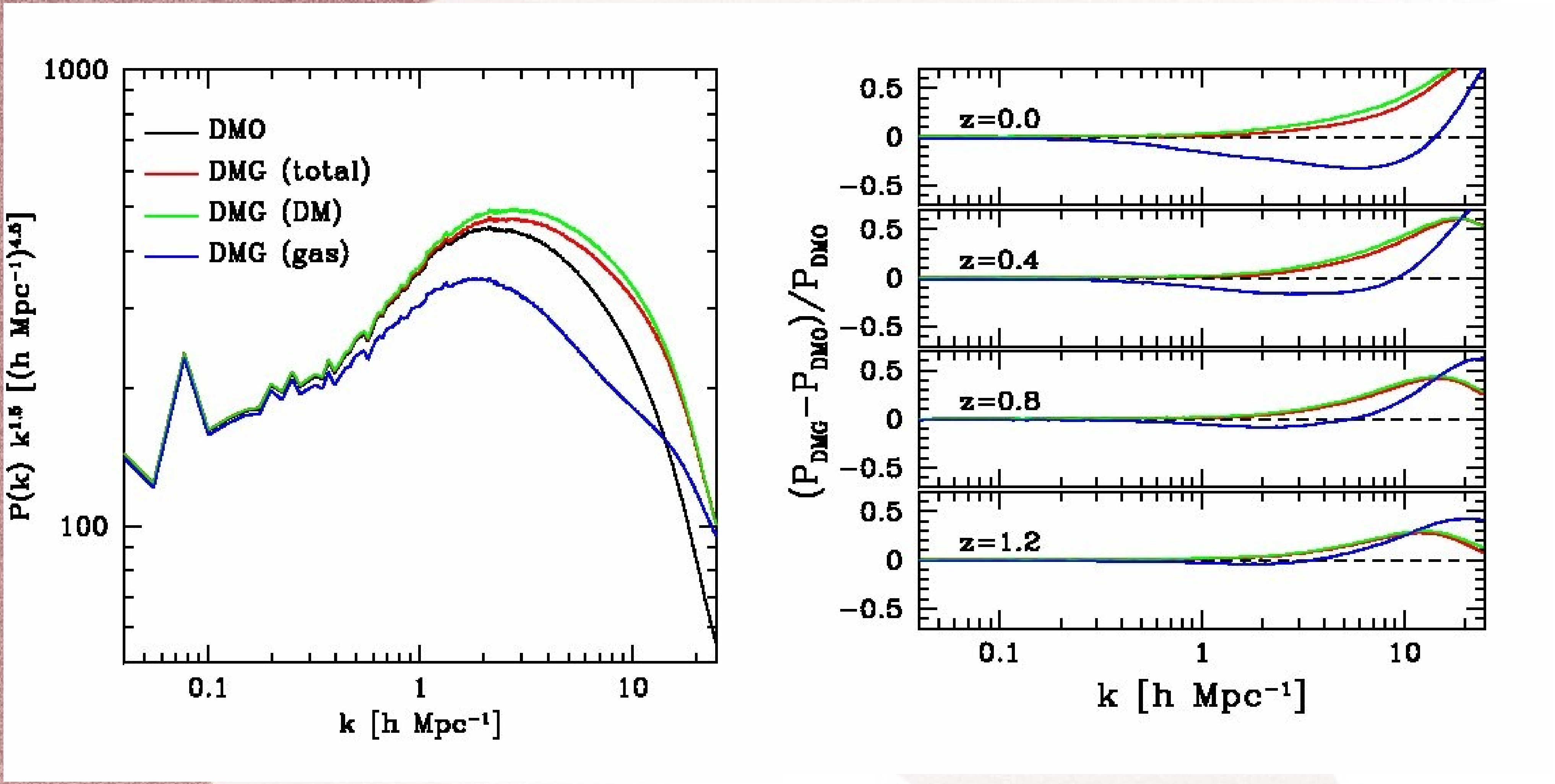


ΛCDM and dDE differ in star formation?!?
we would need more resolution...

Halo mass function



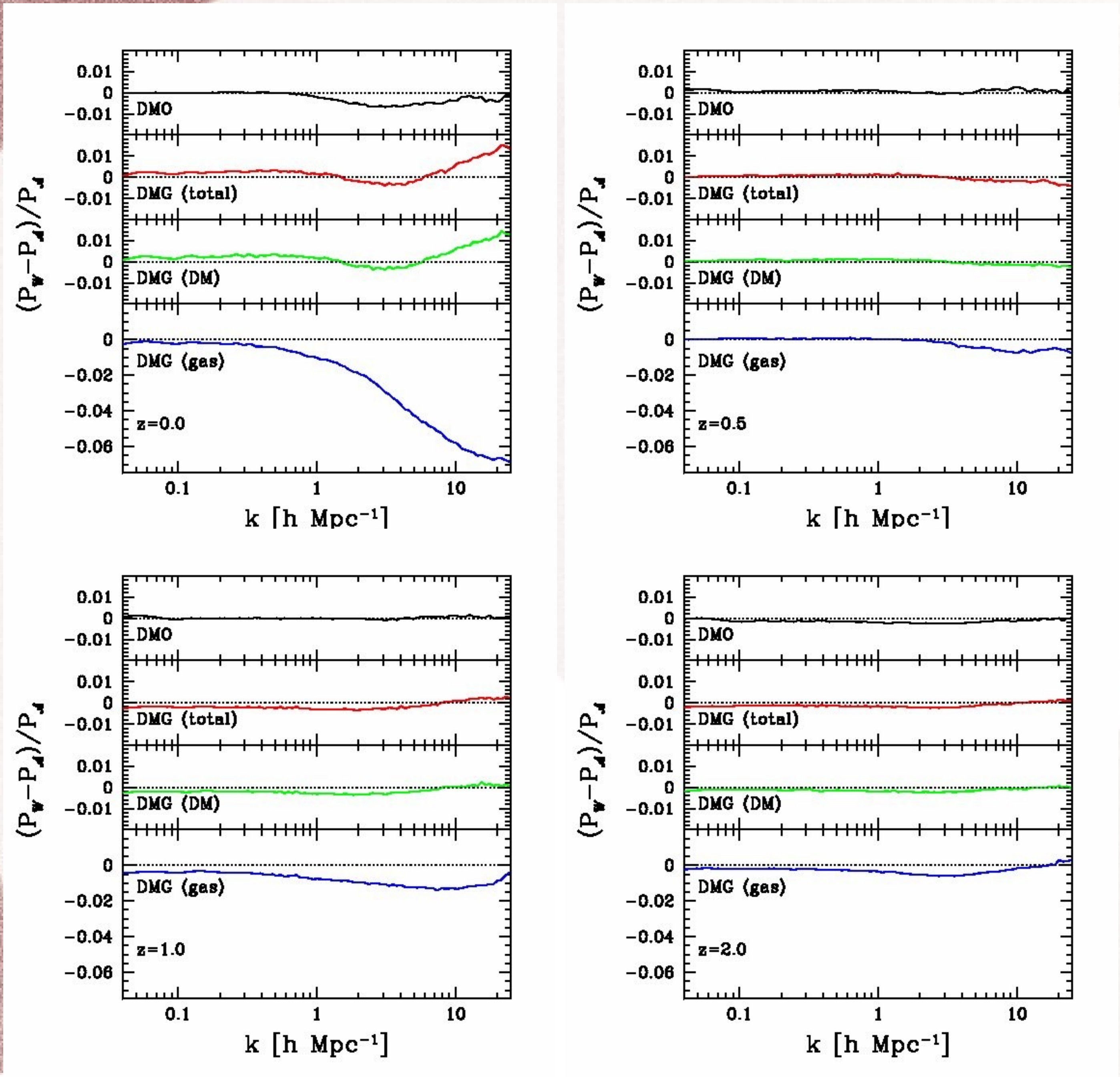
Matter power spectra: Hydro vs N-body



gas: cooling - power shifts inside the halos

dark matter: adiabatic contraction – power increase drastically in non linear regime!!!

Spectral equivalence in hydro simulations



Conclusions

-matter power spectra is sensible to cosmological dynamics;

-matter power spectra is very sensible to baryon physics in non linear regime;

-spectral equivalence between dDE and w=const works very well also with baryon physics;

-when halofit expression will be available for w=const models, will be straightforward to extend it to any w(a) model;

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Thank you