DYNAMICAL DARK ENERGY: HIGH ACCURACY POWER SPECTRA AT HIGH REDSHIFT

Luciano Casarini [1,2] Andrea Maccio' [3] Silvio Bonometto [1,2]

[1] Dept. Physics G. Occhialini, Milano-Bicocca University
[2] I.N.F.N. Sezione di Milano-Bicocca
[3] MPI-Astrophysics , Heidelberg

Intro

- Tomographic cosmic shear : (hopefully) allowing to measure spectra up to 1% accuracy (Huterer & Tanaka 2005)
- Are we ready to predict spectra with such precision for any reasonable cosmology?
- ΛCDM : "easy" to simulate ; *Halofit* expression (Smith et al. 2003)
- w=const. : some extension of *Halofit* (McDonald, Trac & Contaldi 2006)
- w(a) : Francis, Lewis & Linder 2007 (FLL) approach

  -- z=0: spectral equivalence (within 1%)

  any w(a) vs. (suitable) w=const.

  -- z>0: method extended allows 2-3% precision
- This paper : 1% precision (or much better) at any z. (arXiv:0810.0190)

Linking w_{dyn} with w_{const}

M-model: $w=w(a)$ — *W-models :* $w=\text{const}$

dyn. DE cosmology ⟷ auxiliary model

FLL	**Weak Requirement**	**Strong Requirement**
$d_{LSB}^{M}(z=0) = d_{LSB}^{W}(z=0)$	$d_{LSB}^{M}(z) = d_{LSB}^{W}(z)$	$d_{LSB}^{M}(z) = d_{LSB}^{W}(z)$
	$\sigma_8^{M}(z)=\sigma_8^{W}(z)$	$\sigma_8^{M}(z)=\sigma_8^{W}(z)$
	$\omega^{M}(z)=\omega^{W}(z)$	$\omega^{M}(z)=\omega^{W}(z)$
	if true at $z=0$, true at any z	$\Omega_m^{M}(z)=\Omega_m^{W}(z)$
	$h^{M}(0)=h^{W}(0)$	then: $h^{M}(0)\neq h^{W}(0)$
GLOBAL LINKING: *W* is the same for every redshift	*LOCAL LINKING*: *W* is different for every redshift	*LOCAL LINKING*: *W* is different for every redshift

Models & Simulations

$w(a)= w_o+w_a(1-a)$	**SUGRA**
w_o=-0.8 w_a=-0.732	Λ=0.1 GeV
Ω_c=0.193	Ω_c=0.209
Ω_b=0.041	Ω_b=0.046
h= 0.74	h= 0.70
σ_8=0.76	σ_8=0.75
n_s=0.96	n_s=0.97

exactly one of FLL "dDE"models

call it: polynomial model

Close to WMAP5 best-fit

z=0.0	w_c=-1.000	σ_8=0.760	z=0.0	w_c=-0.763	σ_8=0.750
z=0.6	w_c=-1.040	σ_8=0.767	z=0.6	w_c=-0.740	σ_8=0.744
z=1.2	w_c=-1.086	σ_8=0.775	z=1.2	w_c=-0.712	σ_8=0.735
z=1.8	w_c=-1.121	σ_8=0.782	z=1.8	w_c=-0.691	σ_8=0.727
z=2.4	w_c=-1.150	σ_8=0.787	z=2.4	w_c=-0.675	σ_8=0.721

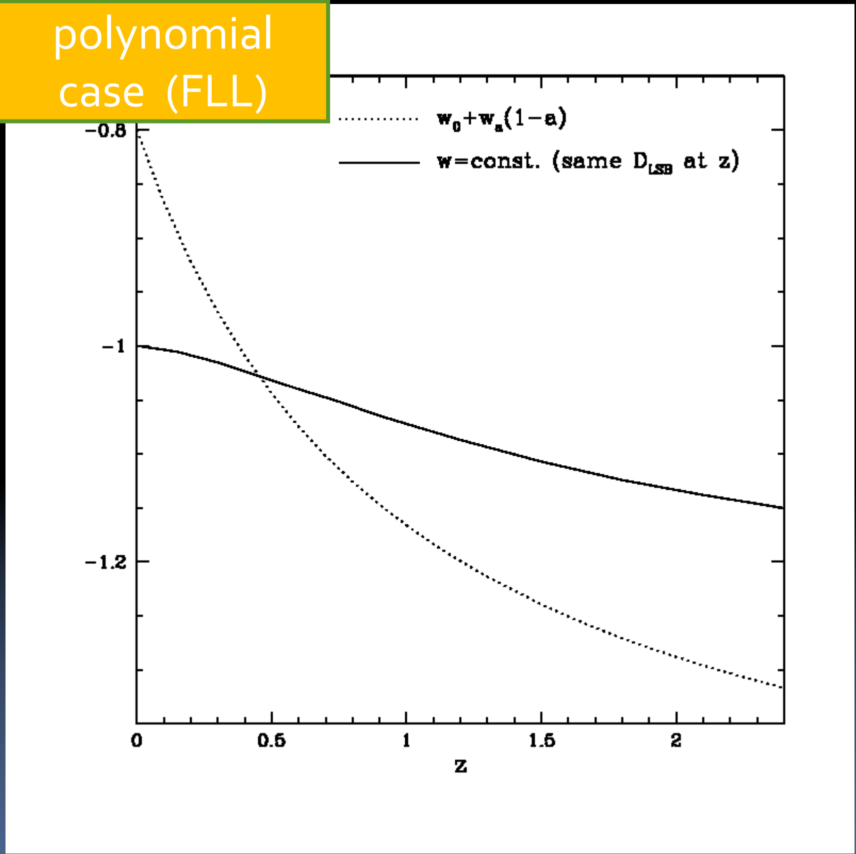
IC: PM for ART (A.Klypin)

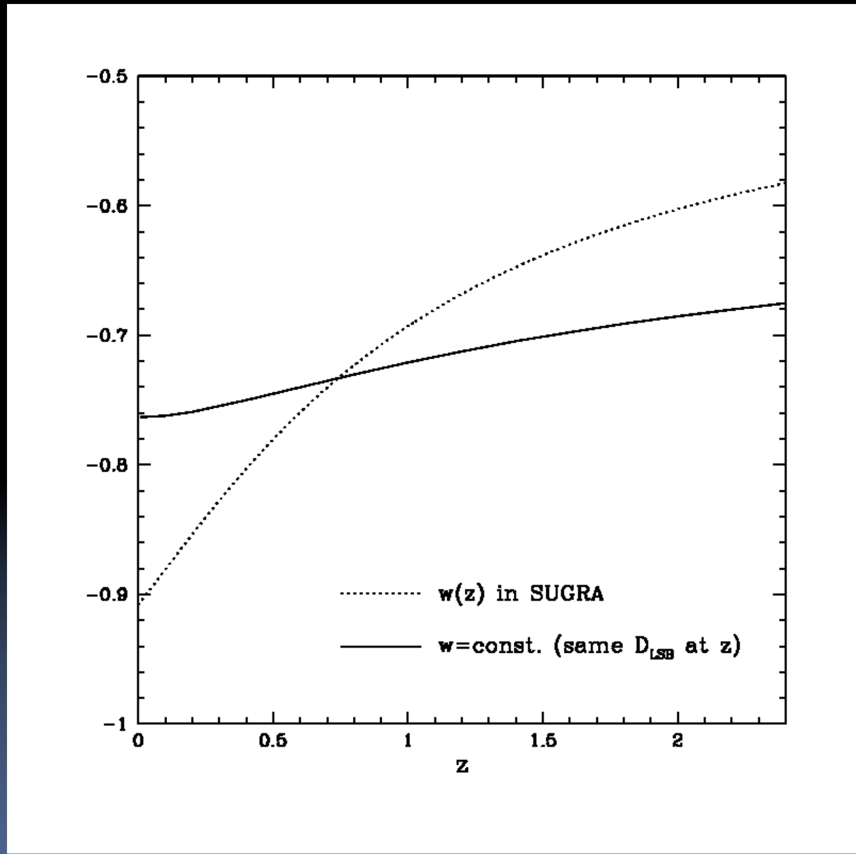
SIM: PKDGRAV (J.Stadel)

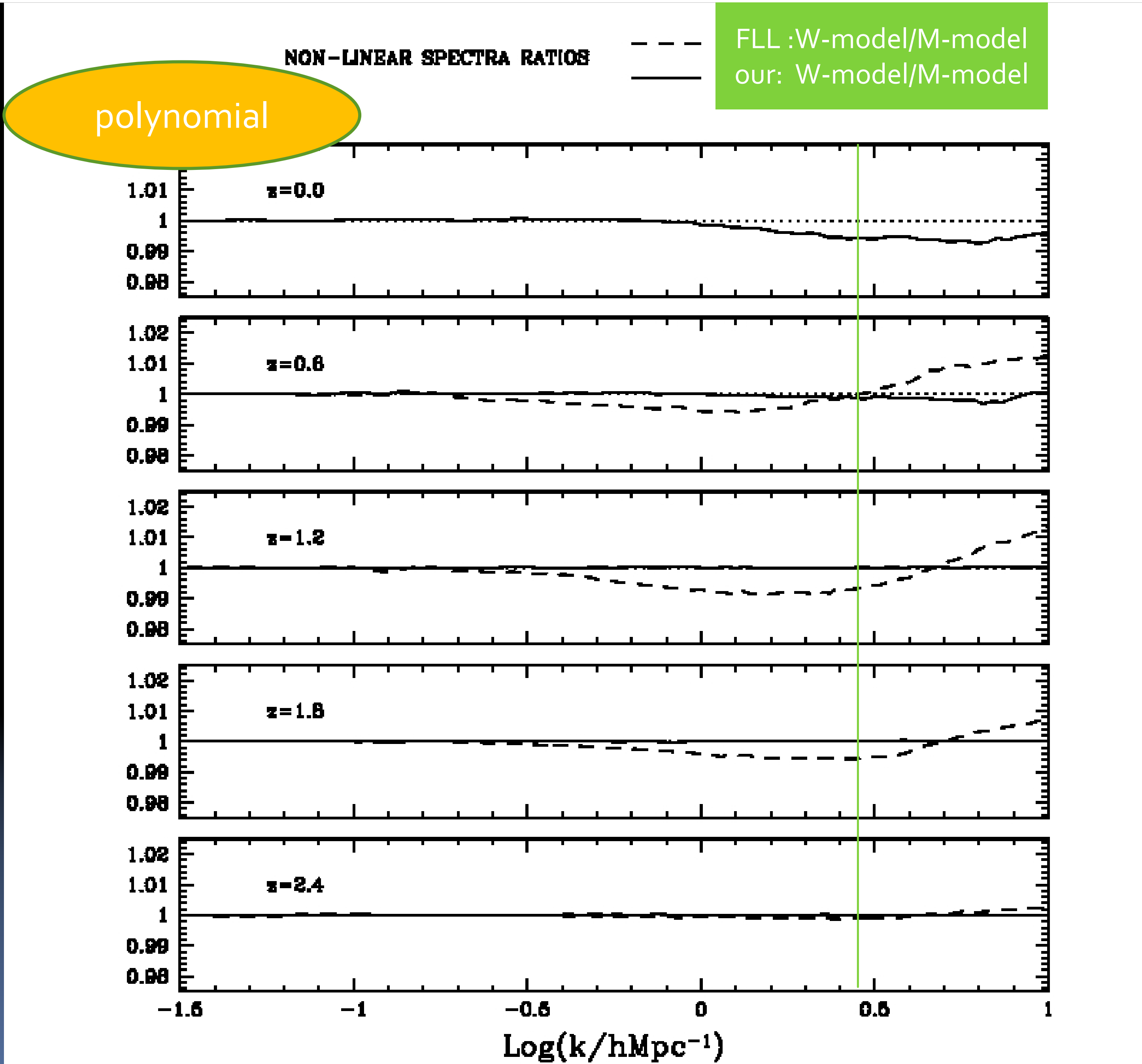
L_{box}=256 $h^{-1}M_{pc}$ N=256^3 ε=25$h^{-1}M_{pc}$ z_i=24

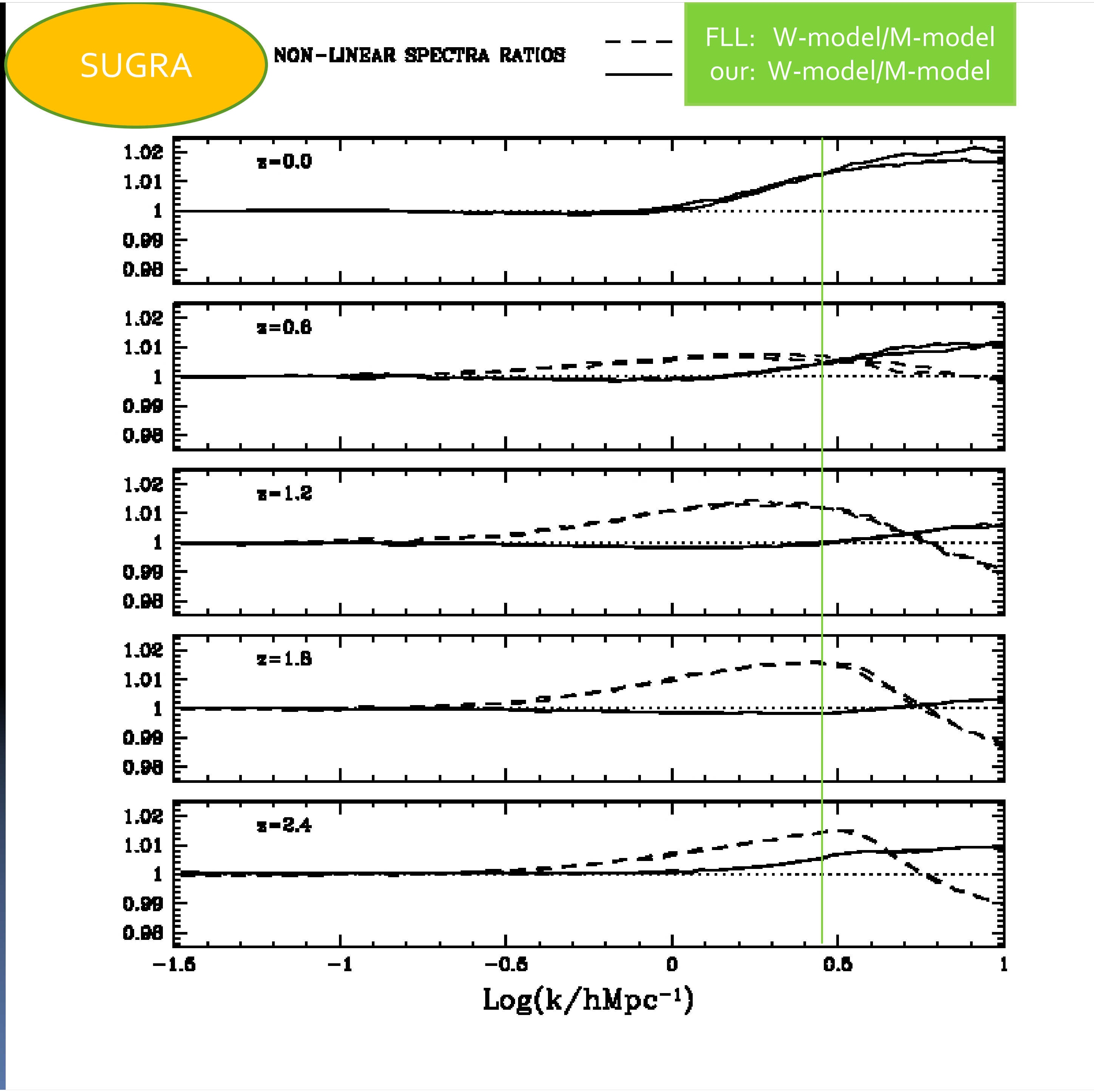
Variable vs constant w

polynomial case (FLL)

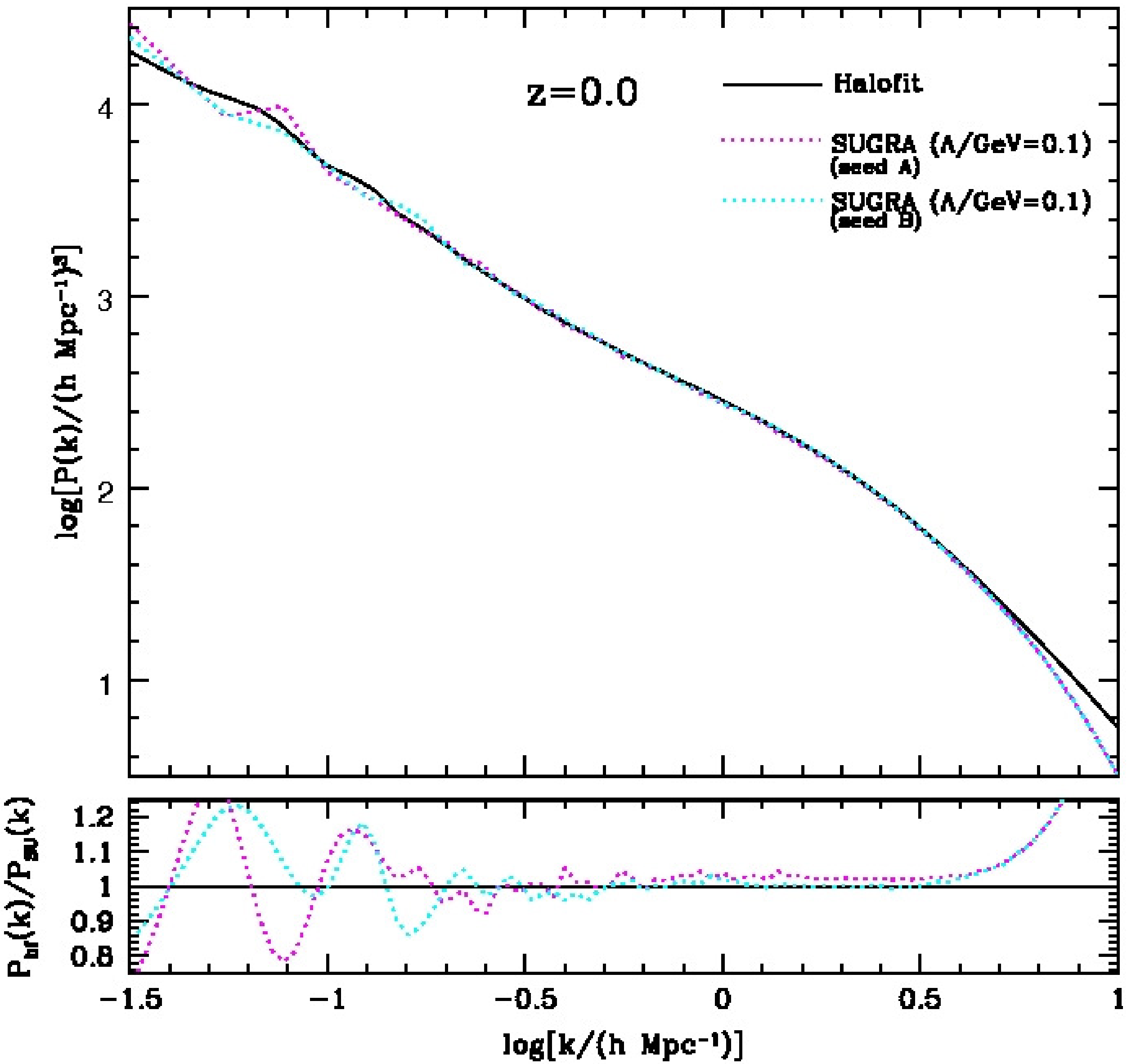


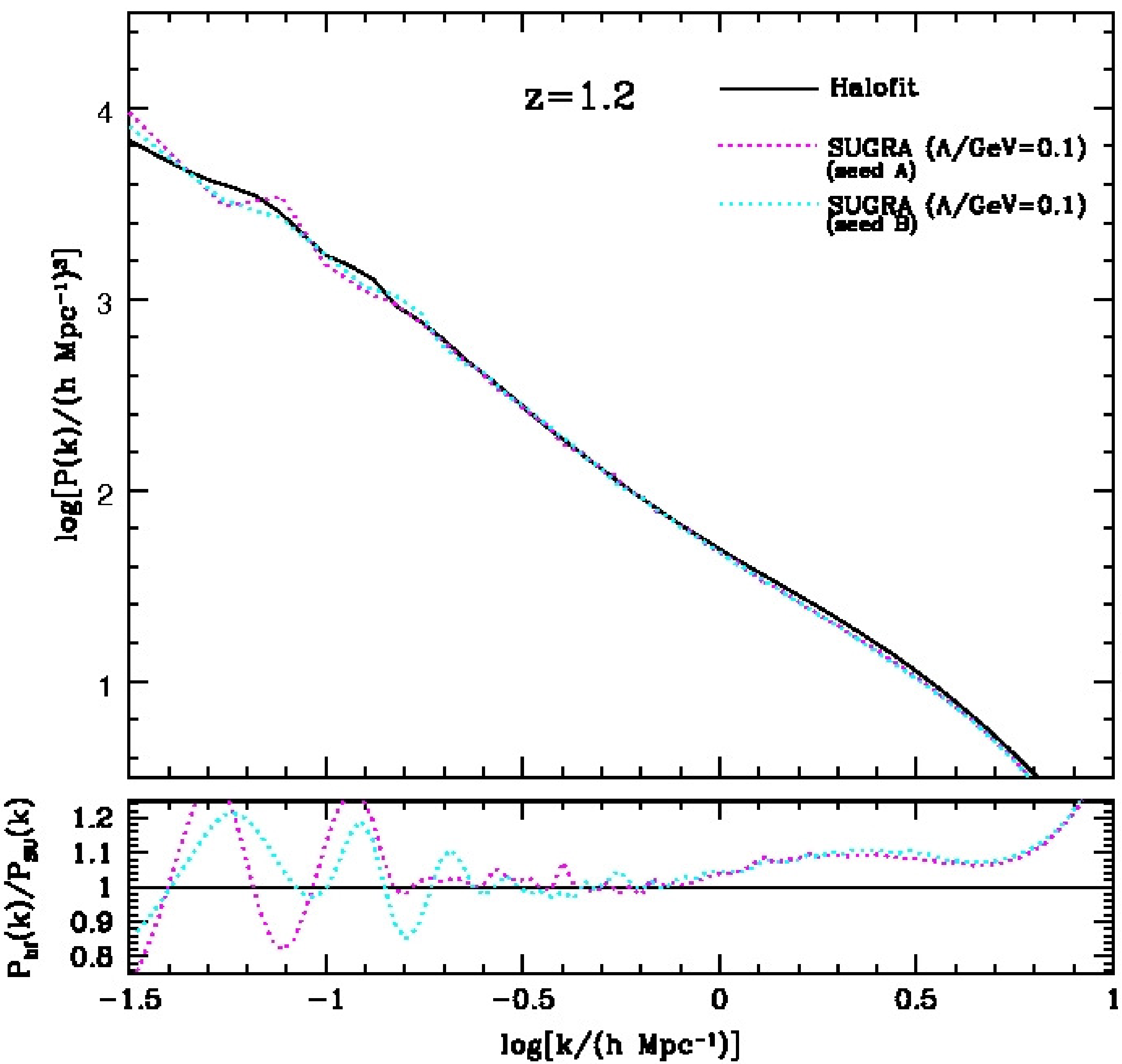



NON-LINEAR SPECTRA RATIOS
FLL :W-model/M-model
our: W-model/M-model
polynomial
z=0.0
z=0.6
z=1.2
z=1.8
z=2.4
1.02
1.01
1
0.99
0.98
−1.5
−1
−0.5
0
0.5
1
Log(k/hMpc⁻¹)

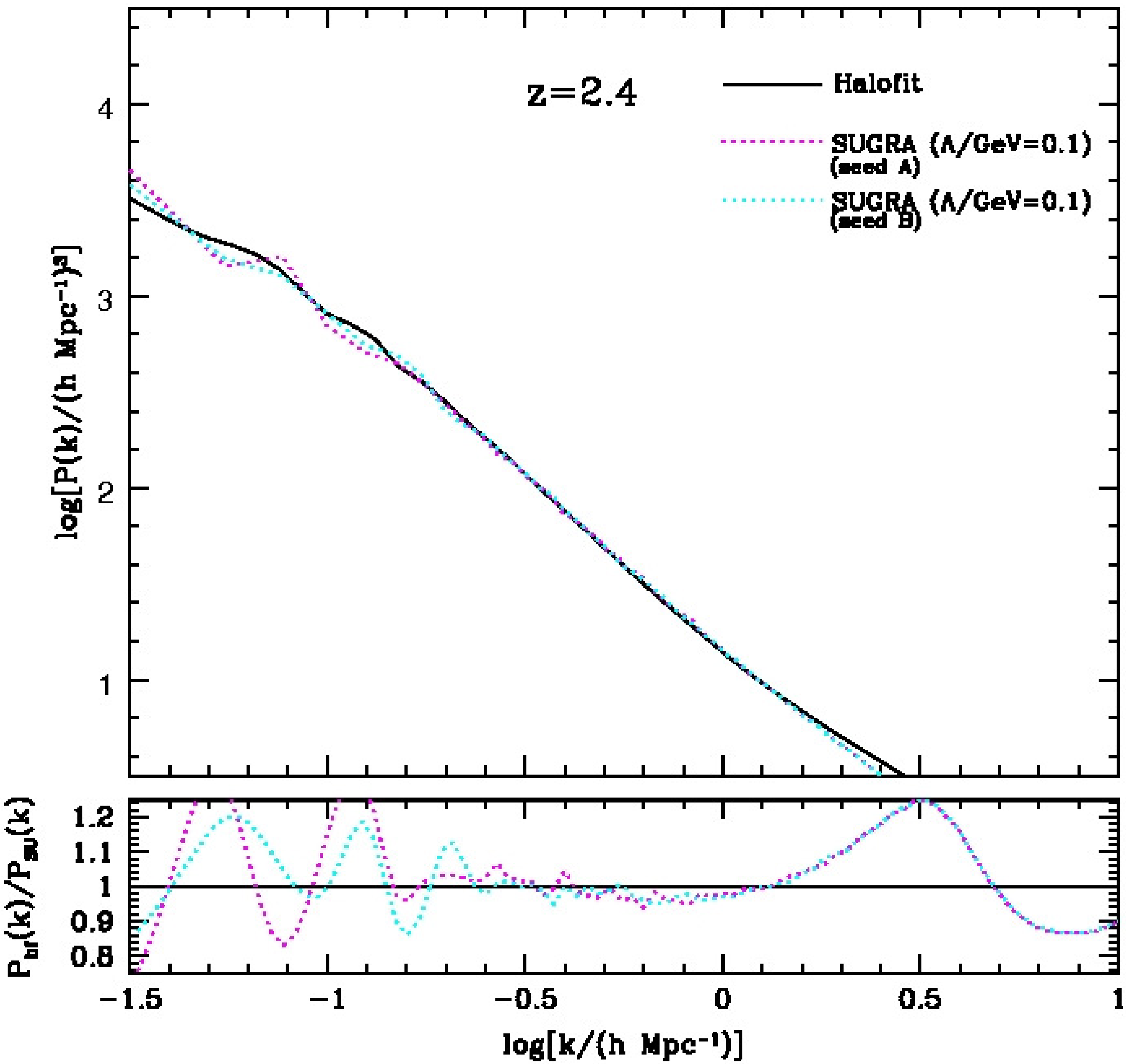


SUGRA
NON-LINEAR SPECTRA RATIOS
FLL: W-model/M-model
our: W-model/M-model
z=0.0
z=0.6
z=1.2
z=1.8
z=2.4
1.02
1.01
1
0.99
0.98
−1.5
−1
−0.5
0
0.5
1
Log(k/hMpc−1)


z=0.0
Halofit
SUGRA (Λ/GeV=0.1)
(seed A)
SUGRA (Λ/GeV=0.1)
(seed B)
log[P(k)/(h Mpc⁻¹)³]
P_nl(k)/P_su(k)
log[k/(h Mpc⁻¹)]



z=1.2
Halofit
SUGRA (Λ/GeV=0.1) (seed A)
SUGRA (Λ/GeV=0.1) (seed B)
log[P(k)/(h Mpc⁻¹)³]
P_hr(k)/P_su(k)
log[k/(h Mpc⁻¹)]
4
3
2
1
1.2
1.1
1
0.9
0.8
−1.5
−1
−0.5
0
0.5
1



z=2.4
Halofit
SUGRA (Λ/GeV=0.1) (seed A)
SUGRA (Λ/GeV=0.1) (seed B)
log[P(k)/(h Mpc⁻¹)³]
P_hf(k)/P_su(k)
log[k/(h Mpc⁻¹)]
4
3
2
1
1.2
1.1
1
0.9
0.8
−1.5
−1
−0.5
0
0.5
1

Conclusions

- weak requirement performing better than FLL (anywhere)

- **weak requirement** : per-mil precision level (typical)

  & NO > 1% discrepancy

  strong requirement? No thanks

- Available *Halofit* expressions : no sufficient approximation

  expected: available for a limited range of const.-w models not cover ing WMAP5 parameter range

- *Halofit* extensions to w=const models required soon.