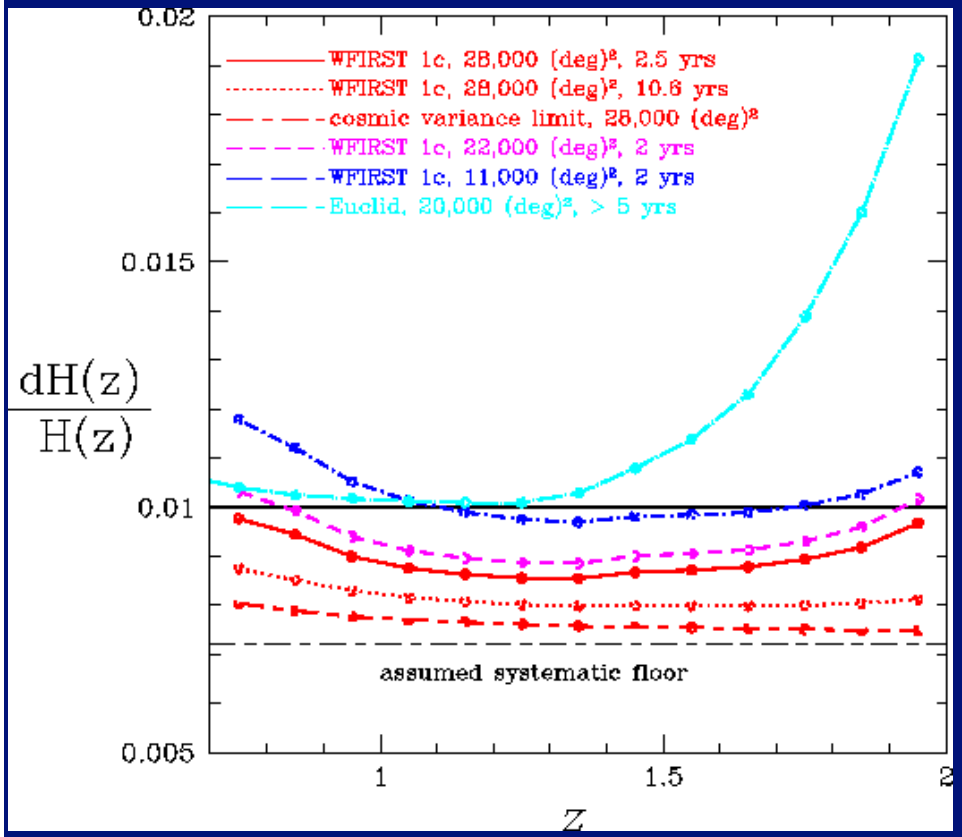
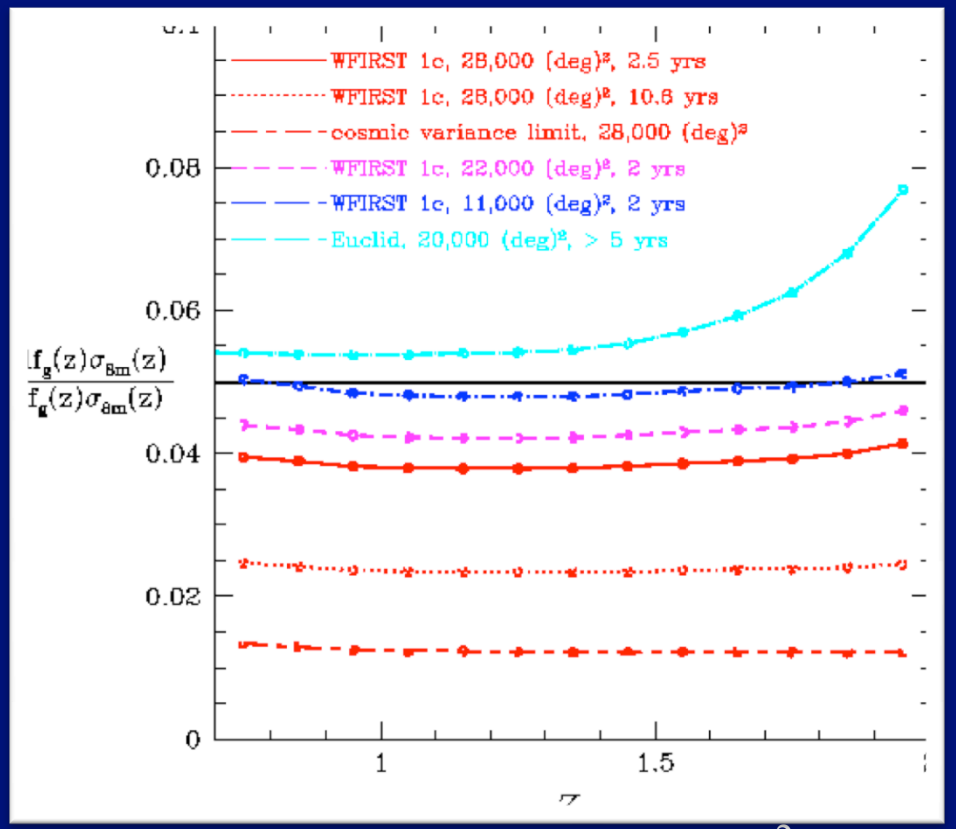
Model-Independent DE FoM of Baryon Acoustic Oscillations & Redshift Space Distortions

Yun Wang, Chuck Bennett,
Chris Hirata, & Rachel Bean

WFIRST SDT #4, May 10, 2011

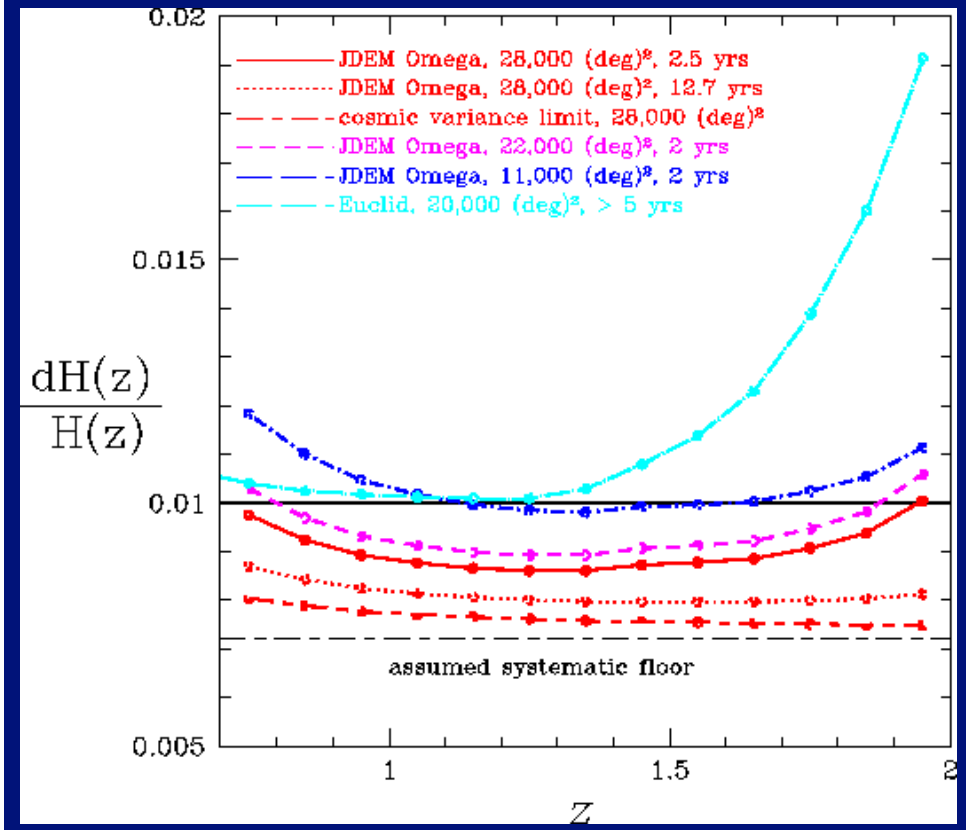
Model-independent FoM for the spectroscopic survey:
* Expansion history H(z) to 1%
* Growth history $f_g(z)$ to 5%

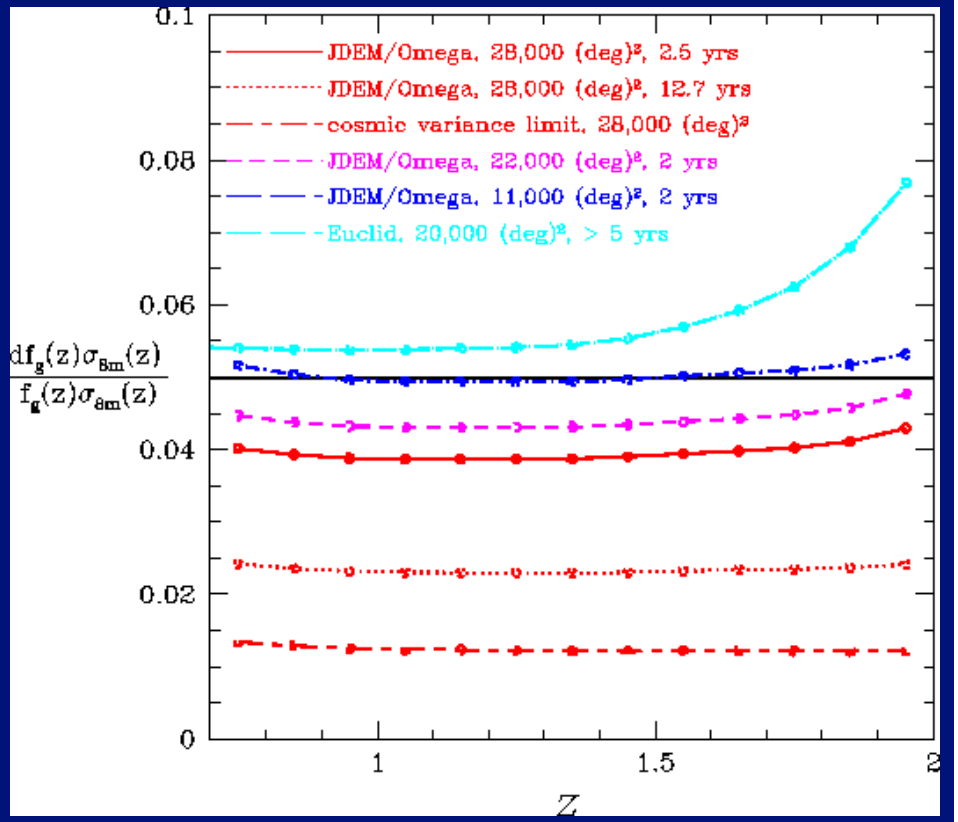




Yun Wang, 5/10/2011

JDEM Omega


JDEM Omega, 28,000 (deg)², 2.5 yrs
JDEM Omega, 28,000 (deg)², 12.7 yrs
cosmic variance limit, 28,000 (deg)²
JDEM Omega, 22,000 (deg)², 2 yrs
JDEM Omega, 11,000 (deg)², 2 yrs
Euclid, 20,000 (deg)², > 5 yrs
assumed systematic floor
dH(z)/H(z)
z


JDEM/Omega, 28,000 (deg)², 2.5 yrs
JDEM/Omega, 28,000 (deg)², 12.7 yrs
cosmic variance limit, 28,000 (deg)²
JDEM/Omega, 22,000 (deg)², 2 yrs
JDEM/Omega, 11,000 (deg)², 2 yrs
Euclid, 20,000 (deg)², > 5 yrs
df_g(z)σ_8m(z) / f_g(z)σ_8m(z)
z

WFIRST 1c BAO/RSD

* Assuming GR
* deep: 2640 deg^2/yr; wide: 11,000 deg^2/yr
* assuming systematic error of 0.2% *sqrt(N_bin) per redshift bin.
* binsize dz=0.1, 0.7<z<2 --> dsys=0.0072 per bin [note that dsys*sqrt(2)=0.0102]
* FoM(ρ_X):== FoM($X_{0.67}$, $X_{1.33}$, X_2)

Survey	FoM(w_0,w_a)	FoM(ρ_X)	dln[H(z=2)*s]	dln[f_g(2)*σ_8(2)]
wide 1 yr + deep 1 yr	167.3	4484.3	0.0107	0.051
wide 2 yrs (22,000 deg^2)	224.8	7491.4	0.0102	0.046
wide 28,000 deg^2 (2.5 yrs)	274.6	10405.6	0.0097	0.041
deep 28,000 deg^2 (10.6 yrs)	594.7	34485.9	0.0081	0.024
comic var. 28,000 deg^2	1706.3	178425.5	0.0075	0.012
Euclid 20,000 deg^2 (>5 yrs)	166.4	5153.7	0.0191	0.077

JDEM Omega BAO/RSD

* Assuming GR
* deep: 2200 deg^2/yr; wide: 11,000 deg^2/yr
* assuming systematic error of 0.2% *sqrt(N_bin) per redshift bin.
* binsize dz=0.1, 0.7<z<2 --> dsys=0.0072 per bin [note that dsys*sqrt(2)=0.0102]
* FoM(ρ_X):== FoM($X_{0.67}$, $X_{1.33}$, X_2)

Survey	FoM(w_0,w_a)	FoM(ρ_X)	dln[H(z=2)*s]	dln[f_g(2)*σ_8(2)]
wide 1 yr + deep 1 yr	160.0	4170.2	0.0111	0.053
wide 2 yrs (22,000 deg^2)	217.0	7126.1	0.0106	0.048
wide 28,000 deg^2 (2.5 yrs)	264.9	9896.1	0.0100	0.043
deep 28,000 deg^2 (12.7 yrs)	610.6	36140.6	0.0081	0.024
comic var. 28,000 deg2	1706.3	178425.5	0.0075	0.012
Euclid 20,000 deg2 (>5 yrs)	166.4	5153.7	0.0191	0.077

Yun Wang, 4/14/2011

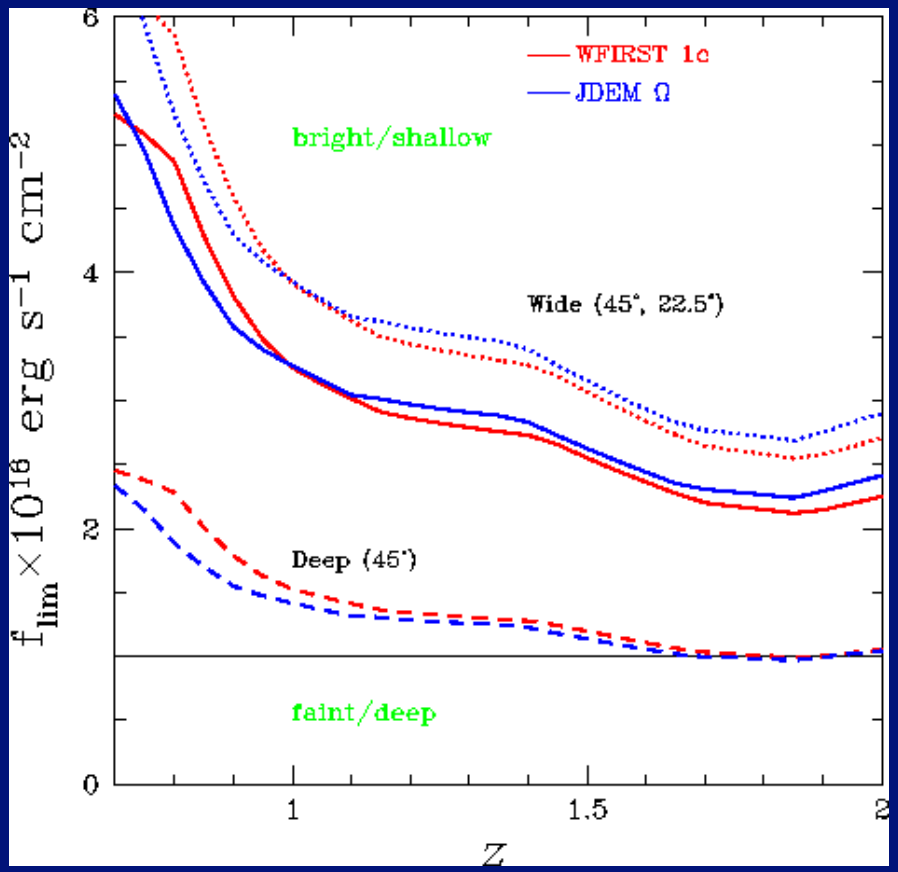
Extra Slides

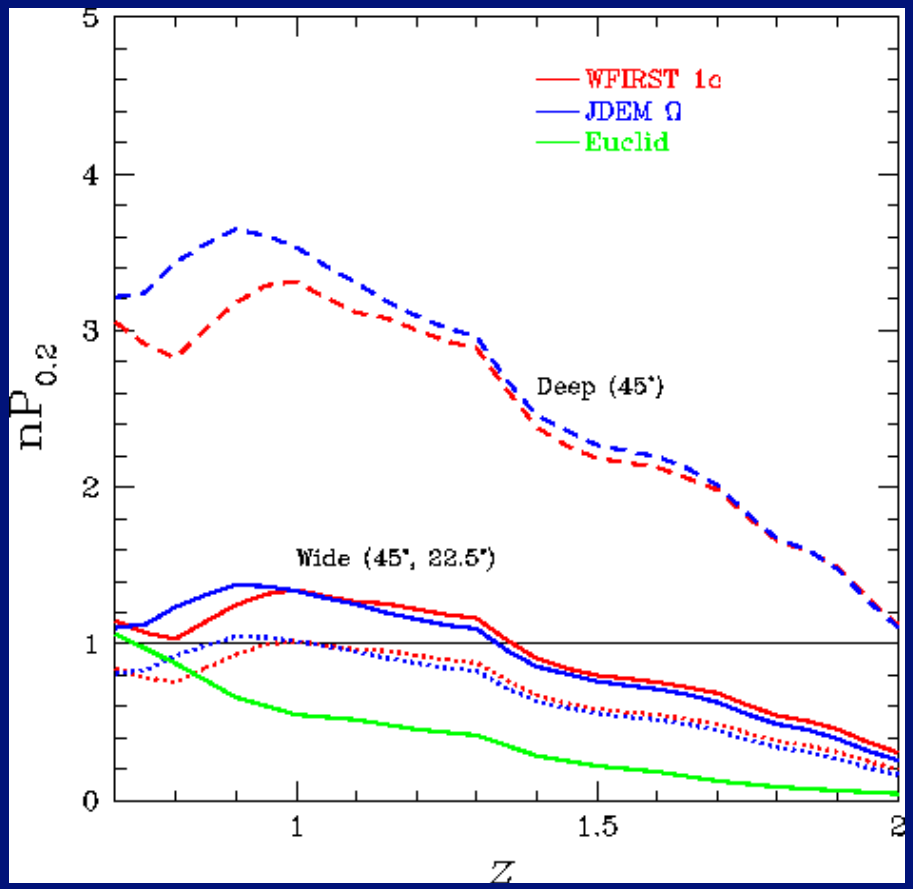
WFIRST BAO/RSD Capability

WFIRST: WL/BAO/RSD: 2640 deg^2/yr; BAO/RSD only: 11,000 deg^2/yr

Euclid WL/BAO/RSD: < 4000 deg^2/yr

* WFIRST is ~ 5 times more sensitive than Euclid





Yun Wang, 4/14/2011

JDEM/Ω versus WFIRST/1c

- JDEM/Ω: D=1.5m obstructed configuration (FoV=0.532 deg^2)
- WFIRST/1c: D=1.3m unobstructed configuration (FoV=0.448 deg^2)

- Insignificant gain in DE FoM for BAO/RSD:
  - Overall galaxy yields differ only at 1-2% level, with the smaller PSF for WFIRST/1c (particularly at longer wavelengths) roughly balanceing the shorter exposure times driven by the smaller FoV.

Measuring DE & Testing GR

*BAO/RSD only. Testing GR by measuring γ

Stage III+	FoM(w0,wa)	$d\gamma$
WFIRST deep (2 yrs)	956.17	0.0328
WFIRST wide (2 yrs)	1356.70	0.0269
WFIRST deep+wide (1yr+1yr)	1076.76	0.0305
Euclid (> 5 yrs)	1109.58	0.0236
Stage III	90.64	0.2

If GR is not modified

*Assuming GR (fixing γ), BAO/RSD only

	No priors		+ Stage III	
	no RSD	+RSD	no RSD	+RSD
WFIRST deep (2 yrs)	46.94	142.28	1038.19	1391.85
WFIRST wide (2 yrs)	93.88	284.56	1422.17	2073.47
WFIRST deep+wide (1yr+1yr)	58.00	173.93	1150.25	1575.16
Euclid (>5 yrs)	74.80	210.21	1132.41	1716.44
Stage III	---	---	---	116.06