

# **Baryon Acoustic Oscillations and Redshift Space Distortions Subgroup Progress Report**

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# Overview

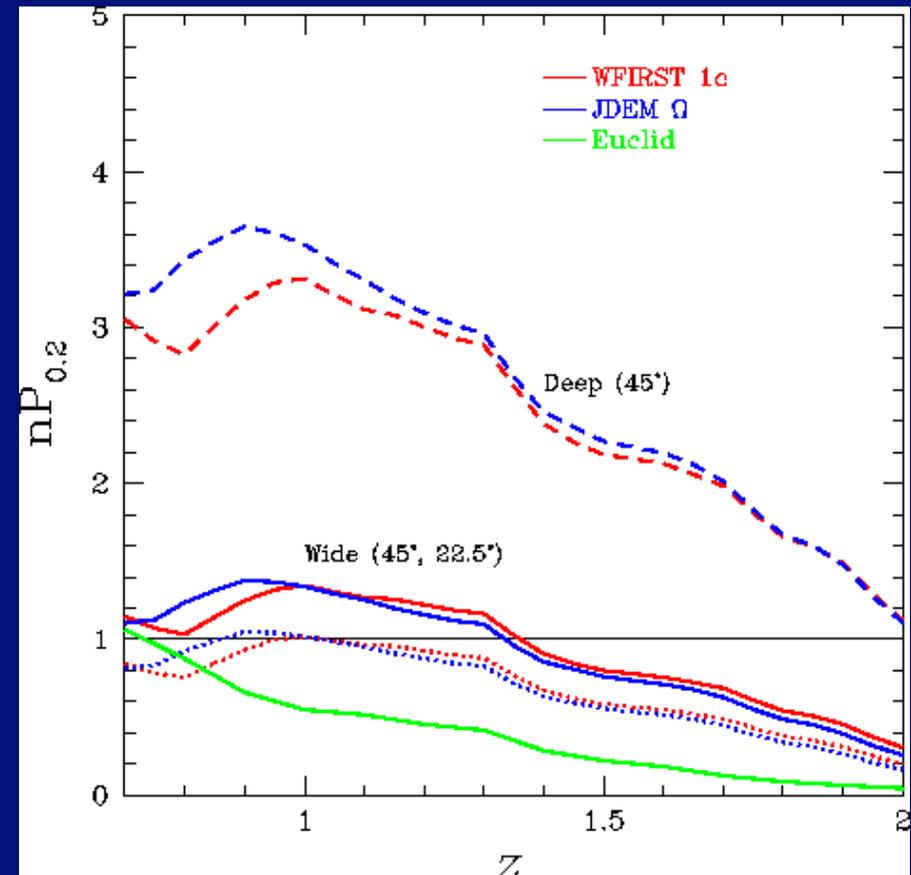
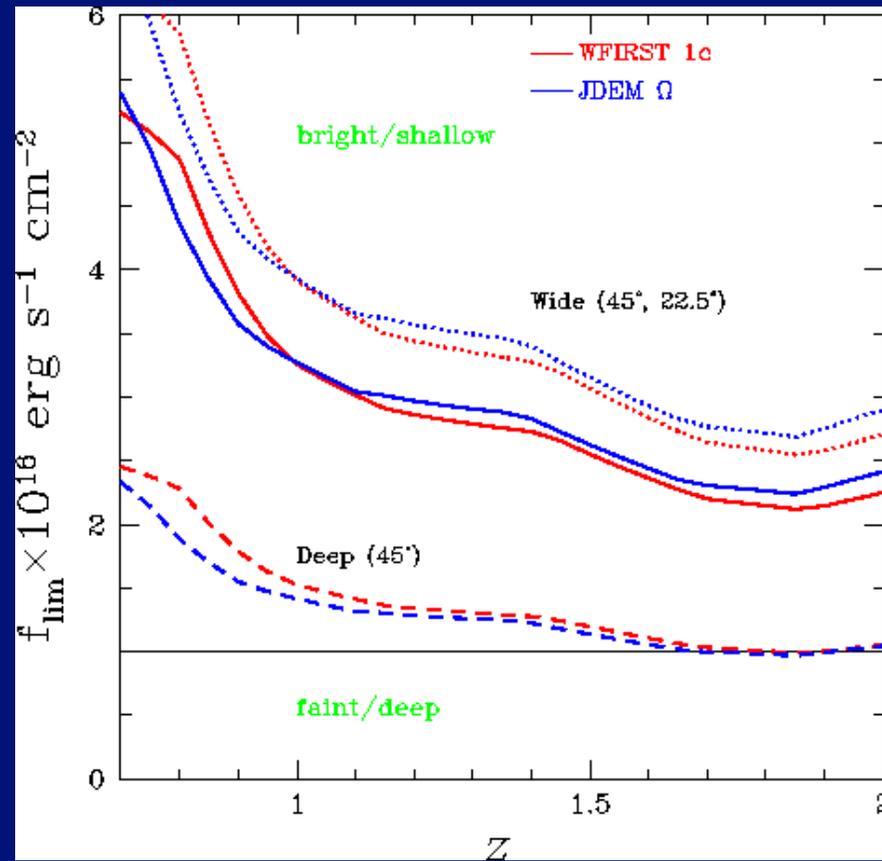
- WFIRST BAO/RSD survey is defined by
  - Upper bound: A cosmic-variance limited BAO survey over  $\sim 28,000$   $\text{deg}^2$  is the best possible survey
  - Lower bound: A BAO survey significantly better than what will be done from the ground by the time of WFIRST data release
- The NWNH panel specified a requirement of 200 million galaxies, which implies a  $\sim 28,000$   $\text{deg}^2$  spectroscopic survey.
- A fast and wide BAO/RSD survey is strongly recommended
  - Its implications are explored in terms of FoM under current constraints
  - It improves the dark energy FoM
  - It complements a deeper combined WL/BAO/RSD survey

# WFIRST BAO/RSD Capability

WFIRST: WL/BAO/RSD: 2640 deg<sup>2</sup>/yr; BAO/RSD only: 11,000 deg<sup>2</sup>/yr

Euclid WL/BAO/RSD: < 4000 deg<sup>2</sup>/yr

\* WFIRST is ~ 5 times more sensitive than Euclid



# JDEM/ $\Omega$ versus WFIRST/1c

- JDEM/ $\Omega$ : D=1.5m obstructed configuration  
(FoV=0.532 deg<sup>2</sup>)
- WFIRST/1c: D=1.3m unobstructed configuration  
(FoV=0.448 deg<sup>2</sup>)
- 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 balancing the shorter exposure times driven by the smaller FoV.

# Measuring DE & Testing GR

\*BAO/RSD only. Testing GR by measuring  $\gamma$

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

# DE Forecasting from BAO/RSD

- Propagate the measurement errors in  $\ln P_g(k)$  into measurement errors for the parameters  $p_i$ :

$$F_{ij} = \int_{k_{\min}}^{k_{\max}} \frac{\partial \ln P_g(\mathbf{k})}{\partial p_i} \frac{\partial \ln P_g(\mathbf{k})}{\partial p_j} V_{\text{eff}}(\mathbf{k}) \frac{d\mathbf{k}^3}{2(2\pi)^3}$$

- $\Delta \ln P_g(k) \propto [V_{\text{eff}}(k)]^{-1/2}$

$$V_{\text{eff}}(\mathbf{k}) = \int d\mathbf{r}^3 \left[ \frac{n(\mathbf{r}) P_g(k, \mu)}{n(\mathbf{r}) P_g(k, \mu) + 1} \right]^2$$

$$= \left[ \frac{n P_g(k, \mu)}{n P_g(k, \mu) + 1} \right]^2 V_{\text{survey}}$$

$$\mu = \mathbf{k} \cdot \mathbf{r} / kr$$

# Systematics Included in the BAO/RSD Forecast:

- Nonlinear effect: 50% reduction in NL damping via reconstruction of linear density field with  $k_{\max}=0.5h/\text{Mpc}$  (standard in BAO forecasting)
- Floor systematics in  $H(z)$  and  $D_A(z)$ : 0.2% per 0.1  $z$  bin [to be increased to  $0.2\%(N_{\text{bin}})^{1/2}$  per  $z$  bin]
- Random smearing by peculiar velocities of 290 km/s along the line of sight

# Extra Slides

# If GR is not modified

\*Assuming GR (fixing  $\gamma$ ), 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