Cosmology with the 6dF Galaxy Survey

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International Centre for Radio Astronomy Research

Outline

Program for the next 20min.

- The 6dF Galaxy Survey.

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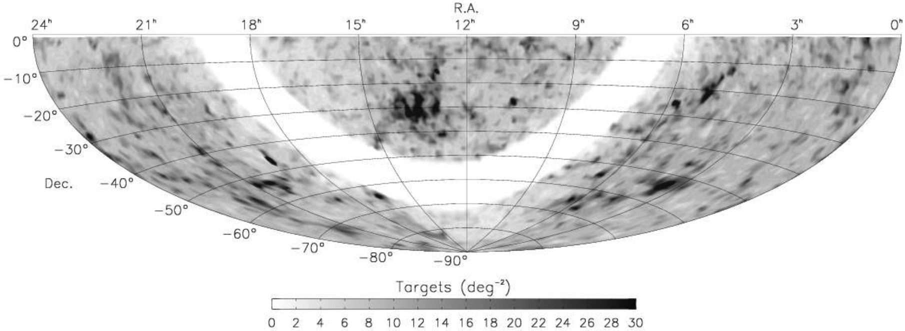
- Predictions for WALLABY using 6dFGS.

What is 6dFGS?

- Spectroscopic survey of southern sky (17,000 deg^2).
- Primary sample from 2MASS with $K_{tot} < 12.75$; also secondary samples with $H < 13.0$, $J < 13.75$, $r < 15.6$, $b < 16.75$.
- Median redshift 0.05 ($\approx$ 150 Mpc).
- Effective volume $\approx 2x10^7 h^{-3} Mpc^3$.
- 125.000 redshifts (137.000 spectra).



The correlation function

What is a correlation function?

$$dP = \overline{n}^2(1 + \xi(r_{12}))dV_1 dV_2$$

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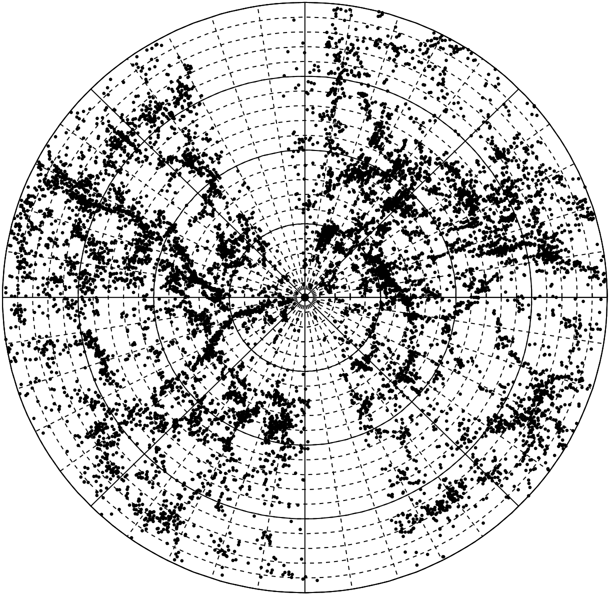

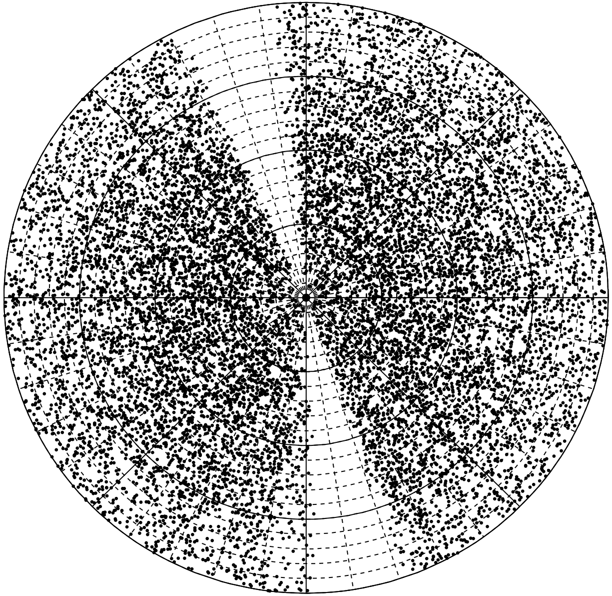

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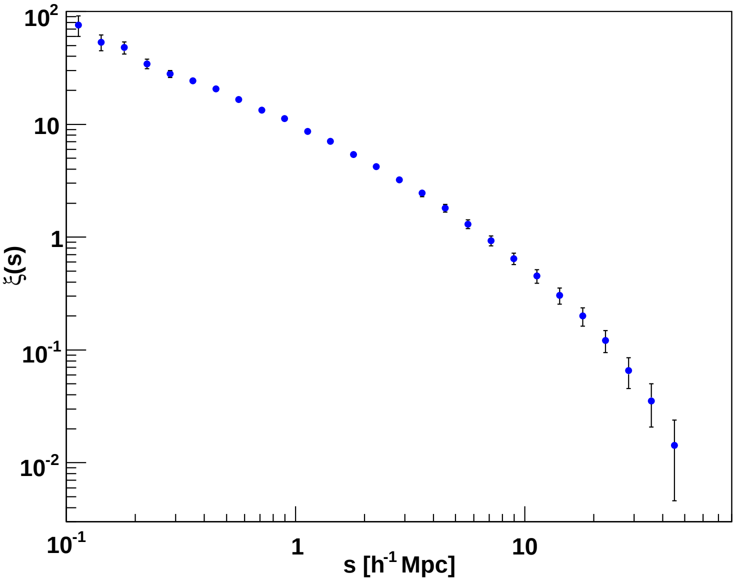
3. The correlation function can be calculated via

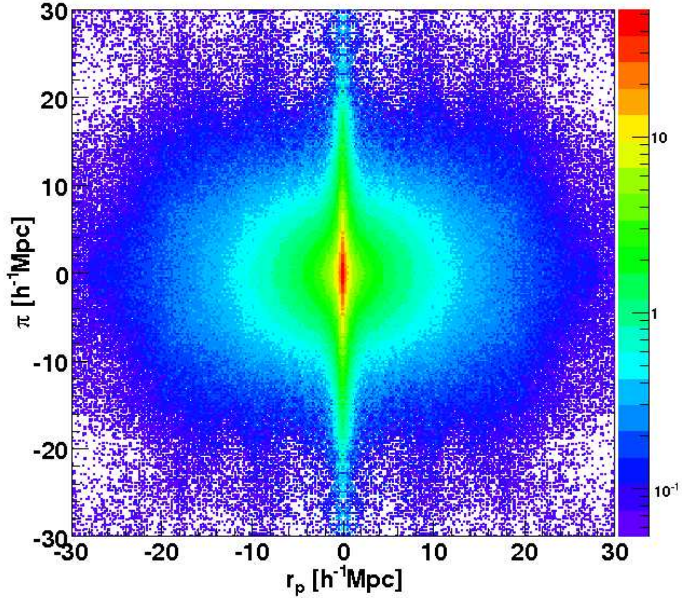
$$\xi(s) = \frac{DD(s)}{RR(s)} - 1$$

(In my analysis I used the Landy & Salay estimator)

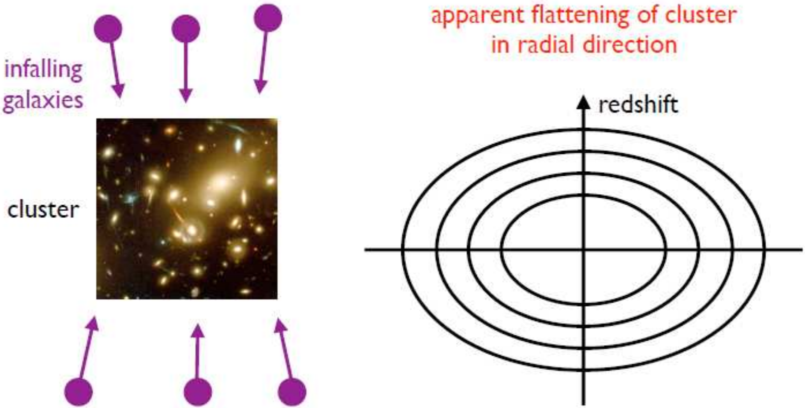
6dF correlation function



6dF 2D correlation function



Redshift space distortions



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f = growth rate, $b \approx 1.22$, $\Omega_m = \frac{\rho_m}{\rho_0}$

Theoretical predictions for γ:
ΛCDM: $\gamma = 0.55$

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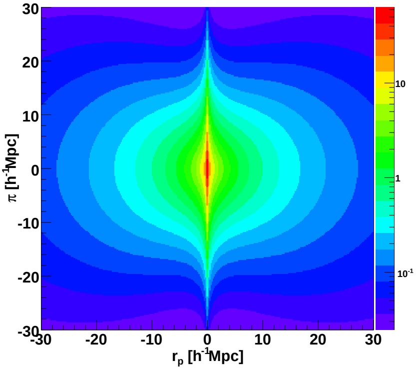

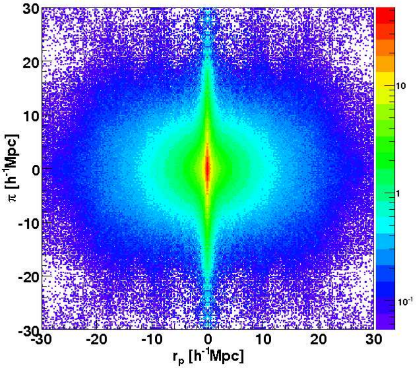

Model free parameters: $\beta, \sigma_v, r_0, \gamma$

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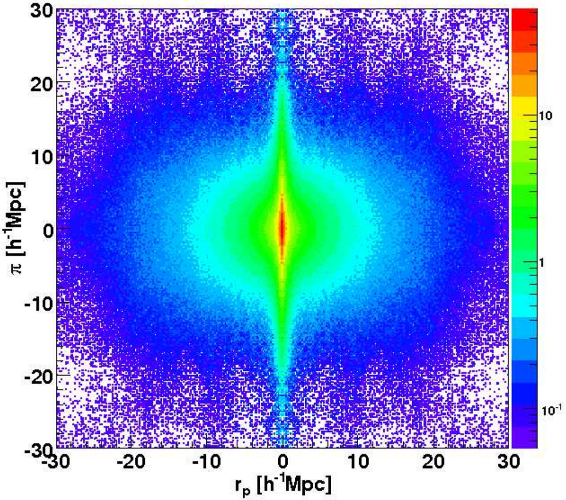

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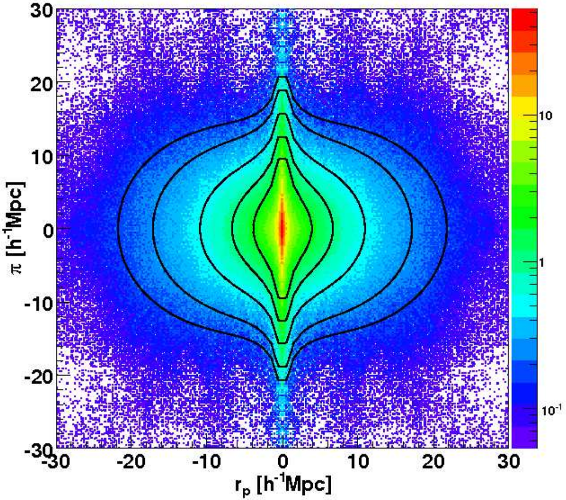

$\beta = 0.44 \pm 0.04, \sigma_v = 586 \pm 51, r_0 = 6.01 \pm 0.09, \gamma = 1.75 \pm 0.03$

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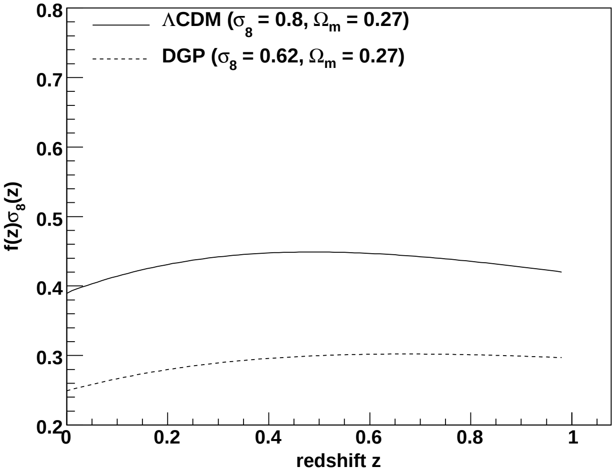
Testing general relativity



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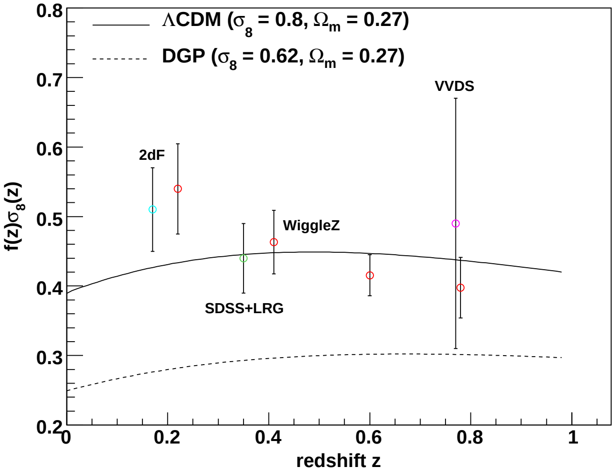

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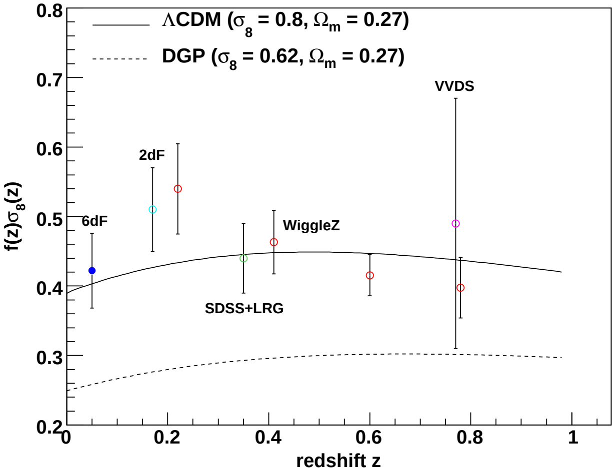

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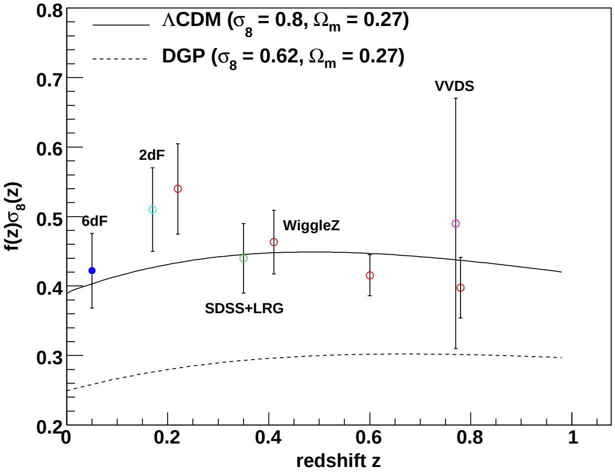
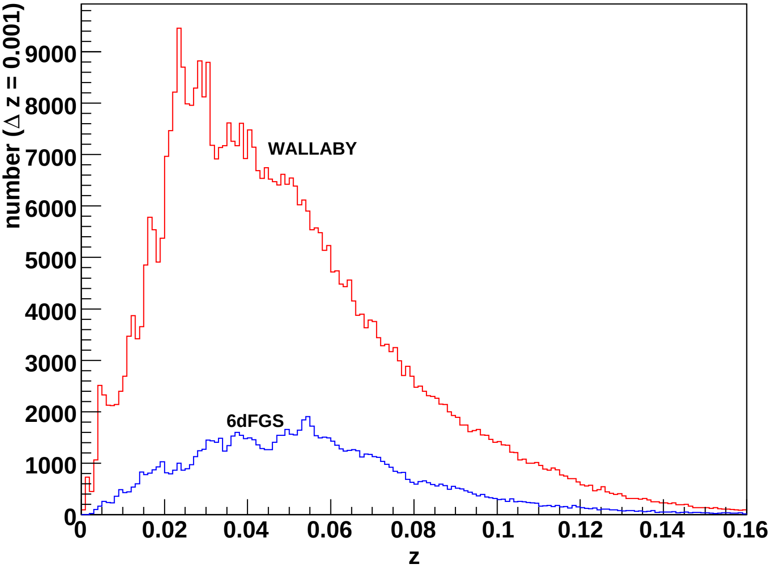


$$\Lambda\text{CDM} : \gamma = 0.51 \pm 0.1 \text{ (predicted } \gamma = 0.55)$$

$$\text{DGP} : \gamma = 0.31 \pm 0.1 \text{ (predicted } \gamma = 0.69)$$

What can we learn about WALLABY using 6dFGS?

Compare 6dfGS with WALLABY



Correlation function error

Jack-knife and Poisson error:

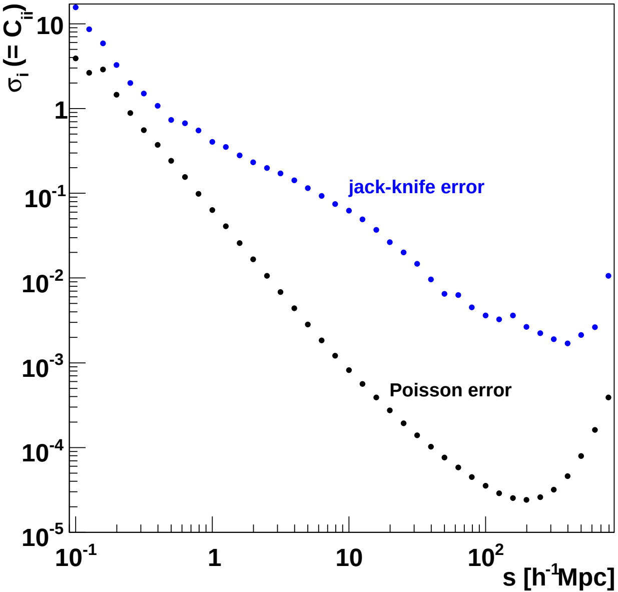
$$\sigma_{jk}(s) = \sqrt{\frac{(N-1)}{N}\sum_{k=1}^{N}(\xi^k(s) - \bar{\xi}(s))^2}$$

$$\sigma_{\text{Poisson}}(s) = \frac{1+\xi(s)}{\sqrt{DD(s)}}$$

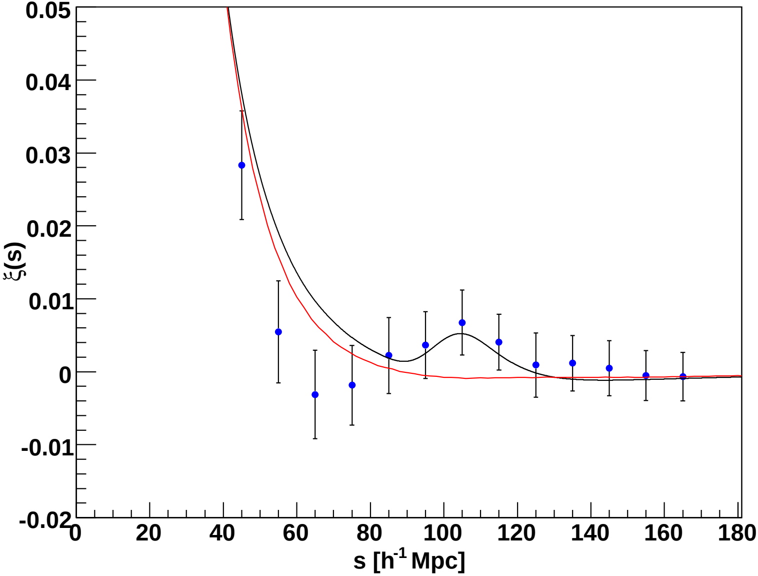
with the mean value of ξ

$$\bar{\xi}(s) = \sum_{k=1}^{N}\xi^k(s)/N$$

Correlation function error



BAO peak in the correlation function



Conclusion

- Gravitational evolution introduces distortion in the redshift space correlation function (redshift-space distortions).
- Redshift space distortions allow an estimate of Ω_m.
- Redshift space distortions allow to test theories of gravity.
- Since 6dF and WALLABY are both cosmic variance limited at large scales the BAO detections will have a comparable S/N.

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Thank you