Probing the Isotropy of Cosmic Acceleration Using Different Supernova Samples

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Introduction

Recent studies indicated that an anisotropic cosmic expansion may exist. We use four data sets of type Ia supernovae (SNe Ia) to probe the isotropy of cosmic acceleration. We also study the effects of anisotropic coordinate and redshift distribution on fitting results.

Data and Methods

Data sets	Sample size	z up to
Union2.1	580	1.414
Constitution	397	1.55
JLA	740	1.30
Paetheon	1048	2.30

Dipole fitting assumes a dipolar deviation on redshift-distance modulus relation, then derives the dipole's direction and magnitude using statistic approaches.

Hemisphere comparison divides samples into two hemispheres perpendicular to a polar axis, then fits cosmological parameters using samples in each hemisphere independently and compares their differences.

Summary

- **No anisotropic deviation** of significance from ΛCDM model was found.
- Redshift tomography results show slightly **larger anisotropy at lower redshift range**.
- Using **Cartesian components** rather than spherical coordinates as parameters for dipole fitting yields **more reasonable results**.
- Anisotropy distribution of **coordinates** can cause fitted dipole direction to concentrate in places where samples density deviate from the average most, cause dipole magnitude to become larger.
- Anisotropy distribution of **redshifts** does *not* have a significant influence on fitting results.

Know More about My Work

Title: **Probing the isotropy of cosmic acceleration using different supernova samples**
arXiv:1804.05191

Title: **Testing the anisotropy of cosmic acceleration from Pantheon supernovae sample**
arXiv:1804.05191v1

Results

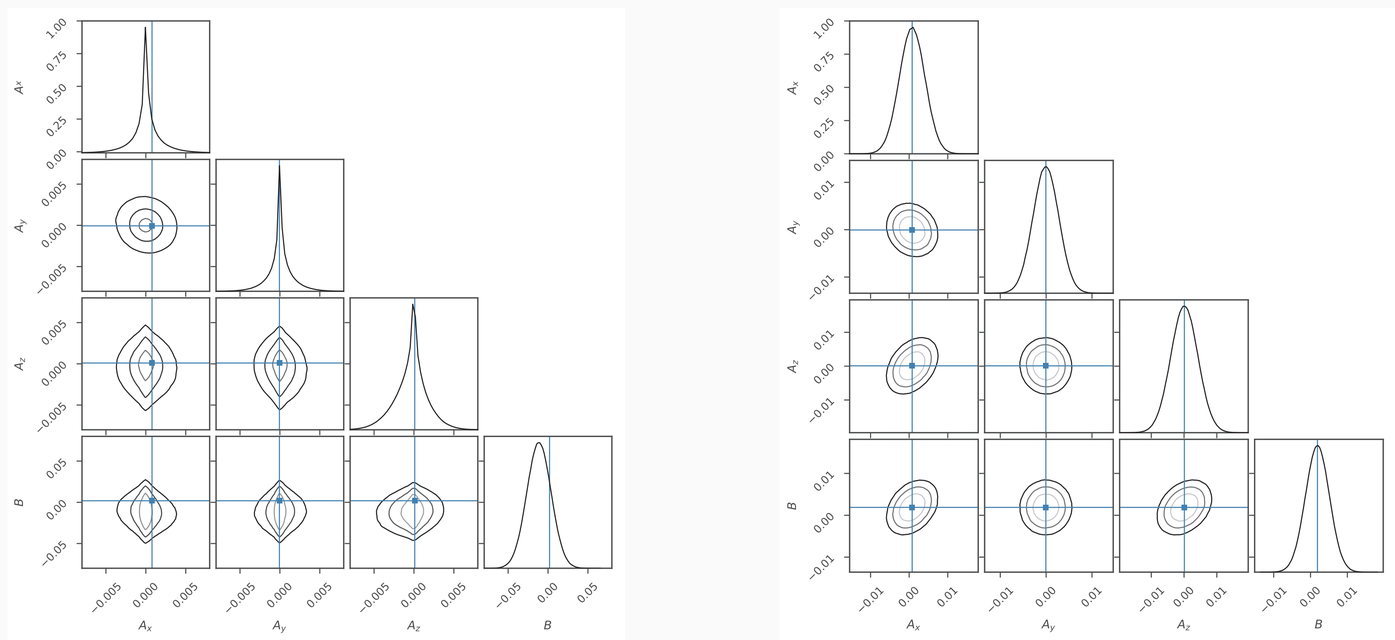
data sets	Union 2.1	Constitution	JLA	Paetheon
l	$309.3^{\circ}{}^{+15.5^{\circ}}_{-15.7^{\circ}}$	$67.0^{\circ}{}^{+66.5^{\circ}}_{-66.2^{\circ}}$	94.4°	329°
b	$-8.9^{\circ}{}^{+11.2^{\circ}}_{-9.8^{\circ}}$	$-0.6^{\circ}{}^{+25.2^{\circ}}_{-26.3^{\circ}}$	-51.7°	37°
A	$(1.46 \pm 0.56) \times 10^{-3}$	$(4.4 \pm 5.0) \times 10^{-4}$	7.8×10^{-4}	7.8×10^{-4}
B	$(-2.6 \pm 2.1) \times 10^{-4}$	$(-0.2 \pm 2.4) \times 10^{-4}$	1.9×10^{-3}	-1.3×10^{-4}
C.L.	98.3%	19.7%	0.23%	47%

Table 1: Best-fitting results of dipole and monopole for four data sets.

The poster is too small to fit all the results. Readers interested in examine the full results could check the online e-prints.

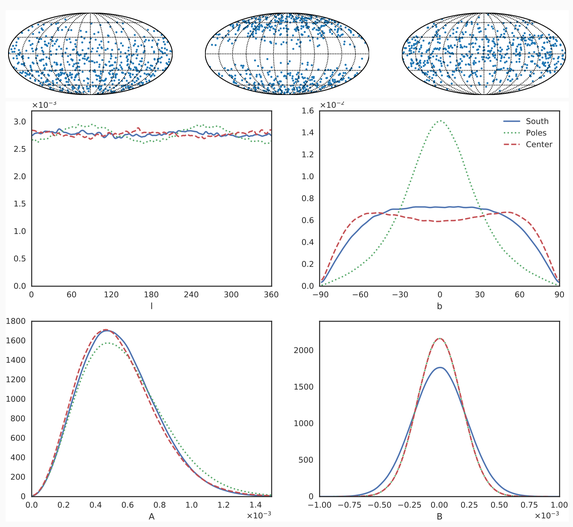
Discussions

1 Different Choice of Fitting Parameters



Fitting spherical parameters directly causes unreasonable spikes when convert to Cartesian coordinates.

2 Anisotropic Coordinate Distribution



we generate three kinds of synthetic data sets with specific coordinate distributions.
The probability density function of the randomly-generated coordinates are propotional to $1 - \sin(b)$, $\sin^2(b)$ and $\cos^2(b)$, respectively. In other words, the coordinates are concentrated on the south galactic pole, both galactic poles and the galactic plane, respectively, as is shown in Figure 2.
The fitted results are shown in Figure 3.

3 Anisotropic Redshift Distribution

The spatial distribution of redshifts can be anisotropic, i.e., the redshift of samples in one patch of the sky may be generally smaller than another patch of sky. We shuffle the coordinates in the original data set. We find that the fitting results does not show deviation from original datasets.

References

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