

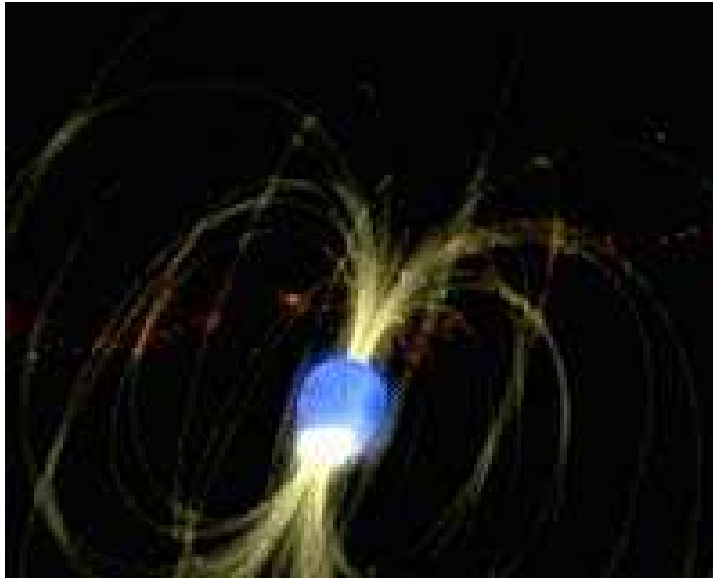
# On the Parallax of Geminga

Frederick M. Walter  
and  
Jacqueline Faherty

Department of Physics and Astronomy  
Stony Brook University  
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Coinvestigators:  
J. Lattimer & G. Pavlov

# Geminga



- An object of fundamental importance
- An intermediate-age neutron star
- The nearest of the  $\gamma$ -ray pulsars

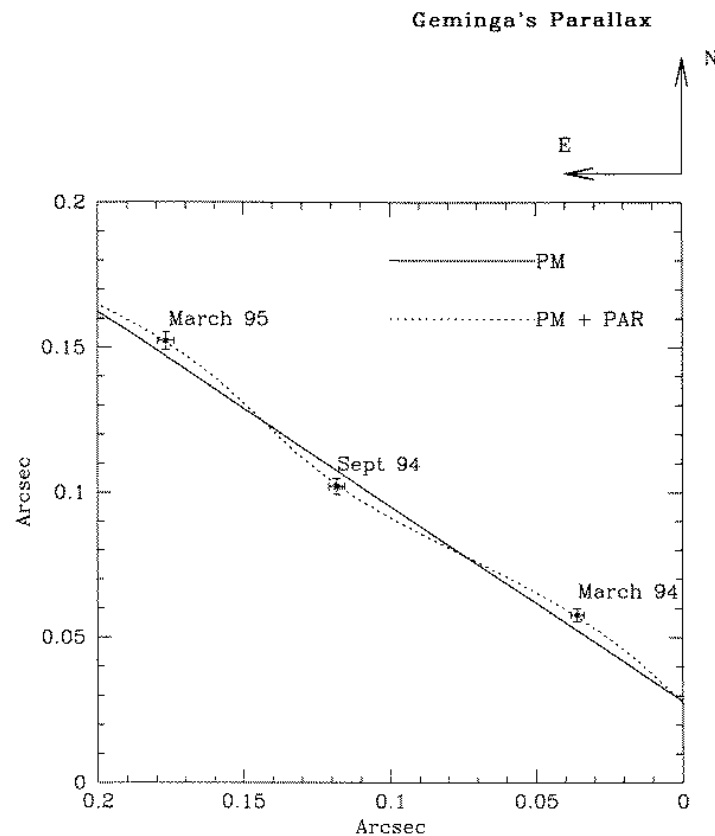
## Why Worry about the Distance?

- Neutron star radius constrains the equation of state
- Thermal emission gives model-dependent angular diameter
- Geminga has a thermal soft X-ray spectrum
- A precise distance determination will give a useful radius.

## What Is Known

Geminga is thought to be a runaway from Orion OB1a (330 pc).

Carraveo et al.<sup>1</sup> deduced a distance of  $157^{+59}_{-34}$  pc, based on three WFPC2 images. We have not been able to confirm this.



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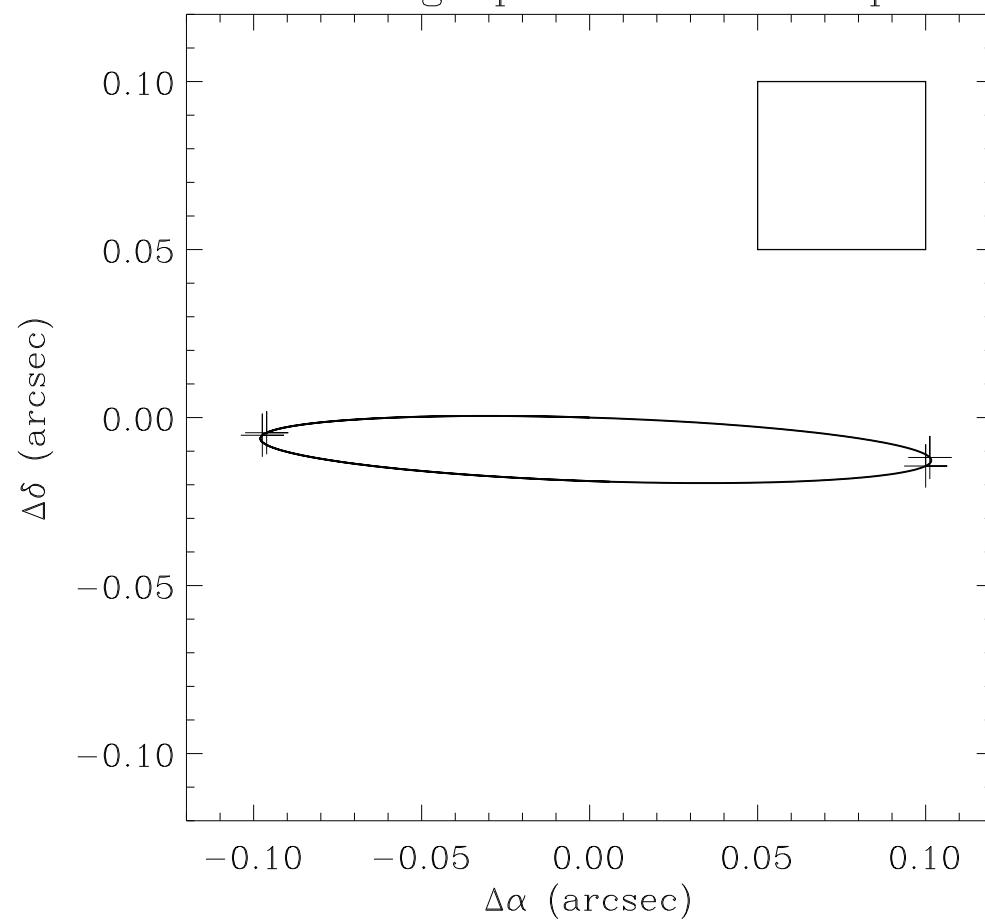
<sup>1</sup>ApJL, 461, L91, 1996

## **The Experiment**

- Obtain deep ACS/WFC V band images
- Large field gives better astrometric grid
- Observations in March and September, at maximum parallactic shift
- Minimum of three observations required to separate parallax and proper motion.
- Minimize differential distortions

# The Scale

Geminga parallax at 200 pc



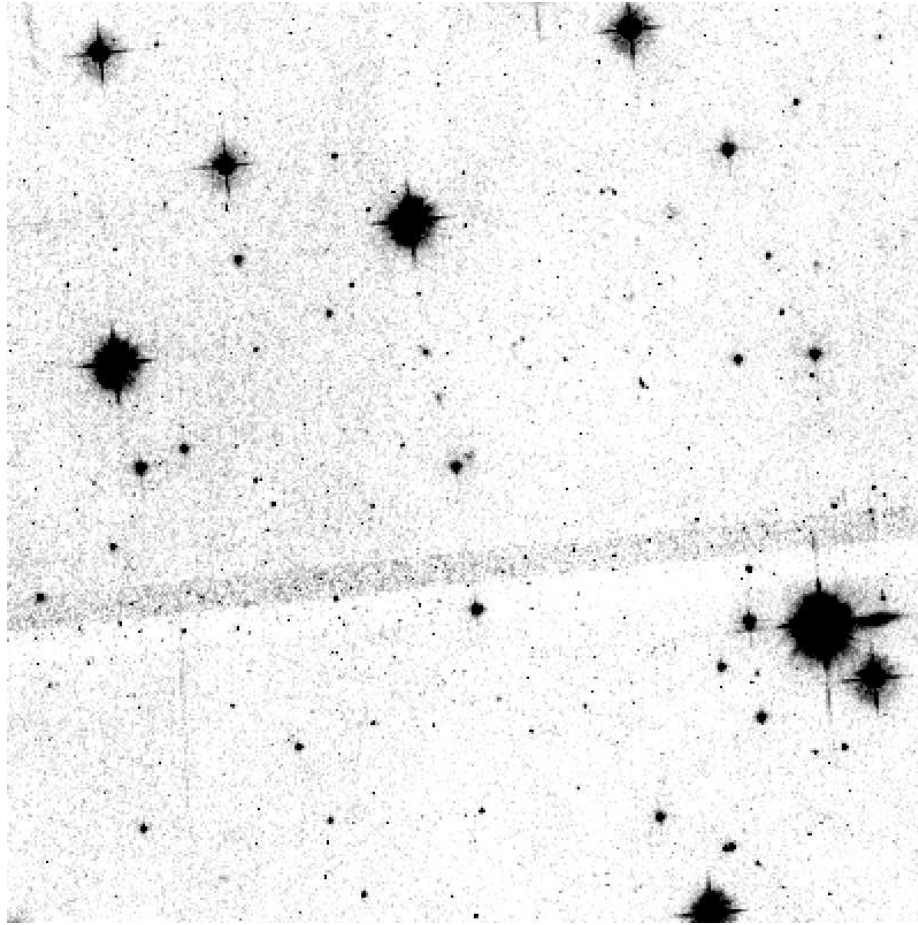
## The Observations

| Date        | Time     |
|-------------|----------|
| 2003 Oct 7  | 6300 sec |
| 2004 Mar 18 | 6840 sec |
| 2004 Sep 21 | 6858 sec |
| 2005 Mar 22 | 6852 sec |

F555W filter to maximize throughput.

All images were dithered.

## The ACS Images

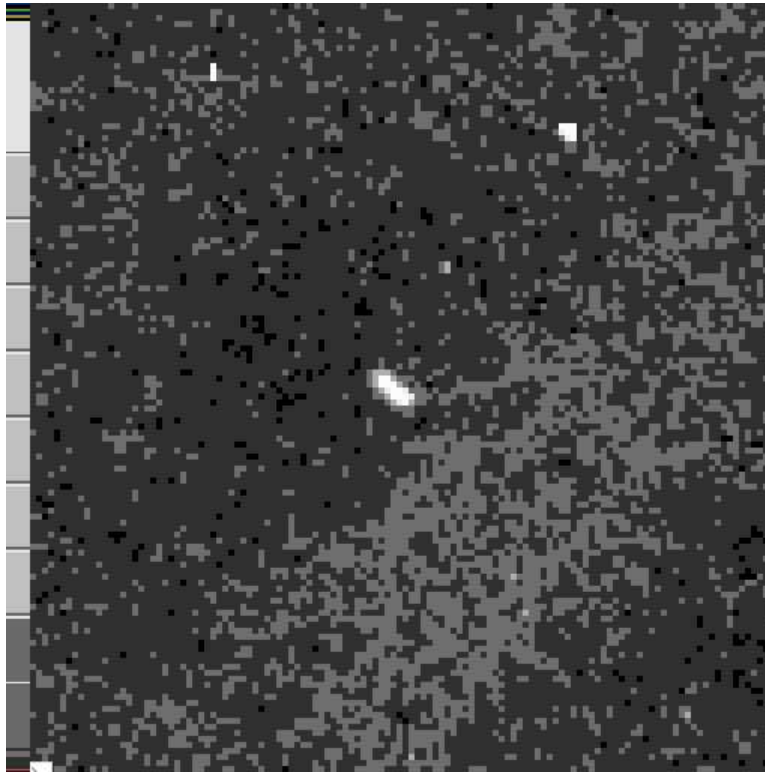




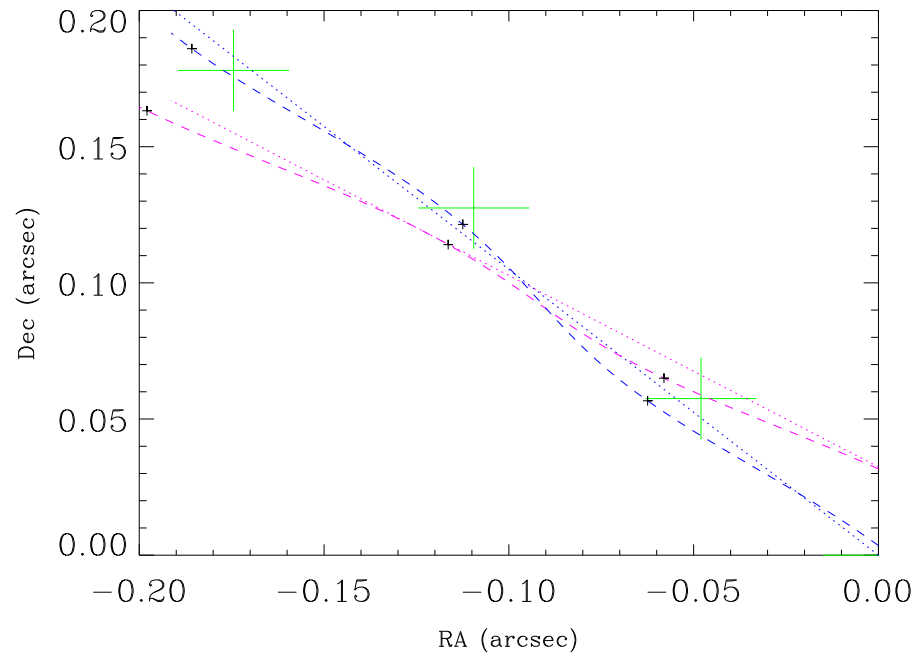
## Simple-Minded Analysis

- Use the drizzled images.
- Identify the stars
- Measure positions of about 100 background stars
- Measure position of Geminga relative to field
- Analyze motion

It Moves!



## The Initial Result



The proper motion is 0.17 arcsec/year, as expected. The position angle is 10 degrees CW from Carraveo's.

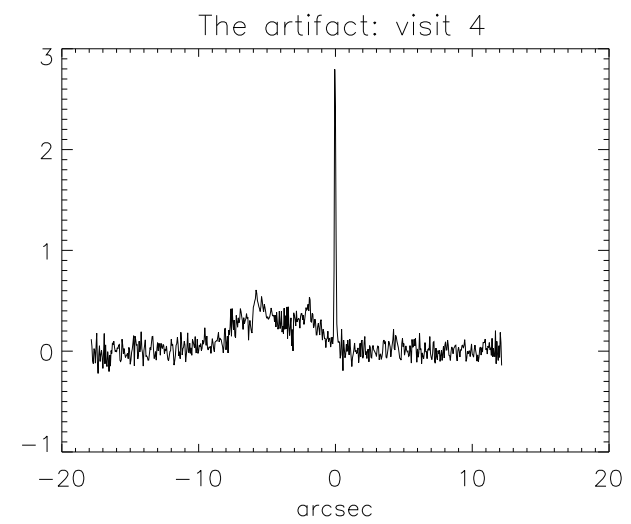
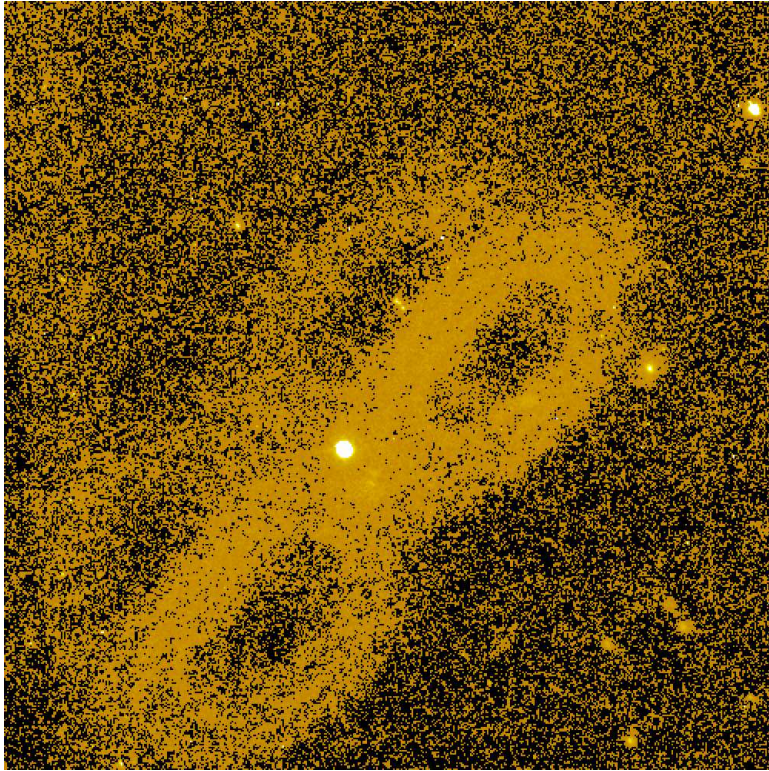
## Parallaxes with the ACS/WFC

- Still a rather poorly calibrated instrument  
(we need 0.01 pix accuracy!)
- An axial instrument - asymmetric distortions.
- Distortion coefficients have been computed  
(J. Anderson)
- position-dependent PSFs are being developed.<sup>2</sup>
- We expect to obtain  $<0.01$  pix (5 mas) accuracy

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<sup>2</sup>J. Anderson, private communication

# The Artifact



And the Parallax is...

And the Parallax is...

$$\mathbf{0.0037}^{+.0016}_{-.0009} \text{ arcsec}$$
$$(273 \pm 84 \text{ pc})$$

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$$\mathbf{0.0037}^{+.0016}_{-.0009} \text{ arcsec}$$
$$(273 \pm 84 \text{ pc})$$

See you in April in London