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Full-sky AS ing Explorer





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S.D. Horner¹, M.E. Germain¹, T.P. Greene²,
K.J. Johnston¹, D.G. Monet¹, M.A. Murison¹,
J.D. Phillips³, R.D. Reasenber³, P.K. Seidelmann¹,
and S.E. Urban¹

¹United States Naval Observatory

²Lockheed Martin Missiles and Space Advanced
Technology Center

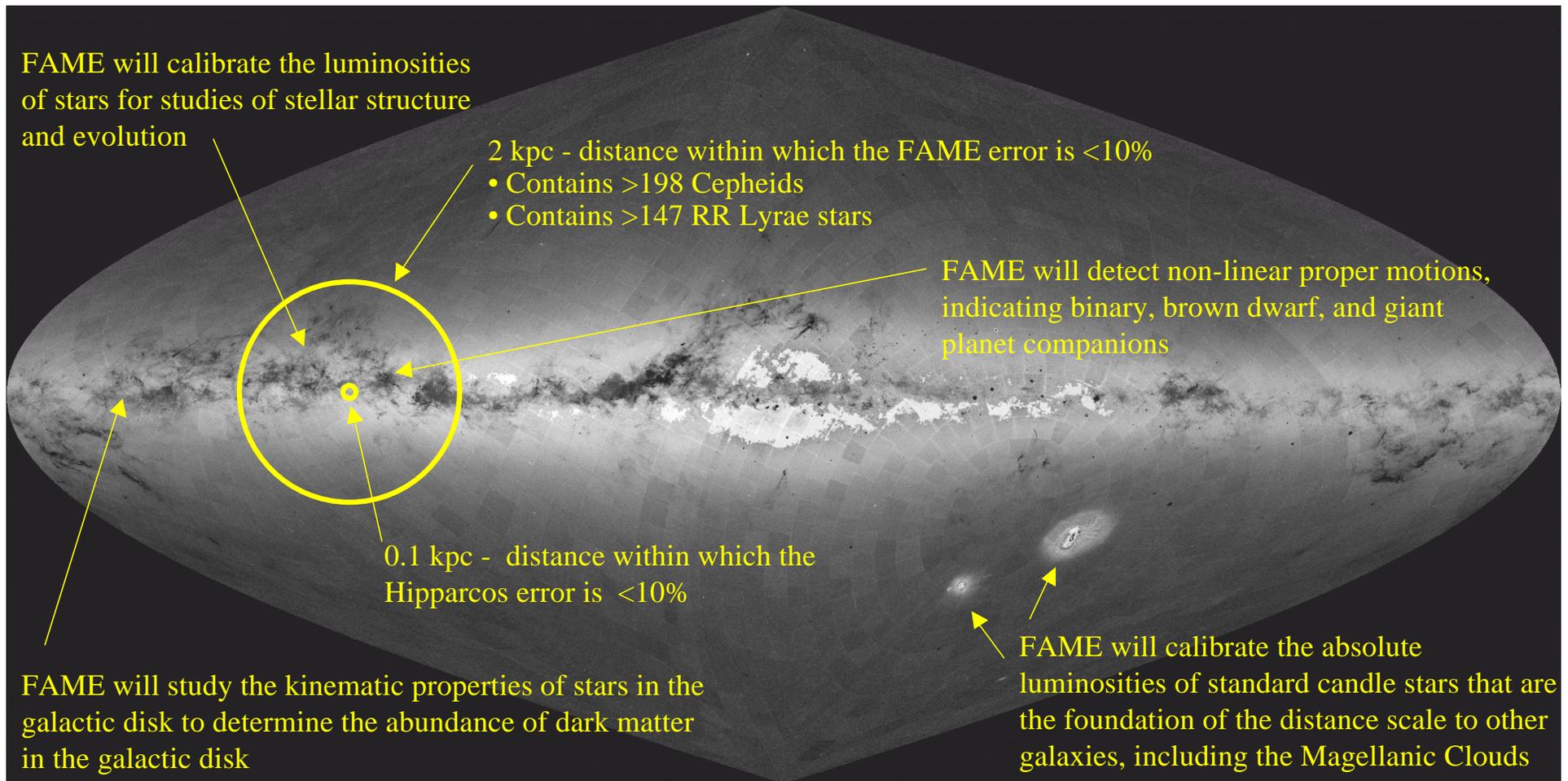
³Smithsonian Astrophysical Observatory

Introduction

- ➔ FAME is a small satellite to perform an all sky, astrometric survey with unprecedented accuracy
 - ➔ Upgrades existing star catalogs by providing a precision optical reference frame of 4×10^7 Stars
 - ➔ Provides positions of all Bright Stars ($5 < m_v < 9$) to $< 50 \mu\text{as}$
 - ➔ Provides positions of fainter stars ($9 < m_v < 15$) to $< 300 \mu\text{as}$
 - ➔ 2.5 year mission allows for accurate measurement of stellar parallaxes and proper motions
 - ➔ Photometric data in four Sloan DSS bands (g', r', i', z')
 - ➔ Measure the positions, parallaxes, and four-color magnitudes of 40 million stars brighter than 15th visual magnitude

- ➡ Measure with 10% error or better the absolute trigonometric parallaxes, positions, and proper motions of stars brighter than 9th visual magnitude within 2 kpc of the Sun
- ➡ Measure the positions, trigonometric parallaxes, and proper motions of all stars out to 15th visual magnitude with accuracies of:
 - 50 μ as at 9th visual magnitude
 - 300 μ as at 15th visual magnitude

FAME Coverage of the Milky Way

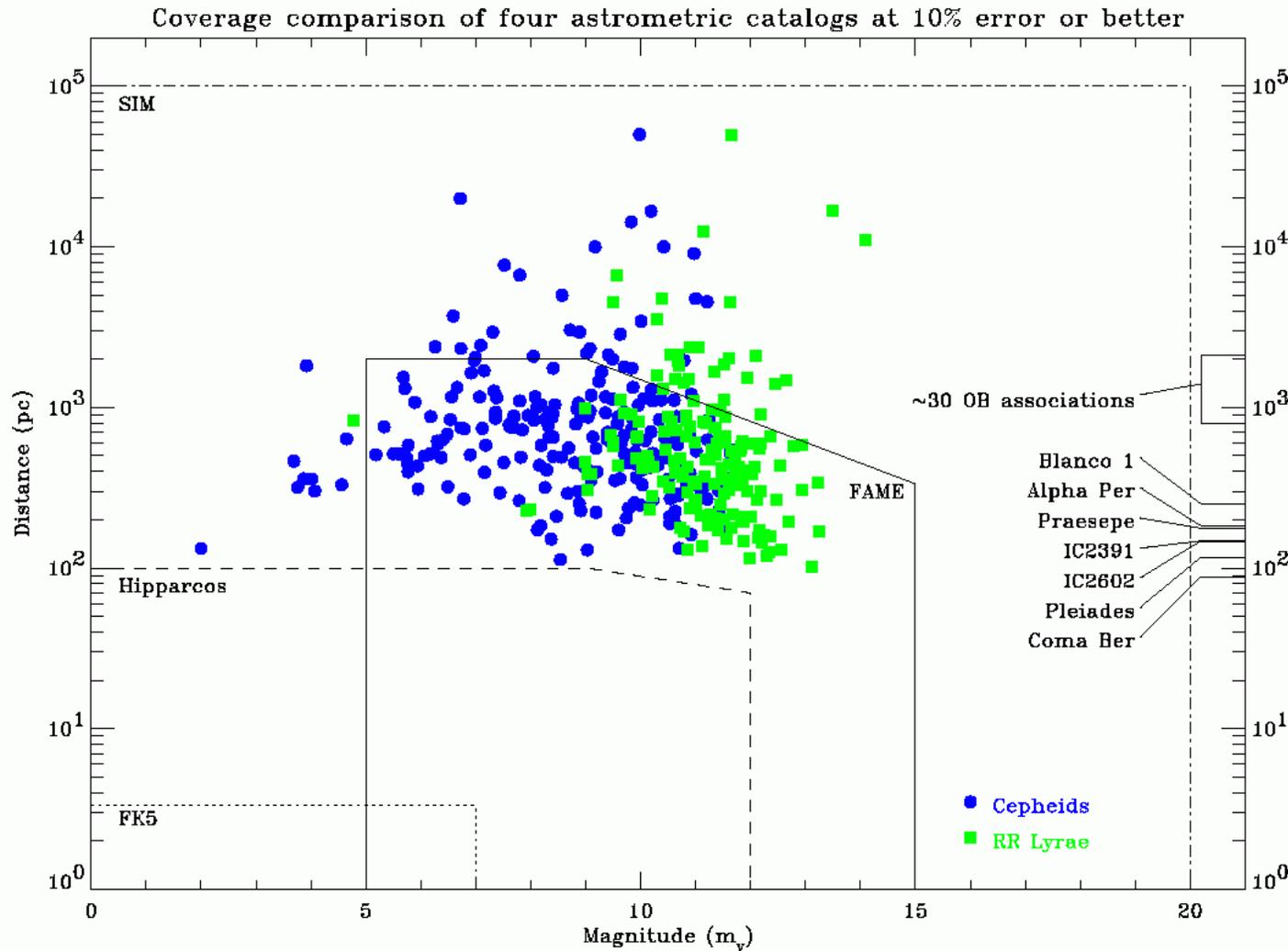


FAME Science - FAME will map our quadrant of the galaxy out to 2 kpc from the Sun providing the information needed to calibrate the standard candles that define the extragalactic distance scale, calibrate the absolute luminosities of stars of all spectral types for studies of stellar structure and evolution, and detect orbital motions caused by brown dwarfs and giant planets. FAME will not only improve on the accuracies of star positions determined by Hipparcos but also expand the volume of space for which accurate positions are known by a factor of 8,000.

Foundation of the Extragalactic Distance Scale

- ➔ FAME parallax observations will accurately determine the distances to the nearest “standard candle” stars
 - Cepheid variables - Luminosity is related to their periods
 - RR Lyrae stars
- ➔ Determining the distance to nearby Cepheids and RR Lyrae stars is fundamental in defining the distance scale to nearby galaxies and clusters of galaxies

FAME Distance/Magnitude Limits and Standard Candle Stars



FAME observations of standard candle stars -

For standard candle stars to serve as the foundation of the extragalactic distance scale, distances to the nearby stars need to be accurately determined. Hipparcos did not determine distances to these stars with a high level of accuracy. FAME is designed to determine distances accurate to 10% error or better to a large sample of Cepheids and RR Lyrae stars, thus refining the extragalactic distance scale. While SIM may obtain distances to some of these stars to better accuracy, SIM is a pointed mission that will only determine distances for a small number of known standard candle stars.

Stellar Evolution

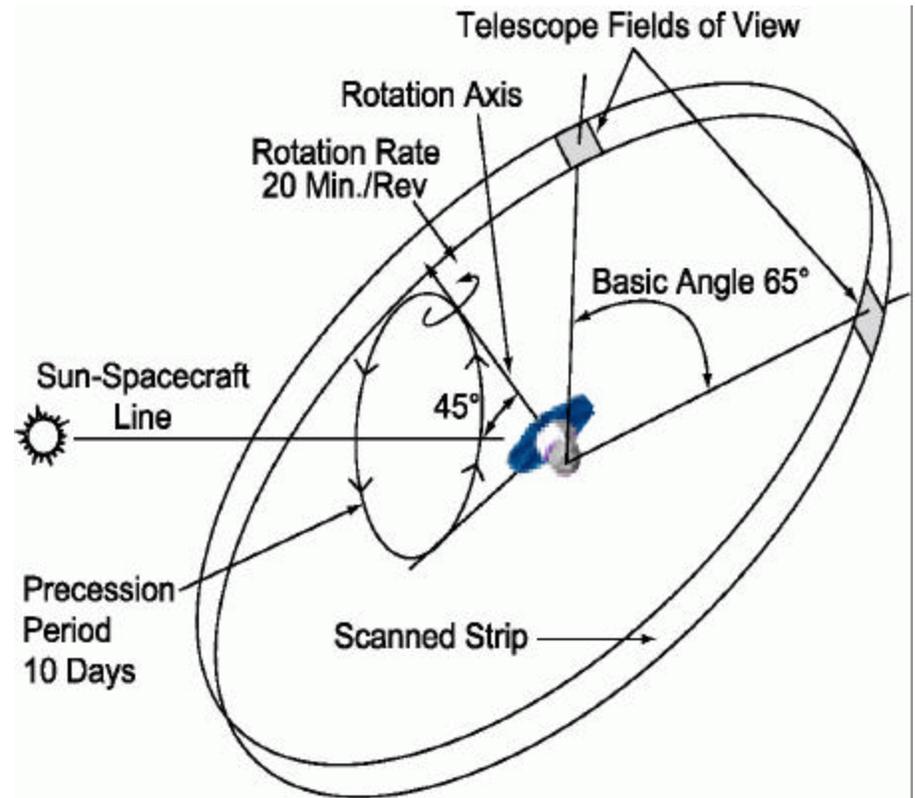
- ➔ Calibrate the absolute luminosities of solar neighborhood stars
- ➔ Enable diverse studies of stellar and galactic evolution
- ➔ Determine distances and ages of galactic globular clusters using the determined absolute luminosities
- ➔ Determine ages of extragalactic globular clusters
- ➔ Resolve discrepancy in distances to the Pleiades and other open clusters

Stellar Companions

- ➔ Determine the inclinations and thus the masses of known exoplanets detected by radial velocity techniques
- ➔ Determine the frequency of solar-type stars orbited by brown dwarf companions in the mass range of 10 to 80 M_{jup} with orbital periods up to twice the duration of the FAME mission
- ➔ Explore the transition region between brown dwarfs and giant planets, which appears to be in the range of 10 to 30 M_{jup}

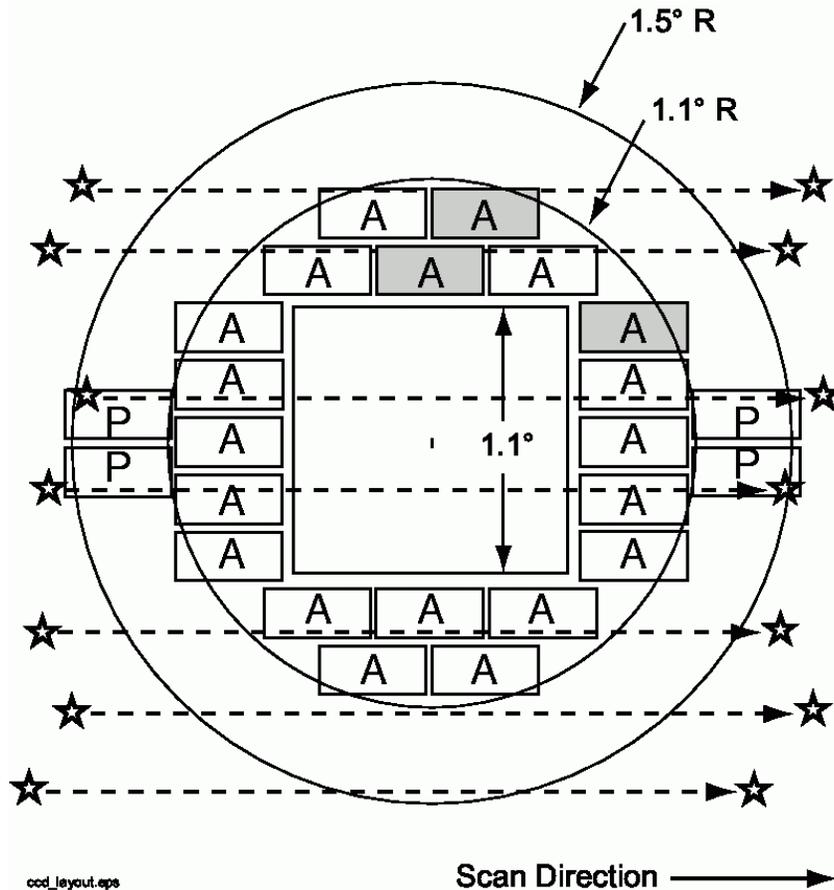
FAME Mission Description

- ➔ The telescope has two fields-of-view separated by a 65° basic angle
- ➔ Spacecraft will rotate with a 20 minute period with the apertures sweeping out a great circle on the sky
- ➔ The spacecraft rotation axis is at a 45° angle to the Sun
- ➔ The solar radiation pressure on the solar shield results in precession about the Sun-spacecraft line with a 10 day period



The FAME observing concept - The axis of the FAME spacecraft is pointed 45° from the Sun and precesses around the Sun with a 10 day period. The FAME spacecraft rotates with a 20 minute period. The two fields of view are normal to the rotation axis and are separated by a 65° degree basic angle.

FAME Instrument Description



ccd_layout.eps

The FAME focal plane - 24 $2k \times 4k$ CCDs arranged around a 1.1° radius from the center of the field of view. Devices marked with 'P' are the 4 photometric CCDs and devices marked with 'A' are the 20 astrometric CCDs. The 3 'gray' devices have neutral density filters for astrometry of brighter stars.

➔ Telescope produces images of Stars using 24 large format CCDs

- ➔ Images of stars are continually traversing CCD array as the spacecraft rotates
- ➔ CCDs use time delay integration
- ➔ Synchronization of CCD clock rate and image motion is assured via rotation rate sensors
- ➔ Star images are time tagged, windowed, and transmitted to Earth.
- ➔ 3 CCDs are covered by neutral density filters for astrometry of bright stars

Conclusions

- ➔ FAME has been proposed as a NASA MIDEX mission to determine accurate positions, parallaxes, and proper motions for 40 million stars
- ➔ Recalibrates the extragalactic distance scale
- ➔ Determines absolute luminosities of a wide range of spectral types
- ➔ Detects companion stars, brown dwarfs, and giant planets
- ➔ Enable studies of the kinematics of our galaxy
- ➔ Define an optical reference frame for future scientific, commercial, and military endeavors

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