Error Budget

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Error Budget

Science Requirements

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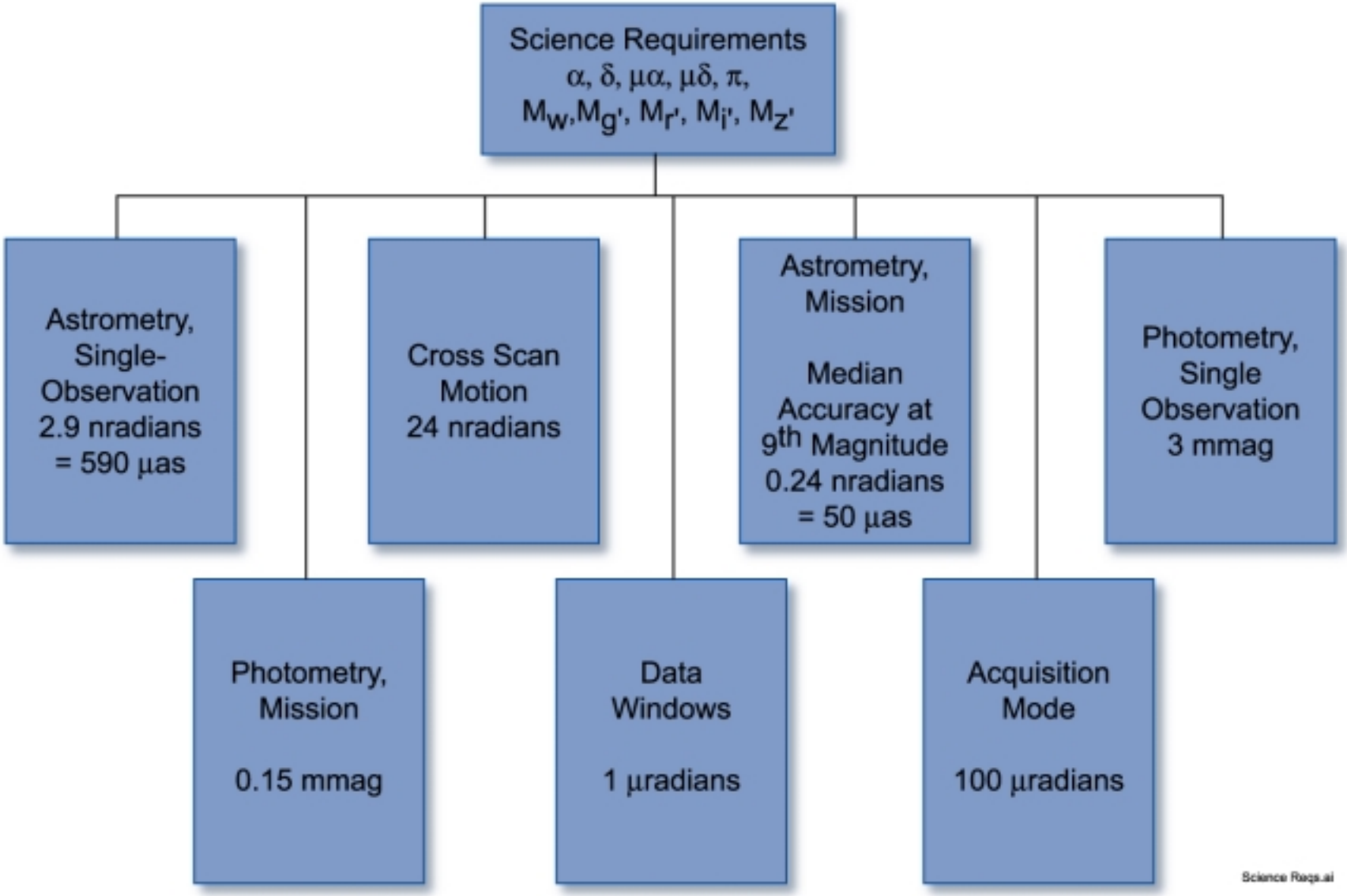
Mission Requirements Document

Science Requirements



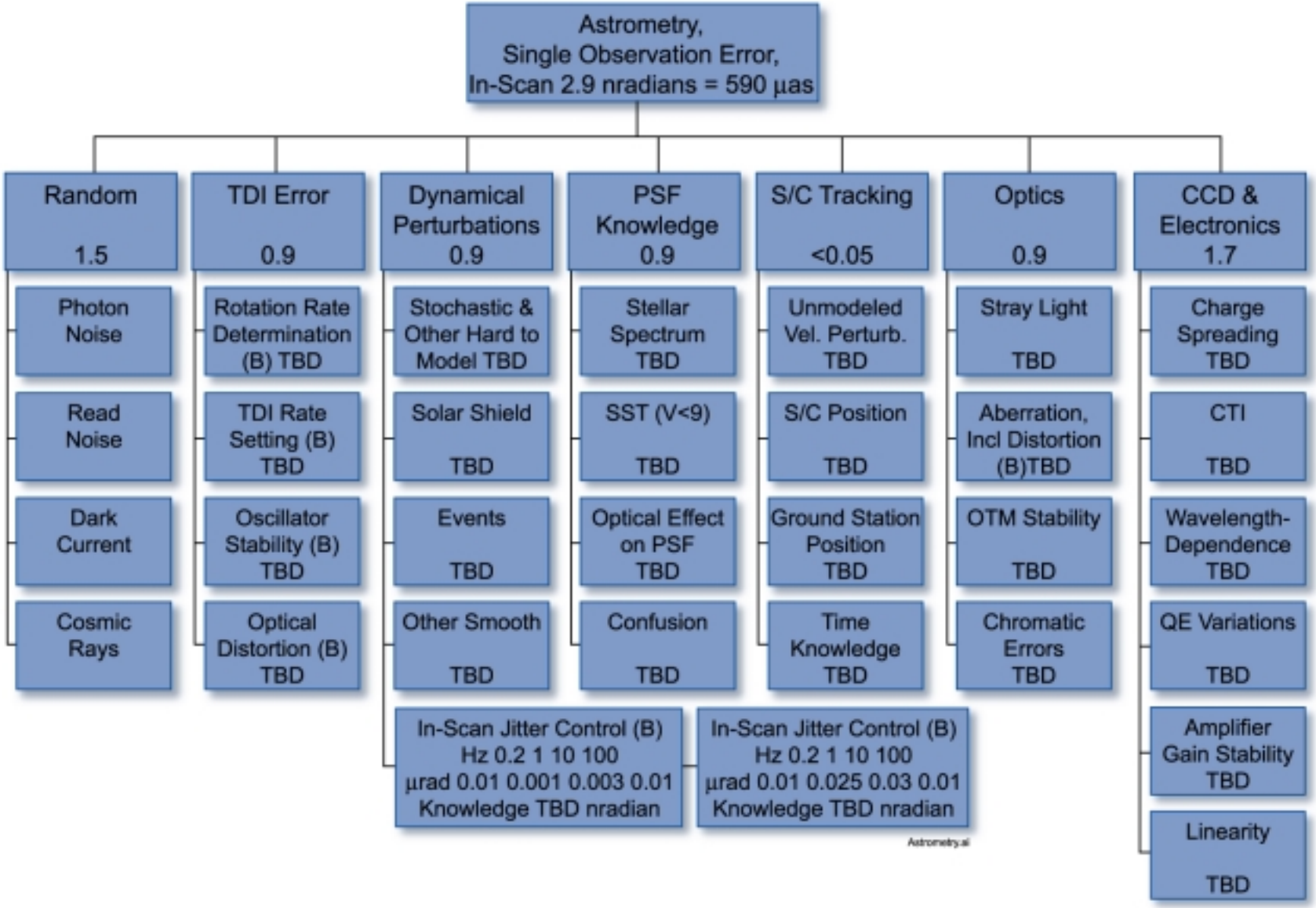
Science Requirements - Astrometry

- **Precision of Individual Astrometric Measurements**
- **Accuracy of Mission Determinations of Position, Parallax, and Proper Motions of 50 μas and 70 μas/yr for 2.5 Year Mission for 9th Magnitude**
- **Applies to 90% of Unconfused Sources With Remaining 10% Not to Exceed 2 Time Accuracy**
- **Coverage is for >98% of Sky**

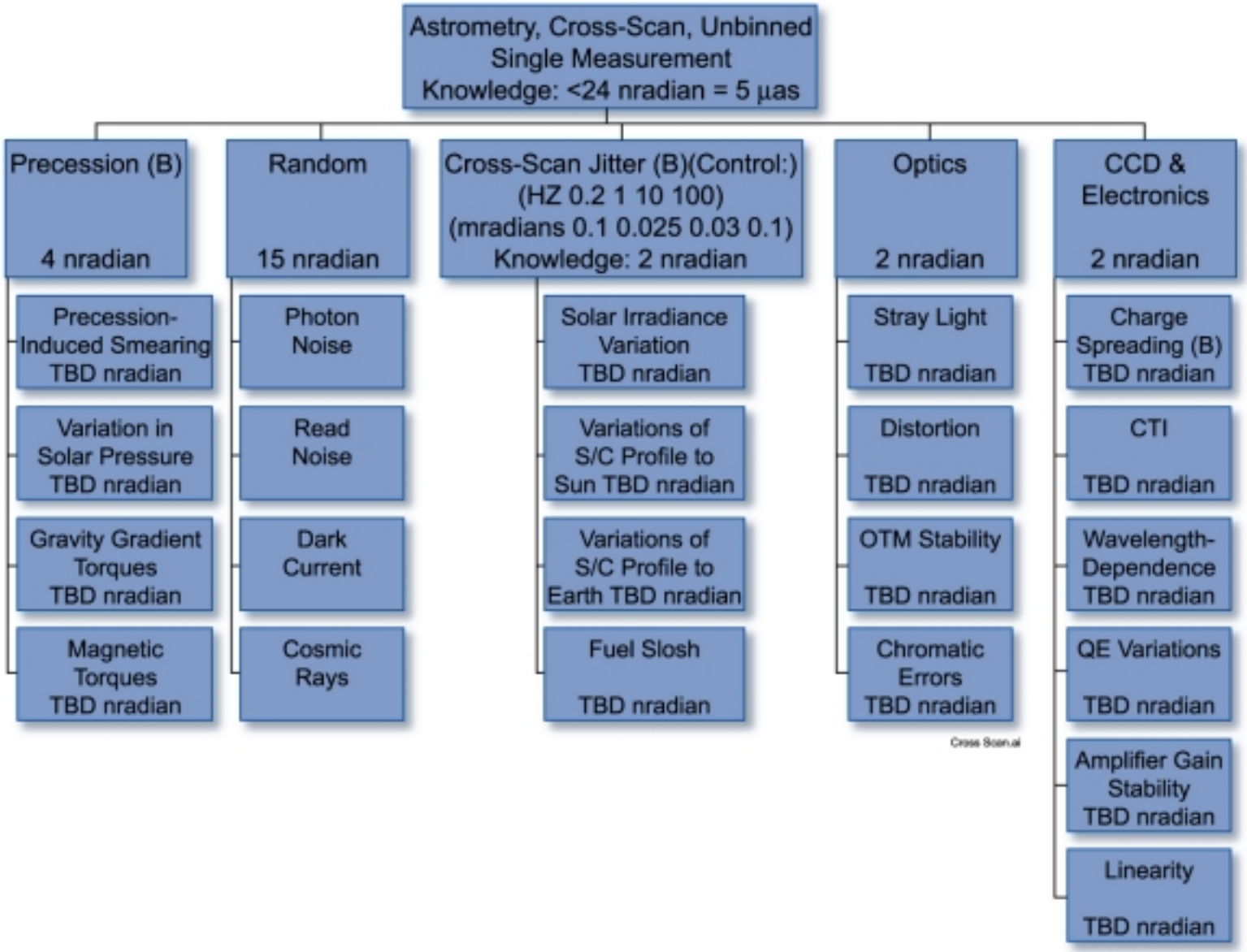
Error Budget Trees – Astrometry

- Single Measurement Along Scan
  - Cross Scan Attitude Knowledge Requirements
- Mission

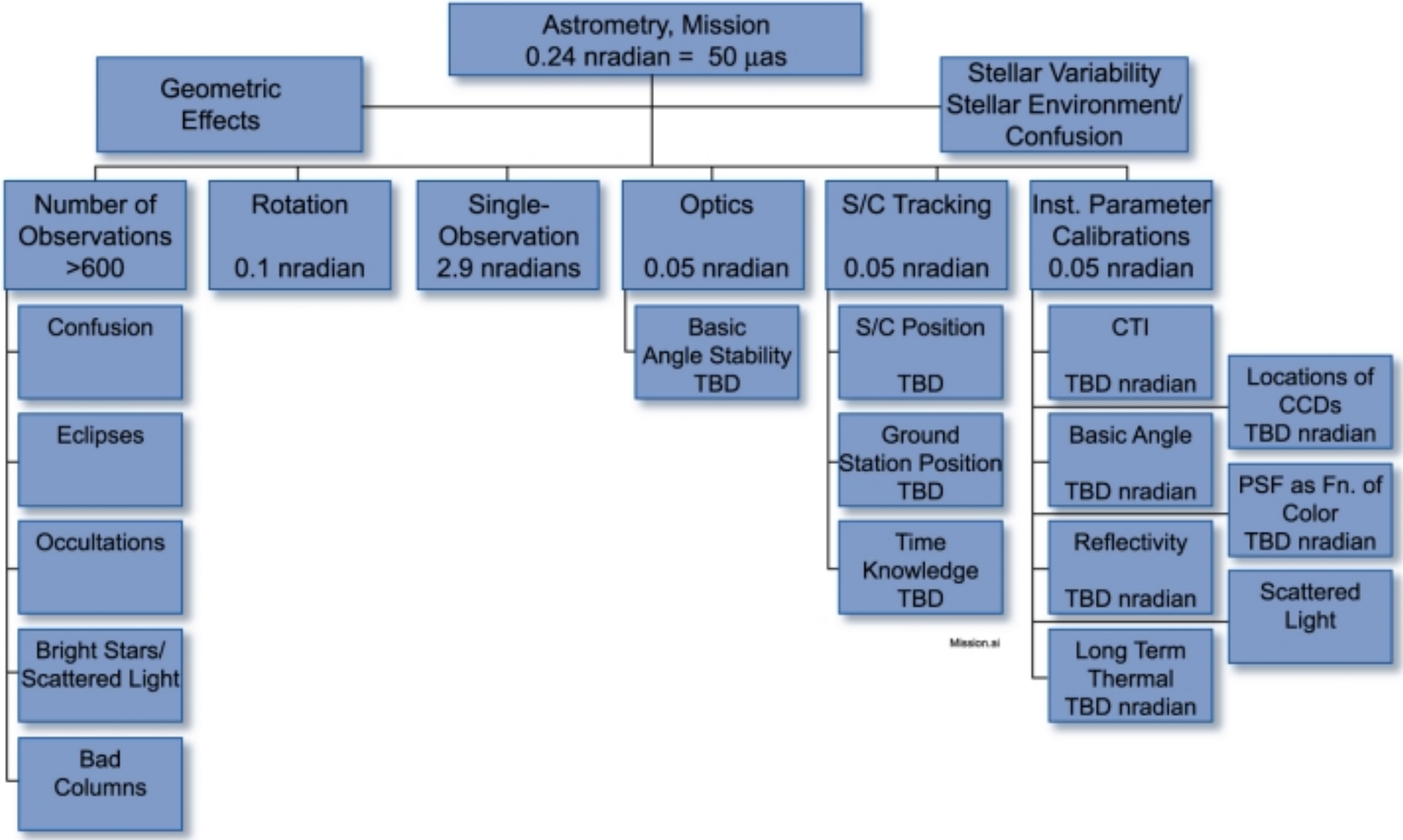
Astrometry, Single-Observation Error, In-Scan



Astrometry, Cross-Scan, Unbinned Single Measurement



Astrometry, Mission



FAME 2.5 Year Mission Geometry

Nominal Sun – Rotation Axis Angle

	45 Degrees	40 Degrees	35 Degrees
Parallax	98	79	65
Longitude	100	86	58
Latitude	100	100	100
PM Longitude	54	43	33
PM Latitude	100	100	100

Percentages of Sky FAME Can Meet or Exceed 50 uas (Position, Parallax) and 50 uas/yr (Proper Motion), for 3 Nominal Sun Angles and Assuming a 580 uas Single-Measurement Standard Error

FAME 2.5 Year Mission

Sun – Rotation Axis Angle

	45 Degrees				40 Degrees				35 Degrees			
	Min	Med	Avg	Max	Min	Med	Avg	Max	Min	Med	Avg	Max
Counts	430	808	854	1959	370	799	854	2054	392	762	854	2362
Parallax	23.4	33.8	36.1	55.0	22.4	35.9	38.1	61.4	20.7	40.3	41.1	68.5
Longitude	15.4	35.0	34.0	51.5	15.3	39.9	37.8	60.0	14.1	46.8	42.8	67.1
Latitude	19.1	27.8	27.9	37.8	20.1	26.8	26.9	37.7	18.6	25.9	26.2	35.2
PM Longitude	20.0	47.9	46.9	73.2	19.1	55.4	52.0	82.0	18.4	64.2	58.9	94.1
PM Latitude	27.5	38.7	38.9	53.6	24.3	37.3	37.6	53.0	25.6	36.1	36.6	51.1

Minimum, Median, Average, and Maximum
Units uas and uas/yr

FAME 2.5 Year Mission

Spin Period

	35 Minutes	40 Minutes	45 Minutes
Parallax	100	98	86
Longitude	100	100	98
Latitude	100	100	100
PM Longitude	62	54	48
PM Latitude	100	100	98

Percentages of Sky FAME Can Meet or Exceed 50 uas (Position, Parallax) and 50 uas/yr (Proper Motion), for 3 Spin Periods (35, 40, and 45 Minutes), Nominal Sun Angle of 45 Degrees, and Assuming a 580 uas Single-Measurement Standard Error

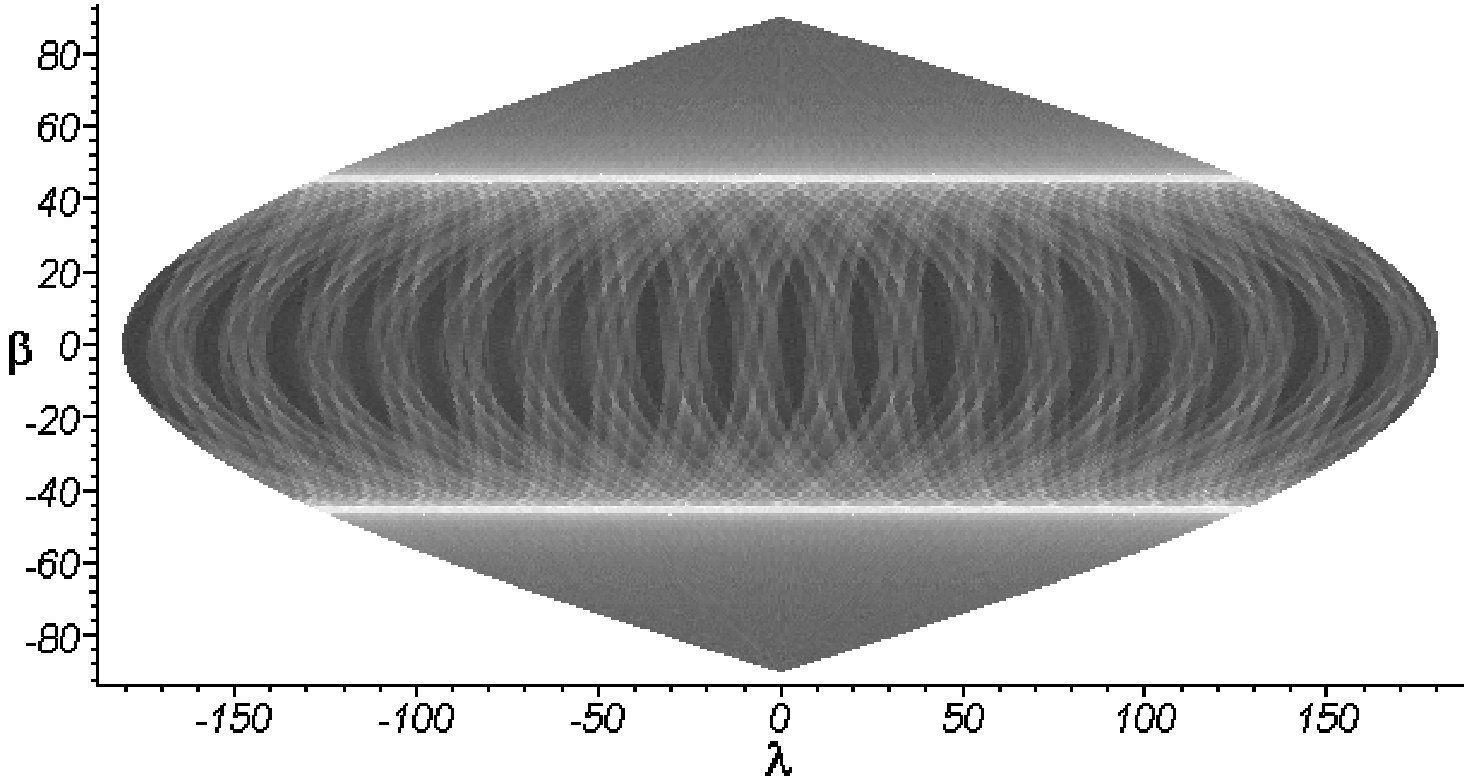
FAME 2.5 Year Mission

Spin Period

	35 Minutes				40 Minutes				45 Minutes			
	Min	Med	Avg	Max	Min	Med	Avg	Max	Min	Med	Avg	Max
No Obs.	505	924	977	2226	430	808	854	1959	377	718	760	1750
Parallax	22.4	31.6	33.8	50.8	23.4	33.8	36.1	55.0	25.6	35.9	38.3	58.0
Longitude	14.5	32.7	31.8	47.4	15.4	35.0	34.0	51.5	16.4	37.1	36.1	54.4
Latitude	17.9	26.0	26.1	33.2	19.1	27.8	27.9	37.8	20.2	29.5	29.6	39.0
PM Longitude	18.9	44.9	43.8	67.6	20.0	47.9	46.9	73.2	21.2	509	49.8	76.8
PM Latitude	26.0	362	36.3	48.9	27.5	38.7	38.9	53.6	28.9	41.1	41.3	55.6

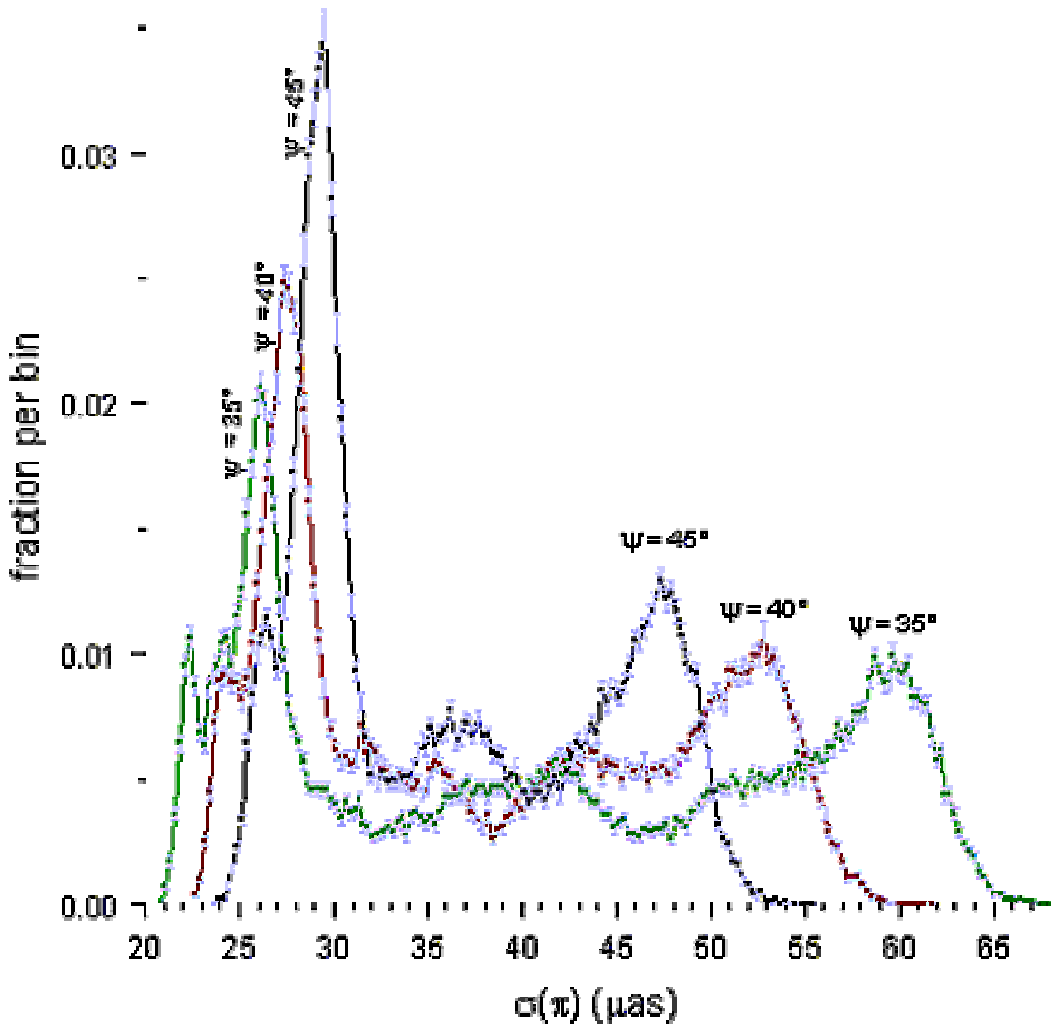
Minimum, Median, Average, and Maximum Values for Spin Periods of 35, 40, 45 Minutes, Based on uas and uas/yr
Precession Cone Angle is 45 Degrees

Observation Density Distribution



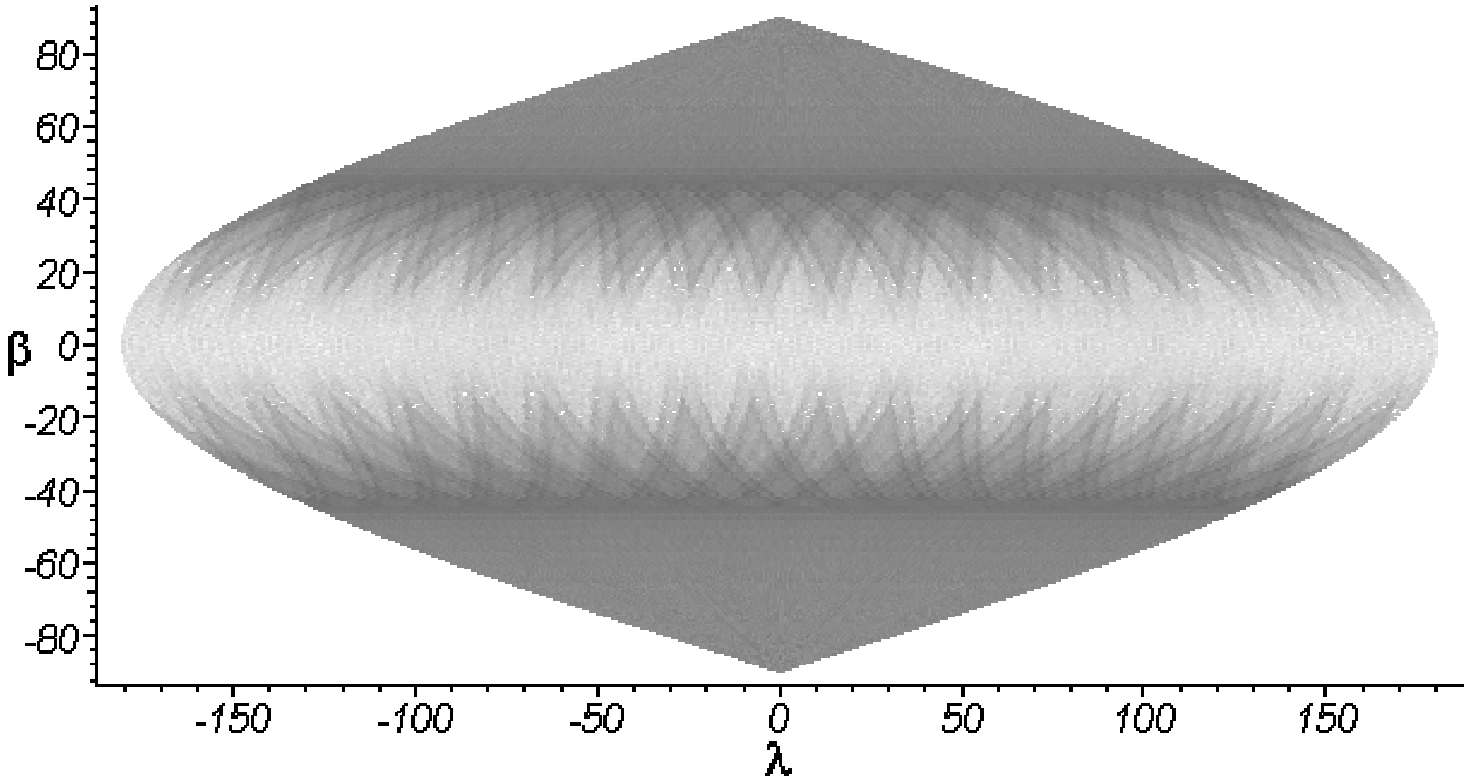
2.5 Year Mission, Sun – S/C Rotation Angle 45°, Spin Period 40 Minutes, Precession Period 20 Days

Histogram of Parallax Error for Sun-Rotation Angle ψ of 35, 40, and 45 Degrees



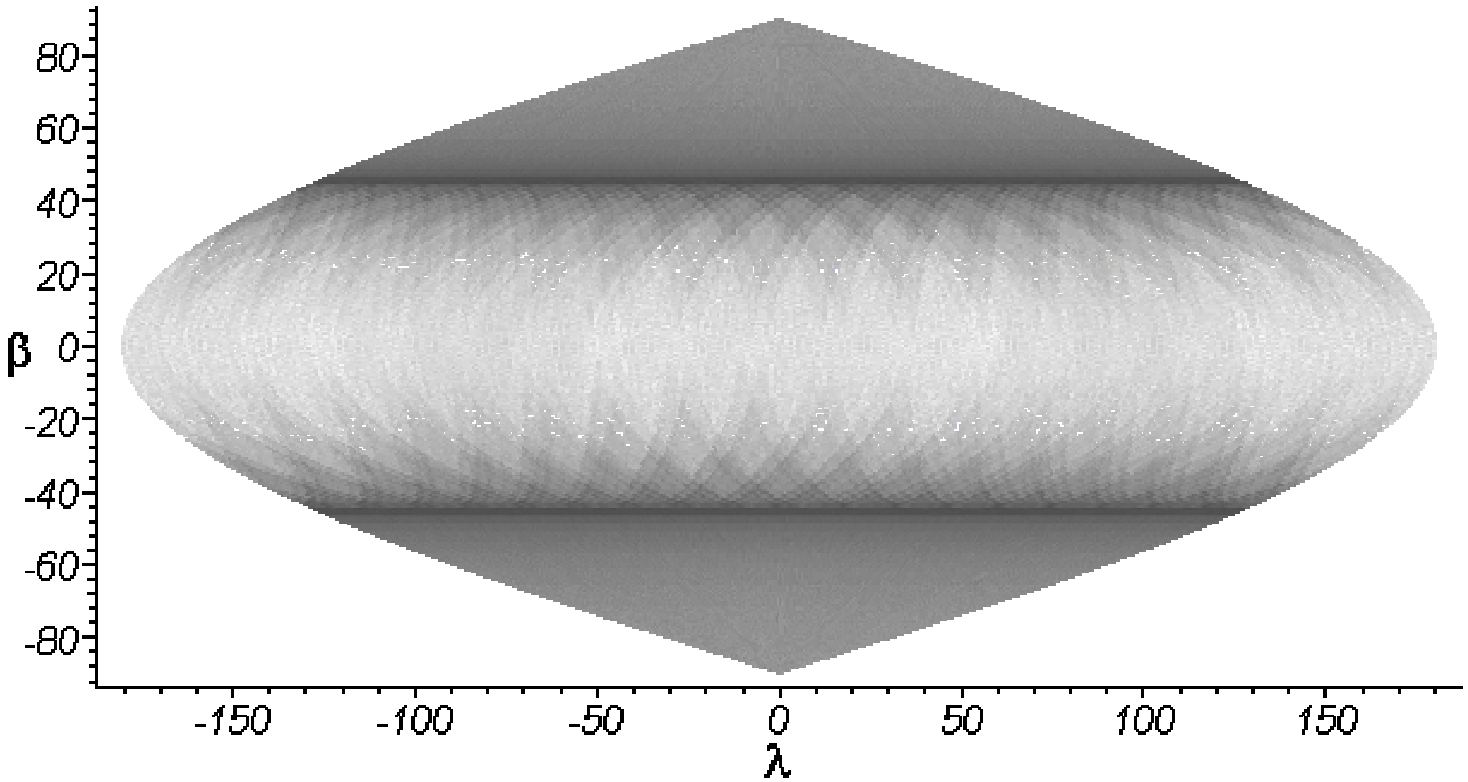
Error Bars are 1 σ, Assuming Poisson Statistics for Each Bin

Error in Parallax σ_π (1 of 3)



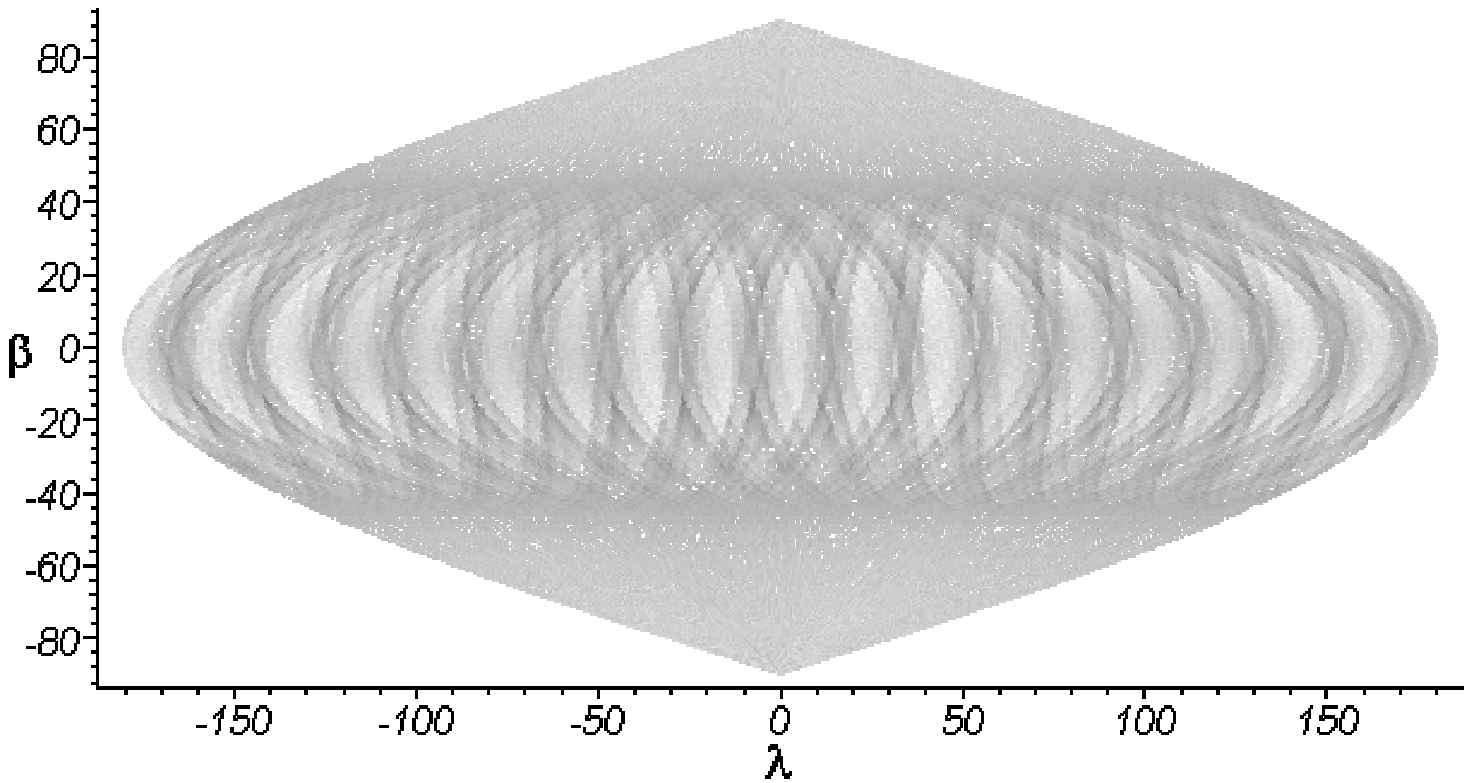
Different Precession Periods

Error in Ecliptic Longitude σ_λ



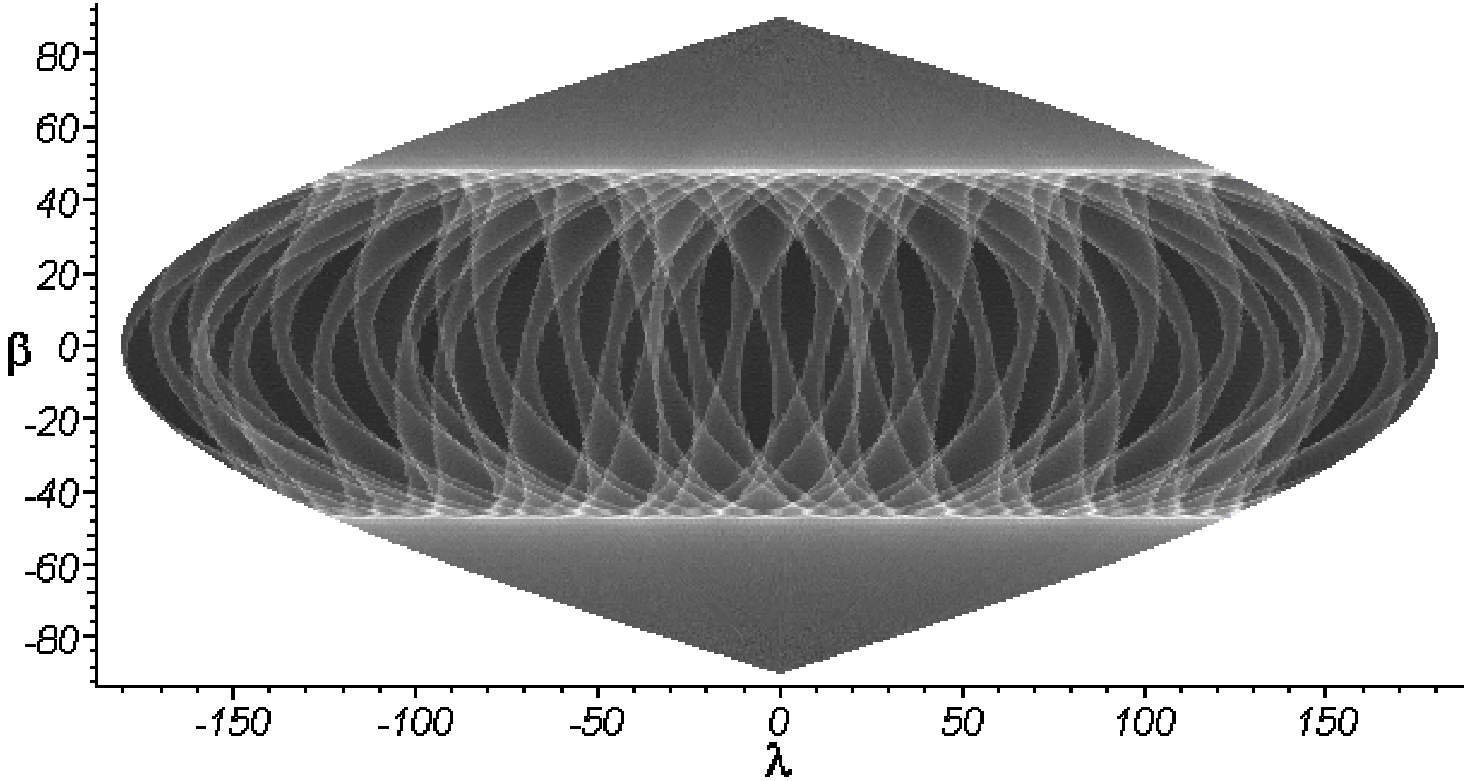
5-Year Extended Mission

Error in Ecliptic Latitude σ_β



HIPPARCOS

HIPPARCOS Observation Density



FAME 5 Year Mission

Sun-Rotation Axis 45 Degrees

	5-Year Mission			
	Min	Med	Avg	Max
Counts	1009	1600	1709	3797
Parallax	16.5	23.2	25.2	37.2
Longitude	11.0	23.7	23.5	33.6
Latitude	15.2	19.2	19.2	22.5
PM Longitude	7.3	17.1	16.5	24.5
PM Latitude	9.0	13.6	13.5	17.2

Science Requirements - Photometry

- **Precision of Individual Measurements in Astrometric and SDSS Filters to mmag at M_v = 9 Degrading to 40 mmag at M_v = 15**

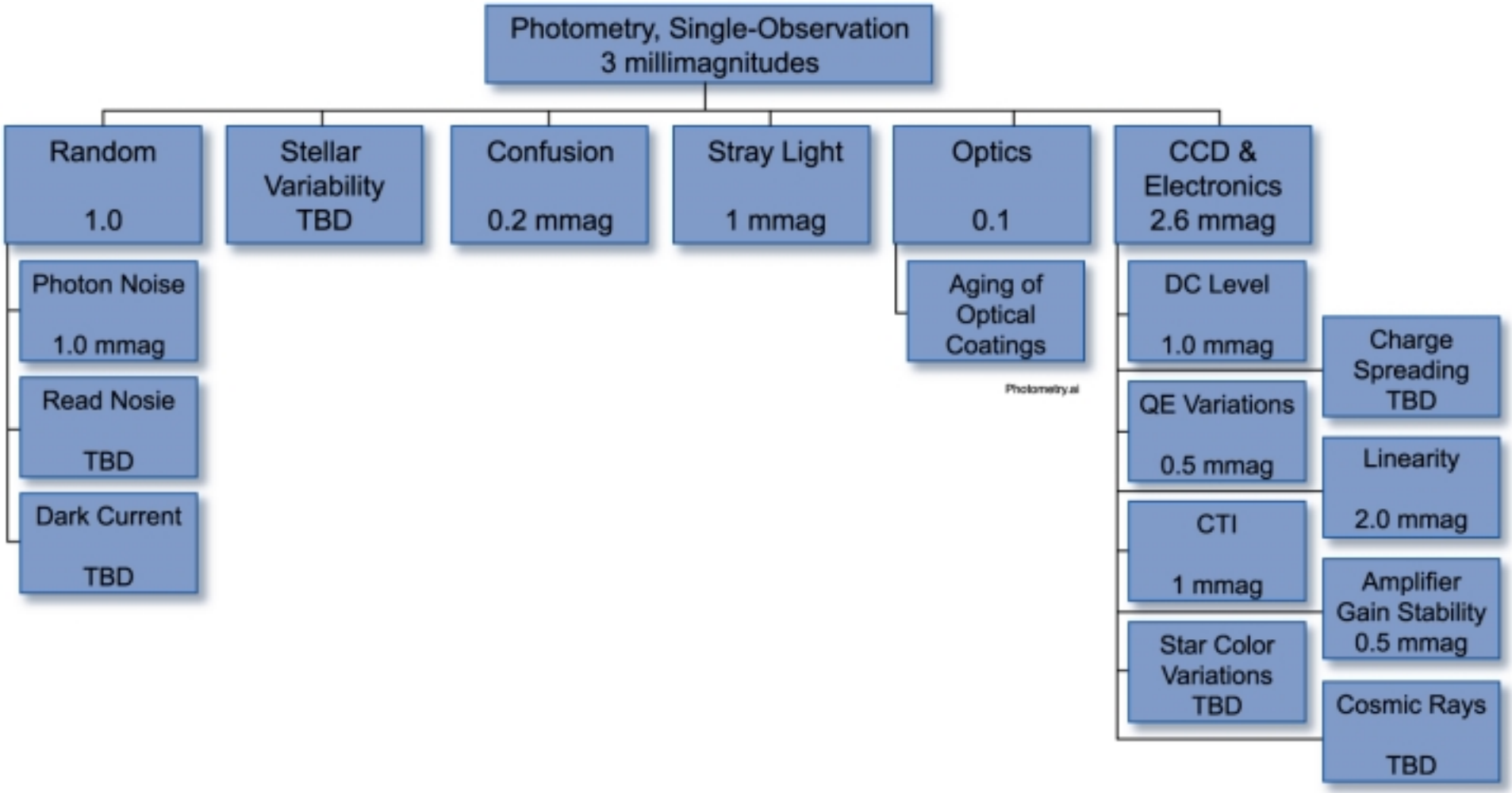
- **Mission Instrumental (Astrometric and SDSS) Systems Precision of 0.1 mmag at M_v = 9 to 5 mmag at M_v = 15**

- **Observations on Instrumental System for Astrometric CCDs and on SDSS System for SDSS Filters**

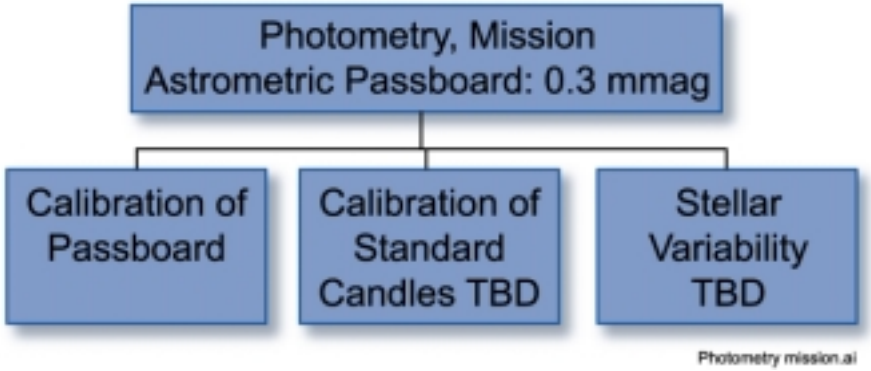
Error Budget Trees - Photometry

- Single Observation
  - Astrometric CCDs
  - SDSS Filters
- Mission

Photometric Errors, Single-Observation



Photometric, Mission

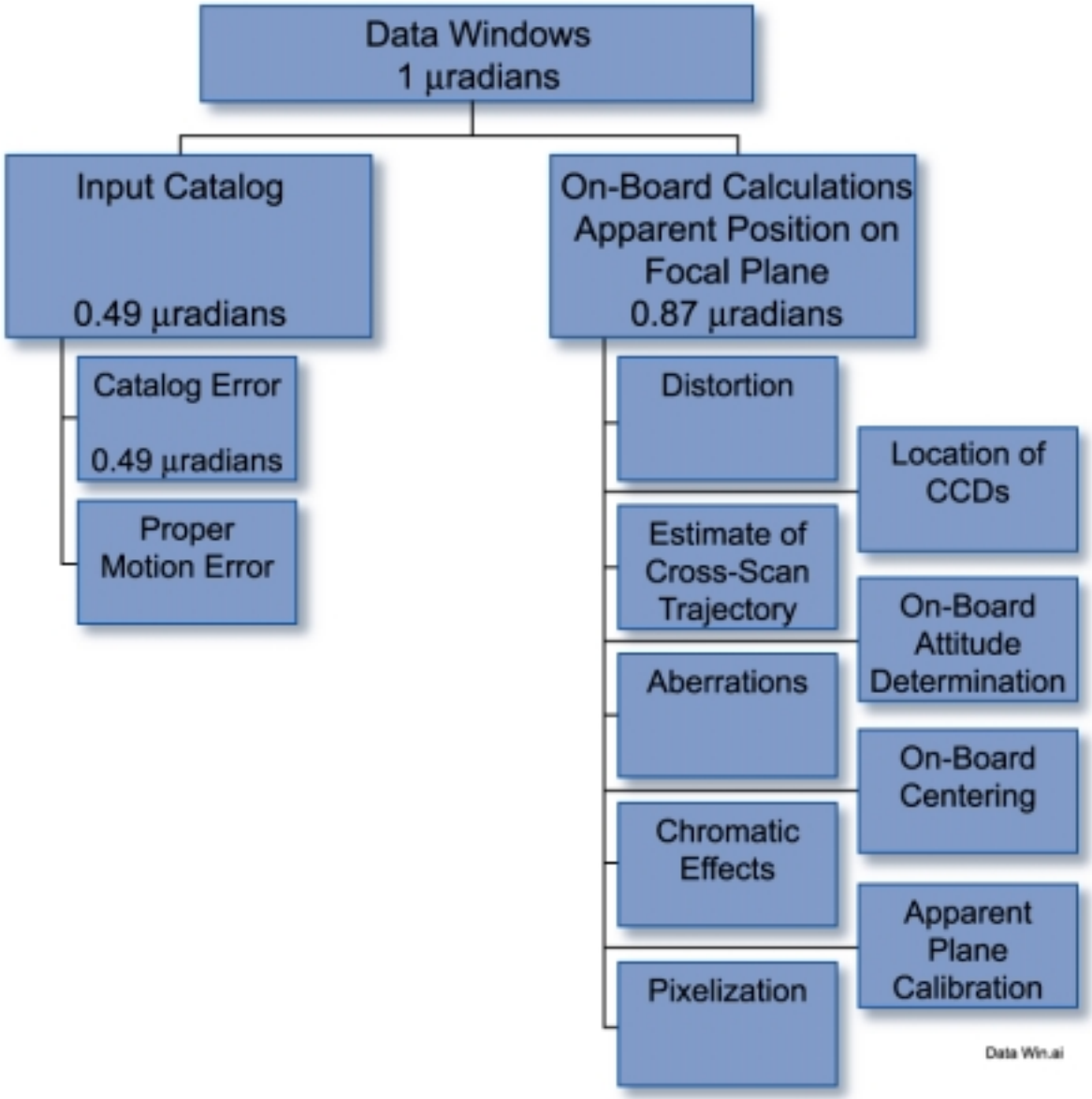
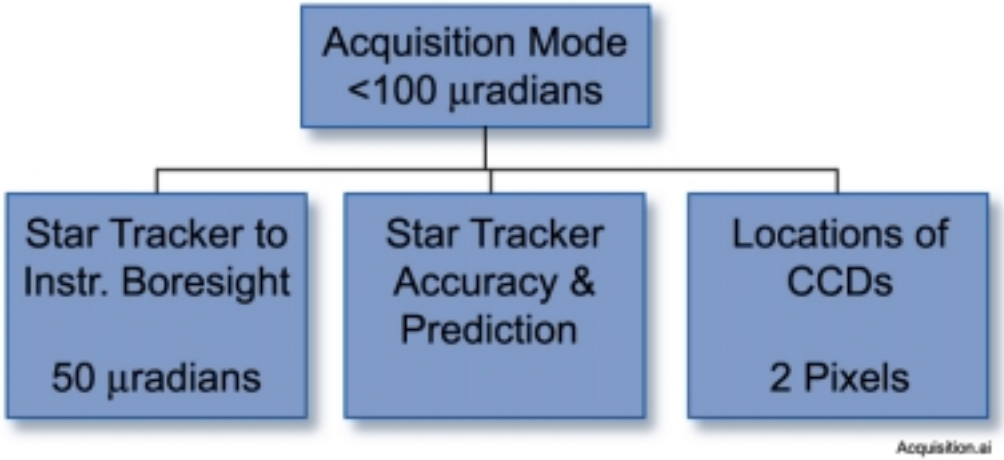


Alignment Error Tree

- **Data Windows**

- **Acquisition Mode**

Data Windows



Acquisition Mode