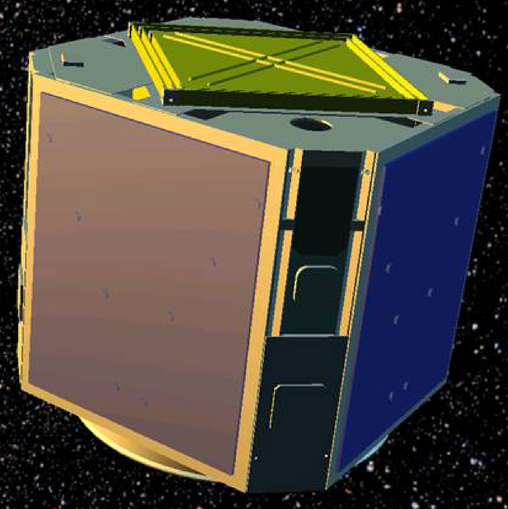
XXVI^th GA IAU, JD13, "Exploiting Large Surveys for Galactic Astronomy", 22-23 Aug. 2006

Development of a very small telescope for space astrometry surveyor

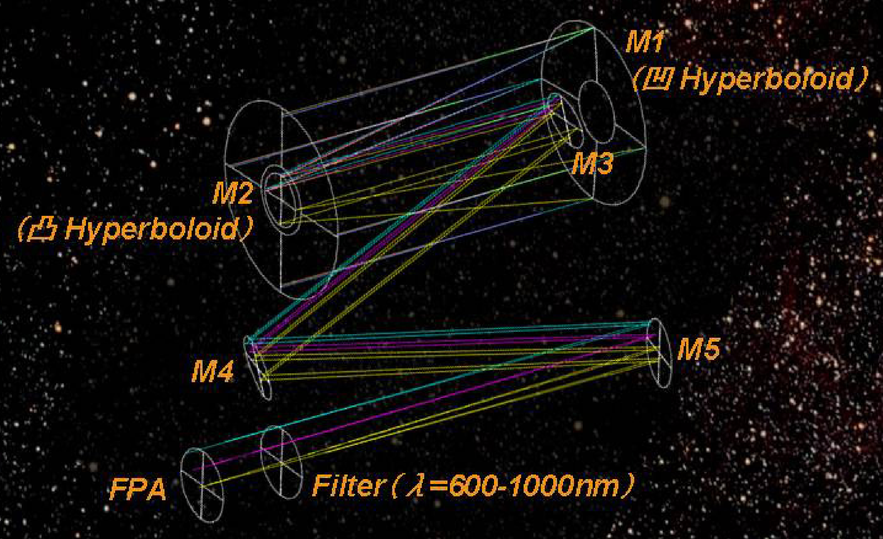
M. Suganuma, Y. Kobayashi, N. Gouda, T, Yano,
(National Astronomical Observatory of Japan)
Y. Yamada (Kyoto Univ.)
N. Takato (Subaru Telescope)
M. Yamauchi (Univ. of Tokyo)



The current design of Nano-JASMINE: a 10-kg satellite for space astrometry

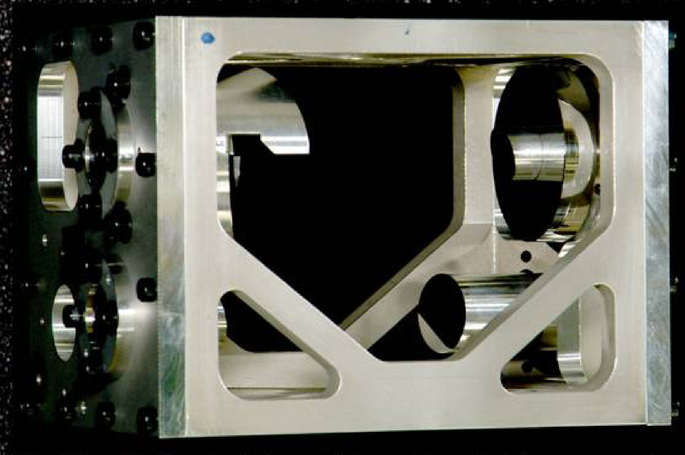
Nano-JASMINE is a nano-size astrometry satellite that is to be launched in 2008 and will demonstrate some key technologies required for JASMINE (Japan Astrometry Satellite Mission for Infrared Exploration) in a real space environment. It also measures absolute positions of bright stars (z≤7.5 mag) with accuracies about 1 milli-arcsecond in a few years mission.

- The telescope only occupies a volume about 15x12x12 cm, and weighs two kilograms or less.
- Almost all of the structures and the optical elements of the telescope, including two aspherical mirrors three flat mirrors and a dual-angled flat mirror that combines the beam from a relative angle of 99.5 degrees into the primary mirror, are made out of aluminum alloy, being figured by diamond turning machines.



Optical layout of Nano-JASMINE Telescope

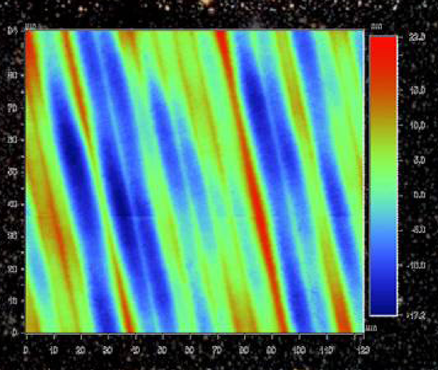
Mirrors for Nano-JASMINE telescope. Their reflecting surfaces are shaped directly with diamond turning machine.



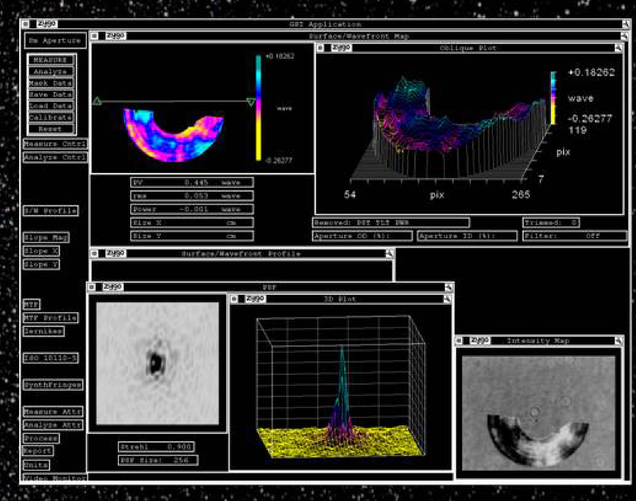
A Bread Board Model (BBM) of the Nano-JASMINE telescope. All parts were shaped out of aluminum alloy and attached by screws

Specifications of Nano-JASMINE Telescope

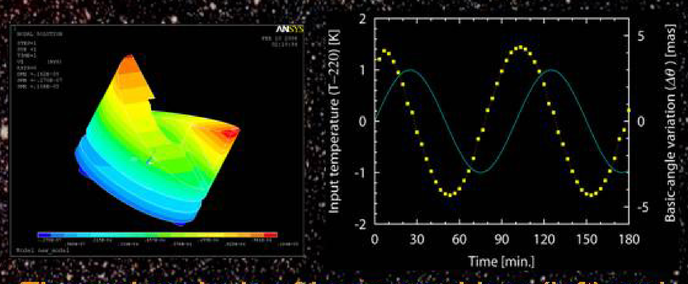
Effective aperture	5cm
Focal length	167cm (F/33)
Optics type	Ritchey-Chretien type, with two aspherical mirrors and three flat mirrors that bend the optical pass after secondary
Field of view (FOV)	0.5 x 0.5 deg
Basic angle	99.5 deg
Mirror Surface	Ag/Au coat on diamond-figured aluminum
Wavelength	λ= 0.6-1.0μm
Detector	1kx1k C C D, with Time Delay Integration (TDI) operation
Pixel scale	15μm (1.76 arcsec/pix)
Operating Temperature	- 50℃ ~ - 100℃ (stability < 1K)



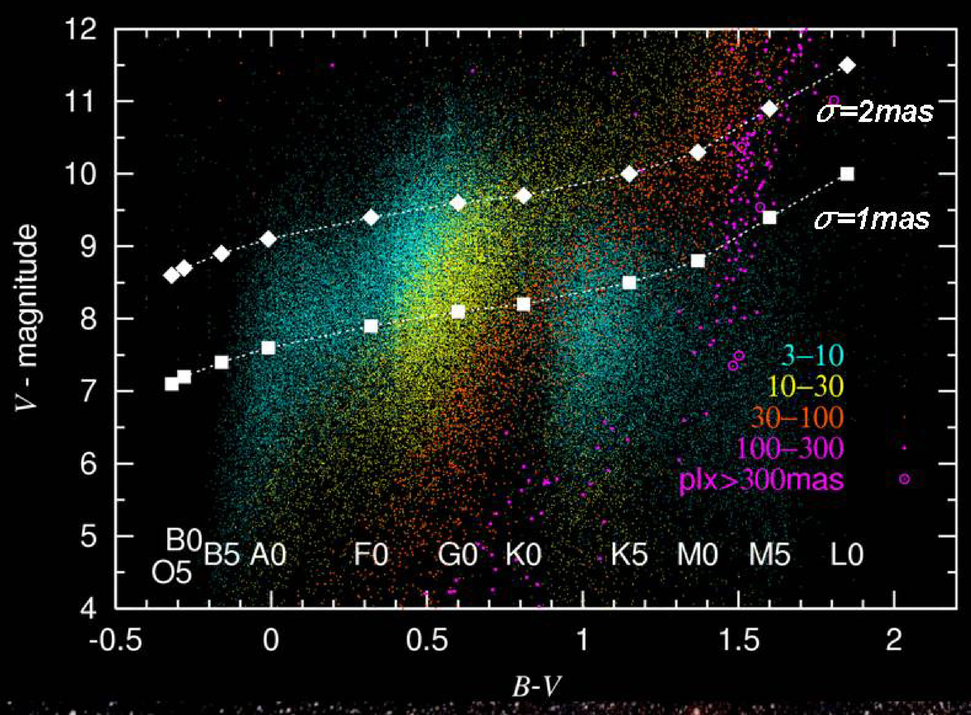
Microscopic surface roughness of the reflecting surfaces for a 94x123 μm area. The roughness is Ra=5-8nm, for which optical loss at λ=800nm is 1% per each mirror.



Total wavefront errors through whole optics. Top : Before vibration test. Bottom : After vibration test (11G rms). Screwing of some mirrors are to be improved, though the optics keeps diffraction limited performance at λ=800nm



Thermal analysis of beam combiner (left) and estimated variations of basic angle of beam-combiner (yellow points in the right panel) when input temperature variation at the legs of combiner is ΔT=±1K (blue line). ΔT=±0.1K is required for global astrometry of σ = 1 mas.



Limiting magnitudes under the photon noise limit, as a function of stellar spectral type. Squares are for accuracy of 1-mas, and diamonds 2-mas. Dots represent stars in Hipparcos catalog, divided into several parallax classes.