1. SUBMIT TO: **AS04**

2. Conference Title: **Interferometry in Optical Astronomy**
   Conference Chair: **Francesco Paresce**

3. ABSTRACT TITLE: **Full Aperture Metrology for Space Interferometry Mission**

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5. PRESENTATION: **Oral Presentation**

6. ABSTRACT TEXT

We present an implementation of full aperture metrology (FAM) for space interferometry mission (SIM). The microarcsecond angular resolution targeted by SIM requires that the metrology system be accurate to ~ 20 picometer level, given the base length of 10 meters of SIM's optical interferometers for visible wavelengths. At this level of accuracy, thermal and mechanical management of each optic becomes very challenging if subaperture metrology - where the metrology beam sees only a portion of optics that the starlight sees - is used. Two main problems are thermal distortions of optics and beam walk; both of these cause metrology beams and starlight to see different optical path. What we propose is a fiber based FAM that alleviates these problems by making the metrology beam and the starlight to see largely the same surface area of each optic.

The proposed scheme has a fiber-fed metrology source at the front-end internal metrology fiducial of each arm of SIM interferometer. The relative phase of the two fiber outputs are measured to 50 pm, and the wavefront of the fiber output has to be known to $\lambda/100{,}000$ over 15 degrees. The primary mirror has a holographic optical element (HOE) imprinted on its surface that will take the diverging metrology beam and make it parallel to the starlight. After the primary mirror, the

metrology beam and the starlight co-propagate with similar size and divergence. There is a minor difference that arises primarily due to the wavelength difference.

There are 5 important technical issues that need to be resolved for the success of the proposed FAM system: 50 pm fiber length measurement, holographic optical element on the primary, fiber wavefront calibration, beam weight error mitigation by inverse Gaussian filter, and fiber tip contamination issues. In this presentation, we will give a brief account of how we are attempting to address each of these areas.

7. KEY WORDS

Interferometry, metrology, full-aperture, picometer

8. BRIEF BIOGRAPHY (of principal author)

Received B.S. in EECS at U.C. Berkeley, in 1979; Ph.D. in Electrical Engineering at Univ. of Southern California in 1986. From 1986 to 1998, worked at Rockwell Science Center doing basic and applied research on many different types of nonlinear optical phenomena and devices, including four-wave mixing, phase conjugation, image processing, RF photonics, and holographic memory, using cw to femtosecond lasers. Since 1998, have been working on picometer metrology for Space Interferometry Mission at Jet Propulsion Lab.