Space Interferometry: The Next Frontier

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The Decade Survey for Astronomy and Astrophysics in the 1990s recommended the development of an interferometric mission to "... achieve a 1000 fold improvement in our ability to measure celestial positions. " The design goal was to measure positions of widely separated objects to visual magnitude 20 with an accuracy of 30 microarcseconds. Our futuristic hope was that the mission might ultimately achieve a precision of 3 microarcseconds.

Whatever you do in astronomy, you need to know distances to what you study. Precise distances enable fundamental science that is otherwise impossible. This is the reason the Decade Survey placed such a high priority on the development of a space interferometric mission.

I have to confess that this interferometric project was the Decade Survey's most ambitious and challenging recommendation and that many of us wondered if we were not asking for too great a leap from our engineers and scientists. Somewhat to my surprise, an extraordinarily talented team of astronomers and engineers have developed a mature and robust design, informed by ground based tests, that more than satisfies the Decade Survey recommendations. This achievement guarantees, in my view, great science.

An improvement of a factor of 10 in instrumental sensitivity or precision often leads to major discoveries in astronomy. A thousandfold improvement in precision is extremeley rare and, if recent astronomical history is any guide, seems almost certain to lead to revolutionary discoveries.

This book provides a clear and simple statement of how SIM will work and what will be some of the major arenas for the scientific studies. Just glance at the topics listed; there is almost certainly something close to your own personal wish list. Here are just a few that make my mouth water: calibrating stellar evolution theory by measuring precisely

the distances to stars of many different types with accurately known masses, luminosities, and pulsation characteristics; measuring the masses to better than 1% of stars in binary systems; determining the size, the rotation rate, and the mass distribution of the Galaxy; establishing direct distance measurements to nearby spiral galaxies independent of all intermediate distance indicators; and measuring the peculiar velocities of nearby galaxies that reflect the initial perturbation spectrum and the distribution of mass, dark and visual, in our own neighborhood.

May I offer you a suggestion? If you teach a course in astronomy, use this book as a reference text and point out how the accepted theories you present will be rigorously tested by SIM. Ask the students to propose new research topics that cannot be carried out today because of limitations in astrometric precision. If you do research in astrophysics, take this book as a personal challenge and consider how SIM can be used to resolve fundamental questions in your subject area that today appear unanswerable.

The precision provided by SIM promises to open a vast frontier of precision science.