Ansys

CASE STUDY /

Ansys + University of Notre Dame

OpticStudio has been critical to our work. Without it, we would never have identified key optical aberrations we needed to consider for our system design to prevent an impact on our science. We saved a great deal of time and money, and improved productivity, by being able to understand these aberrations during design and then modify and improve key elements before proceeding to fabrication."

Dr. Jonathan Crass
Assistant Research Professor, Department of Physics / University of Notre Dame

CASE STUDY

Notre Dame Astrophysics Uses OpticStudio to Simulate Diffraction-Limited Spectrograph Performance for the Large Binocular Telescope

To discover planets outside our own solar system (exoplanets), scientists use the radial velocity (RV) technique to observe slight variations in a star's color signature over time using a spectrograph, which separates incoming light by wavelength or frequency and records the result in a multi-channel detector. Typical spectrographs contain some quasistatic optical aberrations, which must be identified because they make spectrograph data misleading, imprecise, or inconclusive.

Challenges

Existing instruments used large (100 µm) multi-mode fibers to efficiently transmit light to the spectrograph. But recent advances in ground-based adaptive optics systems made it possible to correct for changes in the atmosphere in real time and provide beams in the near-infrared to astronomical instruments. This allows the use of significantly smaller (5-10 µm) single-mode fibers. The challenge was to develop the Doppler spectrometer element of the instrument to include one of the first diffraction-limited spectrographs for extremely precise RV studies of exoplanets.

Ansys Products Used

- OpticStudio Professional

Engineering Solution

University of Notre Dame physicists used OpticStudio Professional to develop the iLocater, the first optimized single-mode, fiber-fed radial velocity-based instrument for the discovery and study of exoplanets. The ideal method for achieving accuracy in optical system development for diffraction-limited spectrographs is physical-optics propagation (POP). POP uses scalar diffraction theory to propagate electrical fields through space, a process requiring careful balance between achieving a high spectral resolution with a wide grid size that captures all spatial frequencies. For the Notre Dame team, using OpticStudio to simulate POP effects was essential for ensuring the iLocater project's success.

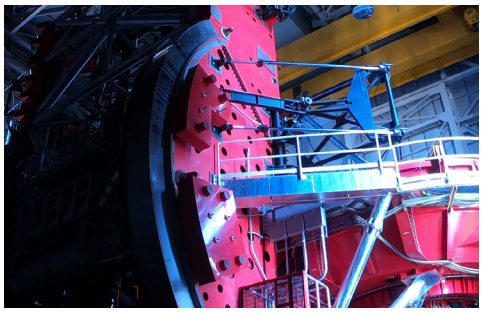
Benefits

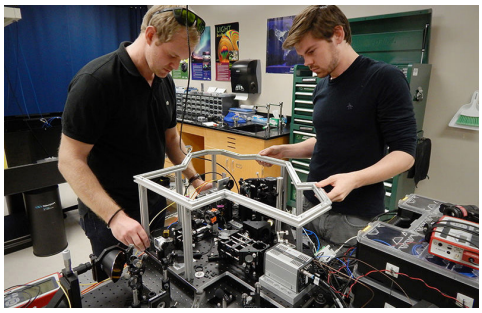
The use of OpticStudio:

- Enabled the development of iLocater, one of the first optimized single-mode fiber fed radial velocity-based instruments for the discovery and study of exoplanets.
- Confidently created a durable optical design for a diffraction-limited spectrograph.
- Readily simulated and triaged impact of optical aberrations to optimize system precision.

Company Description

The University of Notre Dame (UND) near South Bend, Indiana, is a leading US graduate and undergraduate research and teaching institution. The college is renowned for its position at the forefront of research and scholarship, achieving breakthrough discoveries in areas ranging from astrophysics, cancer, radiation chemistry, and nanoelectronics to environmental sciences, peace studies, tropical disease transmission, and robotics.





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