



Ansys + The University of Notre Dame

“Ansys Zemax 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 / University of Notre Dame

/ Notre Dame Astrophysics Simulates Diffraction-limited Spectrograph Performance for Large Binocular Telescope

Precise simulation enables rapid design iterations for a radial velocity instrument, building confidence in spectrograph design

/ Challenges

The University of Notre Dame's Department of Physics supports wide-ranging astronomy research in ground-based optical and infrared astronomy, as well as in observational/theoretical astrophysics and cosmology. Many of its ground-based observational achievements come from its famous partnership with the Large Binocular Telescope (LBT) at the Mount Graham International Observatory in Arizona. Scientists from all telescope partners use the LBT to address astronomical challenges ranging from the study of objects in our solar system to studies of the early universe.

Over the past two decades, ground-based adaptive optics systems have now advanced sufficiently to where they are able 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, enabling efficient diffraction-limited spectrograph designs. This change in design concept is the driving force behind the development of iLocator, the first optimized single-mode fiber-fed radial velocity-based instrument for the discovery and study of exoplanets.

/ Ansys Products Used

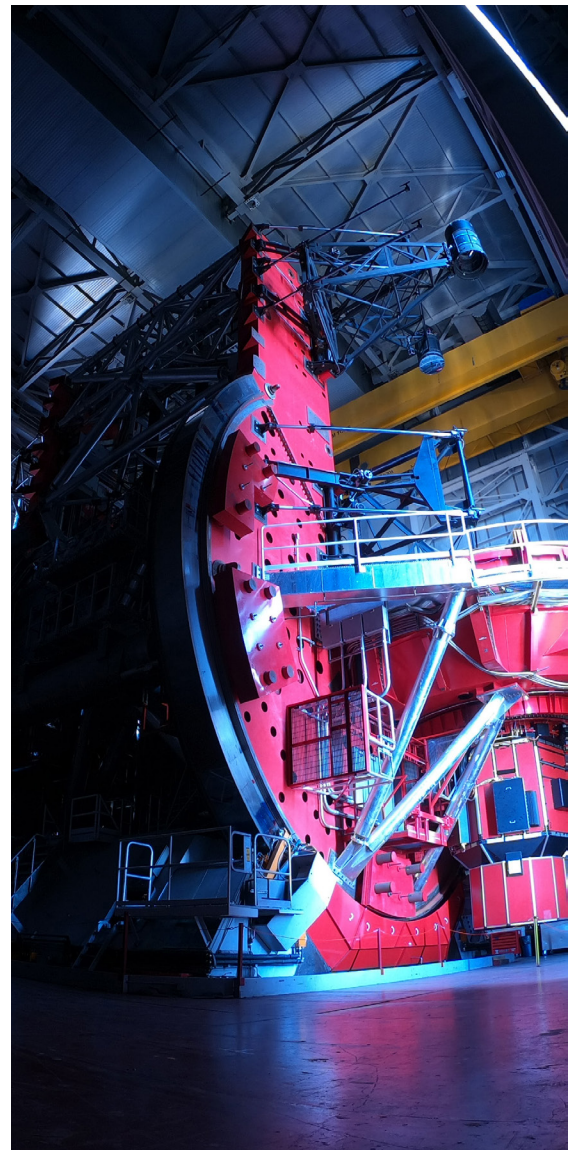
- Ansys Zemax OpticStudio

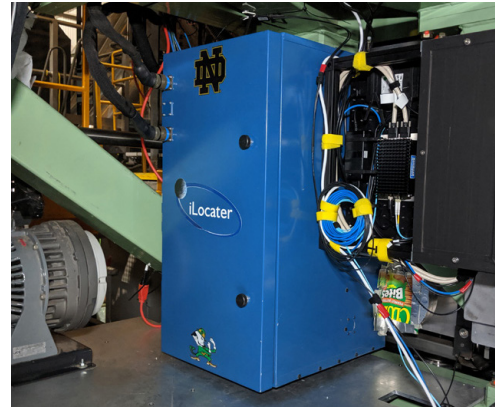
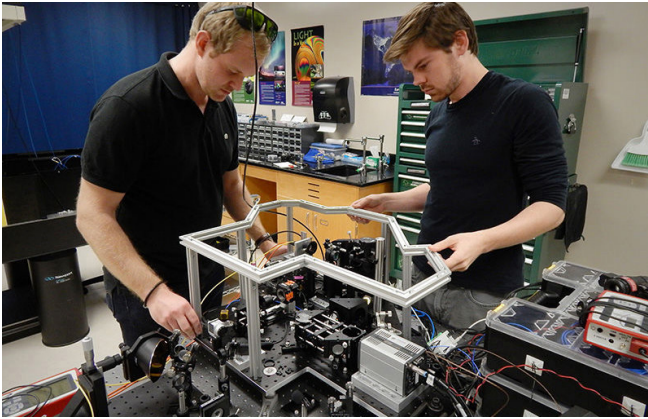
/ Engineering Solution

The University of Notre Dame originally used Ansys Zemax OpticStudio to design and optimize the instrument fiber injection system for LBT, which was successfully commissioned at the telescope in 2019. More recently, the university has embarked on developing the Doppler spectrometer element of the instrument that includes one of the first diffraction-limited spectrographs to be used for extremely precise RV studies of exoplanets. To achieve this submeter-per-second precision, it was necessary to build capabilities into the iLocator spectrograph to identify and compensate for Doppler-like color shifts that distort or dilute its output data using OpticStudio.

/ Benefits

- Single integrated solution for tracking design and fabrication wavefront performance
- Wide-ranging simulation capabilities, including physical optics propagation (POP)
- Easy interoperability with computer-aided design (CAD) platforms





/ Results

- Enabled the development of iLocator, 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 U.S. 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.

ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
U.S.A.
724-746-3304
ansysinfo@ansys.com

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