Designing an interactive educational activity for high-contrast imaging using a real coronagraph

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The study of exoplanets is one of the most well known topics when it comes to astronomy, and naturally captures people's attention and imagination. However, the methods to find these planets around their host stars and study them may be difficult to understand for the vast majority of the public.

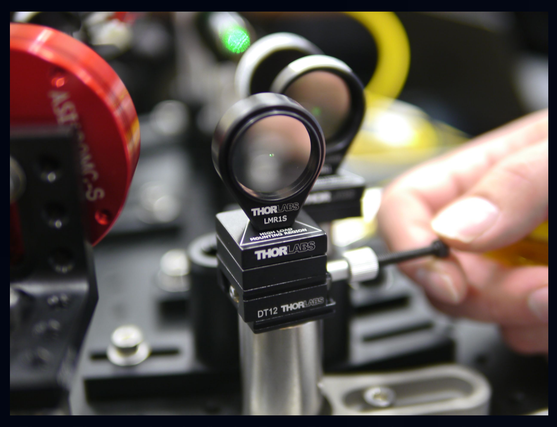

Fig. 1: The "star blocker" (aka Focal Plane Mask), one of the interchangeable and adjustable parts of the coronagraph.

By developing an interactive portable coronagraph demonstration bench, we illustrate how an actual coronagraph works.

Fig. 2: The coronagraph is an excellent tool for hands-on, live demonstrations, adjustable to age and knowledge, from middle schoolers to professional astronomers.

This coronagraph demo bench is composed by two laser beams. By adjusting mask locations into the beam of light, and regulating the diaphragm the user can experience how to eliminate the direct starlight to reveal a nearby faint planet. The image is shown in the focal camera and the pupil camera.

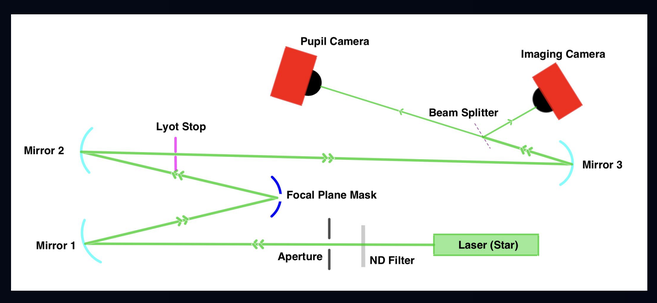

Fig. 3: Diagram of this demo bench using one laser beam.

Seeing is believing:

The **power** of exoplanet direct imaging can be **demonstrated** with **hands-on activities** showing the exoplanet system and the simulated light through a coronagraph.

Fig. 4: Transversal view of the coronagraph demonstration bench.

Check out the real thing at NASA's Exoplanet Exploration booth!

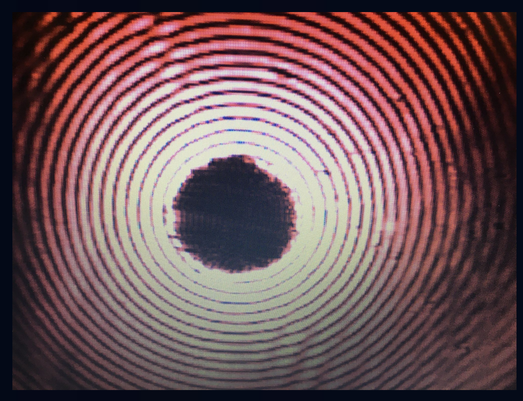

Fig. 5: Image on the focal plane camera with the FPM only, no Lyot Stop. Diffracted light from the star still dominates.

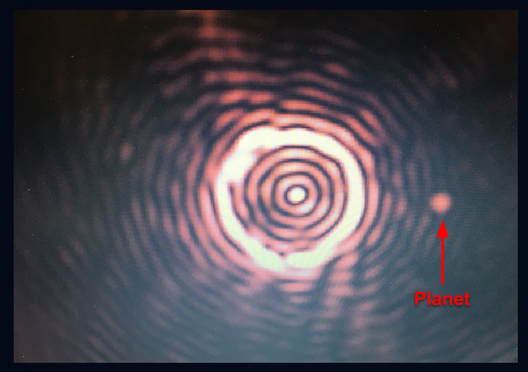

Fig. 6: Image with the FPM plus Lyot Stop; much of the starlight is suppressed and we can see objects around it clearer, like the simulated planet to the right.

This activity includes an introduction of exoplanets, their diversity and the search for life, and then two physical manipulatives including the coronagraph demonstration bench and The Unbelievable Blinder Experiment (TUBE), a simple high-contrast simulator.

In particular, TUBE has proven itself to be very successful in the concept introduction to a general or younger audience, starting with a simpler example before moving to the full demonstration.

Fig. 7: TUBE simulates a high contrast scene and has proven to be a great tool to explain the basic concepts of coronagraphy.

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