



## **Pushing the Limits of Visible-Light Spectro-Imaging:** The Evolution of FIRST on SCExAO

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**Current PIC performance** Transmission : 30% (Goal 50 to 75%) Cross-talk : 0.2% average (Goal <1%)

**Current PIC limitations** High polarization cross-talk decreasing the overall throughput



## Image reconstruction with FIRST-PL (in-lab)

In-lab calibration of the Photonic Lantern (in collaboration with Sylvestre Lacour+ @ LIRA)

Linear relation between the PSF position and the output flux  $\rightarrow$  Tests reconstructing PSF on-axis, off-axis and binary  $\rightarrow$  Injecting a signal from a companion emitting in Hα and applying Spectral Differential Imaging (SDI) to reconstruct the image of the emitting companion.



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| Drawings: Courtesy of Elsa Huby   |   |  |
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| Perspectives  | Acknowledgements - Affiliations   | References   |
| <ul> <li>→ Add new Photonic Lantern coupled to a R~60,000 spectrograph</li> <li>→ Wavefront sensing with FIRST-FIZ and -PL for petalling control</li> <li>→ More developments on the PIC side for delivery</li> </ul> | The authors wish to recognize and acknowledge the very significant cultural role and reverence that the summit of Mauna Kea has always had within the Hawaiian community. We are most fortunate to have the opportunity to conduct observations from this mountain.<br>The development of FIRST was supported by Centre National de la Recherche Scientifique CNRS (Grant ERC LITHIUM - STG -639248). The development of SCExAO was supported by the National Astronomical Observatory of Japan (NAOJ), the Astrobiology Center of the National Institutes of Natural Sciences, Japan, the Subaru Telescope, the Japan Society for the Promotion of Science (Grant-in-Aid for Research #23340051, #26220704, #23103002, #19H00703 & #19H00695), and the Mt Cuba Foundation.<br><sup>1</sup> SSEI – CoE - IfA - University of Hawaii, <sup>2</sup> Subaru telescope, <sup>3</sup> Astrobiology Center, <sup>4</sup> LIRA – Observatoire de Paris, <sup>5</sup> University of Arizona, <sup>6</sup> KASI, <sup>7</sup> SAIL, <sup>8</sup> Observatoire de Ia Côte d'Azur, <sup>9</sup> Univ. of Texas, <sup>10</sup> IPAG, <sup>11</sup> Caltech, <sup>12</sup> IfA – University of Hawaii, <sup>13</sup> University of Sydney, <sup>14</sup> SETI, <sup>15</sup> UCLA, <sup>16</sup> SOKENDAI, <sup>17</sup> UCI, <sup>18</sup> Univ. of Tokyo | Lacour et al., <i>MNRA</i> , 2007<br>Huby et al., <i>A&amp;A</i> , 2012<br>Huby et al., <i>A&amp;A</i> , 2013<br>Lallement et al., <i>JATIS</i> , 2023<br>Vievard et al., <i>A&amp;A</i> , 2023<br>Kim et al. ,ApJ, 2024 |