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Deep learning technique for highly vivid structural color filter metasurfaces

Arthur Clini de Souza, Stéphane Lanteri, Hugo Enrique Hernandez-Figueroa, Marco Abbarchi, David Grosso, Badre Kerzabi, Mahmoud Elsayy

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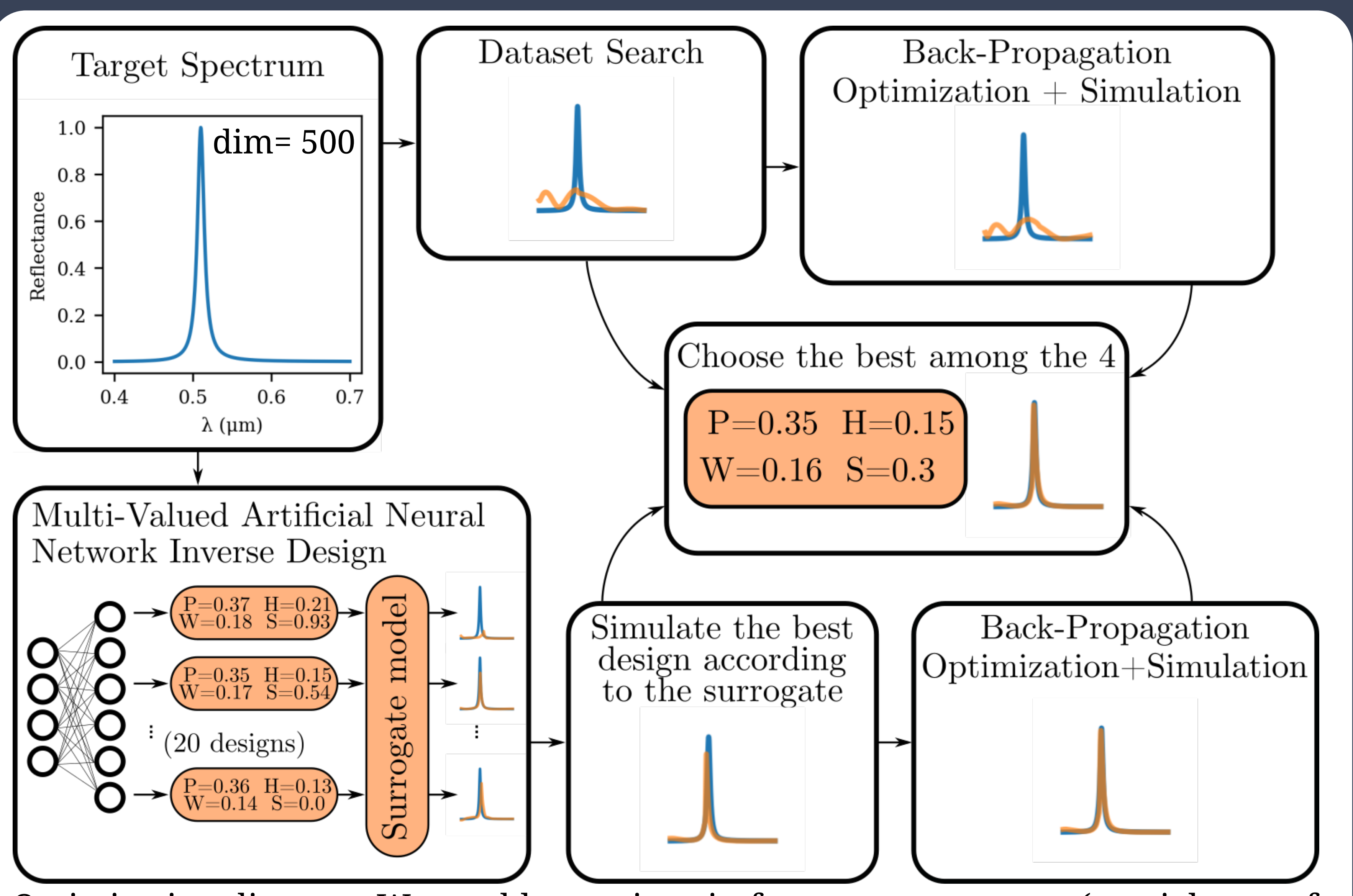
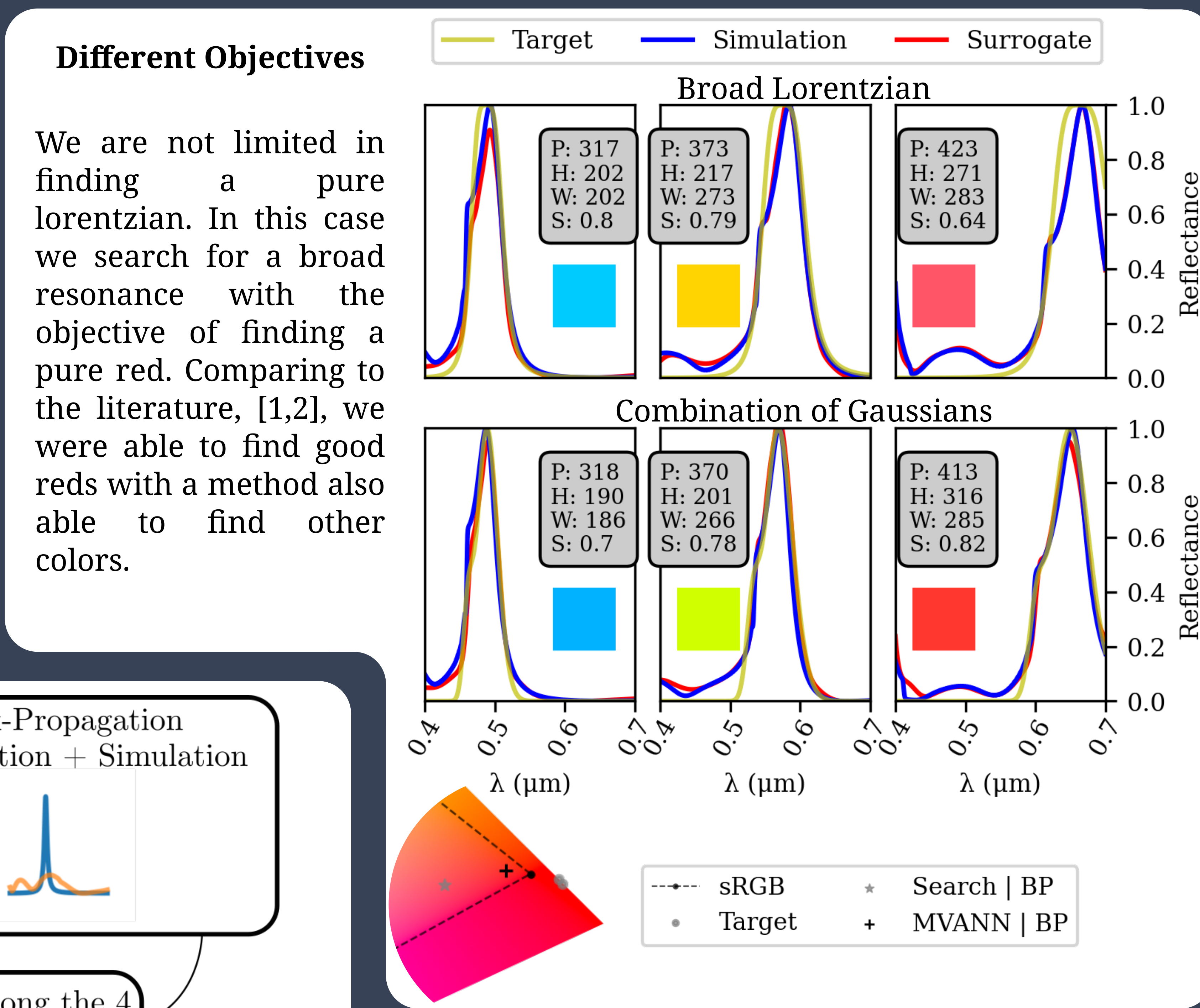
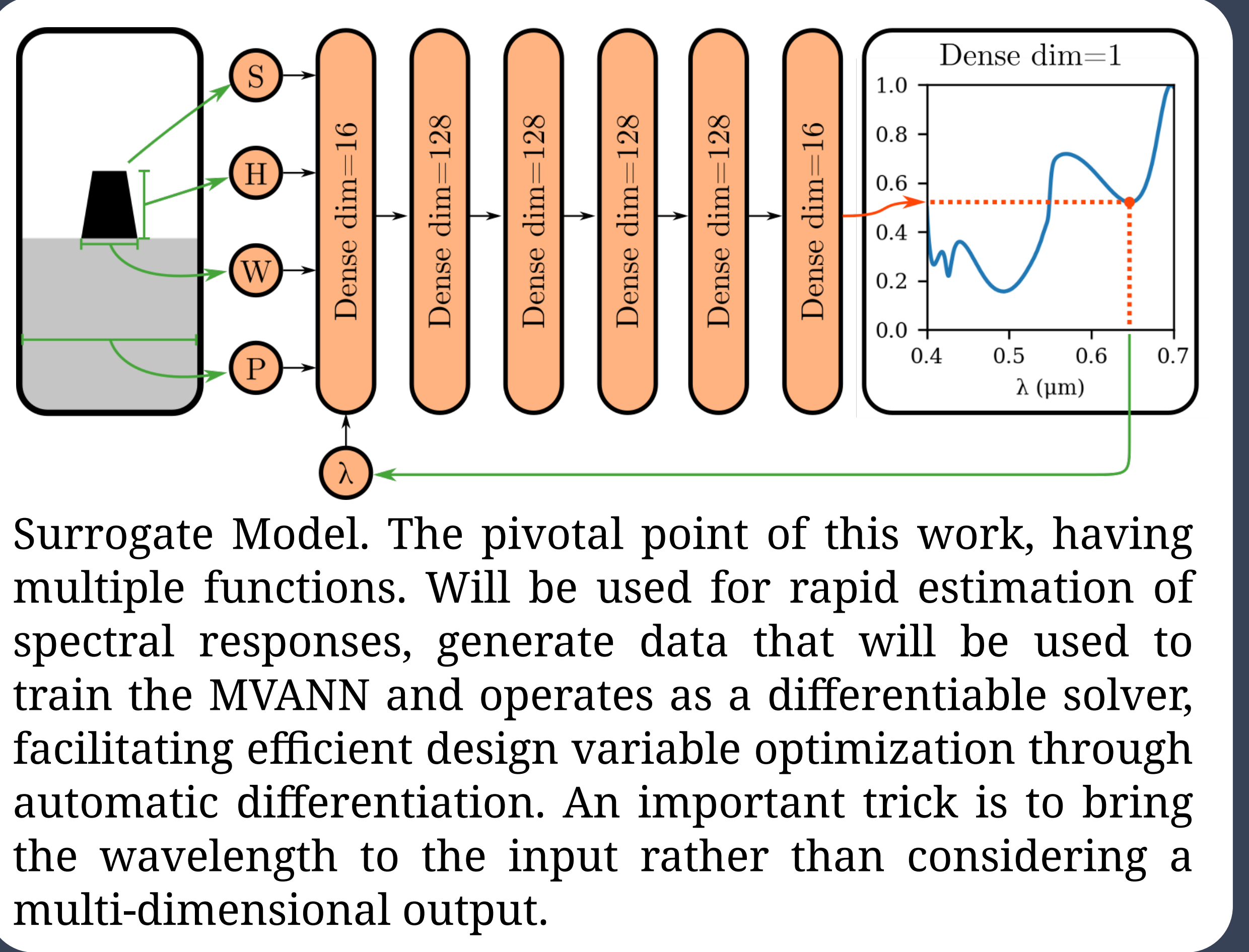
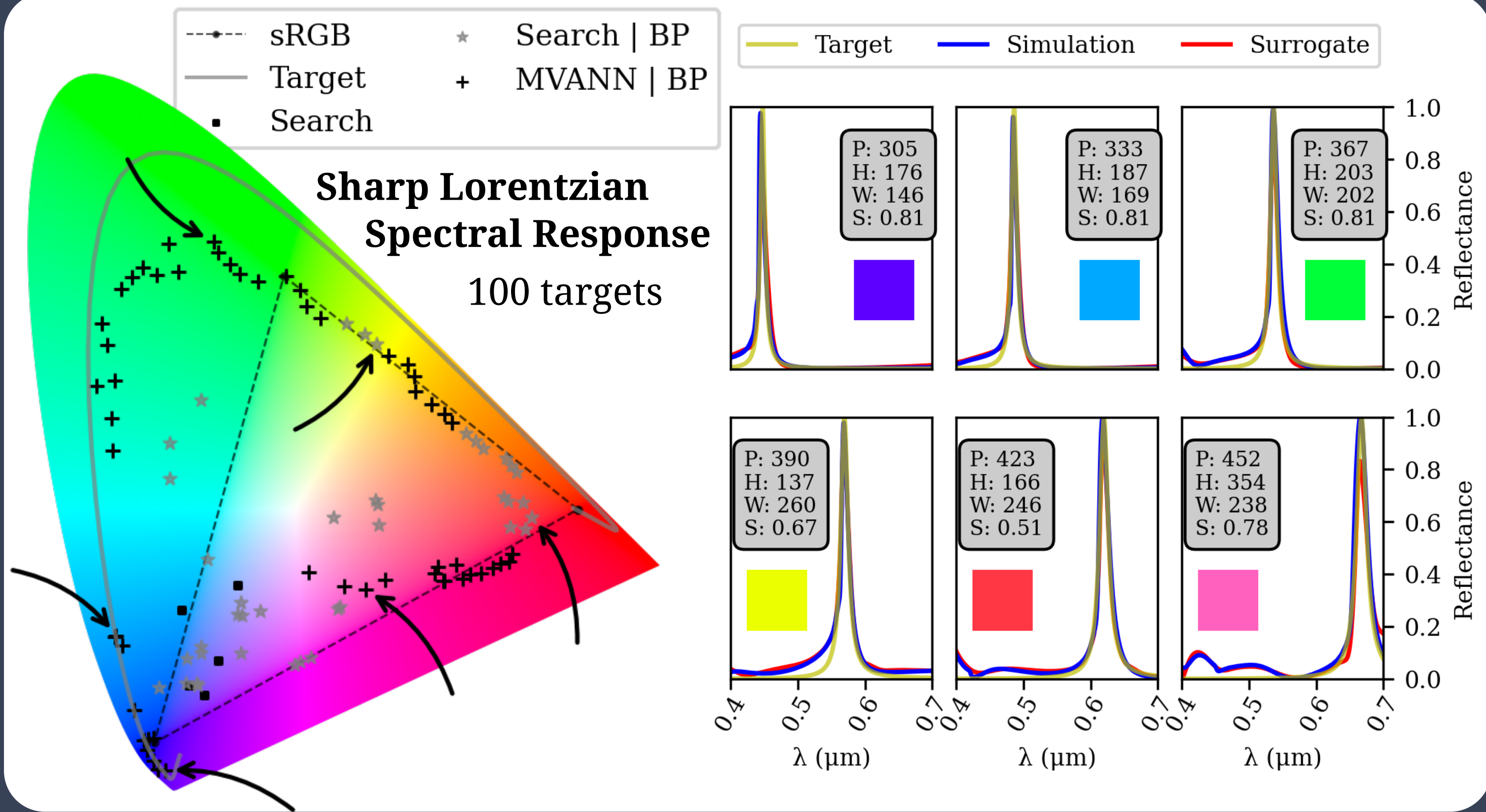
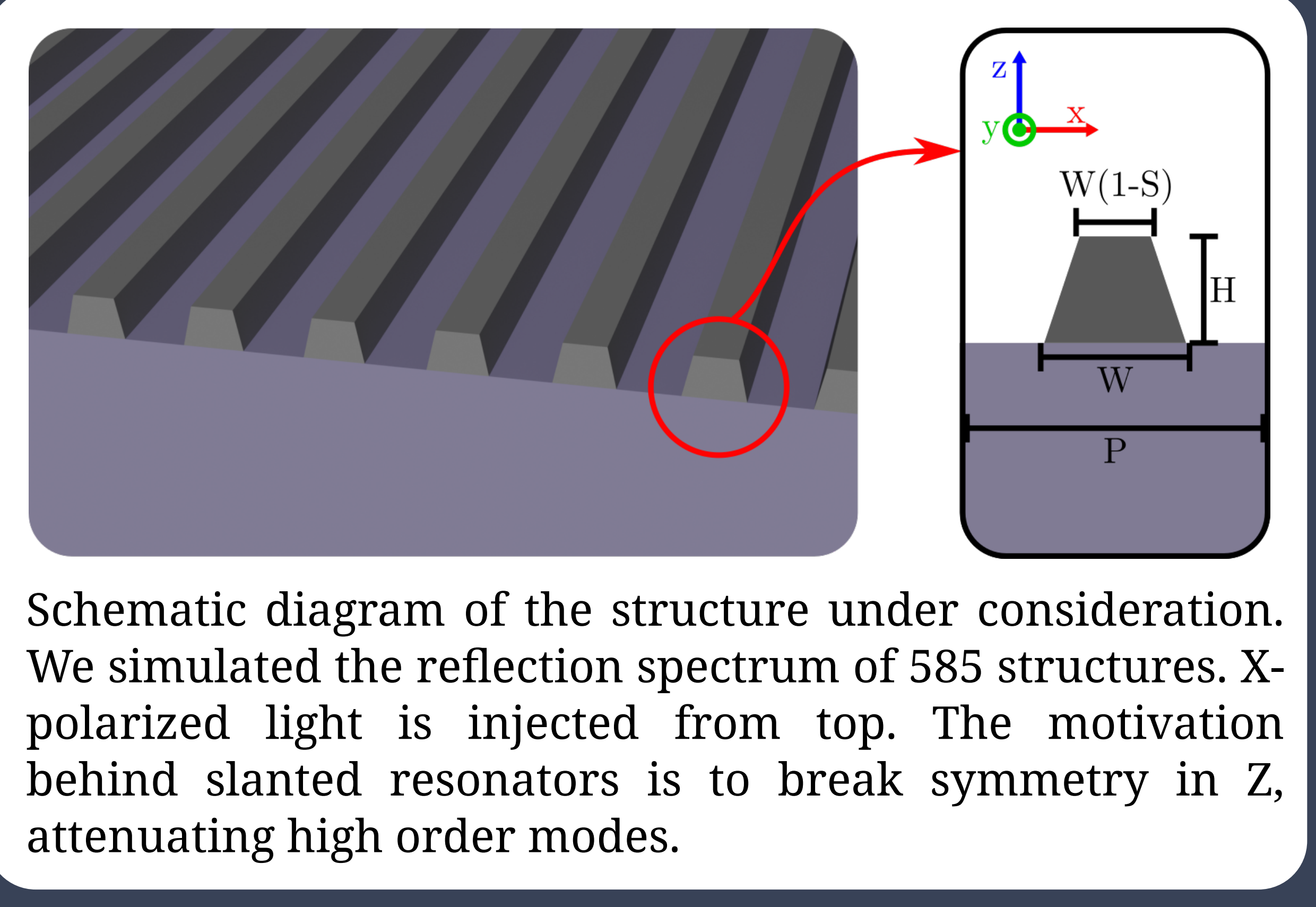
Arthur Clini de Souza^{1,2,3}, S. Lanteri¹, H. E. Hernandez-Figueroa², M. Abbarchi^{3,4}, D. Grosso^{3,4}, B. Kerzabi³, M. Elsayw¹

¹Université Côte d'Azur, Inria, CNRS, LJAD, Sophia Antipolis, France, ²University of Campinas (UNICAMP) Campinas, São Paulo, Brazil
³Solnil, Marseille, France, ⁴Université Aix Marseille, CNRS, Université de Toulon, Marseille, France

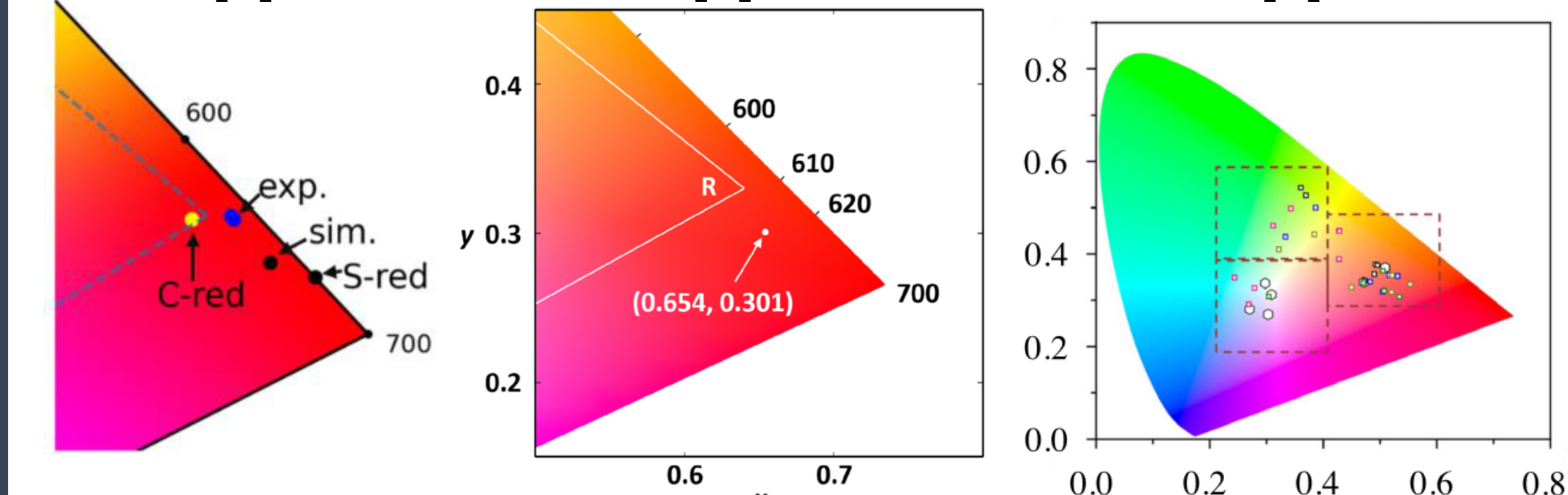
Arxiv paper:



We introduce a novel technique for designing color filter metasurfaces using a data-driven approach based on deep learning. Our innovative approach employs inverse design principles to identify highly efficient designs that outperform all the configurations in the dataset, which consists of **585 distinct geometries solely**. By combining Multi-Valued Artificial Neural Networks and back-propagation optimization, we overcome the limitations of previous approaches, such as poor performance due to **extrapolation and undesired local minima**. Consequently, we successfully create reliable and highly efficient configurations for metasurface color filters capable of producing exceptionally vivid colors that go beyond the sRGB gamut. Furthermore, our deep learning technique can be extended to design various pixellated metasurface configurations with different functionalities.



Other approaches requires more data to optimize a single objective. In the case of [1,2] the authors focus solely in the red color. In [1] they optimized 13 variables using 360 simulation while in [2] was performed 9600 simulations to optimize 6 variables. Other example is [3] where it is optimized 7 variables considering 5600 simulations.



[1] Lin, R., et al. (2023). arXiv preprint arXiv:2304.13516
 [2] Dong, Z., et al. (2022) Science Advances 8(8) eabm4512
 [3] Panda, S. S., & Hegde, R. S. (2020). Journal of Nanophotonics, 14(1), 016014-016014