The VORTEX project

- optimized, high performance vortex coronagraphs for E-ELT instruments -

O. Absil[1], M. Karlsson[2], D. Mawet[3], B. Carlomagno[1], V. Christiaens[4,1], C. Delacroix[1], P. Forsberg[2], C. Gomez Gonzalez[1], S. Habraken[1], A. Jolivet[1], P. Piron[1], M. Van Droogenbroeck[5], E. Vargas Catalan[2], P.-A. Absil[6], A. Boccaletti[7], P. Baudoz[7], D. Defrère[8], J. Milli[3], and J. Surdej[1]

[1] Département d'Astrophysique, Géophysique & Océanographie, Université de Liège, Belgium
[2] Angström Laboratory, Uppsala University, Sweden
[3] European Southern Observatory, Santiago, Chile
[4] Departamento de Astronomia, Universidad de Chile, Santiago, Chile
[5] INTELSIG, Université de Liège, Belgium
[6] ICTEAM, Université Catholique de Louvain, Belgium
[7] LESIA, Observatoire de Paris, Meudon, France
[8] Steward Observatory, University of Arizona, USA

WP1 - exploitation

Three of our mid-infrared Annular Groove Phase Masks (AGPMs) have recently been installed at VLT/VISIR, VLT/NACO and LBT/LMIRCam, and obtained first on-sky results (Mawet et al. 2013, Absil et al. 2013, Milli et al. submitted, Defrère et al. in prep). WP1 aims to develop optimized image processing algorithms for these vortex coronagraphs and to perform their scientific exploitation. We will particularly focus on the follow-up of new exoplanets imaged with e.g. VLT/SPHERE and Gemini/GPI, and perform dedicated survey on well-chosen targets.

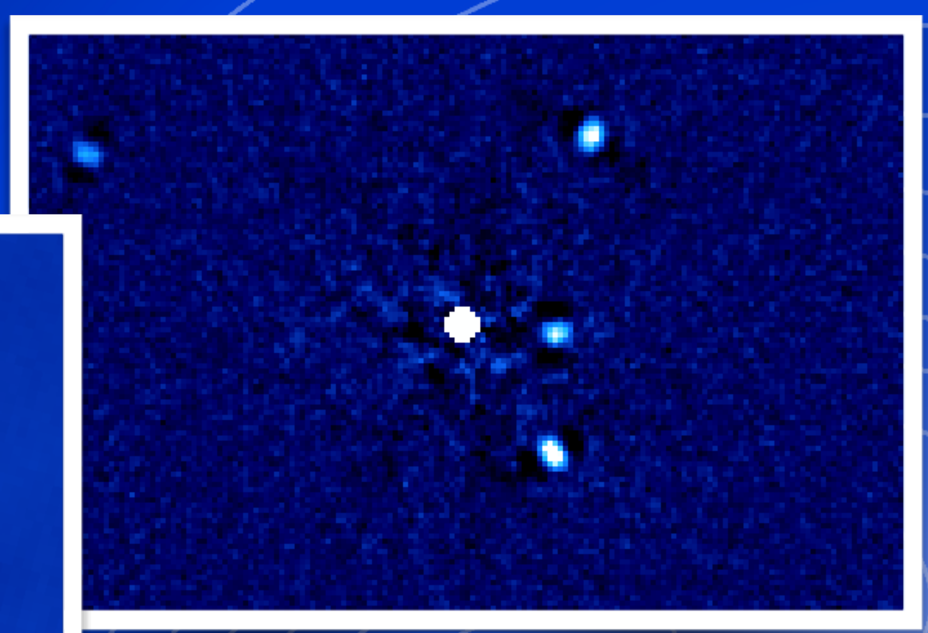


Fig. 2: first light of our L-band AGPM on LBT/LMIRCam, showing the four HR 8799 planets with high SNR after PCA processing by J. Kuhn (Defrère et al., in prep).

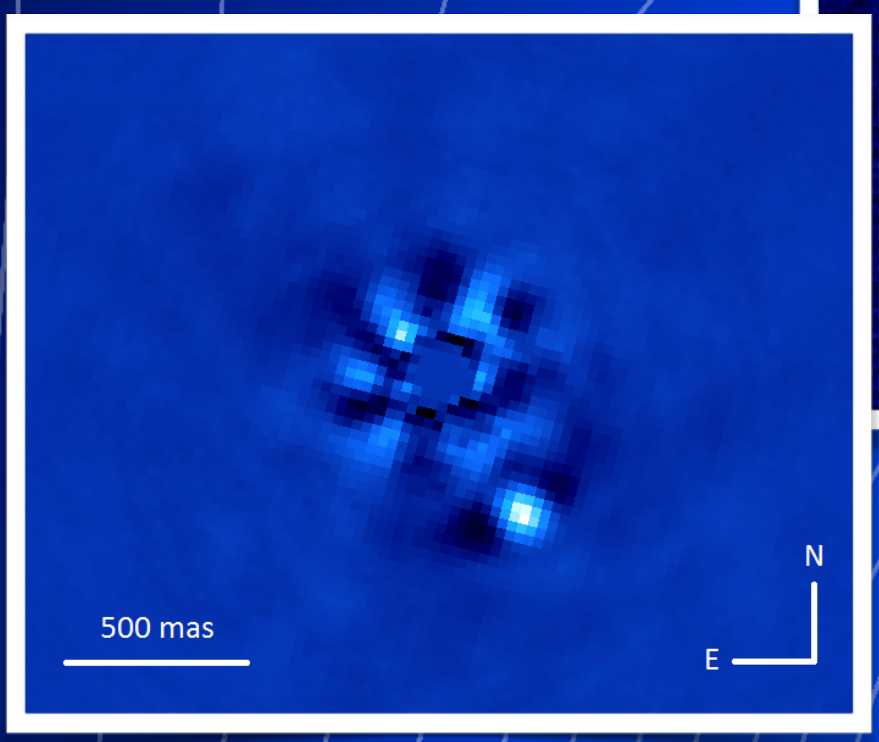


Fig. 1: first light of our L-band AGPM on VLT/NACO, showing the planet around β Pic with high SNR after PCA processing (Absil et al. 2013).

WP2 - new vortices

After 7 years of technology developments, we have produced first science-grade N-band and L-band AGPMs in 2012 (Delacroix et al. 2013). These phase masks, based on subwalength gratings etched ont diamond substrates, provide a peak rejection up to 500:1. WP2 aims to improve upon this performance level and to port our design to shorter wavelengths and higher topological charges (see posters by Carlomagno and Delacroix for details). These developments are directly focused on E-ELT applications.

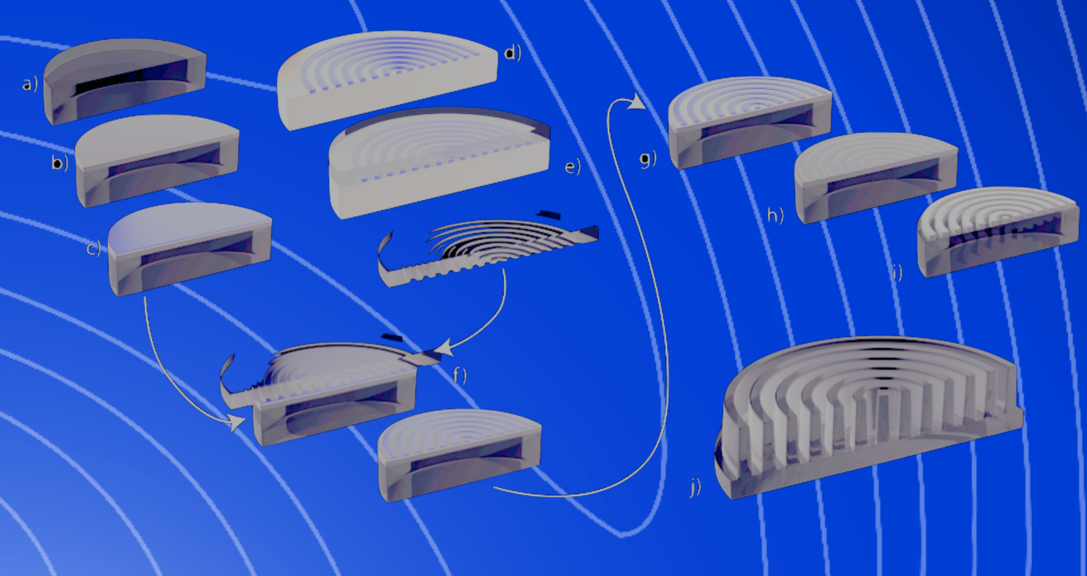


Fig. 3: etching subwavelength gratings onto diamond substrates. The pattern is transfered from a shallow master to the diamond substrate in successive nanoimprint and etching steps (Forsberg & Karlsson 2013).

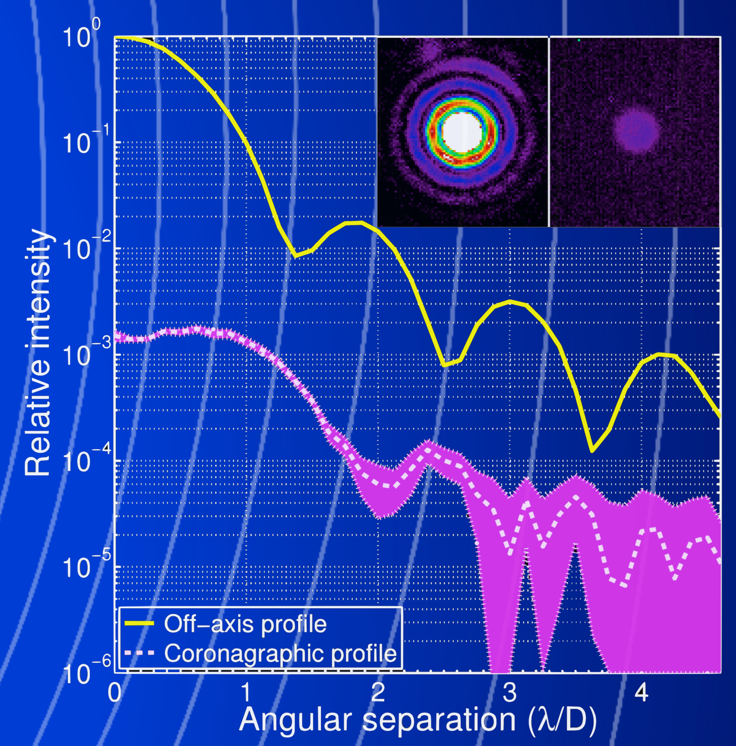
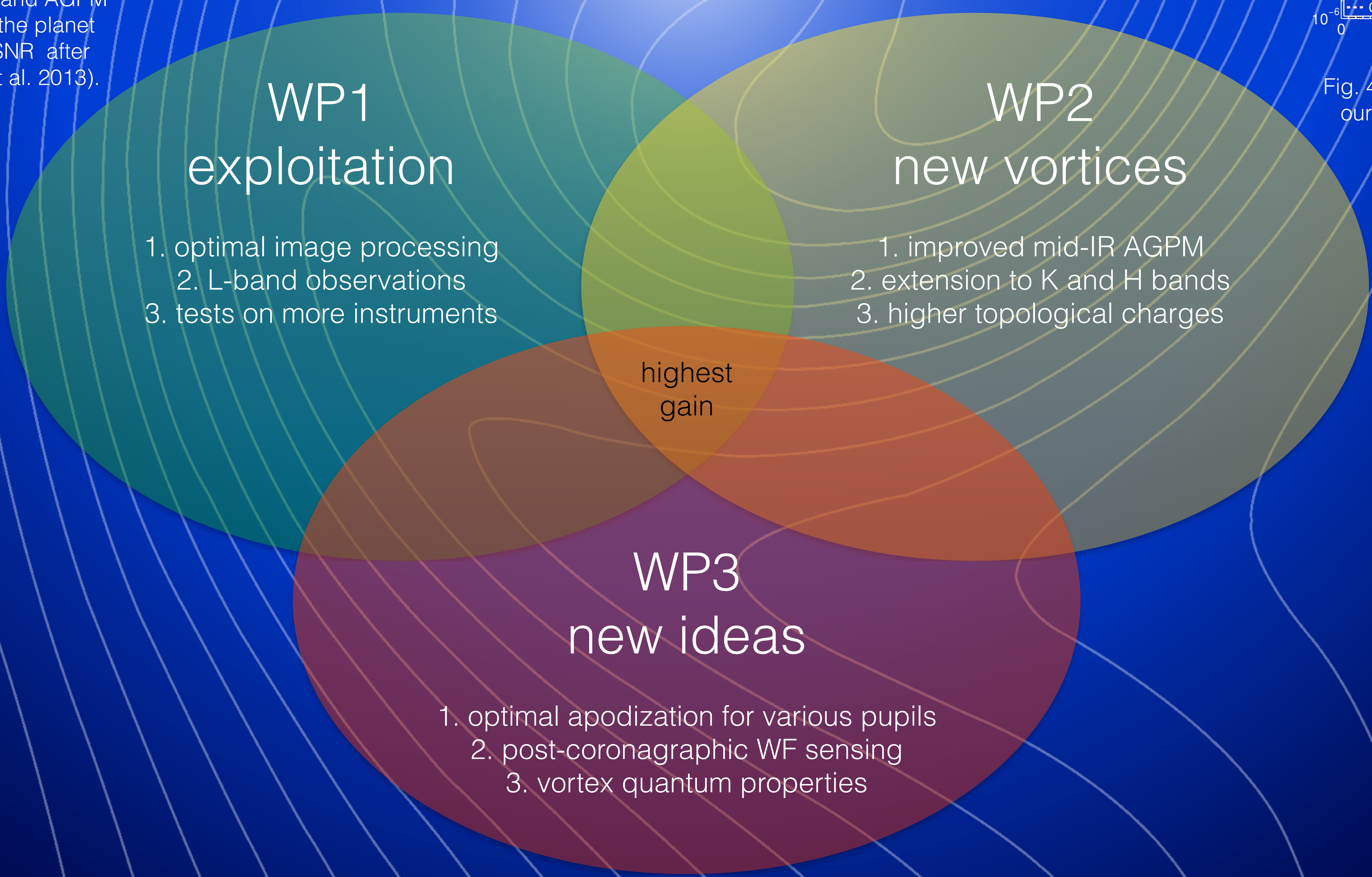


Fig. 4: measured performance of our best L-band AGPM so far (Delacroix et al. 2013).



WP3 - new ideas

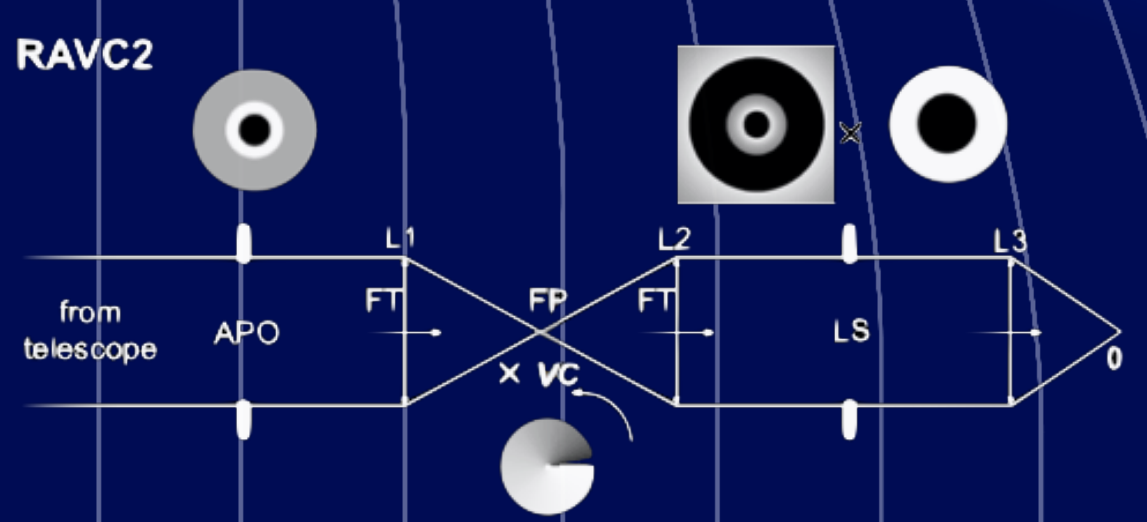


Fig. 5: optimal pupil-plane ring apodizer to cancel out the stellar light diffracted by the central obscuration (Mawet et al 2013)

Fig. 6: dedicated optical bench to test the vortex performance and validate new ideas.

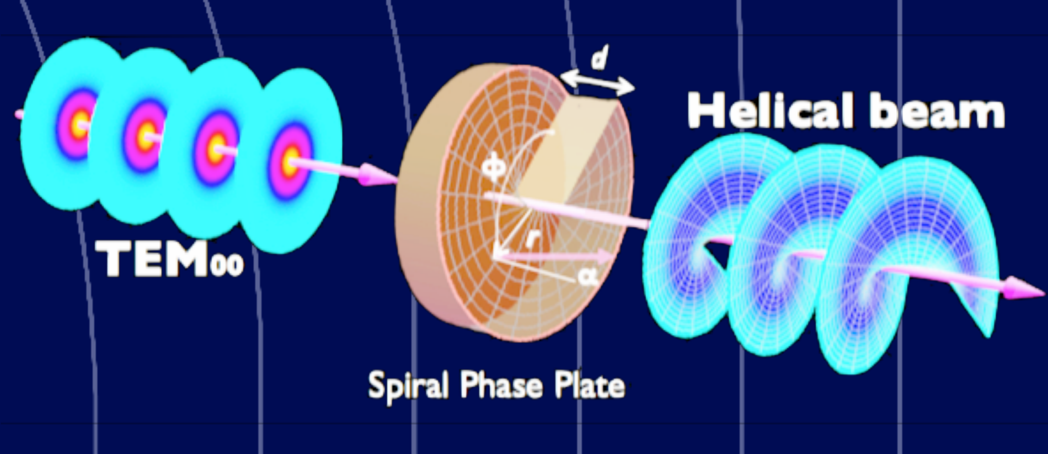


Fig. 7: an optical vortex creates an orbital angular momentum (OAM) on the output photons. This property can be exploited to improve the post-coronagraphic stellar light rejection (Absil et al., in prep).