Development of next generation Vortex Phase Masks

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Direct Imaging of Exoplanets
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Vortex Coronagraphs
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Subwavelength Grating Vortex Coronagraph (SGVC)

In practice...?

[Delacroix 2014]
Annular Groove Phase Mask (AGPM)

Manufacturing in Uppsala

[Delacroix 2013]

Testing on VODCA test bench

[Defrère 2014]

Results from LMIRcam

[Defrère 2014]

What’s next?

[Jolivet 2019]
The need for higher topological charge

- sensitivity of future telescopes to partly resolved stars
The need for higher topological charge

- sensitivity to low order aberrations

[Jolivet 2019]
Segmented designs for higher topological charge

• 3 proposed designs:
  - lines
  - curves
  - hybrid
Segmented designs for higher topological charge

But how to avoid transition regions?
New designs using metasurfaces

- new Degree of Freedom: height, width and **length** of the blocks

- it turns out that the optimal solution is close to continuous grating lines (AGPM)

[Devlin 2017]
Pixelization approaches

ideal

charge-2

charge-4

cartesian
Pixelization approaches

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<th>Ideal</th>
<th>Cartesian</th>
<th>Polar</th>
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Pixelization approaches

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 cartesian  polar  polar sym.

\[ l = 2 \]

\[ l = 4 \]
Adapted cartesian pixelization

optimize locally!
Conclusion

Need for higher topological charge: low-order aberrations and resolved stars

FDTD simulations of full patterns

Metasurfaces provide an exciting new path

local optimization of the block parameters