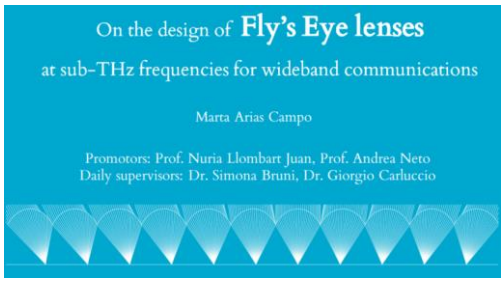
Fly's Eye Lens Antennas

for XG sensing and communications at 180GHz/300GHz

Collaborators in this topic: Dr. M. Arias (IMST/TUD), Dr. S. Bruni (IMST), Dr. G. Carluccio, Dr. D. Blanco, Dr. M. Spirito, Prof. A. Neto, Prof. N. Llombart

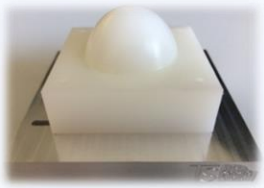
In collaboration with Prof. Earl McCune, we envisioned a communications system based on Fly's eye based base station exploiting >100GHz carries combined with Fly's eye antenna arrays as a solution that can provide 200 times more data rates by using a base station made. A collaboration with the company IMST GmbH was established consolidated by a co-financing a PhD between this ERC and IMST. From IMST's side, the PhD was financed in part by the Germany Ministry of Education and Research (BMBF) in the frame of the project Hypatia, in close collaboration with Fraunhofer Institute for Applied Solid State Physics (IAF) and further academic and industrial partners.

If you are interested in this topic, you can find detailed information in the PhD thesis of Marta Arias:



https://doi.org/10.4233/uuid:a9bb41e0-3d2a-4028-a218-bd85f2053545

High Gain Wide Band Antennas

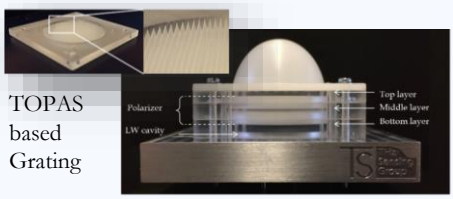


Key idea: Compact, low cost and wide-band integrated lens leaky wave antennas based on very low dielectric permittivity. It can be scaled in directivity easily and to higher frequencies

Performance: 140GHz-220GHz bandwidth, 34dB directivity, 80% aperture efficiency, and an extremely low loss (<0.4dB)

M. Arias Campo, D. Blanco, S. Bruni, A. Neto and N. Llombart, "On the Use of Fly's Eye Lenses with Leaky-Wave Feeds for Wideband Communications," in IEEE Transactions on Antennas and Propagation, vol. 68, no. 4, pp. 2480-2493, April 2020,

Circular Polarization



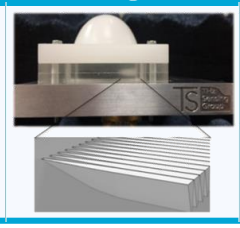
TOPAS based Grating

Key idea: leaky wave antennas radiate most of the energy below the critical angle. This fact enables the embedding of air-dielectric gratings (non-uniform dielectrics) into the lens for tuning it radiating potteries properties such as generation of circular polarization

Performance: 140GHz-210GHz bandwidth, 34dB directivity, 75% aperture efficiency, AR< 3dB also for multi-beams

M. A. Campo, G. Carluccio, D. Blanco, O. Litschke, S. Bruni and N. Llombart, "Wideband Circularly Polarized Antenna with In-Lens Polarizer for High-Speed Communications," in IEEE Transactions on Antennas and Propagation, vol. 69, no. 1, pp. 43-54, Jan. 2021

Steering Enhancement



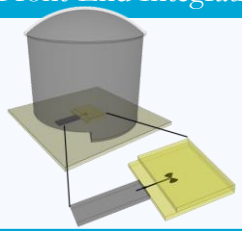
TOPAS based Grating

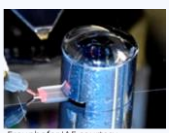
Key idea: Using the new leaky-wave antenna integrated with a non-periodic gratings, we have shown enhanced the steering properties in low-permittivity lenses in combination with planar focal plane arrays

Performance: Fly's eye arrays with 225 beams of >30dBi gain in a 50deg field of view and 140-220GHz bandwidth

M. Arias Campo, G. Carluccio, S. Bruni, and N. Llombart, "Dielectric gratings enhancing the field of view in low dielectric permittivity elliptical lenses," IEEE Trans. Antennas Propag., accepted

Front-End Integration at 300GHz





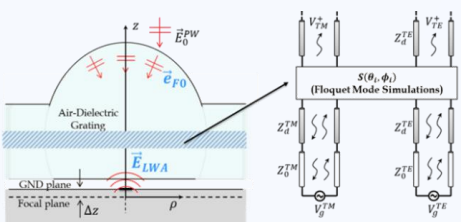
Fraunhofer IAF courtesy

Key idea: The combination of a quartz-cavity leaky wave exciting a shallow silicon lens with and a beam-lead transitions to GaAS GaAs front-ends.

Performance: 220GHz-320GHz bandwidth, 26dB directivity, 74% aperture efficiency, and 70% radiation efficiency

M. . Arias Campo, K. Hole, R. Weber, C. De Martino, M. Spirito, A. Leuther, S. Bruni, and N. Llombart, "H-band quartz-silicon leaky-wave lens with air-bridge interconnect to GaAs front-end," IEEE Trans. THz Sci. and Technol., early access

Spectral Analysis



The CFO theoretical framework, developed during this ERC, in combination with a Spectral field representation of the leaky waves and grating geometries for a complete analysis of these lens antennas enabling a fast optimization of its radiation properties.