UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

Prof. Dr.-Ing. K. Solbach
Prof. Dr.-Ing. A. Beyer

Aufgabe der Abschlussarbeit im ISE Masterstudiengang

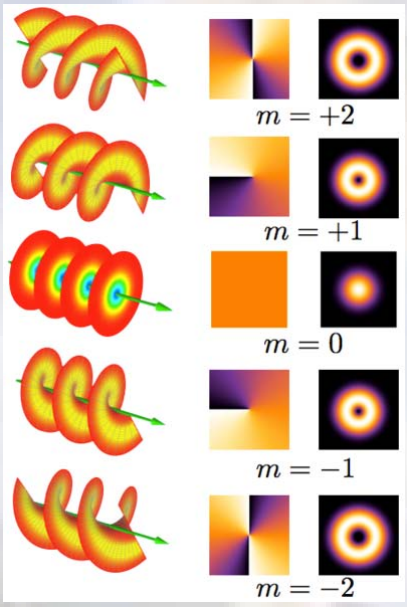
für: Herrn Amar **Al-Bassam**

gestellt von: Prof. Dr.-Ing. Klaus Solbach
Fakultät für Ingenieurwissenschaft - Hochfrequenztechnik

Thema: **Periodic Leaky-Wave Antennas for Orbital Angular Momentum Multiplexing System**

Description:

In today's world, the electromagnetic spectrum, especially at radio and microwave frequencies, is dense with communication frequencies through which a signal or data can be transmitted. This transmission can be done using different multiplexing techniques like Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM), these multiplexing techniques are limited to time and/or frequency.



Images courtesy of wikimedia commons

Fig. Vortex beams with different topological charges *m* in phase and magnitude.

Recently, there has been increasing interest in optical vortex beams due to their unique properties, especially their capability of carrying orbital angular monument (OAM). The OAM can be carried by so called *topological charge m* of vortex beam, which they refer to the helical nature of the wave-front and the integer number of m gives the number of twists per wavelength and its sign gives the handedness of the vortex.

The orbital angular momenta can be used to boost data rate in a communication system by using a proper multiplexing system, where each topological charge represents a communication channel. In theory an infinite number of topological charges can be generated and therefore infinite data rate can be achieved.

Vortex beams can be generated at microwave frequencies as well by using structures like Frequency Selective Surface (FSS) or a radiator like an antenna.

The task of this thesis is mainly focused on the realization of an electro-magnetic structure at microwave frequencies capable of generating vortex beams and investigating the possibility of using such beams in a communication system.

The task is summarized as follows:

- Investigate the feasibility of generating vortex beams carrying orbital angular momentum using a periodic leaky-wave antenna in a ring configuration.
- Develop an electromagnetic model based on the modes of a ring LWA.
- Explore the possibility of generating different topological charges.
- Design a multiplexing scheme accompanying the Ring LWA to detect and separate different topological charges.
- Simulate and fabricate a Ring LWA capable of generating at least two topological charges, followed by measurement of these topological charges.
- If the time allows, build and test a communication channel by using to LWA rings.

A final presentation of the results has to be given in the department of Hochfrequenztechnik (HFT).