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Design of an optical system with off-axis parabolic mirrors for THz system

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A terahertz (THz) range of an electromagnetic spectrum is considered to be used for the 6G wireless network. The important task of such networks is to design a collimated beam to increase the working distance between a source and a THz detector. One of the methods for rapid and targeted data transfer is applied directional beamforming technologies using interference of several antennas. Here for such purpose the possibility of off-axis parabolic (OAP) mirrors usage was studied.
An optical system with two OAP mirrors for collimation and focusing 140THz radiation on the pyroelectric detector surface is considered.
A Gaussian type of the radiation beam based on experimental data was generated with Ansys Zemax OpticStudio software. As an optical system high-reflectivity OAP mirrors of aluminum with a protective coating with a diameter $50.8mm$ and reflected focal length $101.6mm$ were used. For a $140GHz$ source with a total power of $22mW$, Gaussian initial beam profile in the emitter plane and divergence angle of 22° at $1/e^2$ level with peak radiant intensity $0,3W/sr$, collimated beam has been received with divergence angle less than 3° and peak radiant intensity $94,3W/sr$.
The divergence angle $= 2\times d$ 3° caused by diffraction was calculated by equation $d = /w[rad]$, where wavelength $= 2.14mm$ corresponds to the $140GHz$ frequency and $w = 25mm$ is an average mirror semidiameter. The diffraction angle value is comparable to that determined in geometric optics approximation.

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