Two-photon flow cytometer with laser scanning Airy beams
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Flow cytometry is an important technique in biomedical discovery. In the last ten
years in vivo flow cytometers based on one-photon or two-photon excited fluores-
cence have been developed. One drawback of laser beam scanning two-photon flow
cytometer is that two-photon excitation volume is fairly small due to short Rayleigh
range of focused Gaussian beam. Hence, the sampling volume is much smaller than
one-photon flow cytometer, which makes it challenging to count or detect rare cir-
culating cells in vivo. Non-diffracting beams have narrow intensity profiles with an
effective spot size (FWHM) as small as several wavelengths, making them compara-
tble to Gaussian beams. The trade-off of using Airy beams rather than Gaussian
beam is the fact that Airy beams have side lobes that contribute to background
noise. Two-photon excitation can reduce this noise, as the excitation efficiency
is proportional to intensity squared. Therefore, we developed a two-photon flow
cytometer using scanned Airy beams to form a light sheet that could be used to
intersect the blood vessel. The set up can successfully detect and count flowing
micro beads and tumor cells in micro channel. According to our knowledge, this is
the first application of Airy beams in flow cytometry.

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