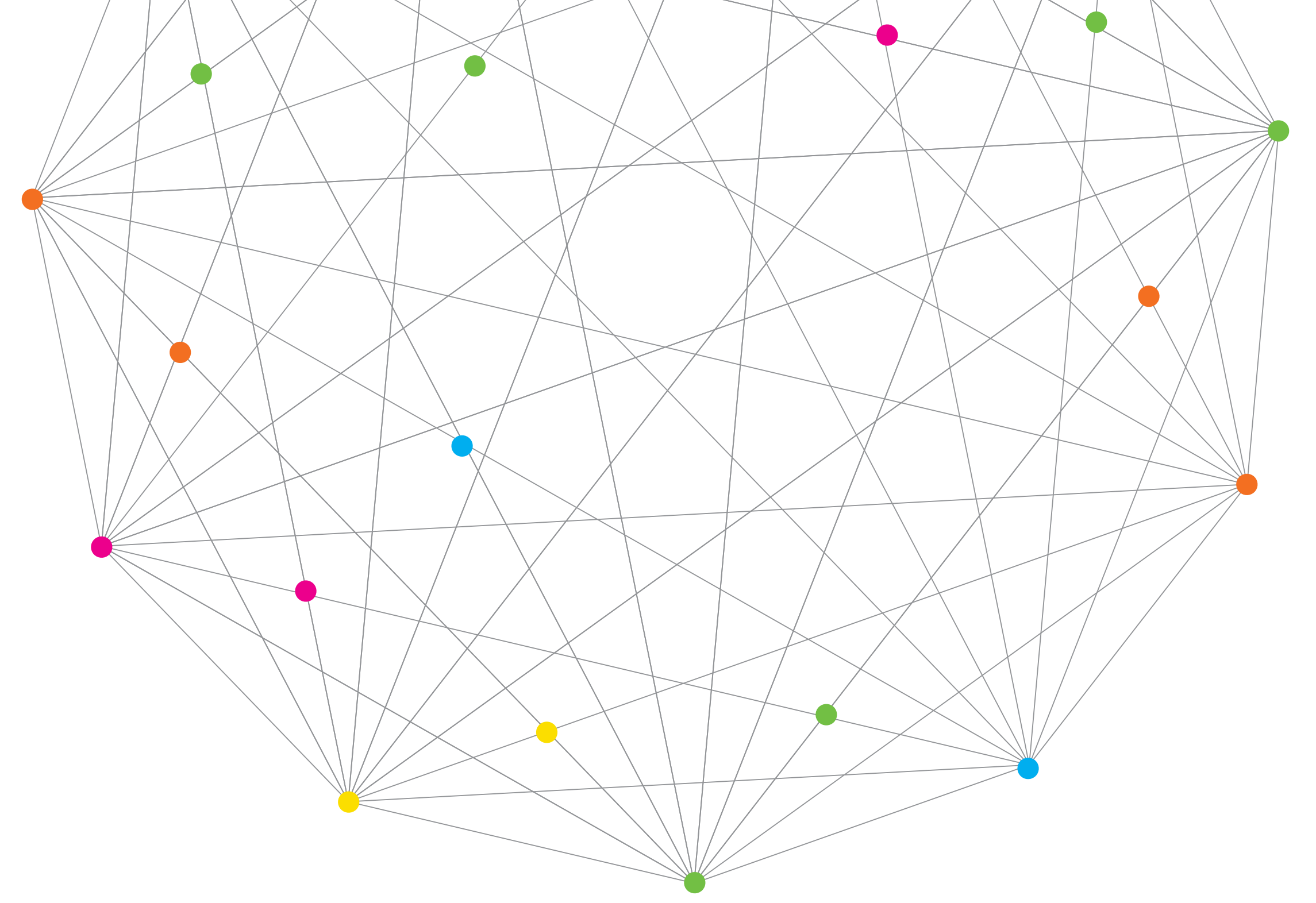


# LASER DOPPLER VELOCIMETRY

Laser Doppler Velocimetry (LDV) - A non-invasive technique for measuring velocity at a point in the flow with very high temporal resolution and high sampling rate.

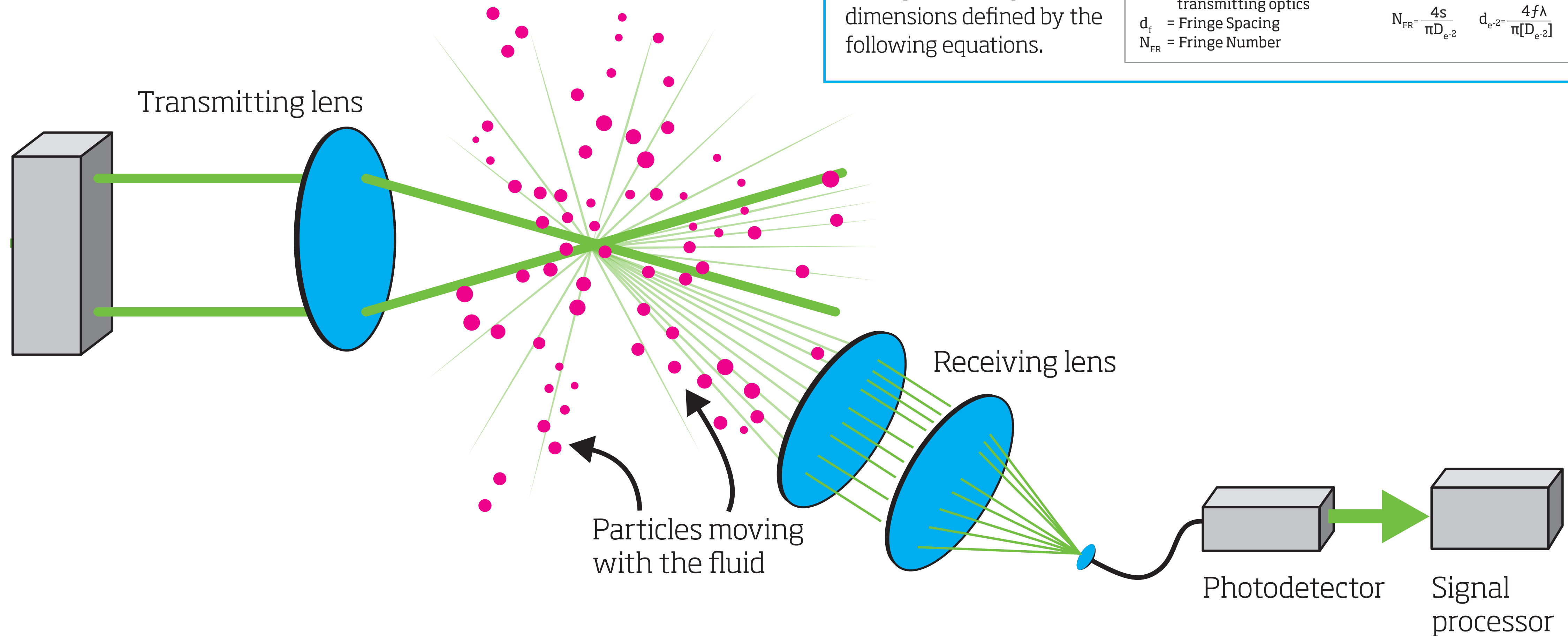
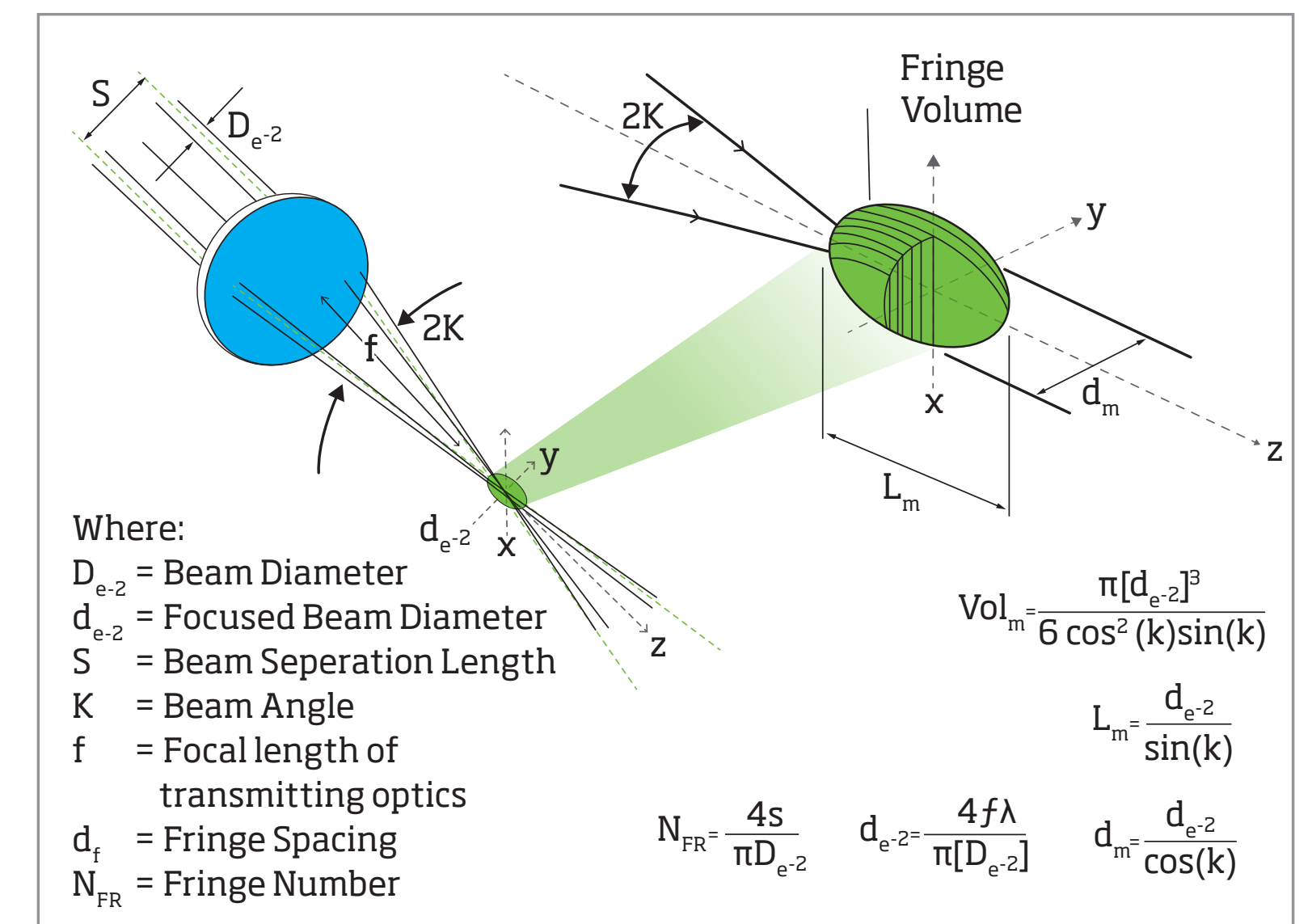


## Principle

To measure one component of velocity, a single laser beam is split into two parallel beams which are focused to cross at the focal point of the transmitting lens. Particles in the flow that pass through the intersection, or measuring volume, scatter light in all directions and are the signal source for velocity information. Scattered light collected by the receiving lens is focused onto the photodetector system, the output of which is sent to the signal processor. The result is velocity measurements displayed by the software.

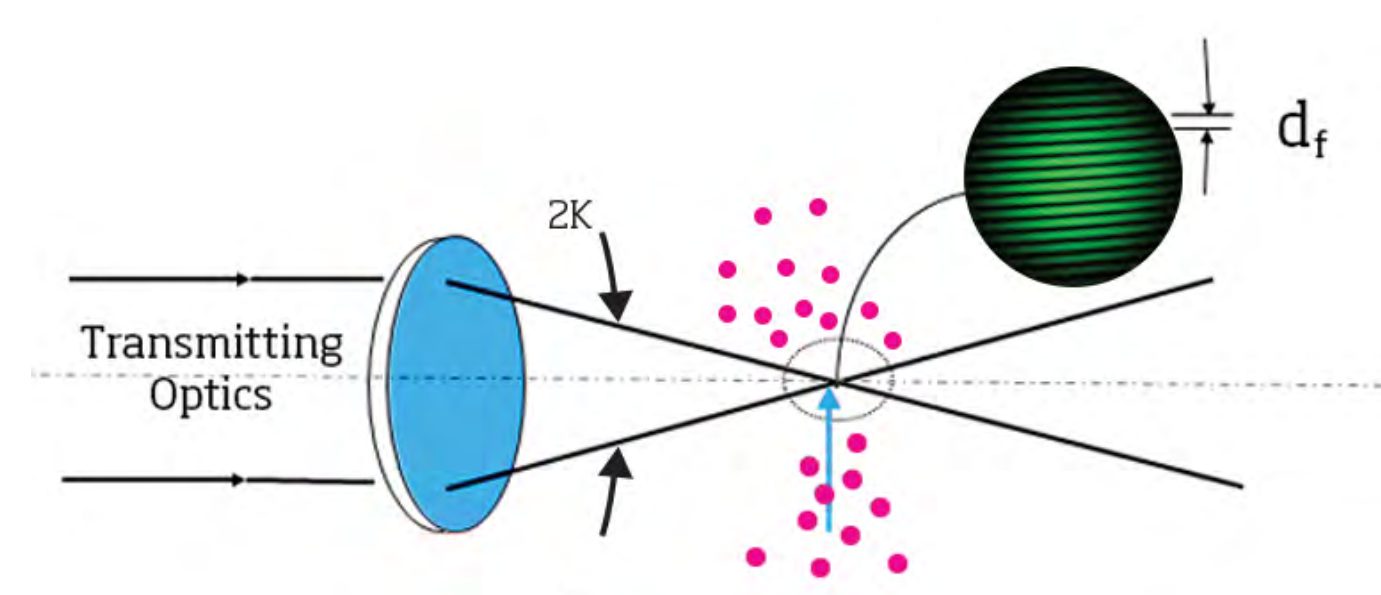
## Definition of Parameters in the Measurement Region at Beam Crossing

For Gaussian beams, the  $e^{-2}$  intensity points are used to define the beam diameter and the beam crossing region (measuring volume). The size of the measuring volume is critical to achieving an accurate velocity measurement. The measuring volume has an ellipsoidal shape with dimensions defined by the following equations.

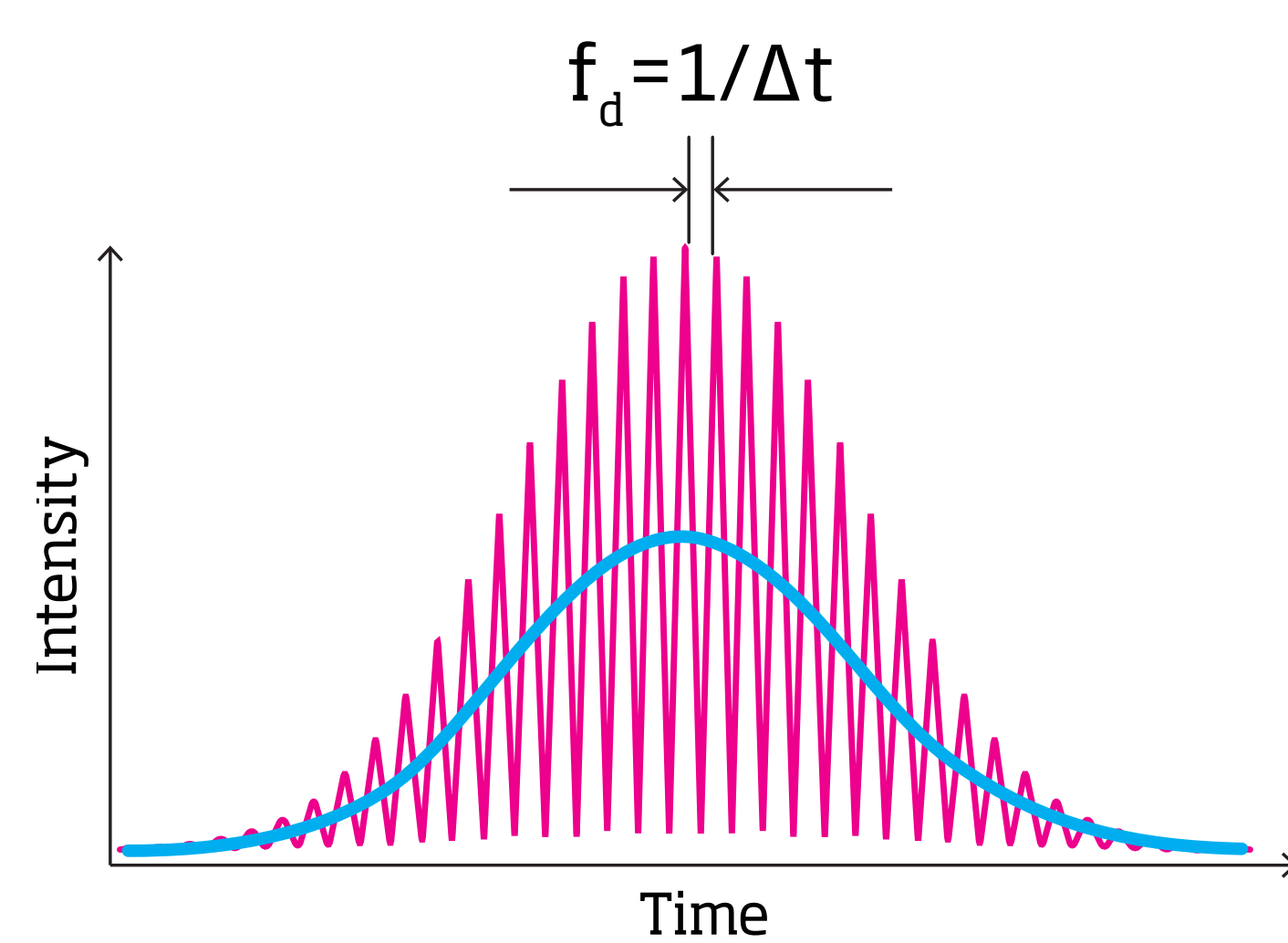


## Velocity from Fringe Spacing and Doppler Frequency

The measuring volume formed at the intersection of the two laser beams has a fringe pattern with definite spacing between the fringes ( $d_f$ ) which is determined by the angle and the focal distance of the two beams.



When a particle passes through the fringe pattern in the measuring volume, it creates a scattered light signal (burst) with sinusoidal varying intensity. The signal's burst envelope is caused by the Gaussian beam intensity distribution. The sinusoidal varying signal has a frequency called Doppler frequency ( $f_d$ ). The signal is processed to find the period ( $\Delta t$ ) with high accuracy. The Doppler frequency is then computed to be  $1/\Delta t$ . Velocity ( $U_x$ ) is calculated as a function of the Doppler frequency ( $f_d$ ) and the fringe spacing ( $d_f$ ).

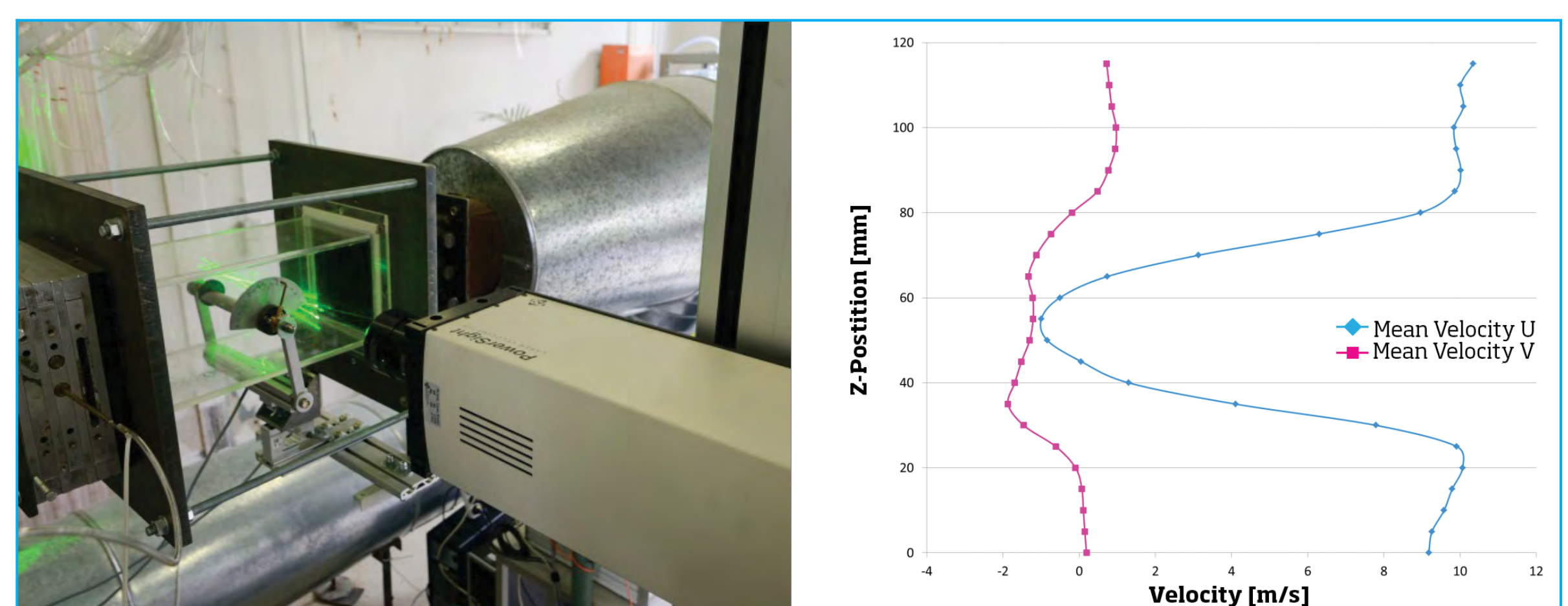


$$u_x = f_d d_f$$

## PowerSight DPSS-Based LDV System Configuration



The PowerSight LDV System uses high-power Diode Pumped Solid State lasers to generate high quality Doppler signals. The system can be expanded from 1D to 2D or 3D configurations to measure multiple components of velocity. PowerSight can be adapted through the use of fiber optic probes, beam expanders and underwater probes to conduct measurements on a broad range of flows.



Wake flow behind an airfoil



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