Supplementary Information

Current measurement analysis

To achieve normalized current measurements, the baseline current, I, and magnitude shift, $|\Delta I|$, from baseline must be measured from the detected signals, as shown below.

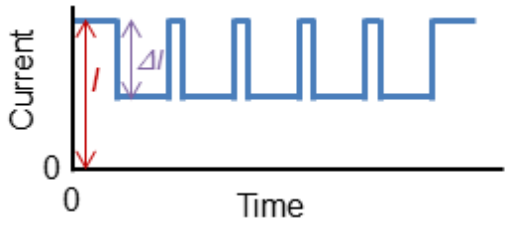

Figure S1: Parameter extraction from current measurements. The magnitude of the current change from baseline, $|\Delta I|/I$, can be readily determined from the current pulse when a particle passes through the node-pore.

Data filtering

To identify smaller particles in a sample and resolve signals masked by noise, low-pass filtering can be applied. The cutoff frequency can be optimized to reduce noise while still retaining the overall signature of the measurement.

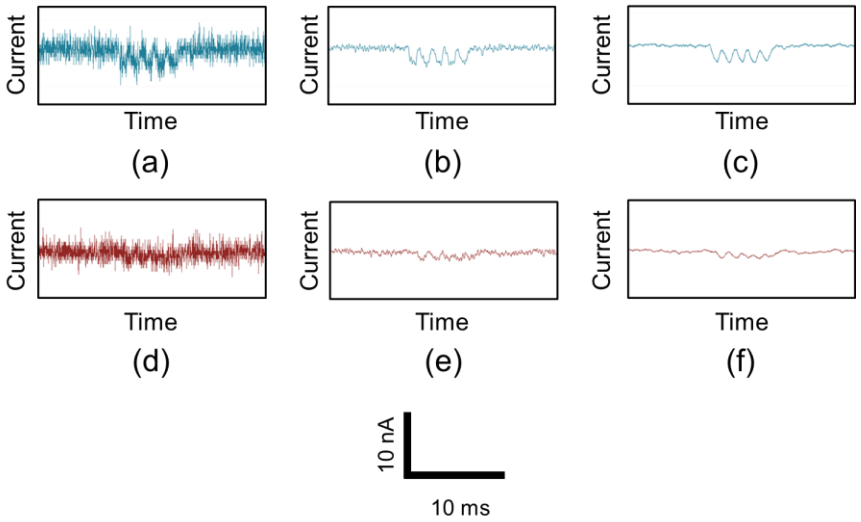

Figure S2: Low-pass filtering of measurement signal. Measurements of particles in human plasma sample transiting a (8 µm x 10 µm x 500 µm, H x W x L) four-node pore. Current vs. time traces of a fibrin particle (a) and HIV (d) before filtering. (b) and (e) show the signals after a low-pass filter with a cutoff frequency of 1500 Hz has been applied. (c) and (f) show the signals after applying a cutoff frequency of 500 Hz to the original signal.

Particle size determination

Colloidal samples of known size (reference colloids) were measured using a four-node device (8 µm x 10 µm x 500 µm, H x W x L) to establish the relation between normalized current and particle size, as shown below. Given that $V_{colloid} << V_{node\text{-}prore}$, we can best use a modified version of the relation defined by DeBlois and Bean[1] and expanded on by Saleh[2],

$$\frac{|\Delta I|}{I} = \frac{d^3}{D^2 L}\left[\frac{D^2}{2L^2} + \frac{1}{\sqrt{1+\left(\frac{D}{L}\right)^2}}\right] F\left(\frac{d^3}{D^3}\right) G\left(\frac{d}{D}\right) \qquad (1)$$

where $F(\frac{d^3}{D^3})$ and $G(\frac{d}{D})$ are numerical correction factors. The normalized current, $\frac{|\Delta I|}{I}$, is a function of pore diameter (D) and pore length (L), and particle diameter (d). $F(\frac{d^3}{D^3})$ was established by Deblois and Bean. $G(d/D) = 53(d/D) + 0.16(d/D)^{-2}$ is a numerical factor that accounts for the distortion of the electric field lines due to the four nodes included in the device. In general, $G(d/D)$ will vary depending on the number of nodes included in the device. For the HIV blood plasma detection we performed, a narrow normalized current range, shown in red below, was used to determine cutoffs for the HIV detection.

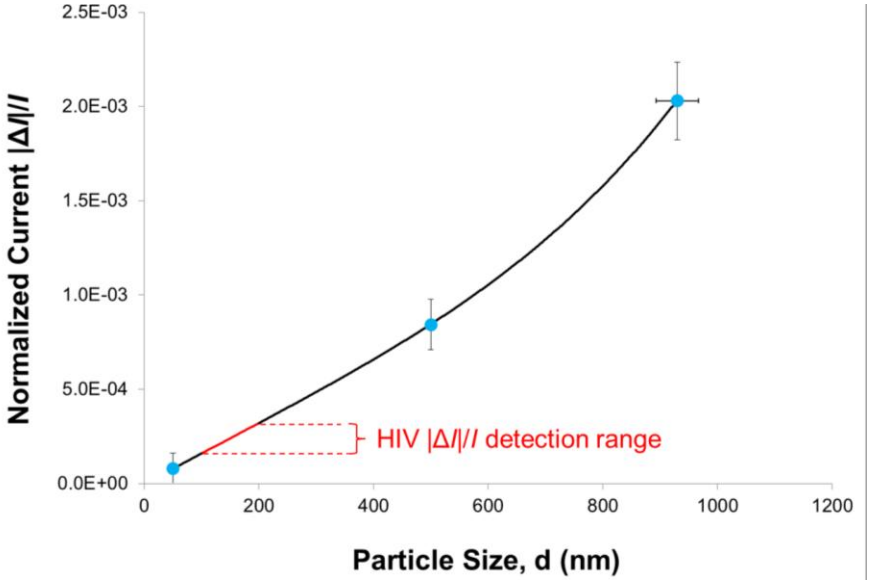

Figure S3: Normalized current vs. particle size. Measurement of three different colloidal samples (blue) using a four node-pore (8 μm x 10 μm x 500 μm, H x W x L). The samples consisted of either 50 nm ± 7 nm (Polysciences, Inc.), 500 nm ± 8 nm (Polysciences, Inc.), or 930 nm ± 37 nm (Interfacial Dynamics Corp.) colloids. The size distribution of each colloid was determined by the respective manufacturer. The curve is the theoretical normalized current from Eq. (1), and the region shown in red represents the range expected for HIV samples (100 – 200 nm). The error bars in normalized current of each colloid size correspond to one standard deviation of the measured distribution. Error bars in size for the 50 and 500 nm colloids are obscured by the size of the plotted points.

Fast Fourier transform analysis

A unique advantage of node-pores is the ability to analyze data using fast Fourier transform peak detection. The steps used in this data translation are explained below.

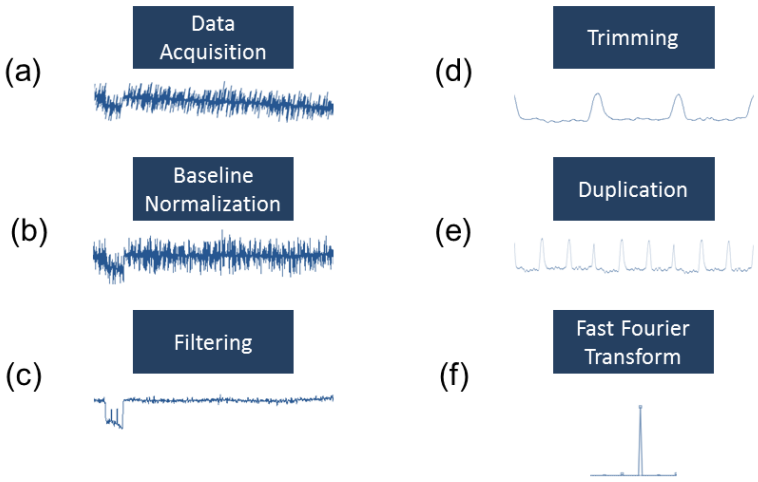

Figure S4: Detection scheme for applying fast Fourier transform (FFT) analysis. (a) Image of raw data during data acquisition. (b) Image of data after normalization to a baseline fit. (c) Data after a low-pass filter has been applied. (d) Data after regions of interest are identified and trimmed using derivative cutoff detection. (e) Duplication of the trimmed data prior to FFT analysis. (f) Calculation of the FFT of the duplication data.

1. R. W. Deblois and C. P. Bean, *Rev Sci Instrum*, 1970, **41**, 909-915.
2. O. A. Saleh, Princeton University, 2003.