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Supplementary Materials for

Voltage controlled on-demand magnonic nanochannels

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Figs. S1 to S6

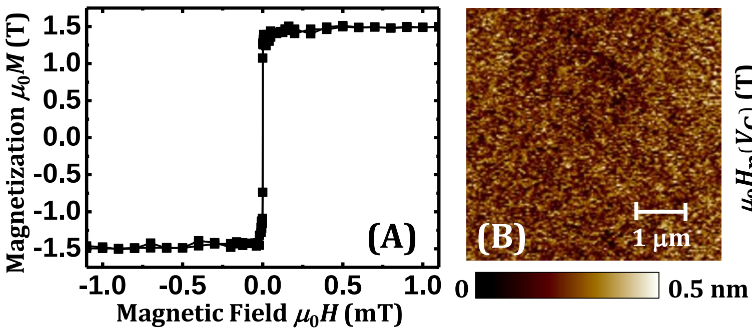

Fig. S1. Determination of topographical and static magnetic properties of CoFeB/MgO heterostructure. (A) In-plane (IP) magnetic hysteresis loop obtained from substrate|Ta(10 nm)|$Co_{20}Fe_{60}B_{20}$(1.6 nm)|MgO(2 nm)|Al_2O_3(10 nm) stack measured by vibrating sample magnetometry (VSM). **(B)** Measurement of topographical properties of the heterostructure with atomic force microscopy (AFM). **(C)** Variation of iPMA field ($\mu_0 H_p$) as a function of gate voltage (V_G) in presence of a bias magnetic field, $\mu_0 H = 200$ mT, where the solid line represents a linear fit.

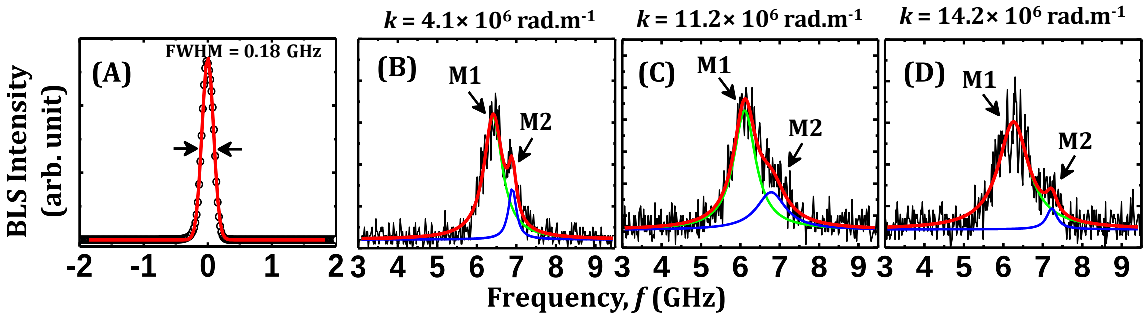

Fig. S2. The BLS response function and representative additional BLS spectra from 1D-EFCMNC at an applied gate voltage, $V_G = -4$ V. (A) The BLS response function as obtained from the Rayleigh peak, where symbols denote experimental points and solid line represents the theoretical fit with Gaussian function. The Stokes side of the BLS spectra taken at $k =$ **(B)** 4.1×10^6 rad.m^{-1}, **(C)** 11.2×10^6 rad.m^{-1} and **(D)** 14.2×10^6 rad.m^{-1}, respectively, obtained for $V_G = -4$ V applied at $\mu_0 H = 200$ mT. The thick solid lines represent theoretical fits using Lorentzian functions (green and blue lines: individual peaks, red line: sum of the two peaks) and the SW peaks (M1 and M2) are indicated by the arrows.

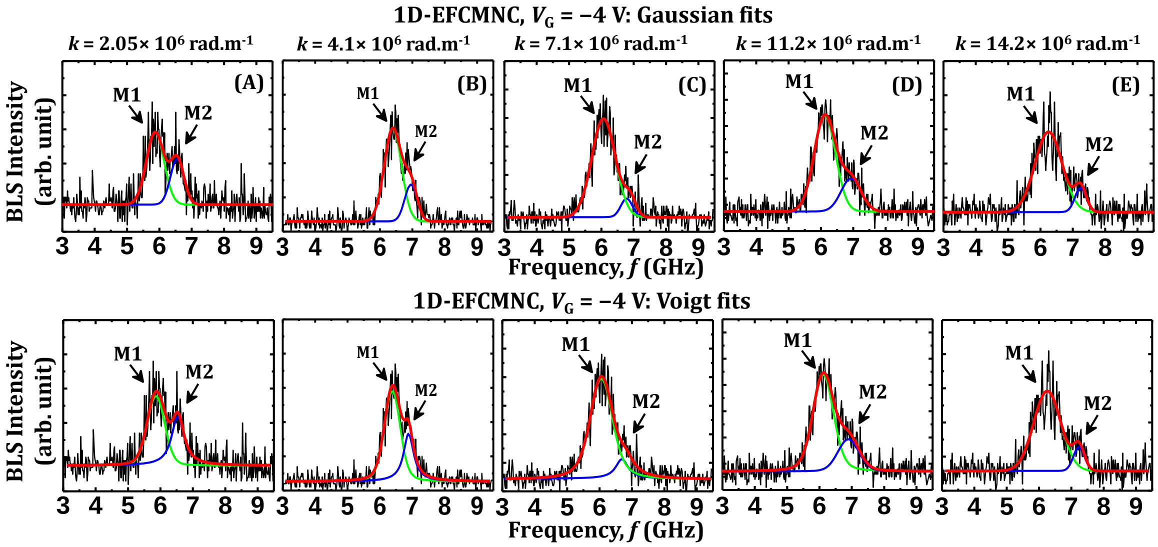

Fig. S3. BLS spectra from 1D-EFCMNC for different wave vectors at an applied gate voltage, V_G = −4 V with Gaussian and Voigt fits. The Stokes side of the BLS spectra taken at k = **(A)** 2.05 × 10^6 rad.m^{-1}, **(B)** 4.1 × 10^6 rad.m^{-1}, **(C)** 7.1 × 10^6 rad.m^{-1} **(D)** 11.2 × 10^6 rad.m^{-1} and **(E)** 14.2 × 10^6 rad.m^{-1}, respectively, obtained for V_G = −4 V applied at $\mu_0 H$ = 200 mT. The thick solid lines in the upper (lower) panel represent theoretical fits using Gaussian (Voigt) functions (green, blue lines: individual peaks, red line: sum of the two peaks) and the SW peaks (M1 and M2) are indicated by the arrows. When compared with the fits in Figure 3(C), (D) and Figure S2 (B) – (D), we observe that the peak positions remained independent of the fitting function, while the intensity profiles vary only marginally between three different functions.

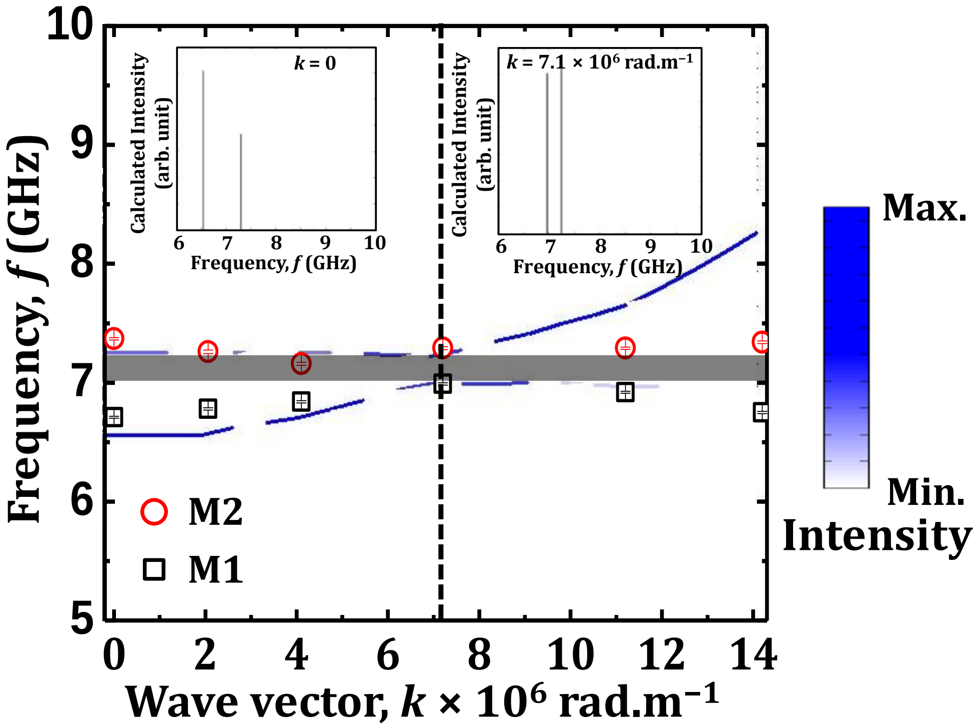

Fig. S4. Experimental and calculated spin wave dispersion at an applied gate voltage, V_G = +4 V. Magnonic band structure of 1D-EFCMNC under the influence of V_G = +4 V applied at μ_0H = 200 mT. The symbols represent peak frequencies in the BLS spectra, while the blue lines denote SW intensities calculated by PWM (the corresponding color map is given at the right side). The dashed vertical line indicates the position of anticrossing and the corresponding magnonic bandgap is shown by the shaded region. The error bars in the experimental data are contained within the symbols. The calculated SW intensities using PWM at k = 0 and 7.1 × 10^6 rad.m^{-1} in 1D-EFCMNC for V_G = +4 V applied at magnetic field μ_0H = 200 mT are shown in the insets.

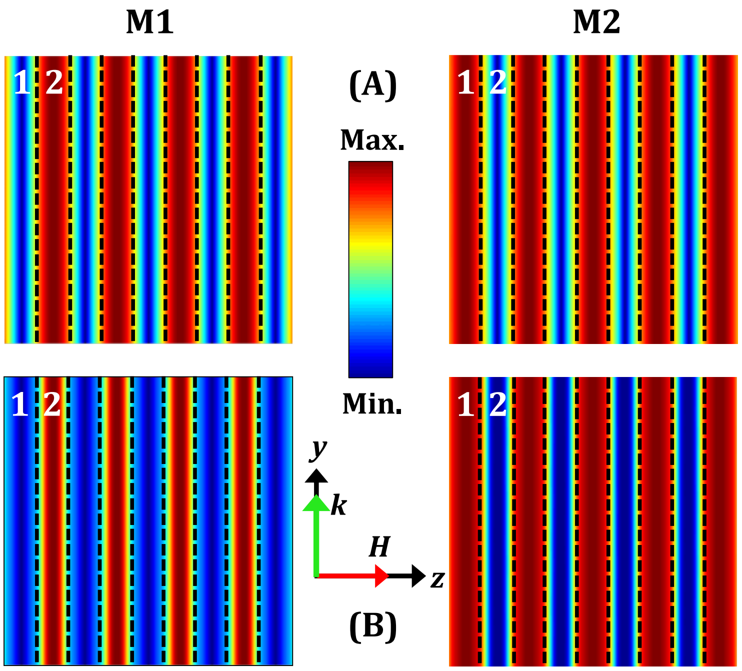

Fig. S5. Spin wave nanochannelling in 1D-EFCMNC under the influence of applied gate voltage, V_G = +4 V. Spatial profiles of the SW modes for k = **(A)** 2.05 × 10^6 rad.m^{-1} and **(B)** 7.1 × 10^6 rad.m^{-1}, respectively, for V_G = +4 V applied at μ_0H = 200 mT. Here, the dotted lines represent the boundary between the regions (i.e. 1: regions without the top electrodes and 2: regions underneath the top electrodes, respectively). The color map and the schematic of H are shown at the centre of the figure.

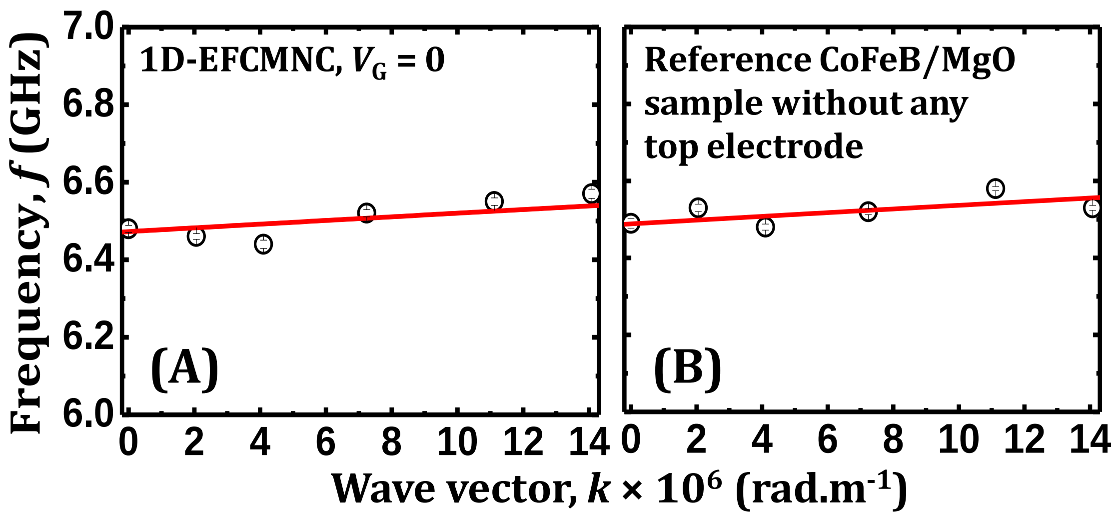

Fig. S6. Spin wave dispersion in 1D-EFCMNC without applied voltage and reference sample. Frequency (f) versus wave vector (k) dispersion curves in the presence of μ_0H = 200 mT from **(A)** the CoFeB/MgO heterostructure with 1D patterned ITO electrodes obtained for V_G = 0 and **(B)** the reference CoFeB/MgO sample without any top electrode. The solid lines represent the fitted curves. The error bars in experimental data are contained within the symbols.