Supplementary Figure S1: X-rays diffraction pattern ($\theta - 2\theta$ scan) for LaTiO$_3$ films (F) deposited on (100)SrTiO$_3$ substrate. After subtracting the contribution of the substrate (S), the lattice parameter of the film is found to be 3.956 Å.
Supplementary Figure S2: a) X-rays diffraction pattern ($\theta$-2$\theta$ scan) around 32° of LaTiO$_3$ films deposited on SrTiO$_3$(110). The (110) peak of the film (F) is observed at $2\theta$=32.193°, close to the (110) peak of the substrate (S), which corresponds to a LaTiO$_3$ lattice parameter of 3.928 Å. b) X-rays diffraction rocking curve ($\omega$ scan) of the (110) peak of LaTiO$_3$ films on SrTiO$_3$(110). The typical width of the curve is around 0.1° showing a very good out-of-plane plane orientation of the layers.
Supplementary Figure S3: Sheet resistance of the 15 u.c. sample as a function of temperature for different values of the perpendicular magnetic field.