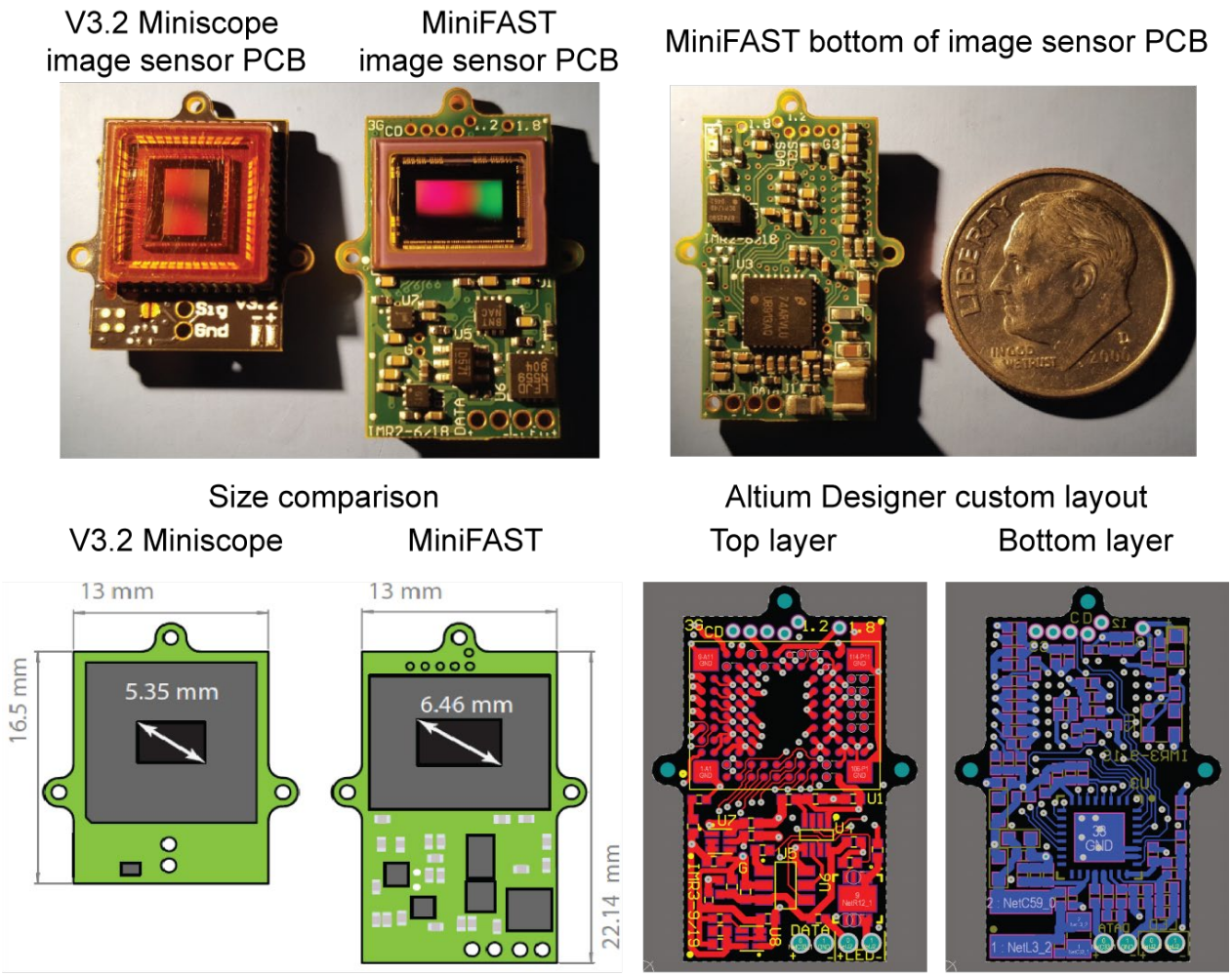
Supplementary Materials

Supplementary Table 1: Currently available miniaturized microscopes published specifications

Microscope Name	Frame Rate	Neural Indicator (animal)	Sensor Resolution	Pixel Size
UCLA Miniscope V3.2 [3]	60 Hz	AAV–GCaMP6f (mouse)	752x480 pixels	6um
miniScope [20]	10 Hz	AAV-GCaMP6s (mouse)	400x400 pixels	6um
Wirefree miniScope[6]	10 Hz	AAV-GCaMP6s (mouse)	200x200 pixels	6um
Finchscope[4]	30 Hz	AAV-GCaMP6s and GCaMP6f (bird)	640x480 pixels	Not published
cScope [7]	60 Hz	Transgenic Thy1-GCAMP6f (rat)	752x480 pixels	6um
Multi-Contrast[21]	15 Hz	Transgenic GCaMP6s (mouse)	640x640 pixels	3um
MiniLFM [9]	16 Hz	AAV-GCaMP6f (mouse)	1280x1024 pixels	5.2um
NINscope [8]	30 Hz	AAV-GCaMP6f (mouse)	808x608 pixels	4.8um
Dual Hemisphere [10]	25 Hz	Transgenic Thy1-GCaMP6s (mouse)	720x576 pixels	6um
Wirefree UCLA Miniscope[5]	20 Hz	AAV-GCaMP6f (mouse)	836x640 pixels	5.8um

Supplementary Figure 1: MiniFAST image sensor PCB overview

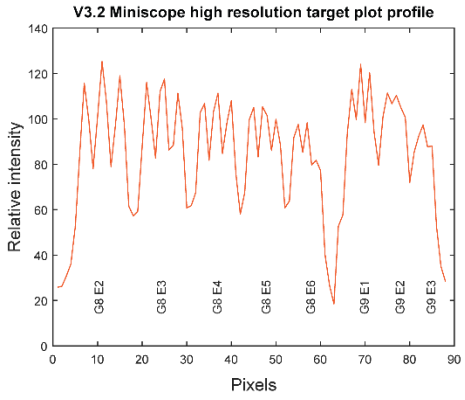


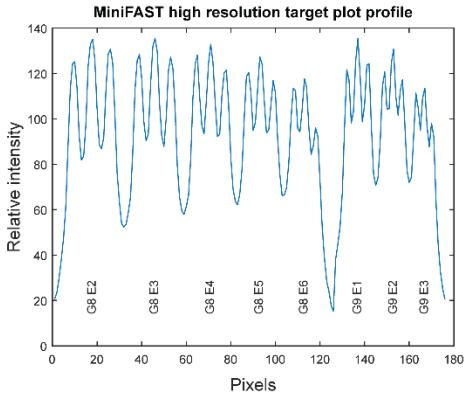
Adapted from figure in (Juneau et al., 2018[29])

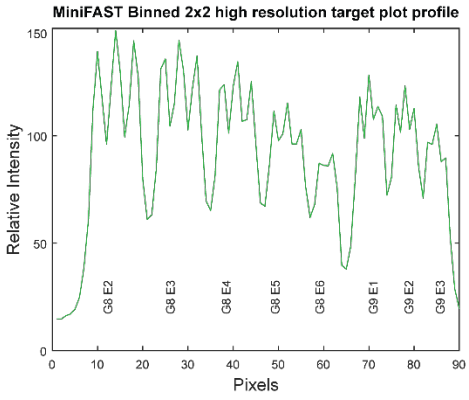
Supplementary Table 2: Miniaturized microscope image sensor specification comparison

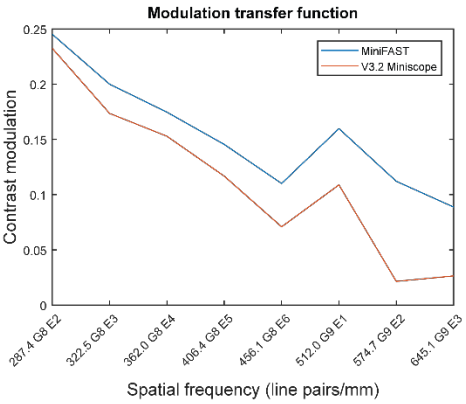
	Miniaturized Microscopes		
Parameters	**V3.2 UCLA Miniscope**	**NINScope**	**MiniFAST**
Weight (PCB,housing, optics)	3.2 g	1.7 g	3.45 g
Image Sensor Manufacturer	On Semi	On Semi	Sony
Image Sensor Model	MT9V032	Python 480	IMX290LLR-C
Shutter	Global	Global	Rolling
Resolution (pixels)	752 x 480	808 x 608	**1920 x 1080 @ 30 Hz**
Pixel Size	6 um	4.8 um	**2.9 um**
Sensor Format	1/3"	1/3.6"	1/2.8"
Maximum Gain	12 dB	11 dB	**30 dB (analog) + 42 dB (digital)**
Max Frame Rate	60 Hz	120 Hz (NINscope @ 30Hz)	**> 500 Hz (with decreasing window size)**

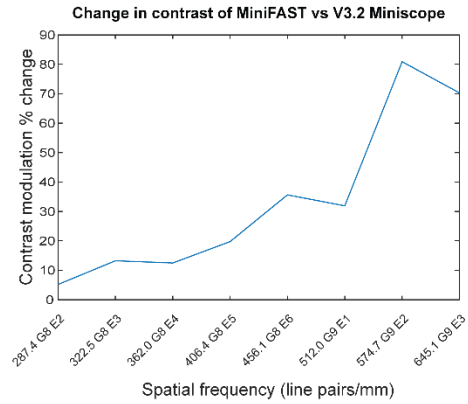
Supplementary Figure 2: High resolution test target extended figures

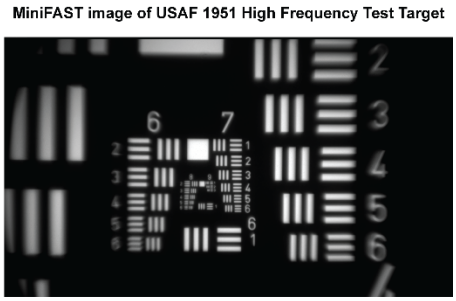




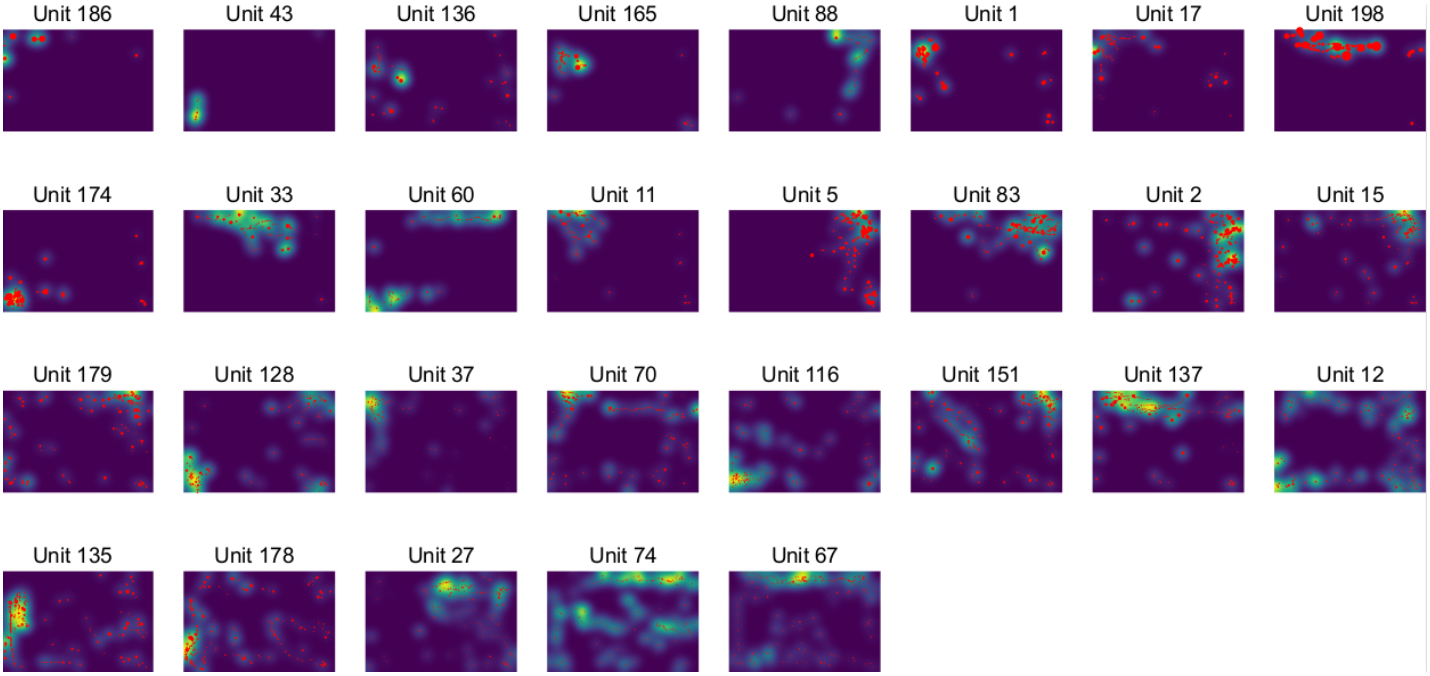






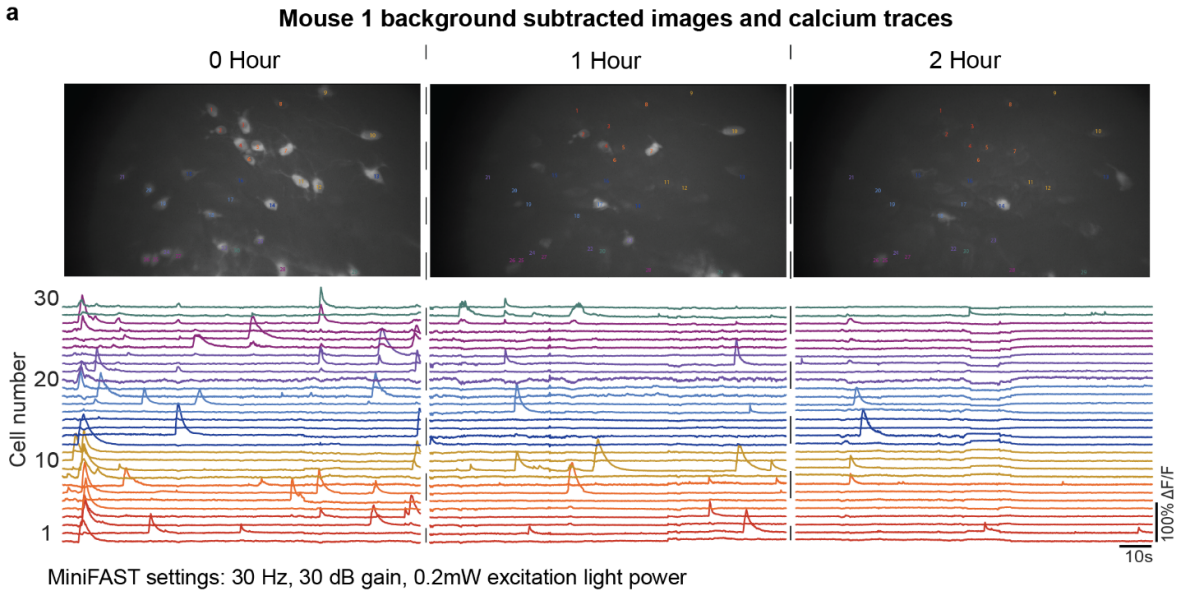


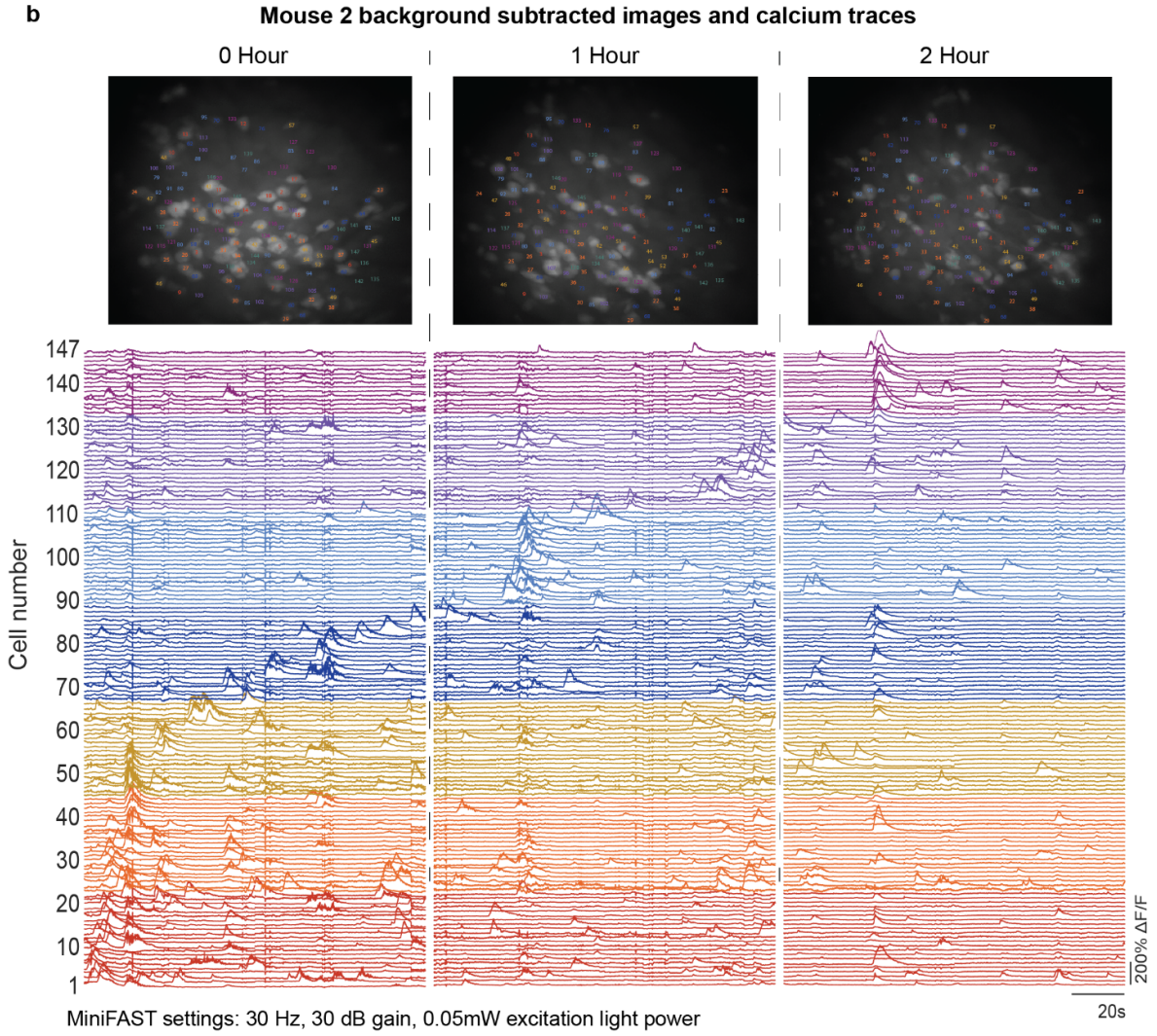
Supplementary Figure 3: Detected place fields from exploration session



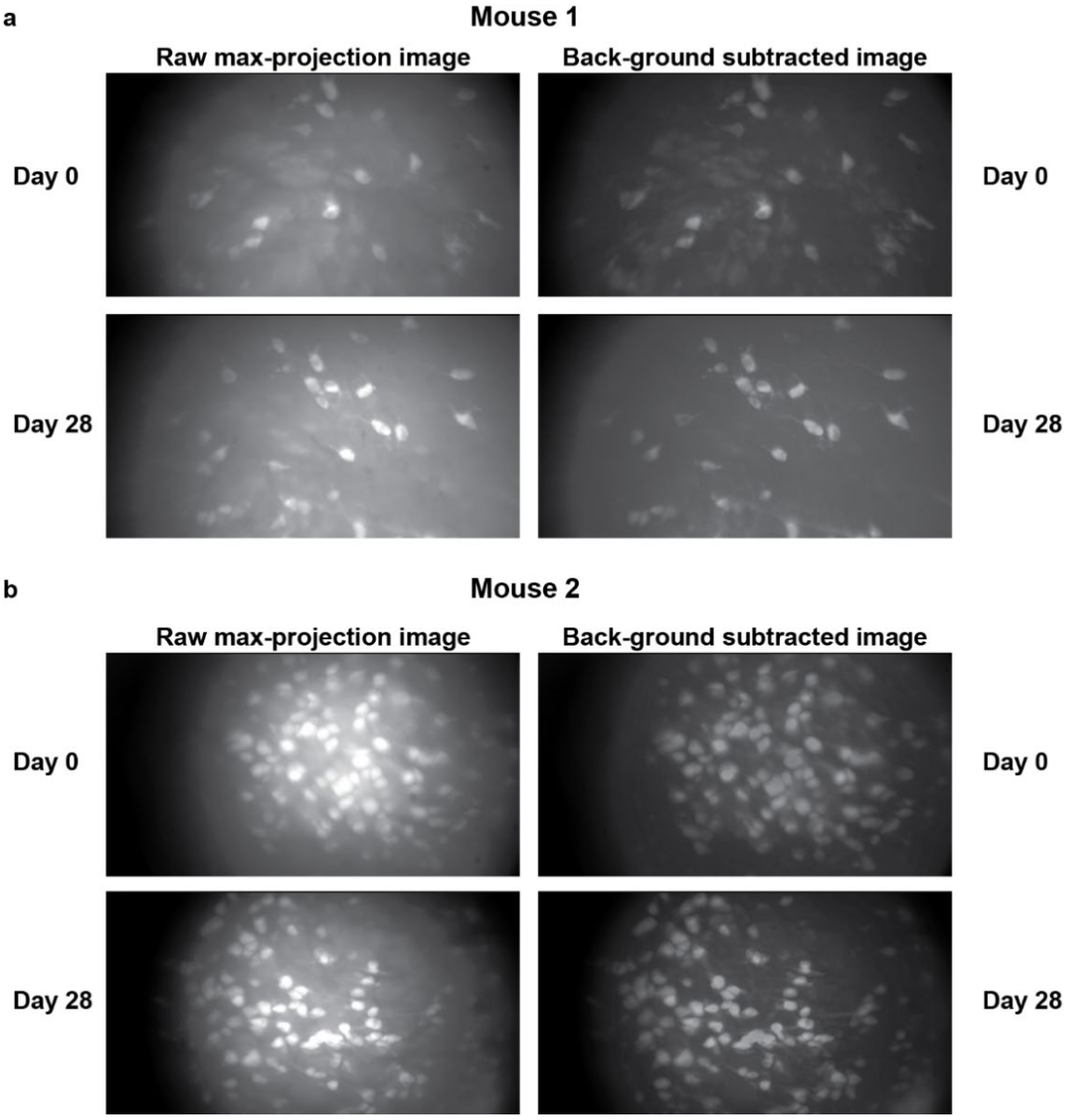
Deconvolved spikes (red) overlaid on inferred ratemaps for 29 neurons which displayed fields which were more spatially tuned than chance (i.e., place cells).

Supplementary Figure 4: 2-Hour continuous imaging session of calcium imaging





Supplementary Figure 5: Long-term (1-month) calcium imaging in CA1 of AAV-GCaMP6f mice



Supplementary Figure 6: Long-term (4-month) calcium imaging in CA1 of transgenic Thy1-GCaMP6f GP5.17 mice