BICCN – two review papers

NEWS & VIEWS FORUM | 06 October 2021

A census of cell types in the brain's motor cortex

An atlas of the cell types found in the motor cortex of the brain has been built using various types of data. Two neuroscientists explain the technological feats involved in the project, as well as the utility of the resource for future research.

Johan Winnubst & Silvia Arber

Article | Open Access | Published: 06 October 2021

A multimodal cell census and atlas of the mammalian primary motor cortex

BRAIN Initiative Cell Census Network (BICCN)

Nature **598**, 86–102 (2021) | Cite this article

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BICCN – Transcriptomic and epigenomic atlas

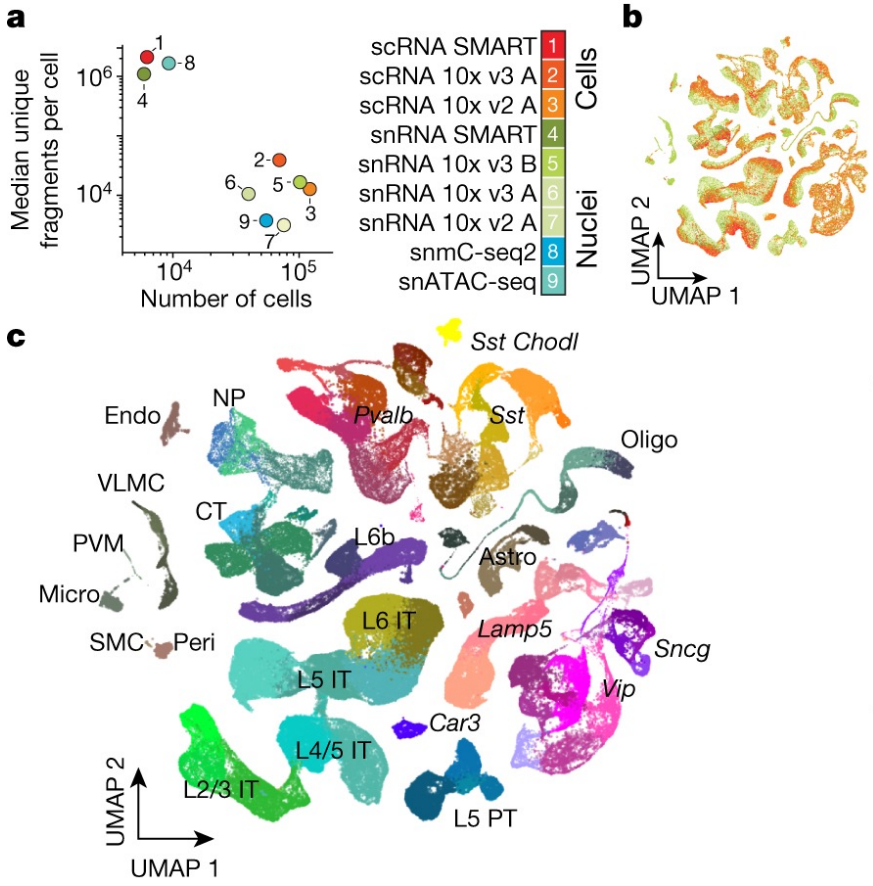
Article | Open Access | Published: 06 October 2021

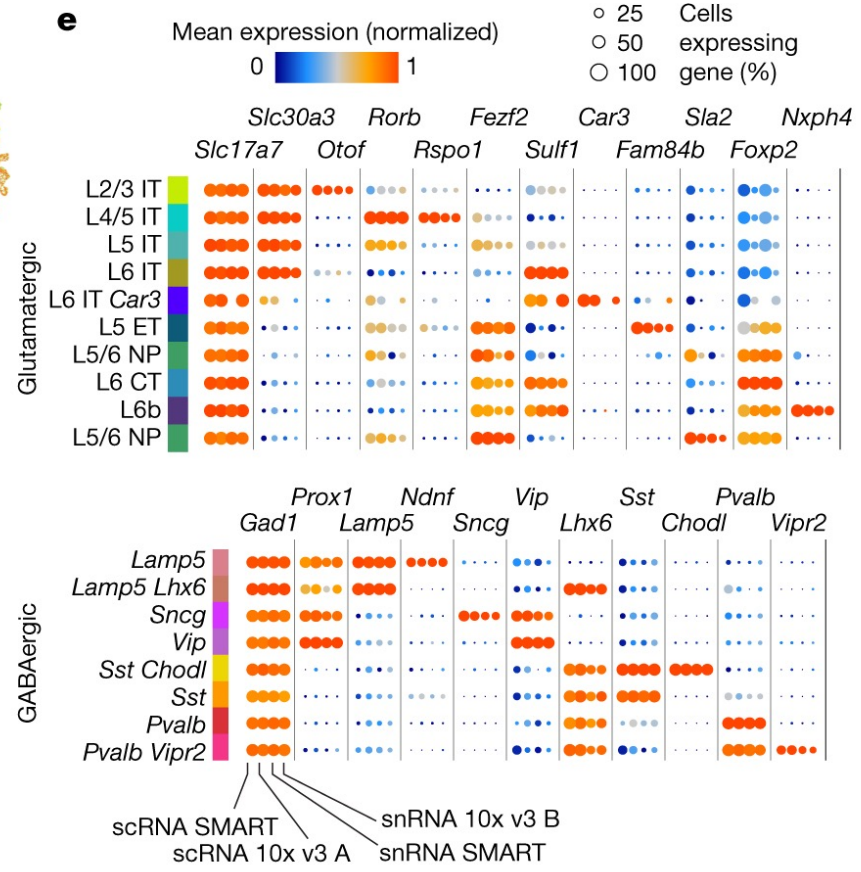
A transcriptomic and epigenomic cell atlas of the mouse primary motor cortex

Zizhen Yao, Hanqing Liu, [...] Eran A. Mukamel

Nature **598**, 103–110 (2021) | Cite this article

Metrics





- **526 k RNA-seq**
- **10k snmC-seq**
- **81k ATAC-seq**

BICCN – comparative analysis across species

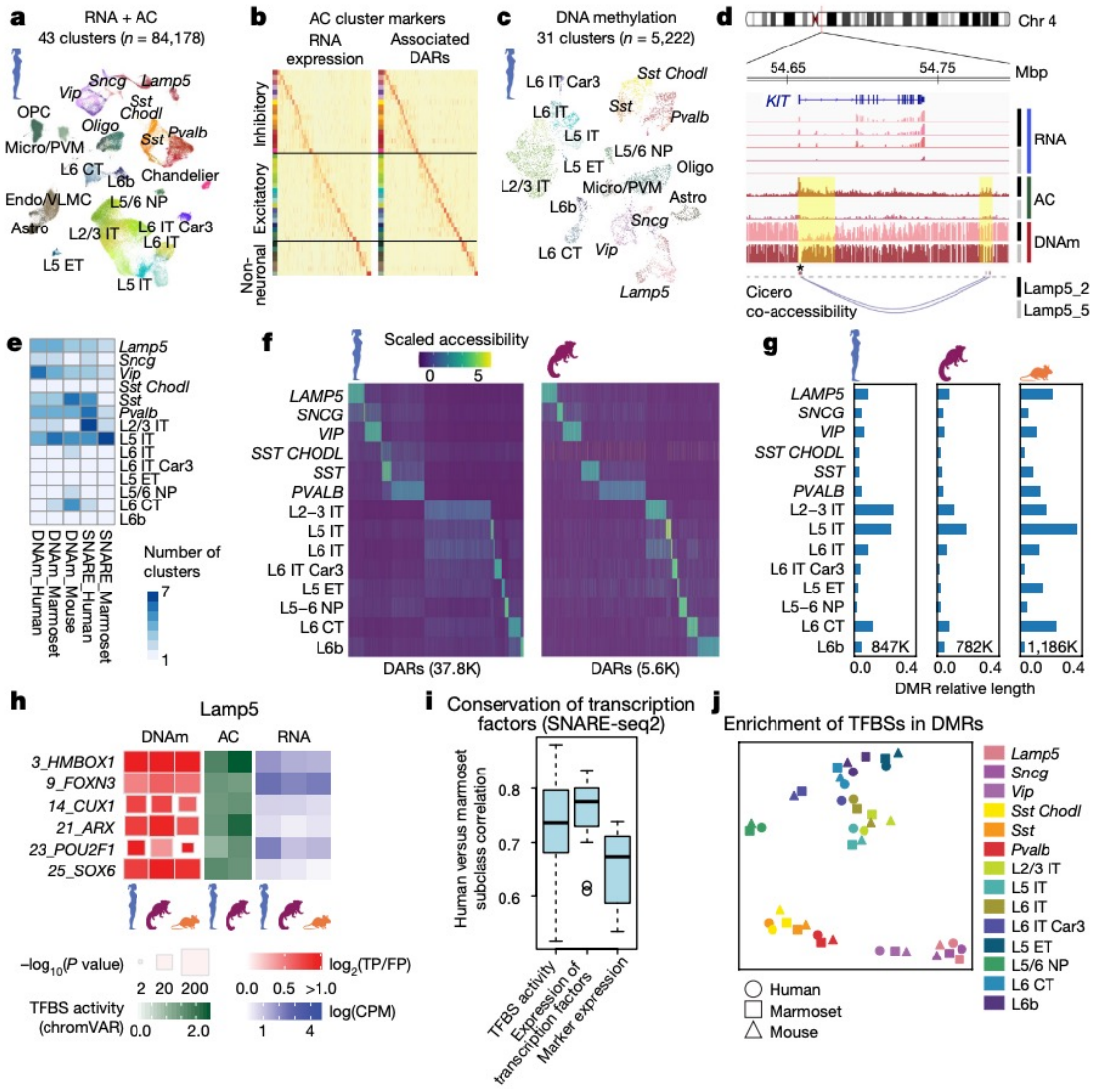
Article | Open Access | Published: 06 October 2021

Comparative cellular analysis of motor cortex in human, marmoset and mouse

Trygve E. Bakken, Nikolas L. Jorstad, [...] Ed S. Lein

Nature **598**, 111–119 (2021) | Cite this article

41 Altmetric | Metrics



- SMART-seq V4
- Droplet Chromium V3
- snmC-seq2
- SNARE-seq2

BICCN – Patch-seq

Article | Open Access | Published: 06 October 2021

Human neocortical expansion involves glutamatergic neuron diversification

Jim Berg, Staci A. Sorensen, [...] Ed S. Lein

Nature **598**, 151–158 (2021) | Cite this article

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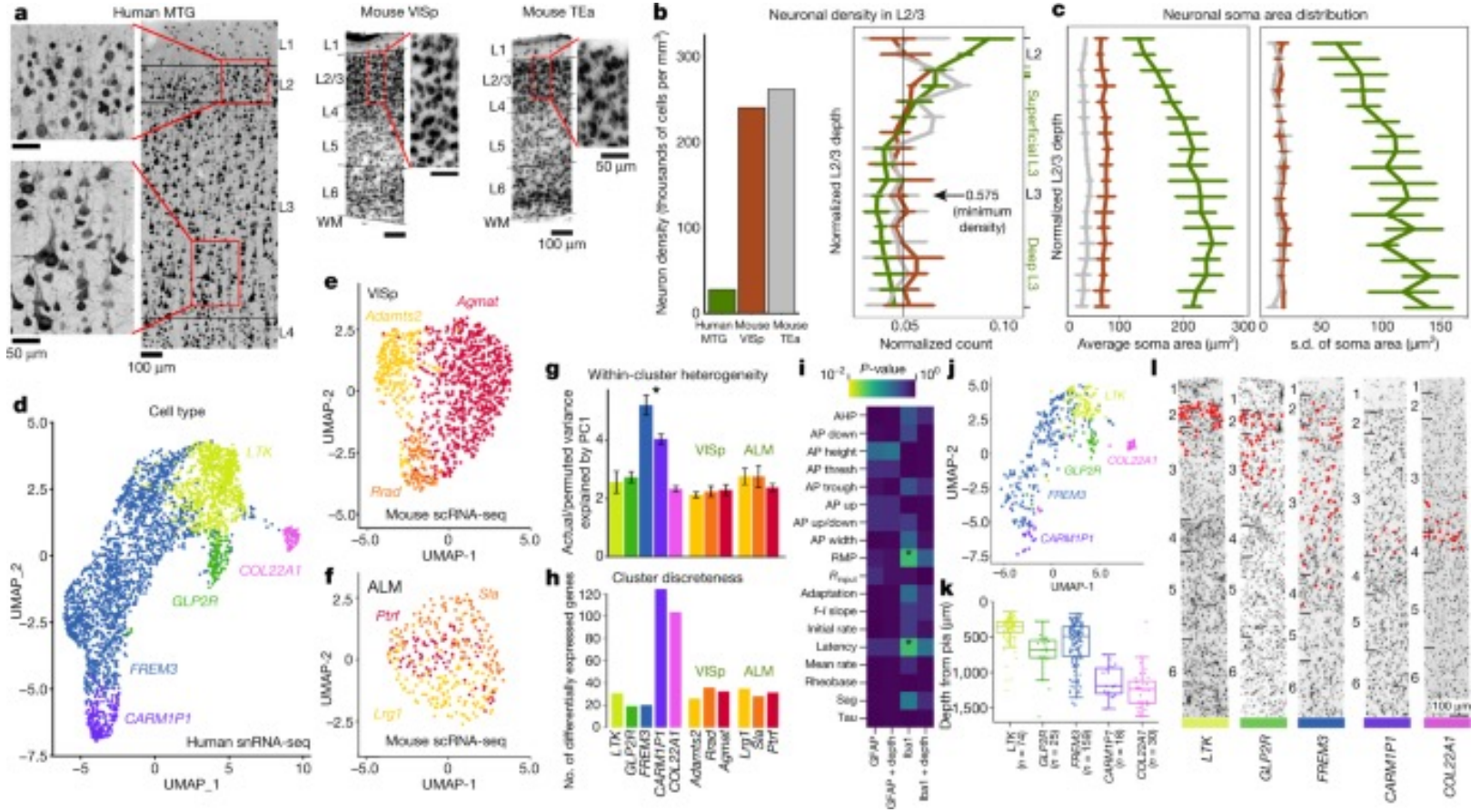

- **Patch-seq (electrophysiological + molecular)**

BICCN – DNA-methylation atlas

Article | Open Access | Published: 06 October 2021

DNA methylation atlas of the mouse brain at single-cell resolution

Hanqing Liu, Jingtian Zhou, [...] Joseph R. Ecker

Nature **598**, 120–128 (2021) | Cite this article

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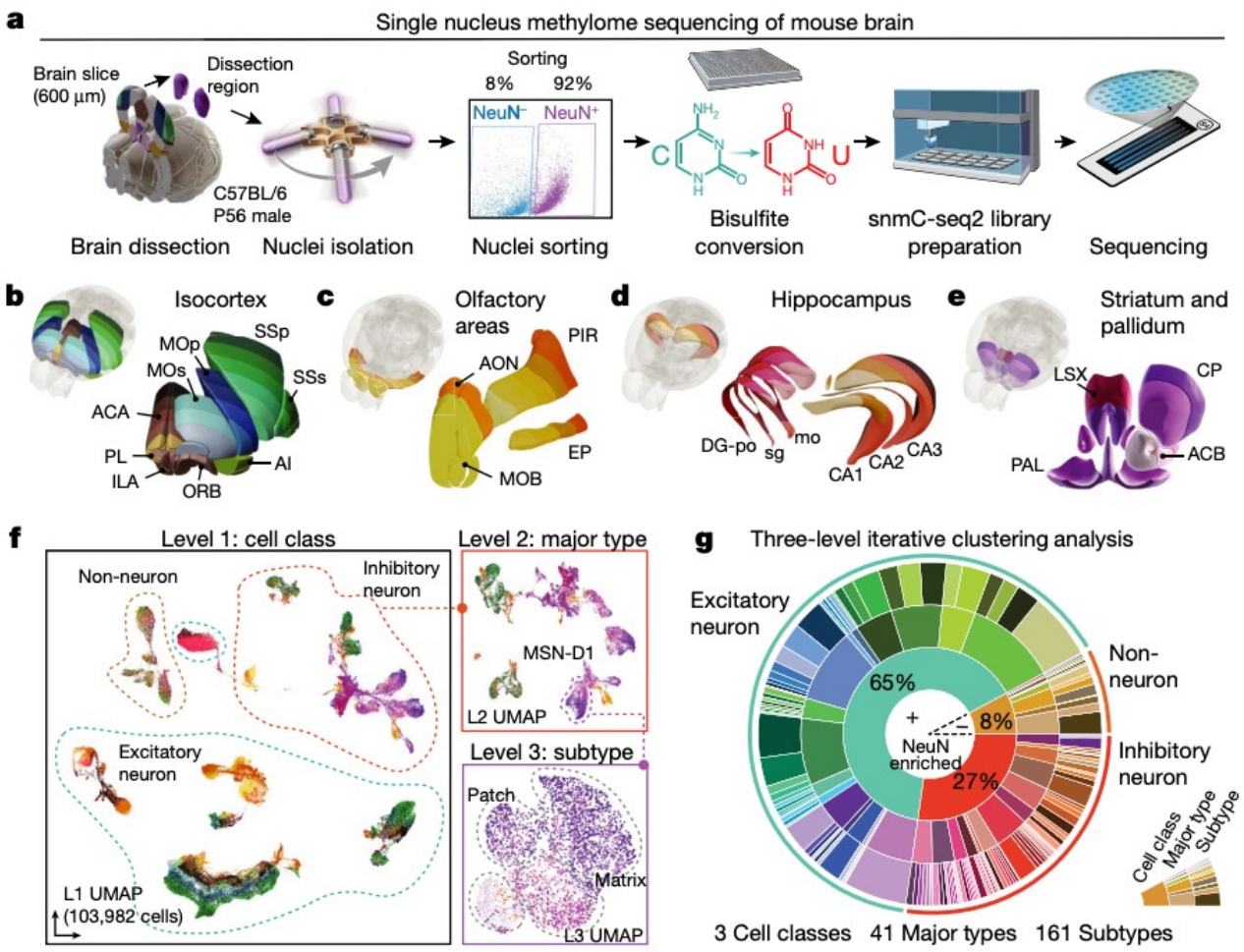
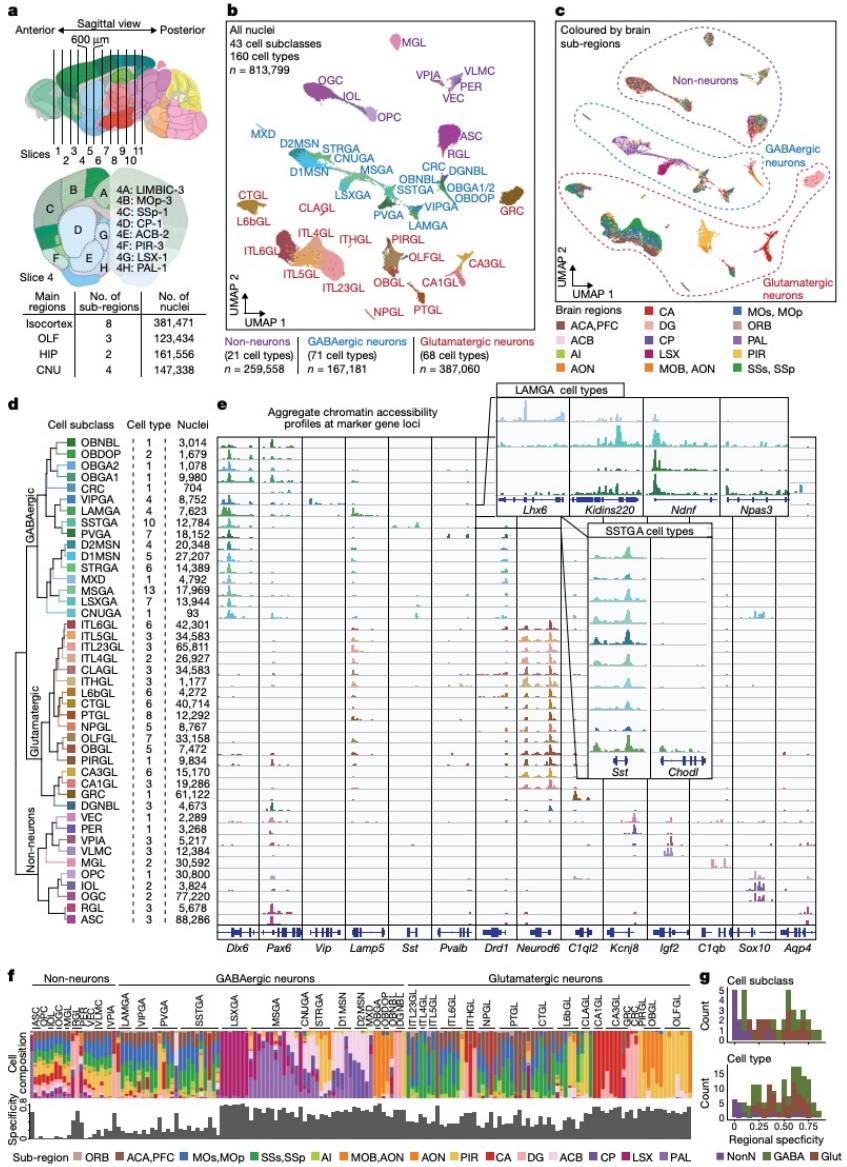


- **104K snmC-seq2**

BICCN – chromatin accessibility atlas



Article | Open Access | Published: 06 October 2021

An atlas of gene regulatory elements in adult mouse cerebrum

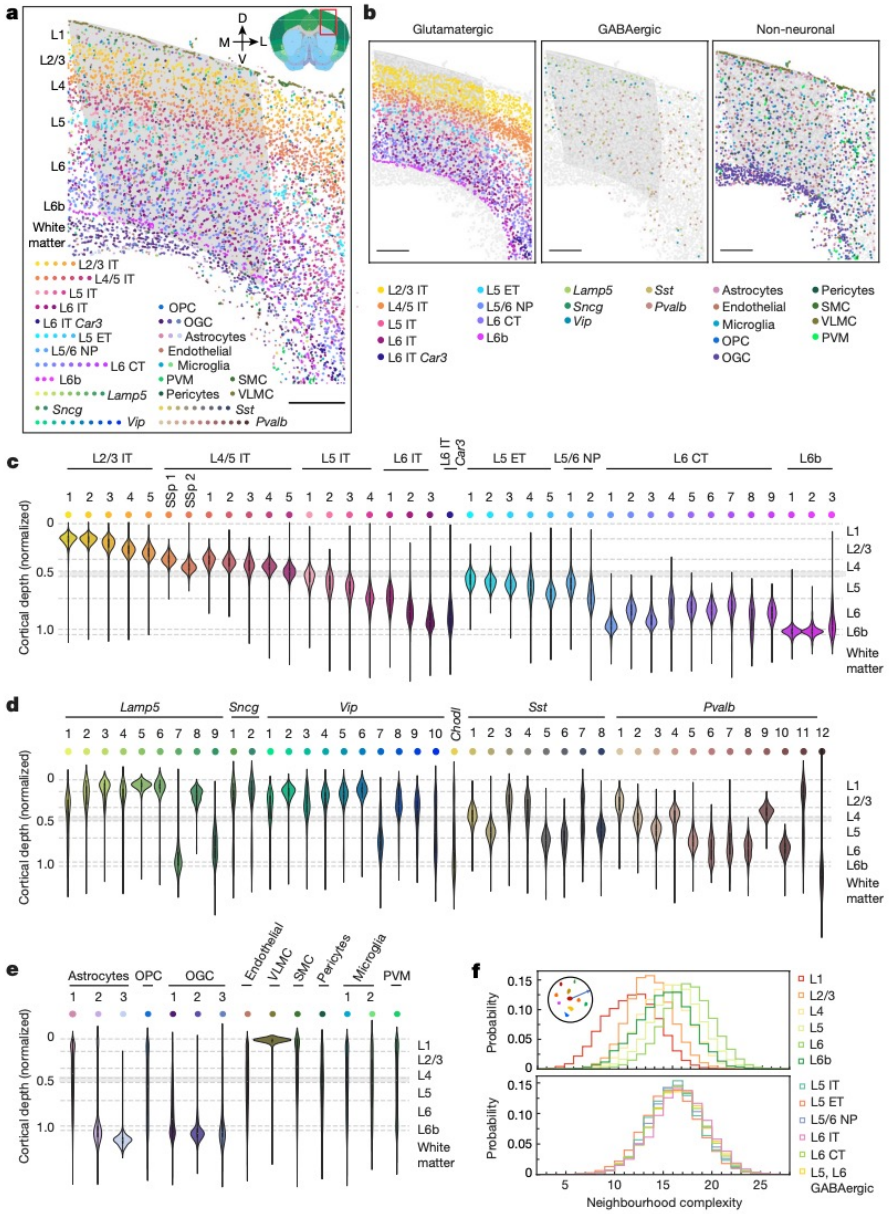
Yang Eric Li, Sebastian Preissl, [...] Bing Ren

Nature **598**, 129–136 (2021) | Cite this article

Metrics

- **814K snATAC-seq**

BICCN – spatial atlas



Article | Open Access | Published: 06 October 2021

Spatially resolved cell atlas of the mouse primary motor cortex by MERFISH

Meng Zhang, Stephen W. Eichhorn, Brian Zingg, Zizhen Yao, Kaelan Cotter, Hongkui Zeng, Hongwei Dong & Xiaowei Zhuang

Nature **598**, 137–143 (2021) | Cite this article

5 Altmetric | Metrics

- **300K MERFISH**

BICCN – 3D anatomy structure

Article | Open Access | Published: 06 October 2021

Cellular anatomy of the mouse primary motor cortex

Rodrigo Muñoz-Castañeda, Brian Zingg, [...] Hong-Wei Dong

Nature **598**, 159–166 (2021) | Cite this article

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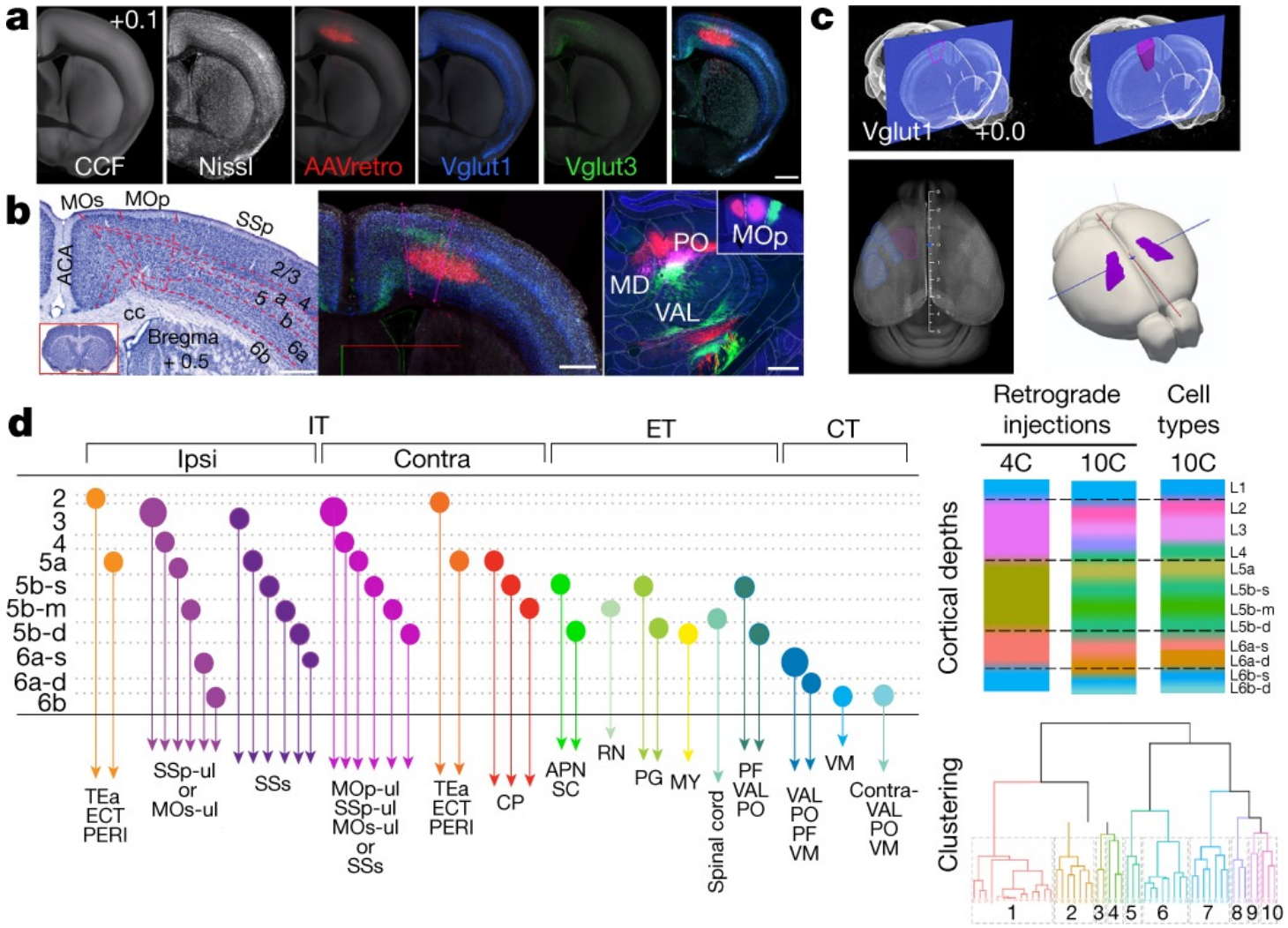

- **Genetic and viral labelling,**
- **Barcoded anatomy by sequencing**
- **Whole-brain imaging**
- **……**

BICCN – network

Article | Open Access | Published: 06 October 2021

The mouse cortico–basal ganglia–thalamic network

Nicholas N. Foster ✉, Joshua Barry, [...] Hong-Wei Dong ✉

Nature **598**, 188–194 (2021) | Cite this article

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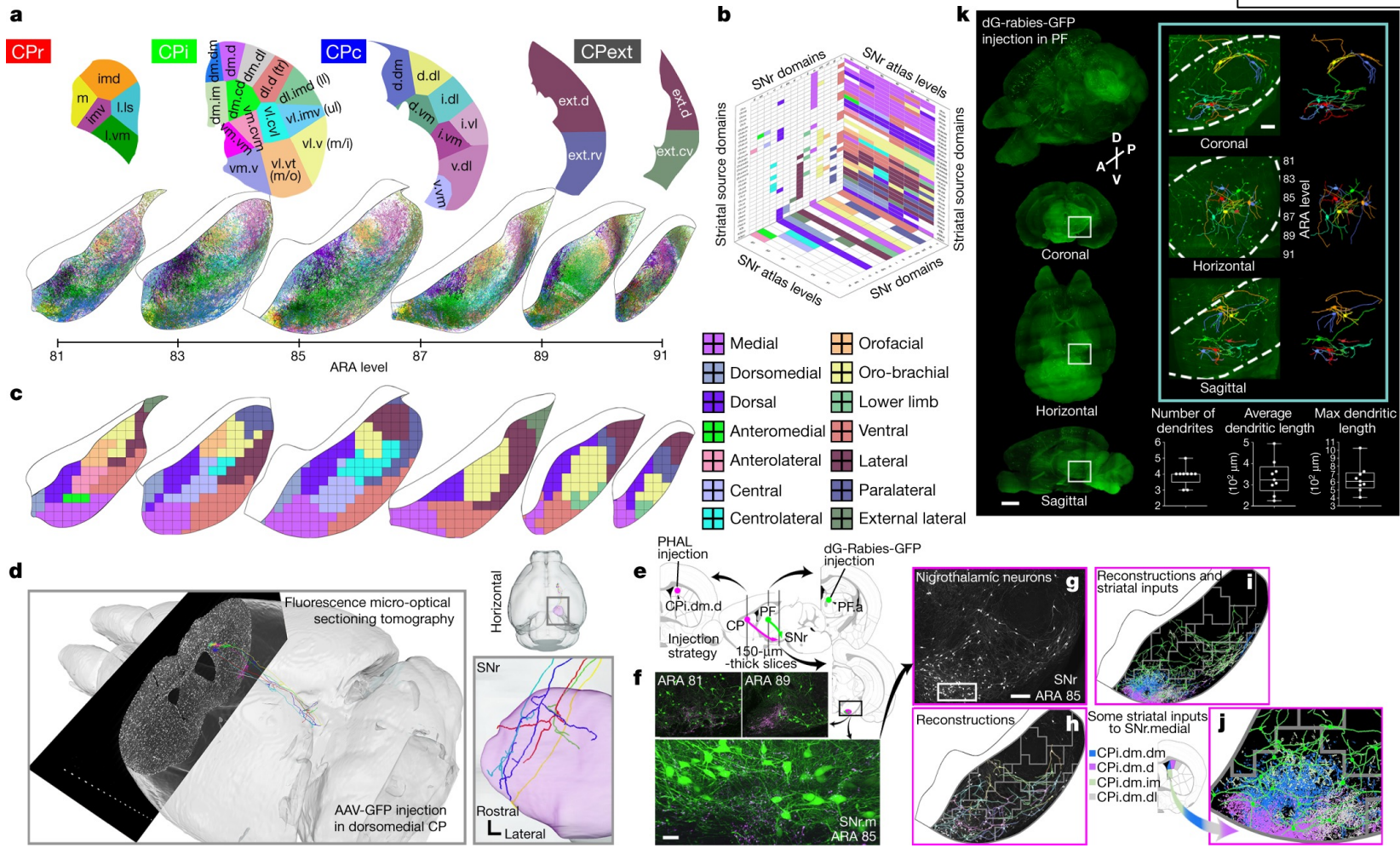

BICCN – retrograde labelling with DNA-methylation sequencing

Article | Open Access | Published: 06 October 2021

Epigenomic diversity of cortical projection neurons in the mouse brain

Zhuzhu Zhang, Jingtian Zhou, [...] Edward M. Callaway

Nature **598**, 167–173 (2021) | Cite this article

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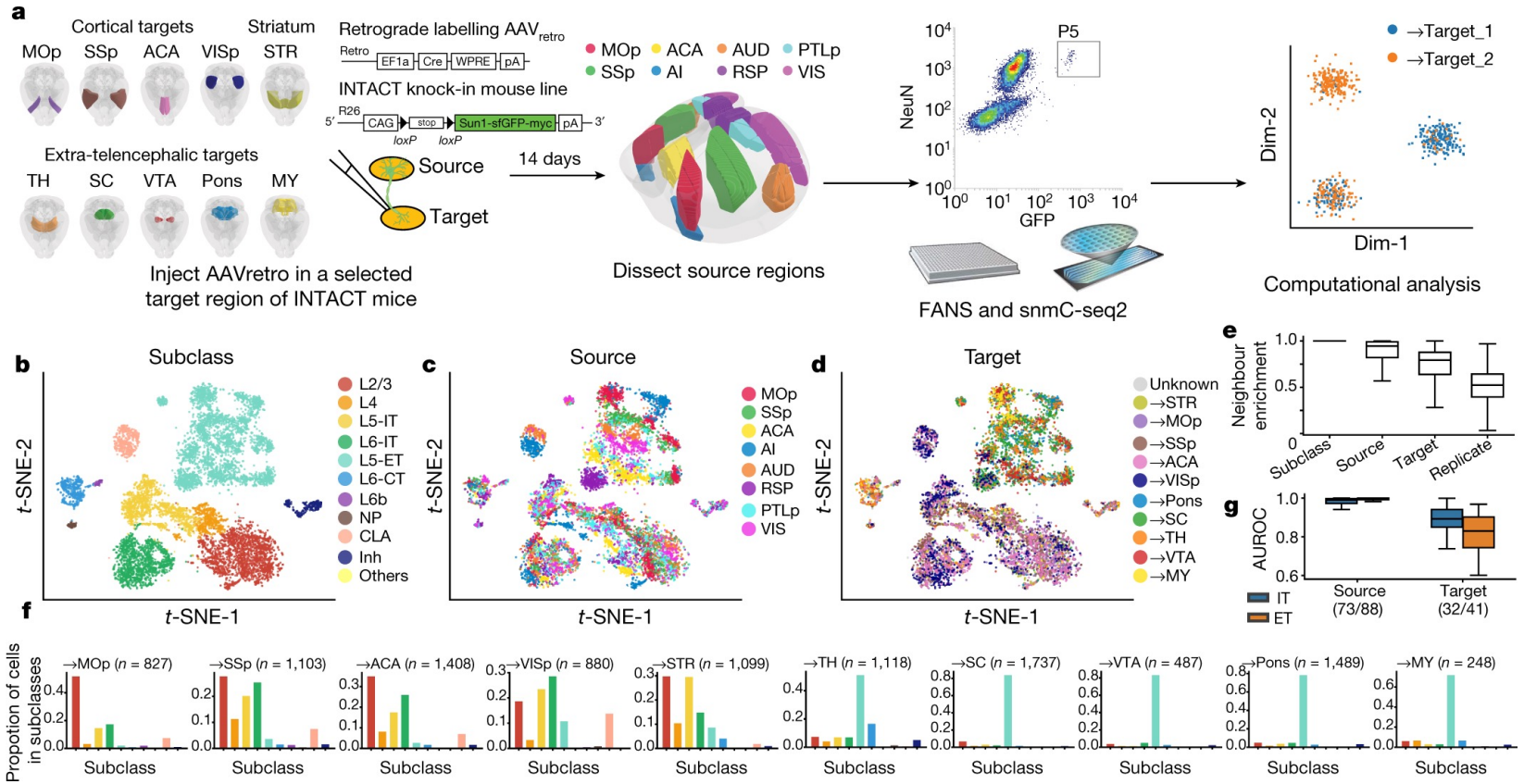

- **12k Epi-retro-seq**

"To address these questions, we developed epi-retro-seq, which applies single-nucleus methylome sequencing (snmC-seq)[8] to neurons dissected from cortical source regions that were labelled on the basis of their long-distance projections to specific cortical and subcortical targets (Fig. 1a)'

BICCN – morphological + molecular reconstruction

Article | Open Access | Published: 06 October 2021

Morphological diversity of single neurons in molecularly defined cell types

Hanchuan Peng ✉, Peng Xie, [...] Hongkui Zeng ✉

Nature **598**, 174–181 (2021) | Cite this article

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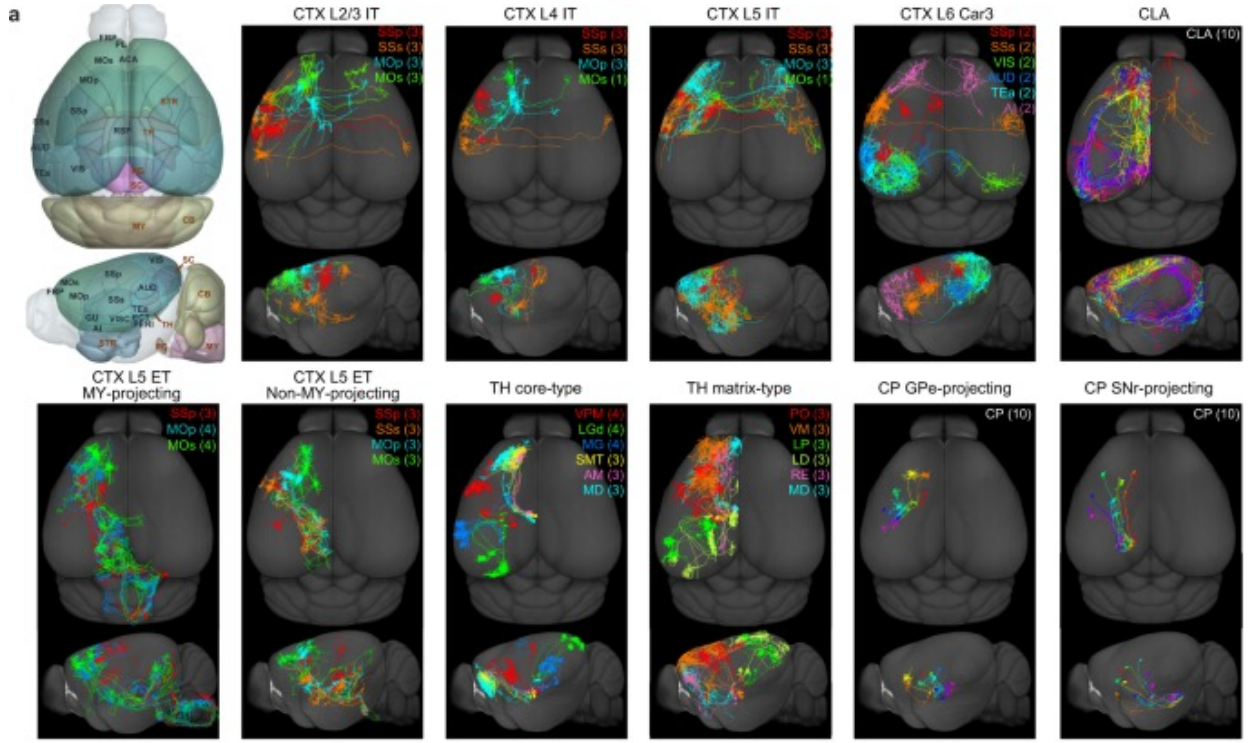


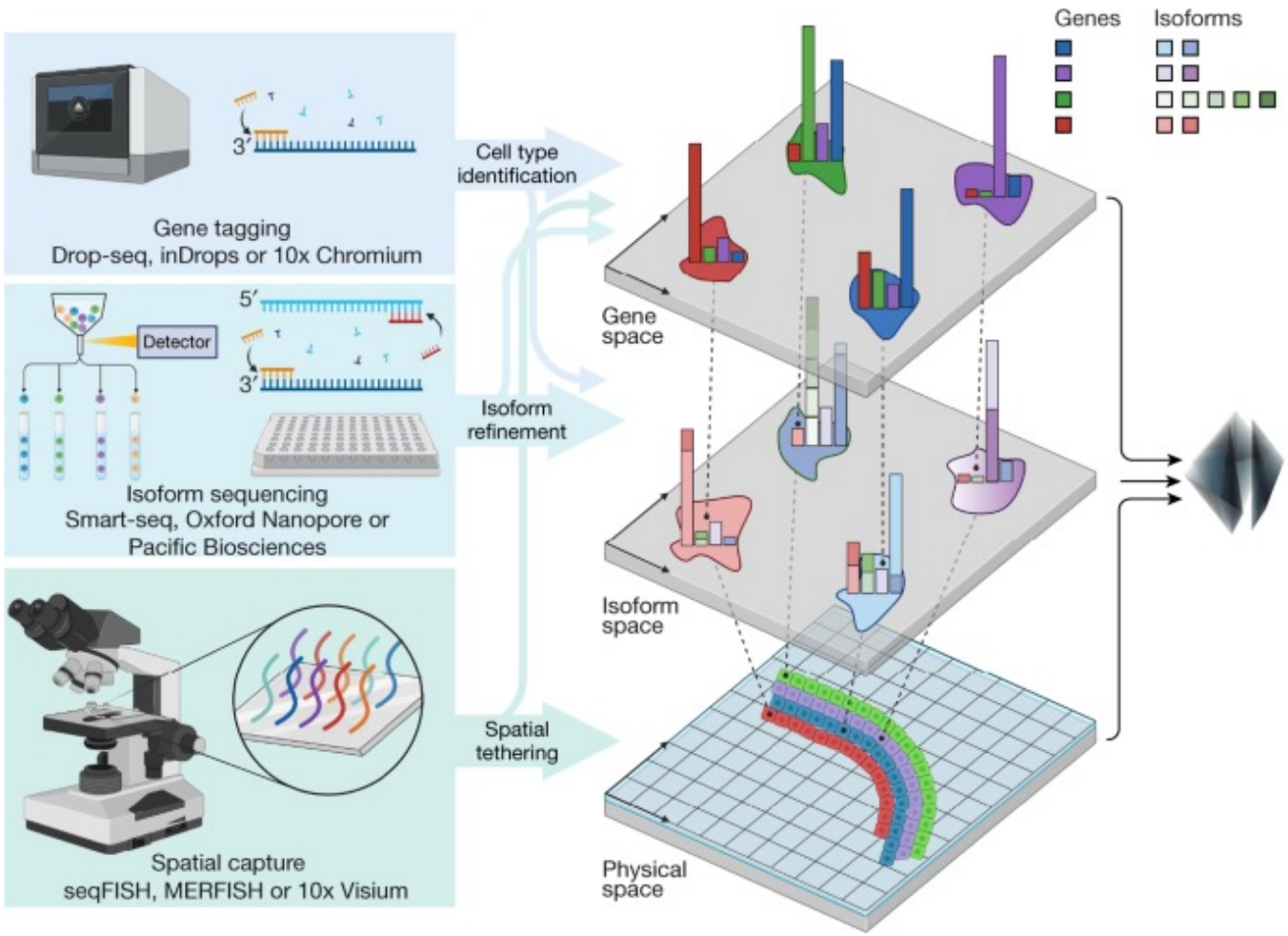
b

Brain structures	Cortex							Thalamus		Striatum	
Driver lines used	*Cux2*		*Plxnd1*	*Gnb4*		*Fezf2, Pvalb*		*Tnnt1, Vipr2*		*Tnnt1, Vipr2, Plxnd1*	
Transcriptomic subclasses	L2/3 IT	L4 IT	L5 IT	*Car3*		L5 ET		*Prkcd_Grin2c*		*Drd1*	*Drd2*
Projection classes	Corticocortical (intratelencephalic)			Corticocortical (claustrum-like)		Corticofugal (extratelencephalic)		Thalamocortical		Striatofugal	
Projection types	L2/3 IT	L4 IT	L5 IT	L6 *Car3*	CLA	MY-projecting	Non-MY-projecting	Core	Matrix	SNr-projecting (direct)	GPe-projecting (indirect)
Source regions analyzed in this study	MOp, MOs, SSp, SSs	MOp, MOs, SSp, SSs	MOp, MOs, SSp, SSs	Lateral cortex (ORBl, MOp, SSp, SSs, AI, GU, VIS, AUD, TEa, etc.)	CLA	MOp, MOs, SSp	MOp, MOs, SSp, SSs	VPM, VPL, VPMpc, VPLpc, LGd, MG, VAL, AM, SMT, MD	PO, LP, LD, MD, IAD, VM, CM, (RE, PVT)	STR (CP)	STR (CP)
Regional difference	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes	-	-
Projection patterns	Divergent	Divergent	Divergent	Divergent	Divergent	Divergent	Divergent	Parallel	Divergent	Convergent	Convergent
Average number of targets	5.4	2.4	11.3	14.3	20.9	16.2	8.9	2.9	7.2	3.0	2.0
Topographic distribution	-	-	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
Projection target variability among cells within a region	High	High	High	High	High	High	High	Low	Medium	Low	Low

Morphological features

- sparse labelling, whole-brain imaging, reconstruction, registration and analysis.

BICCN – Isoform



Article | Open Access | Published: 06 October 2021

Isoform cell-type specificity in the mouse primary motor cortex

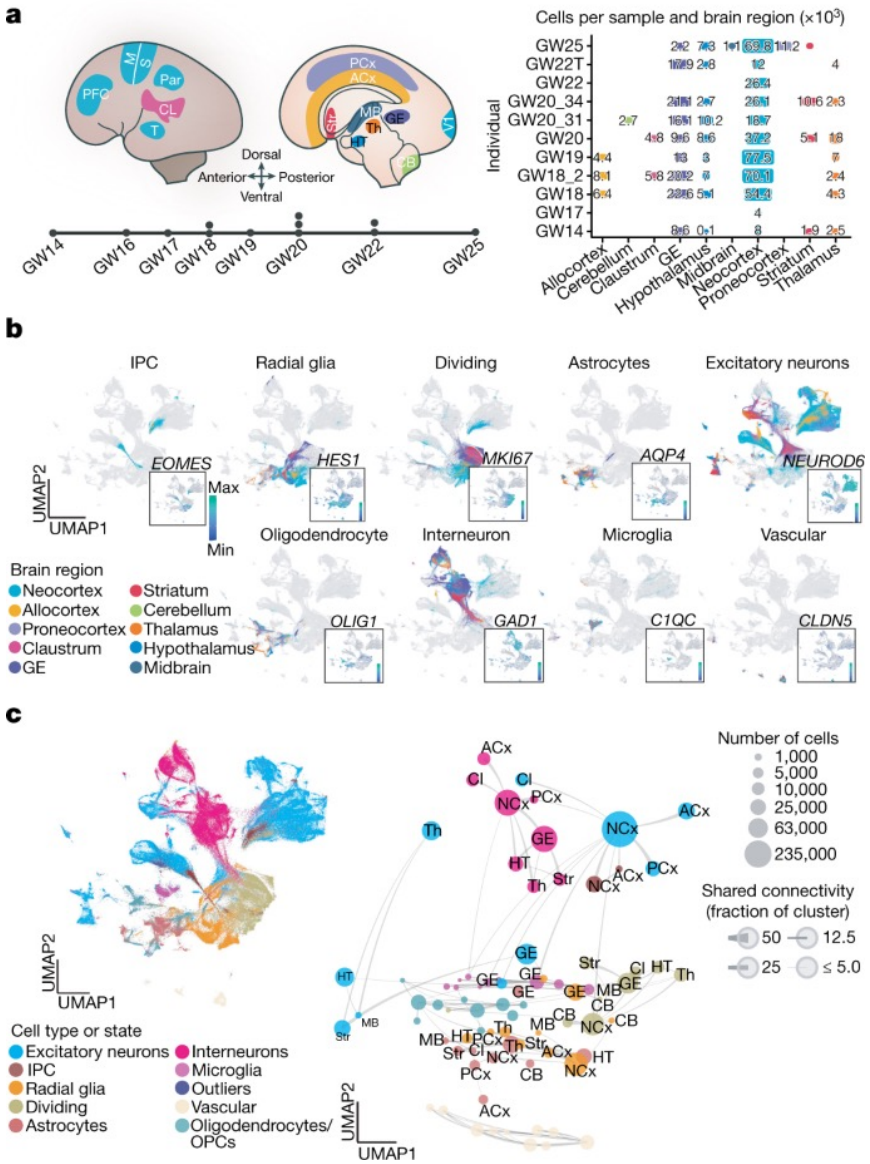
A. Sina Booeshaghi, Zizhen Yao, Cindy van Velthoven, Kimberly Smith, Bosiljka Tasic, Hongkui Zeng & Lior Pachter

Nature **598**, 195–199 (2021) | Cite this article

Metrics

- **6k smart-seq**
- **280k MERFISH**
- **94K 10X**

BICCN – Dynamic signatures



Article | Open Access | Published: 06 October 2021

An atlas of cortical arealization identifies dynamic molecular signatures

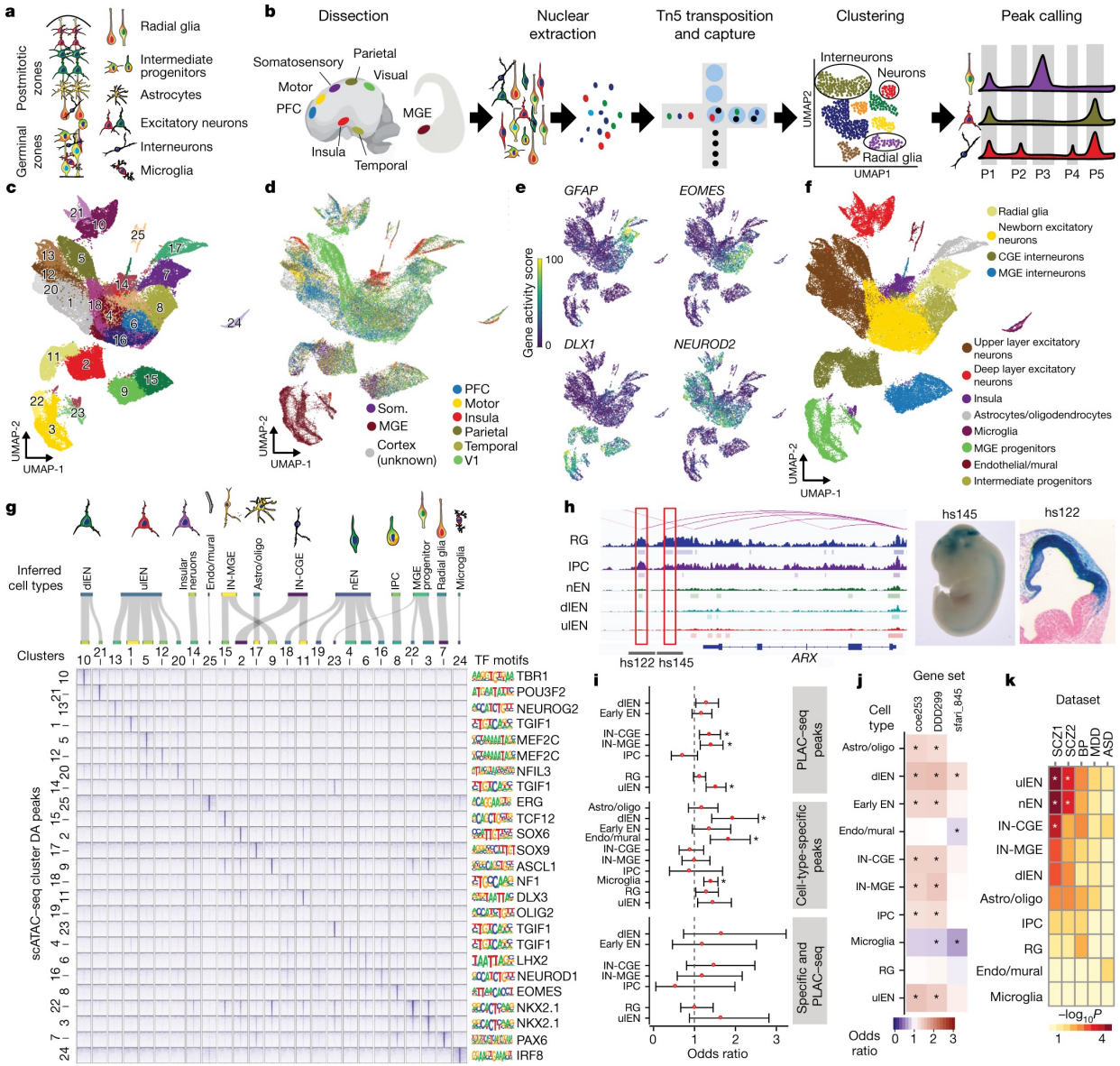
Aparna Bhaduri, Carmen Sandoval-Espinosa, Marcos Otero-Garcia, Irene Oh, Raymund Yin, Ugomma C. Eze, Tomasz J. Nowakowski & Arnold R. Kriegstein

Nature **598**, 200–204 (2021) | Cite this article

12 Altmetric | Metrics

- **700K RNA-Seq**

BICCN – ATAC-seq



Article | Open Access | Published: 06 October 2021

Single-cell epigenomics reveals mechanisms of human cortical development

Ryan S. Ziffra, Chang N. Kim, Jayden M. Ross, Amy Wilfert, Tychele N. Turner, Maximilian Haeussler, Alex M. Casella, Pawel F. Przytycki, Kathleen C. Keough, David Shin, Derek Bogdanoff, Anat Kreimer, Katherine S. Pollard, Seth A. Ament, Evan E. Eichler, Nadav Ahituv & Tomasz J. Nowakowski

Nature **598**, 205–213 (2021) | Cite this article

Metrics

- **77K ATAC-seq**

BICCN – RNA-seq across lobules

Article | Open Access | Published: 06 October 2021

A transcriptomic atlas of mouse cerebellar cortex comprehensively defines cell types

Velina Kozareva, Caroline Martin, Tomas Osorno, Stephanie Rudolph, Chong Guo, Charles Vanderburg, Naeem Nadaf, Aviv Regev, Wade G. Regehr & Evan Macosko

Nature **598**, 214–219 (2021) | Cite this article

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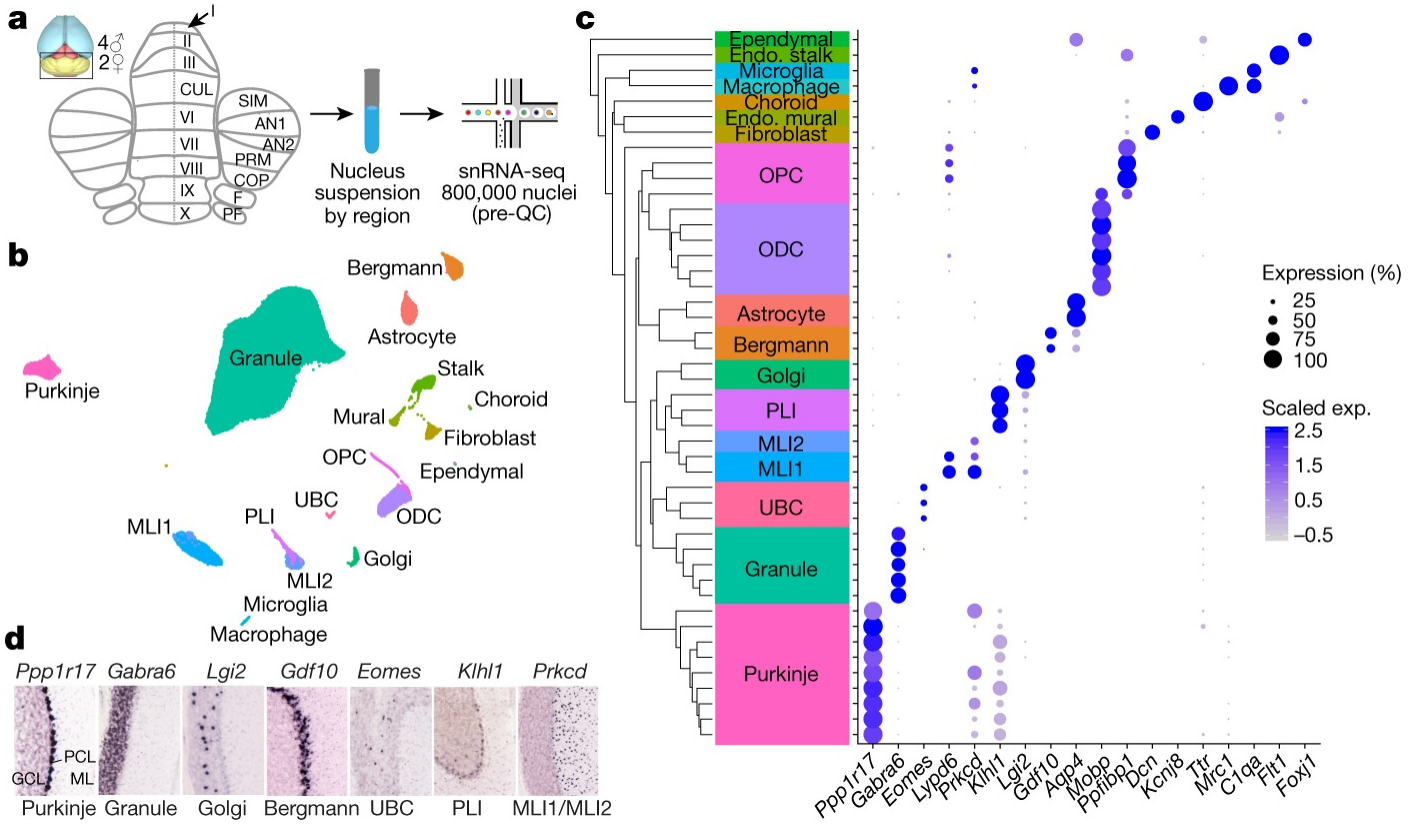

- **611K snRNA-seq**