# Article information:

Electrically pumped topological laser with valley edge modes | Nature  
<https://www.nature.com/articles/s41586-020-1981-x>

# Article summary:

1. Researchers have developed an electrically pumped topological laser with valley edge modes, which could lead to more efficient and robust lasers for use in communication and sensing applications.

2. The device was fabricated using THz QCL wafers with a photonic crystal structure patterned onto the wafer, and was characterized using a Fourier-transform infrared spectrometer.

3. The topological waveguide consists of quasi-hexagonal holes with opposite orientations on either side of the topological interface, and the device exhibited strong localization of edge states to the domain wall between two domains with opposite valley Chern numbers.

# Article rating:

Appears moderately imbalanced: The article provides some useful information, but is missing several important points or pieces of evidence that would be required to present the discussed topics in a balanced and reliable way. You are encouraged to seek a more balanced perspective on the presented issues by exploring the provided research topics and looking at different information sources.

# Article analysis:

The article discusses the fabrication, characterization, and numerical simulations of an electrically pumped topological laser with valley edge modes. The device was fabricated using THz QCL wafers with a photonic crystal structure patterned onto the wafer with a standard metal-semiconductor-metal configuration. The article provides detailed information on the fabrication process and characterization techniques used to measure the emission from different outcouplers.

The article also discusses the design of the valley photonic crystal, which exhibits Dirac points at the corners of the hexagonal Brillouin zone. The effect of symmetry breaking is modeled as a mass term added in the effective Dirac Hamiltonian, which lifts the degeneracy of the Dirac points and gives rise to opposite valley Chern numbers. Based on the topological bulk-boundary correspondence principle, there shall be one forward-propagating edge state at K′ and one backward-propagating edge state at K.

The article provides detailed numerical results for both 2D and 3D band structures, showing that in a 2D VPC with two domains of opposite hole orientations separated by a straight domain wall, the projected bandgap occupies a similar frequency range, and the valley edge states traverse the whole projected bandgap. In contrast, in an actual experiment where the VPC is 3D and patterned onto a THz QCL wafer in a metal-semiconductor-metal configuration, subwavelength vertical confinement of TM-polarized lasing waves within the active layer is ensured.

Overall, while this article provides detailed information on device fabrication and characterization techniques used to measure emission from different outcouplers, it may be biased towards promoting this specific technology without exploring potential counterarguments or risks associated with its use. Additionally, some readers may find certain technical details difficult to follow or understand without prior knowledge in this field.

# Topics for further research:

* Topological photonics
* Valleytronics
* THz QCLs
* Photonic crystals
* Bulk-boundary correspondence principle
* Metal-semiconductor-metal configuration

# Report location:

<https://www.fullpicture.app/item/251b56453a033b0e7ee27b0811db97e5>