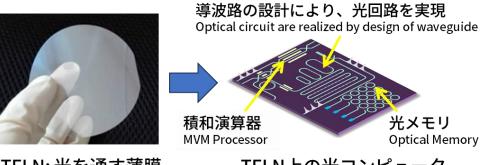# The AI era: Optical computer by TFLN
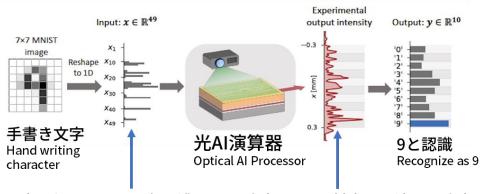
Dramatically reduced energy consumption for AI tech. by large-scale optical circuit on Thin Film Lithium Niobate

# Green Transformation

導波路の設計により、光回路を実現
Optical circuit are realized by design of waveguide



積和演算器
MVM Processor

光メモリ
Optical Memory

TFLN: 光を通す薄膜
Thin Film Lithium Niobate

TFLN上の光コンピュータ
Optical computer on TFLN

応用例：光コンピュータによる人工知能 (AI)



Input: $x \in \mathbb{R}^{49}$

7×7 MNIST image

Reshape to 1D

$x_1$
$x_{10}$
$x_{20}$
$x_{30}$
$x_{40}$
$x_{49}$

Experimental output intensity

Output: $y \in \mathbb{R}^{10}$

手書き文字
Hand writing character

光AI演算器
Optical AI Processor

9と認識
Recognize as 9

入力：個々のマスの色の濃さ
Input: The values of shading of each cell

出力：0-9に対応する波長の強度
Output: Project pattern intensity

## ///Technical Issue

Optical computers have potential for greater energy efficiency than electronic computing systems. However, conventional optical computers are not energy efficient due to the large laser and optical mechanisms required.

## ///Research Goal

Achieve 100x energy efficiency for optical matrix vector matrix multiplication relative to conventional optical computing systems.

### ---Technology

Optical circuit design on Thin Film Lithium Niobate wafer was developed through joint research between NTT and Stanford University.

### ---Novelty

TFLN has been primarily used as optical modulator for communication systems, but NTT is leveraging the nonlinear optical effects of TFLN for applications in optical information processing.

### ---Applicable Business

• Artificial Intelligence, Information Processing.
• Since energy consumption of MVM (Matrix Vector multiplication) will be dramatically reduced, AI-based DNN is a typical target use case.
• Target of commercialization: end of 2035.