

# Low-Cost Perovskite Solar Cells for Space & Lightweight Applications

## The What



Highest efficiency solar cell ever made on plastic



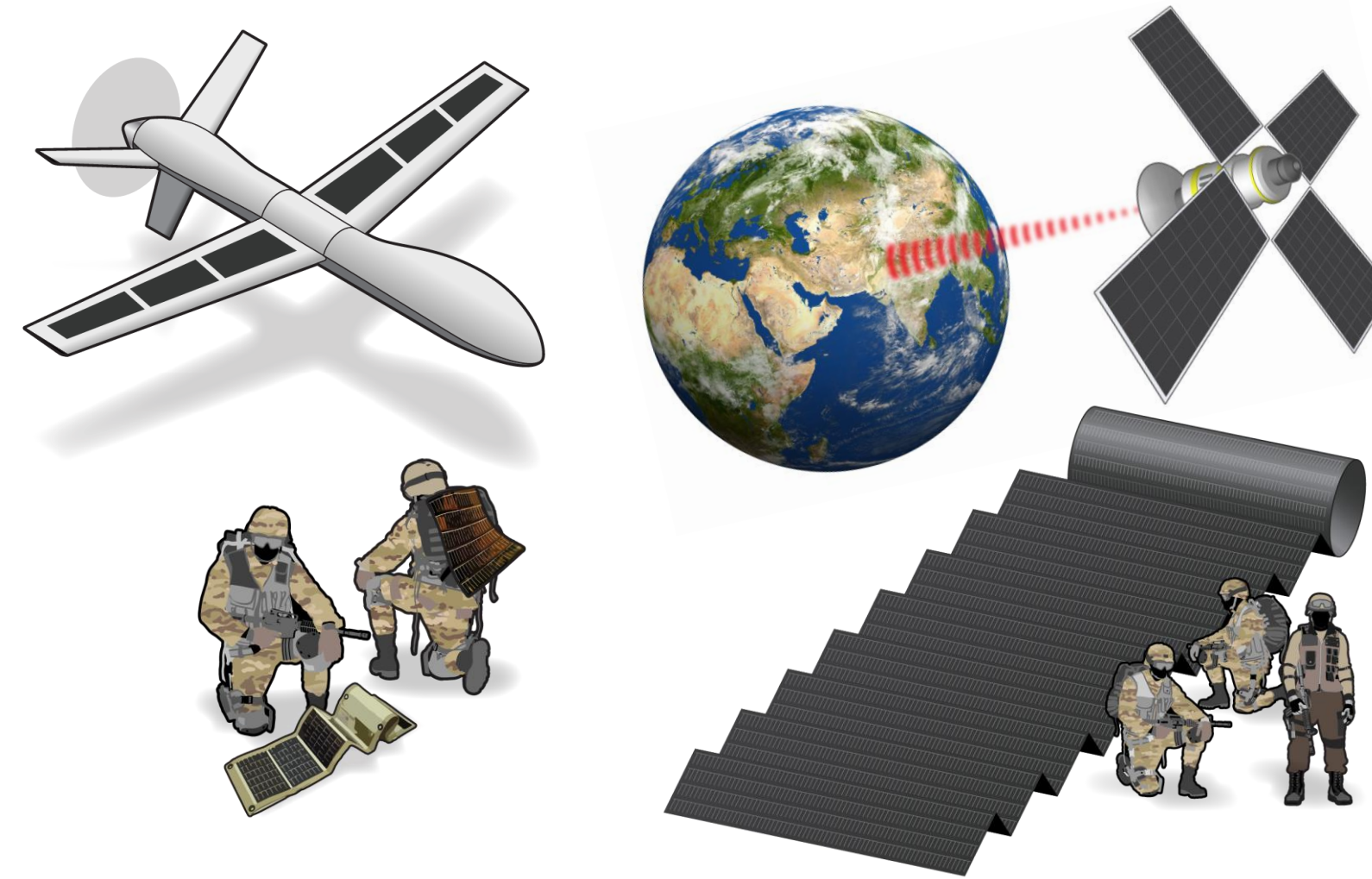
Susanna Blume, Director of Cost Assessment and Program Evaluation, painting a perovskite solar cell



Large-area, roll-to-roll coating on flexible glass—a key technique for low-cost manufacturing

- To perform as needed in space, perovskites solar cells must be hardened against radiation damage.
- The National Renewable Energy Laboratory is developing perovskites solar cells that:
  - Demonstrate 10-year stability in the space environment
  - Reach a power conversion efficiency of 30% at the low cost of < \$1/watt.

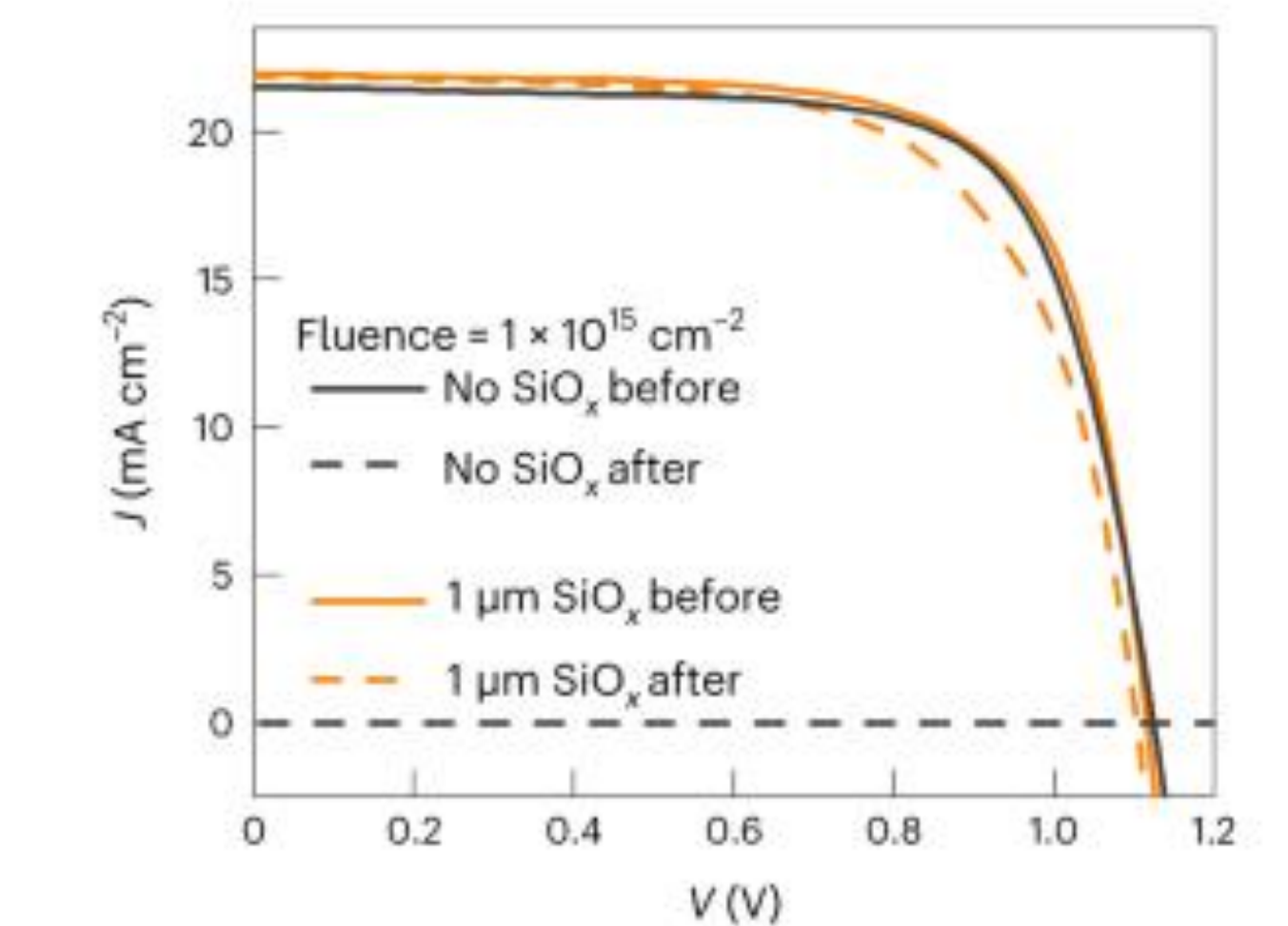
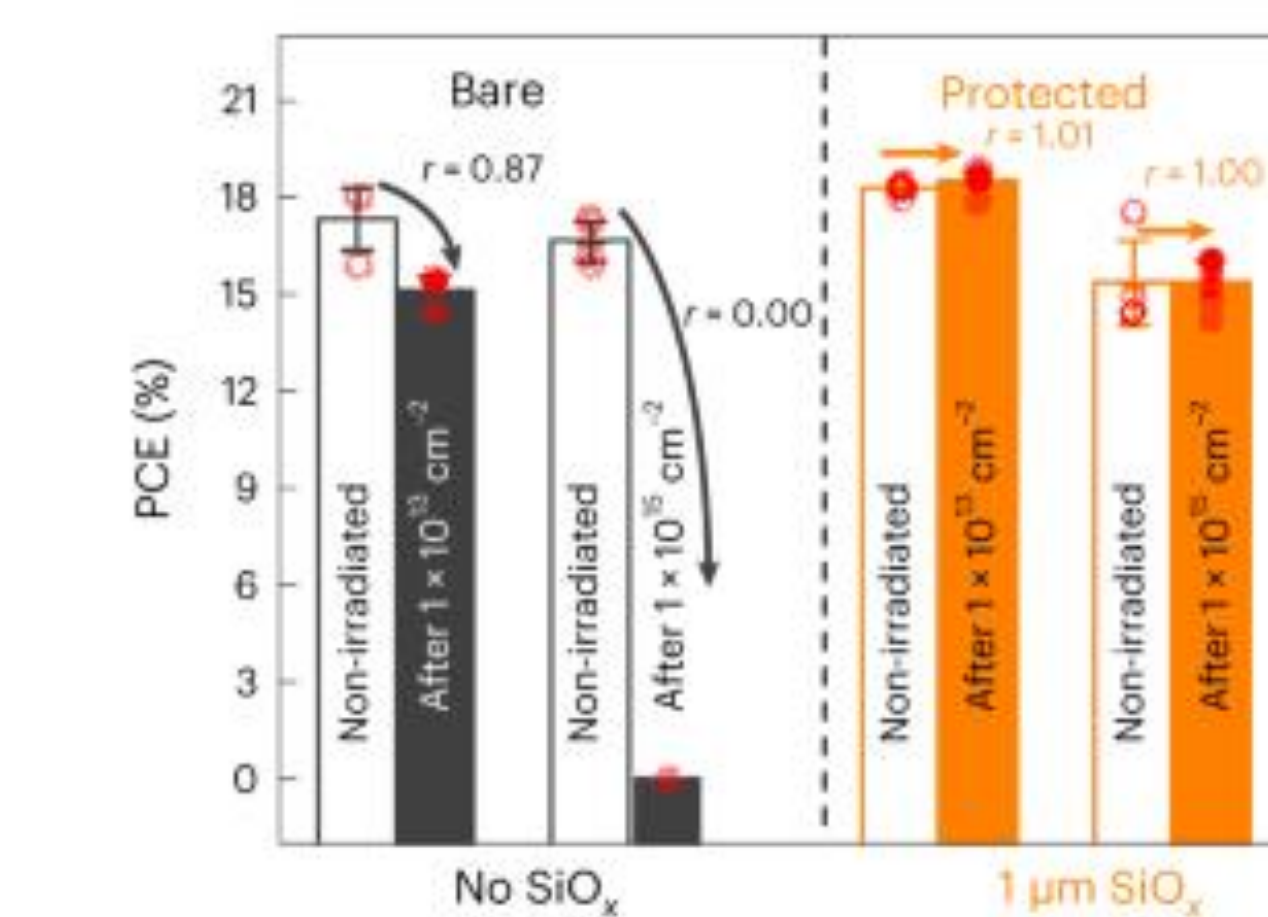
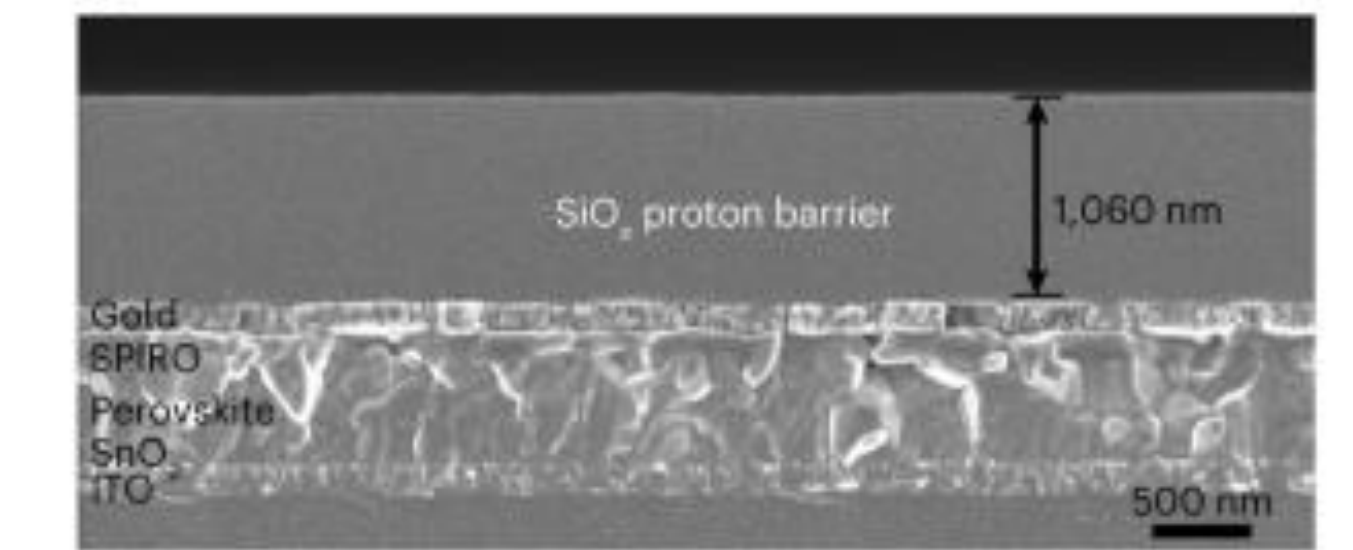
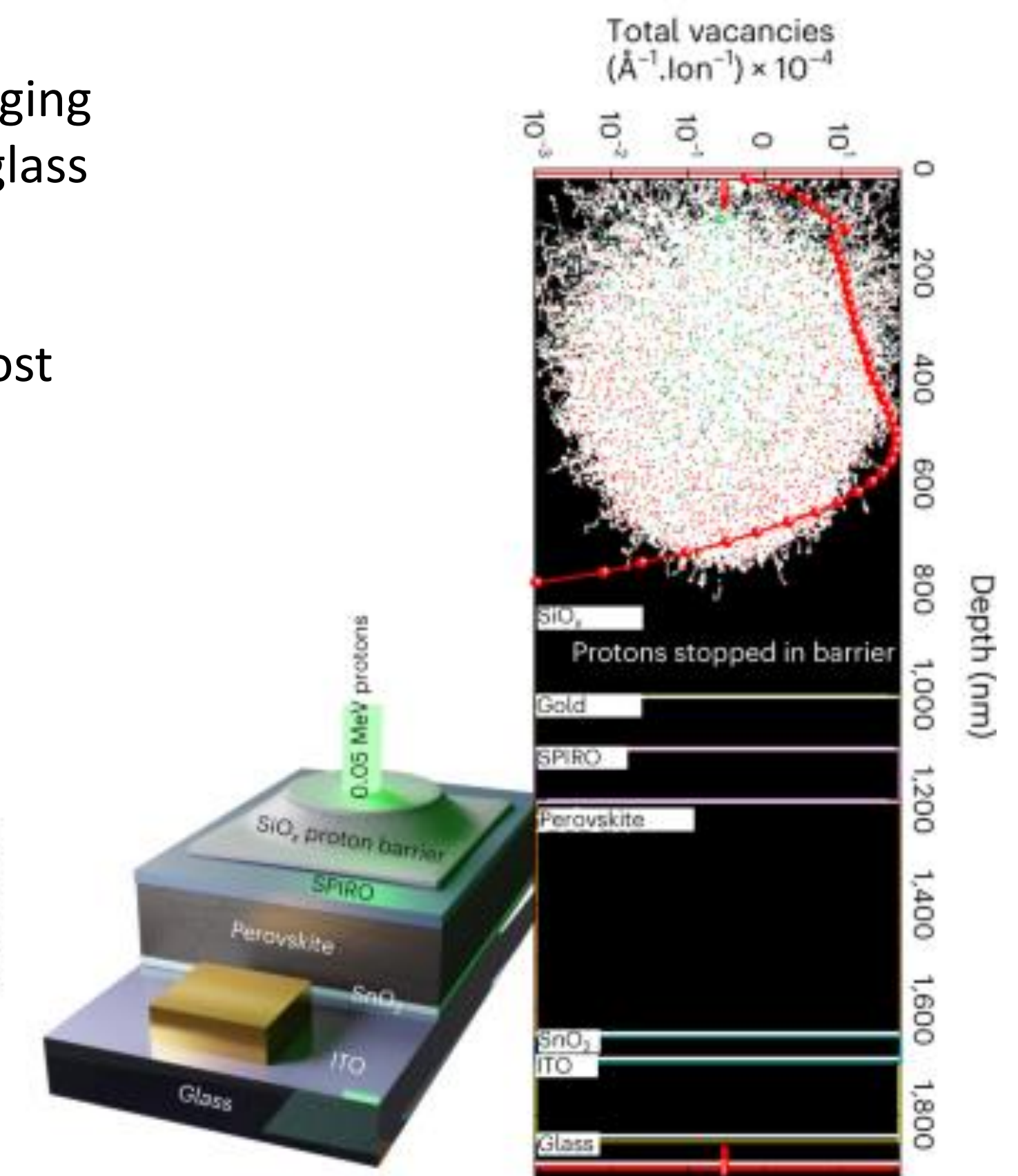
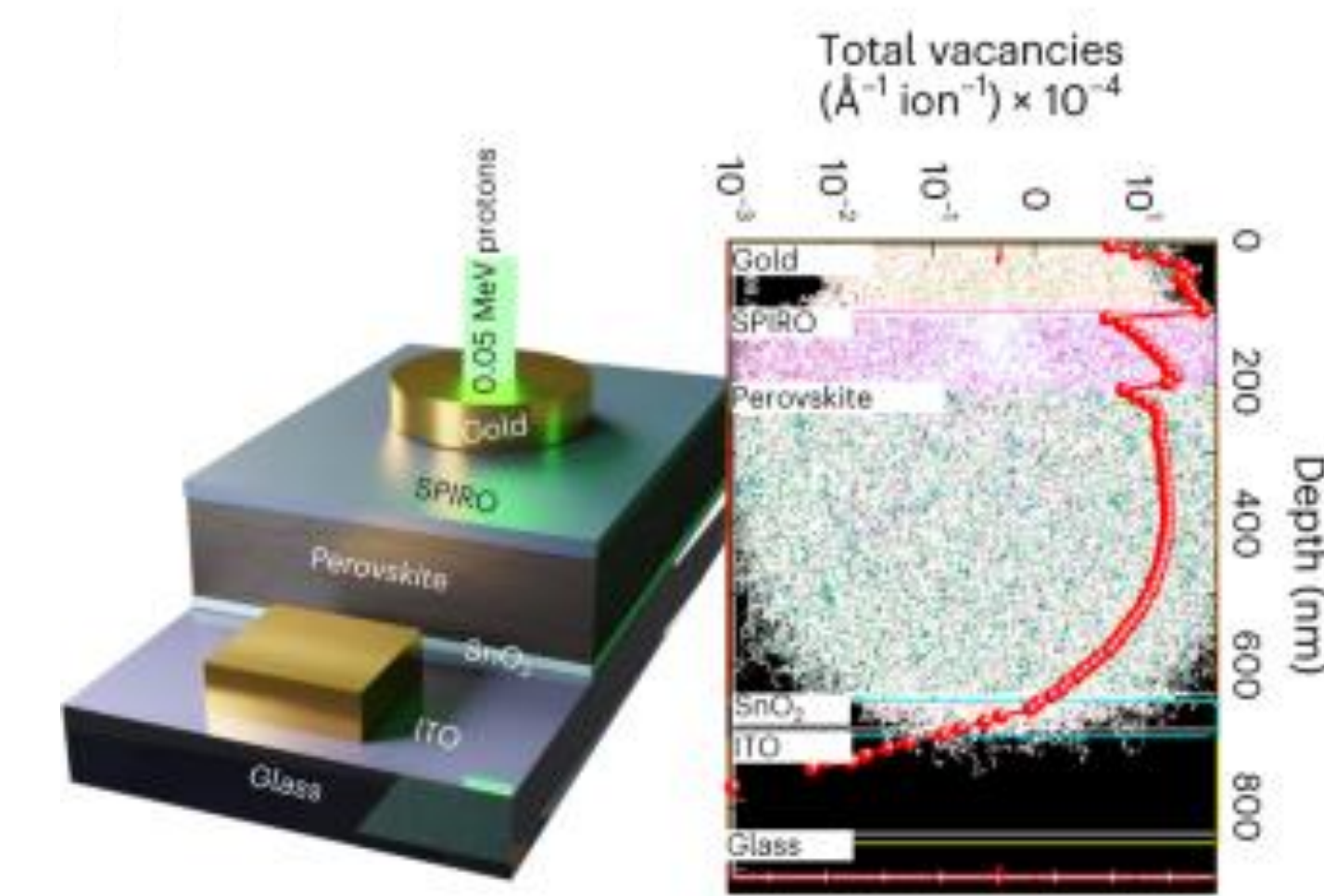
## The Why



- New solar energy applications—like space power beaming and lightweight field deployment—require a new generation of solar cell materials that are:
  - Lightweight
  - Mountable on smooth, flexible surfaces
  - Low-cost
  - Easy to manufacture (print like newspaper).
- Perovskite solar cells meet all these requirements, enabling them to:
  - Supply portable, rapidly deployable power to units and aircraft to mitigate operational energy deficits and enable new capabilities
  - Provide ubiquitous power in the battlespace via power beaming to any point on or above Earth from very large, flexible orbital arrays.

## Recent Results

- Developed simple, low cost, thin oxide packaging scheme 125X thinner than traditional cover glass
- Deposited at the back of the solar cell
- Provides sufficient protection from the most damaging radiation



## Developing the Solar Cells Needed for Space Power and Other Lightweight, Mobile Applications

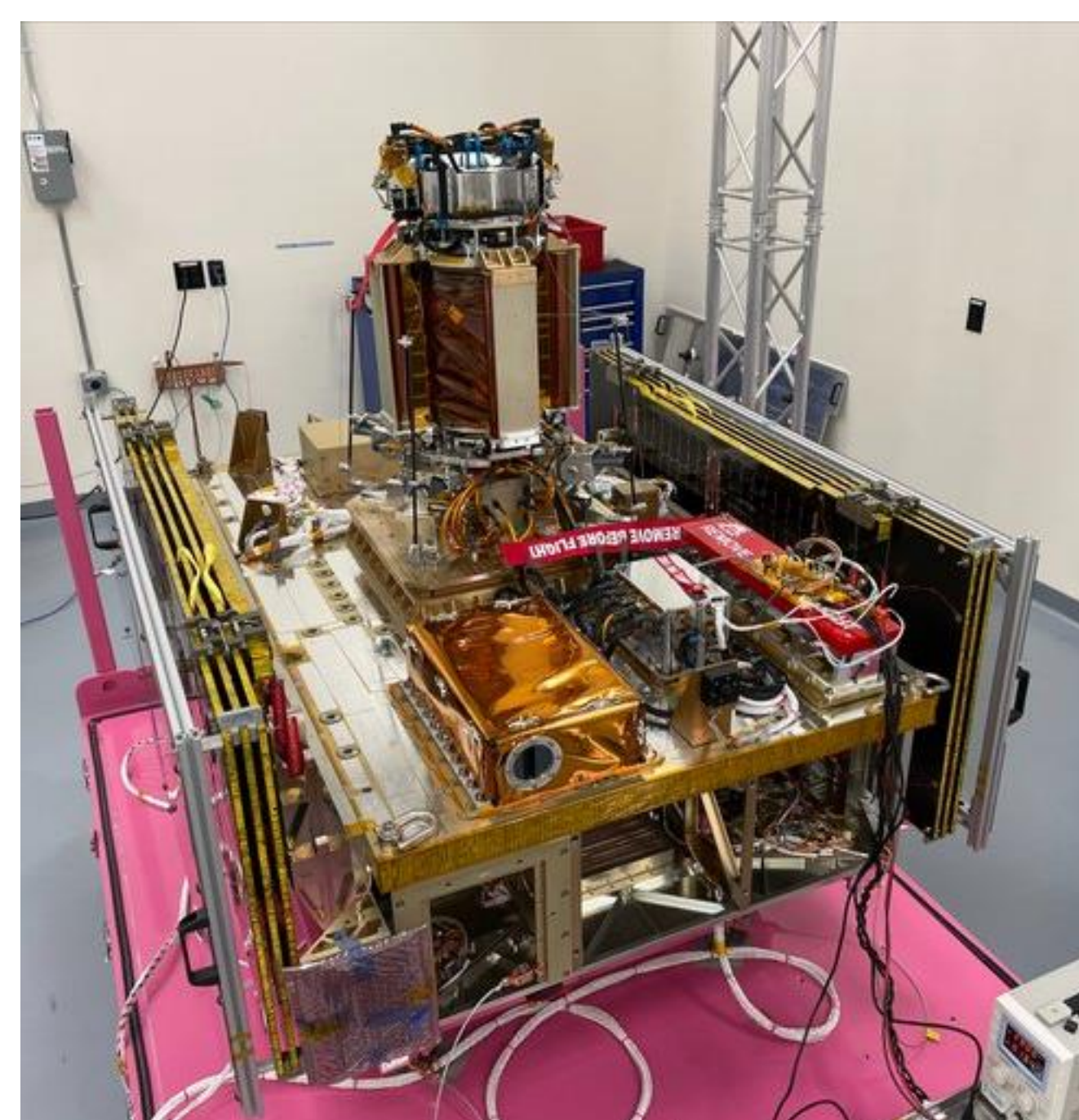


Fig 1. Top: CAD illustration of Alba's final design. Bottom: Photograph of flight hardware during early assembly. All cell carriers are installed; but the solar cells have not yet been attached.



## NREL Perovskite Solar Cells in orbit on Momentus Vigoride 5

- Protects against extremely harsh atomic oxygen as well as full submersion in DI water with no loss in device performance.

