

Federated AI-Ready Cyberinfrastructure for Advanced Microscopy and Imaging

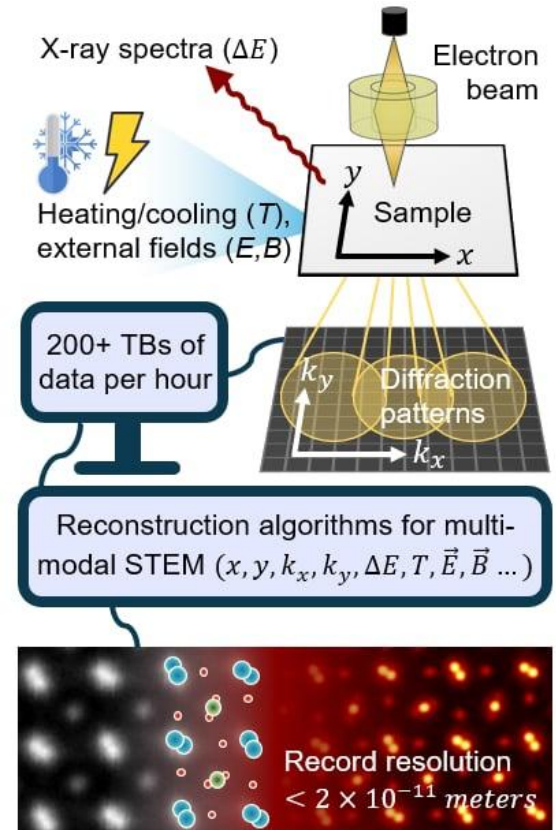
Lewis Tseng – UMass Lowell

Hsien-Yuan (Mark) Hsu – UMass Lowell

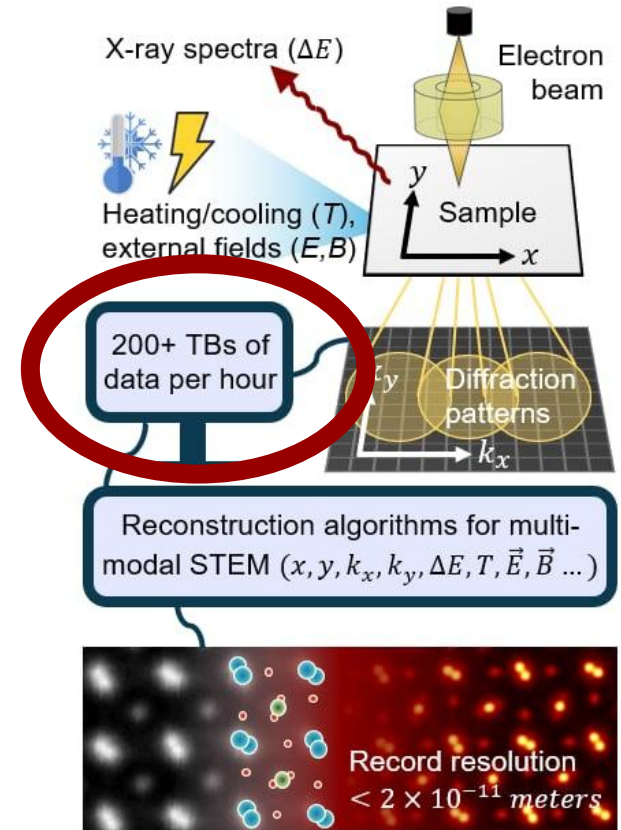
Yu-Tsun (Jim) Shao – USC

We still treat microscopes like cameras.

But they are becoming AI instruments.



We are producing data
faster
than we can turn it into
science.



AI gives us super power

*“In the end, it would utterly
overcome anyone of mortal race
who possessed it.”*

- J.R.R. Tolkien



The Shadow is growing in the age of AI

More data. Faster production.



The Shadow is growing in the age of AI

More data. Faster production.

Deeper fragmentation.

Harder to find.

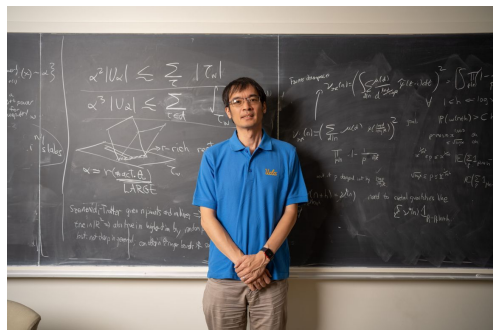
Harder to trust.

Harder to build shared knowledge.



Science = Shared Knowledge

- For a proof to be actually contribute to the broader field, it is **not enough** for it to be correct and easy to read.
- It also needs to be **accepted** and **valued** by the community.



<https://newsroom.ucla.edu/stories/terence-tao-science-stability-future-of-math-washington-post>

Mathematics in the age of AI, Terence Tao
International Congress of Mathematicians
July 2026

Paradox in the age of AI

“Individual gains do not automatically aggregate into collective progress.”

Science: A New Golden Age
July 2026



Shared Knowledge Collective Progress



**AI as a new instrument
of scientific discovery**

The Fellowship Model

A new operating model for collaborative science

A “scientific Fellowship” brings different disciplines together to:

- build shared understanding
- identify what makes sense
- and discover/build together



What makes the Fellowship?

AI accelerates (individual) capability

Federation connects the instruments



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Co-design creates the ecosystem



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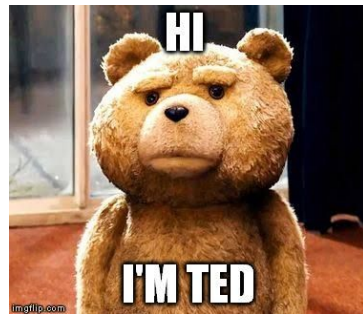
Co-design creates the ecosystem

- Shared language
- Shared imagination
- Shared ownership



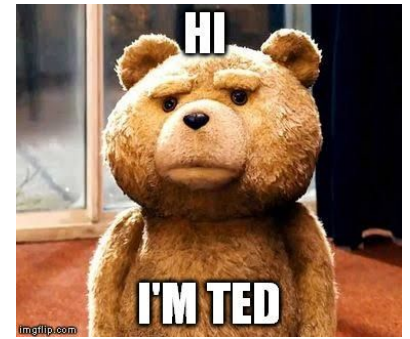
Build the Fellowship through TED

First, we **Teach** domain science and CI integrated with AI + ethics to have **shared language** and create a **shared imagination**.



Then, we **Explore** real AI-ready scientific workflows, constraints, responsibilities, and concerns in a **shared language**, and iteratively refine **shared imagination**.

Finally, we **Design** the architecture, governance, and operating model together, to create **shared ownership**.



Shared Language

Shared vocabulary

Real constraints

Priority workflows

Shared Imagination

Architecture + Workflow

Blueprints

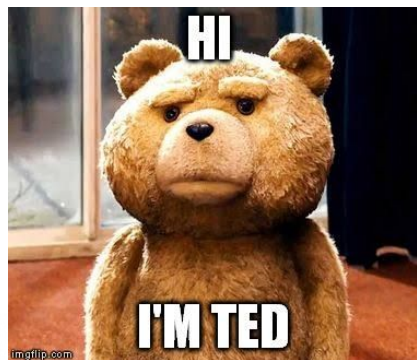
Governance + Trust

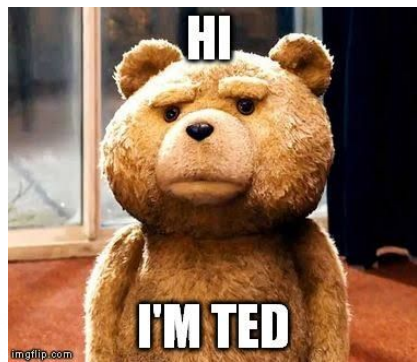
Shared Ownership

Roles + Responsibilities

Shared credits

Collective Progress





Guiding Principles

Co-design with communities

- domain science, CI, IT, AI, **education**

Federated design

- open interfaces, standardized data formats, and interoperability

AI-ready + AI-accelerated + human-in-the-loop

What we will build together

Connect

- A validated multi-institution federated system blueprint for imaging datasets
- Confirmed partners: USC, Argonne, Cornell, BC, NCSU, UMass Lowell

Demonstrate

- Three co-designed AI-ready workflows
- Targeting domains: material science, biology, and earth science

Sustain

- TED framework
- A committed “Fellowship” for discovering shared knowledge

From individual power to collective progress

AI accelerates ~~(individual)~~ capability

Federation connects the instruments

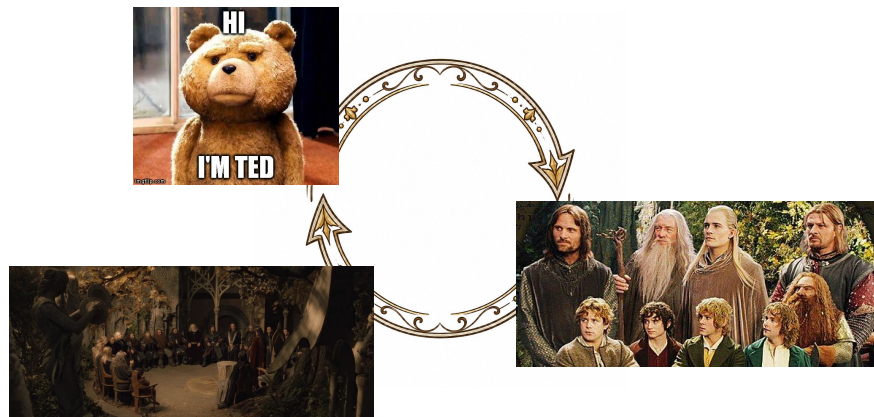
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Q & A

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