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Type: **Talk (15min + 5min)**

Reproducible scientific simulations on the blockchain

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The reproducibility of scientific simulations is one of the key challenges of scientific research.

Current best practices involve version-controlled code, tracking dependencies, specifying hardware configurations, and sometimes using Docker containers to enable one-click simulation setups. However, these approaches still fall short of achieving true reproducibility. For example, Docker depends on the underlying host kernel, and high-performance computing (HPC) codes often link with specific kernel modules and headers. Over time, changes in host kernel versions can render Dockerized simulations unusable. Furthermore, non-deterministic simulations, such as Monte Carlo methods, may not yield identical results even when rerun on the same hardware with the same code.

This talk explores the potential of blockchain technology to address these challenges. By running simulations natively on-chain (via smart contracts) and emitting logs of each state transition, we can achieve reproducibility while also verifying the simulation's authenticity (associating the original author of the simulation and the reporting author).

Other potential ideas include using zero-knowledge proofs to hash the call stack and the stack memory into a Merkle tree or also to think about the tokenisation of compute.

We will delve into the technical feasibility and potential benefits of this approach, including its implications for trust, transparency, and the future of scientific research.

I want to participate in the youngRSE prize

yes

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Session Classification: Reproducibility and Discovery of Research Software

Track Classification: Data and Software Management: computational reproducibility