Protocol cryptoeconomics with the RIG

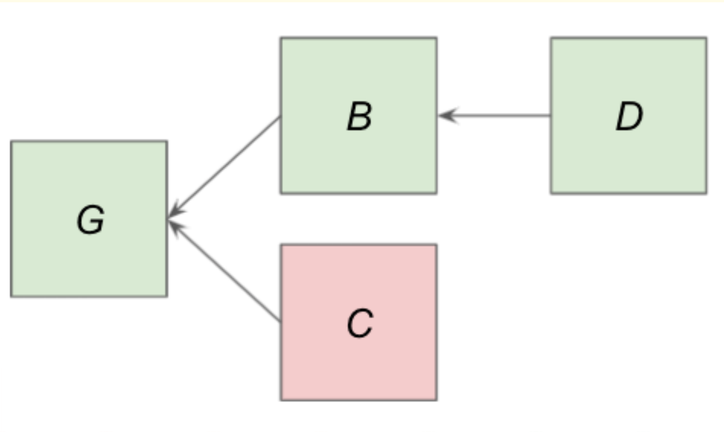
Barnabé Monnot (🦫 @barnabemonnot)
Ethereum Foundation
Robust Incentives Group (RIG)

These slides: https://ethereum.github.io/rig

Robust Incentives Group (RIG)

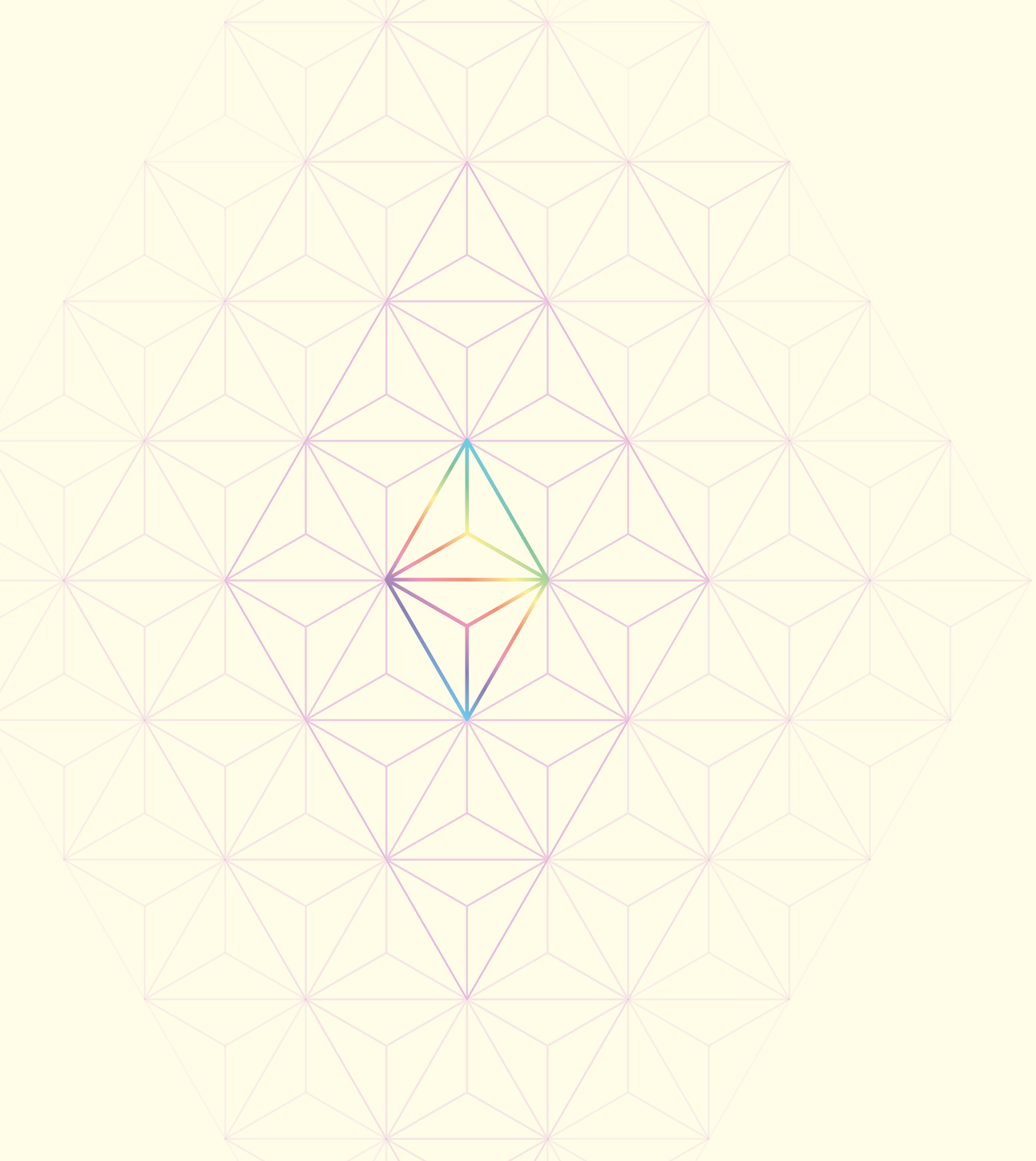
Ethereum research team focused on everything with *strategic* flavour

- Strategic in the sense:
  - Stakeholders make decisions to optimise their payoffs
  - Their payoffs are affected by decisions of other stakeholders
- Extremely general model to study protocol security/cryptoeconomics



Today

- Discuss methodology and results
  - Simulations of the transaction fee market and EIP-1559
  - Simulations of the beacon chain / consensus layer of Proof-of-Stake
- Present a new model for community economic modelling



Modelling EIP-1559

What is EIP-1559?

EIP-1559: A transaction fee market reform to add dynamic congestion pricing

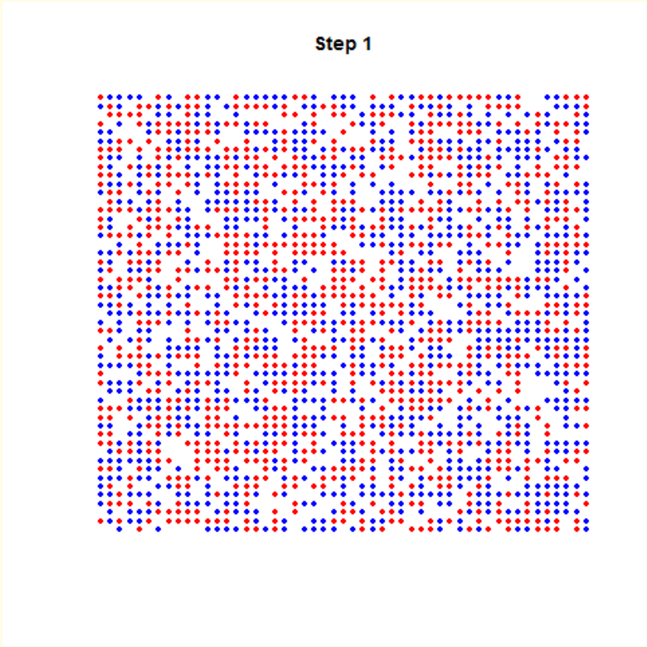
- Users must pay a minimum fee (“base fee”)
- Minimum fee increases when more users want to transact, decreases otherwise
  - Blocks are “double-sized”, max capacity 200%, target 100% fullness
- Users declare a priority fee and their maximum fee, pay current base fee + priority fee
- See Tim Beiko’s talk today!
  2:50 pm, Poissy Room (this room)

Agent-based models for EIP-1559

https://ethereum.github.io/abm1559

Library to simulate the fee market, abm1559

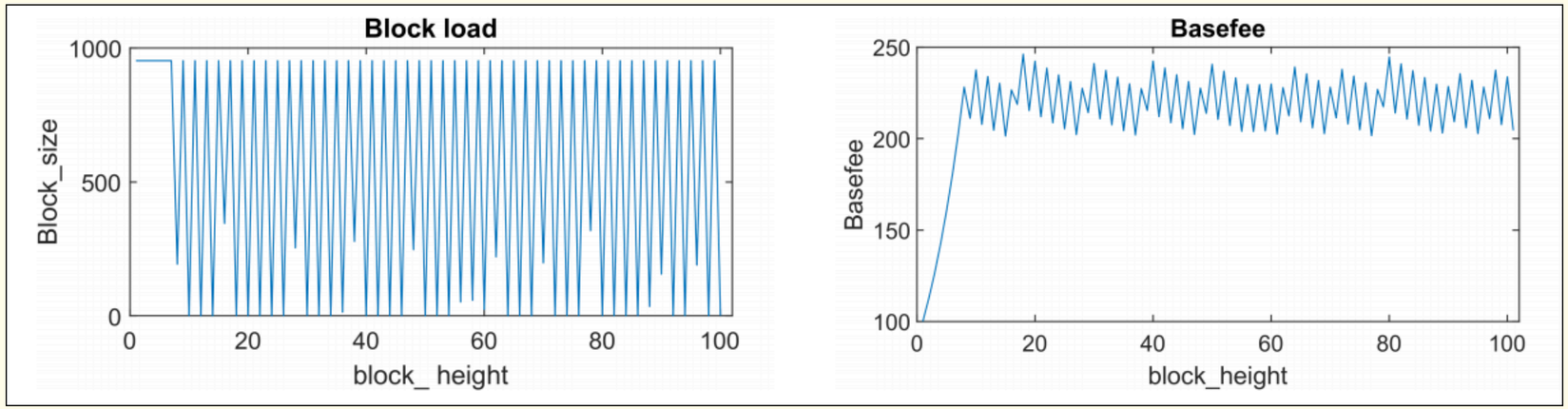
- Code simple behaviours, simulate and observe results!
- **Our agents**
  - Users: Value for the transaction, bidding strategy
  - Block producers: Transaction pool management, inclusion strategies
- **Our environments**
  - Current mechanism, EIP-1559, escalator... any mechanism can be implemented!



Imagine → Prove

https://ethereum.github.io/abm1559

- Simulations clarify emergent phenomena, sometimes reveal unexpected behaviour!
- We formalised proofs of EIP-1559 (in)stability in general and boundary cases
- Work could prove useful to tune EIP-1559 in the future... but get data first!

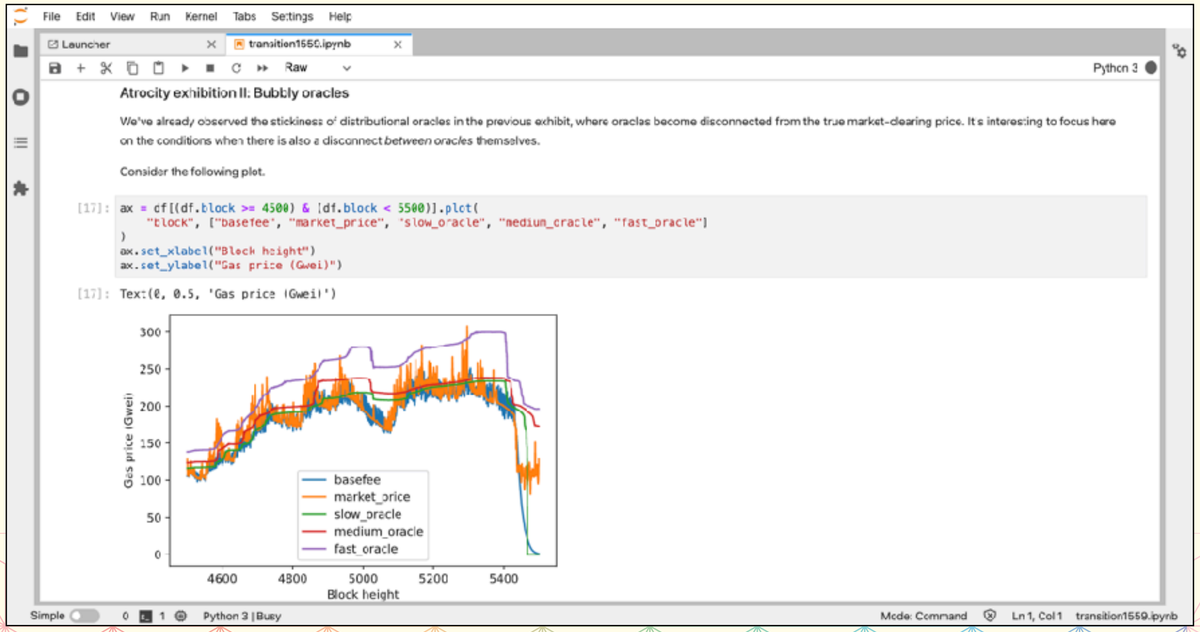


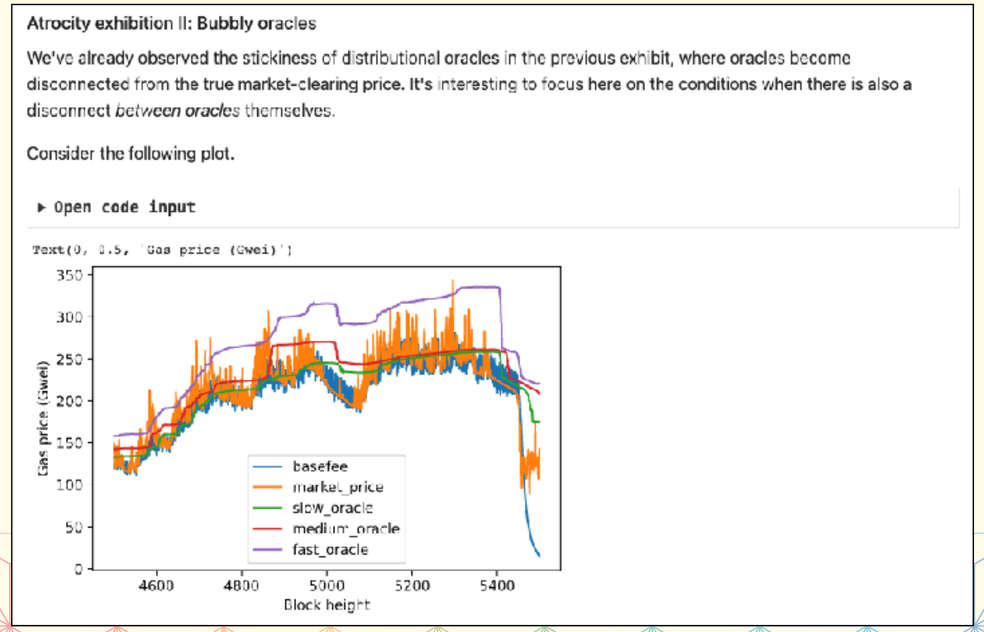
Dynamical analysis of the EIP-1559 Ethereum Fee Market, Leonardos et al., https://arxiv.org/abs/2102.10567

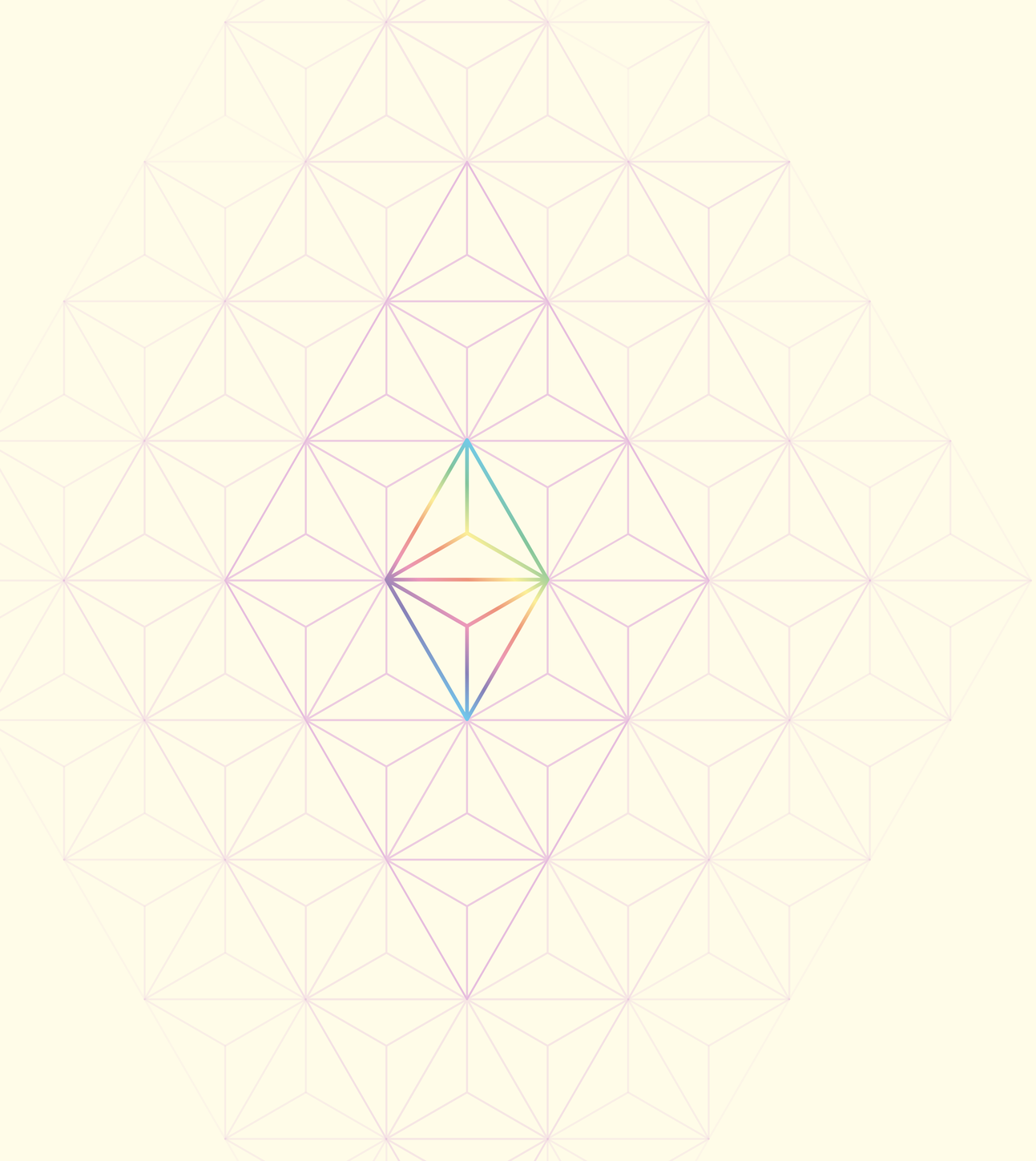
Open source, open science

https://ethereum.github.io/abm1559

- Rely on Jupyter Notebooks to provide reproducible results
- Notebooks exported to reader-friendly formats
- Community has used the library/notebooks to make their own simulations!







Modelling ~~eth2~~ PoS

Beacon Runner

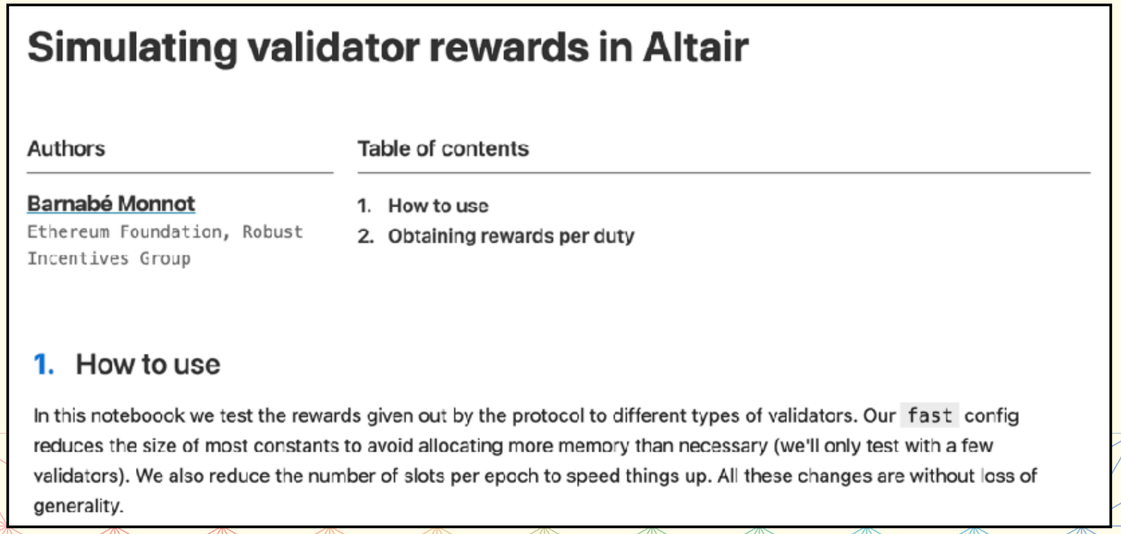
https://ethereum.github.io/beaconrunner

- Adopt the view of **blockchains as controlled dynamical systems**
  - **State:** A chain of blocks
  - **State update:** Adding a new block to the chain, voting on current blocks
  - **Control:** Users and validators participate in consensus
- Beacon Runner : Full-fledged simulation environment for validator behaviours
  - Based on the Python PoS executable specs
  - Simulates p2p layer + consensus actions with agent-based methods

Beacon Runner

https://ethereum.github.io/beaconrunner

- **Payoff testing**
  - Making sure we pay out what we expect to pay out
- **Strategic testing**
  - Are there behaviours other than honest that net a higher profit?



Simulating validator rewards in Altair

Authors

Barnabé Monnot
Ethereum Foundation, Robust Incentives Group

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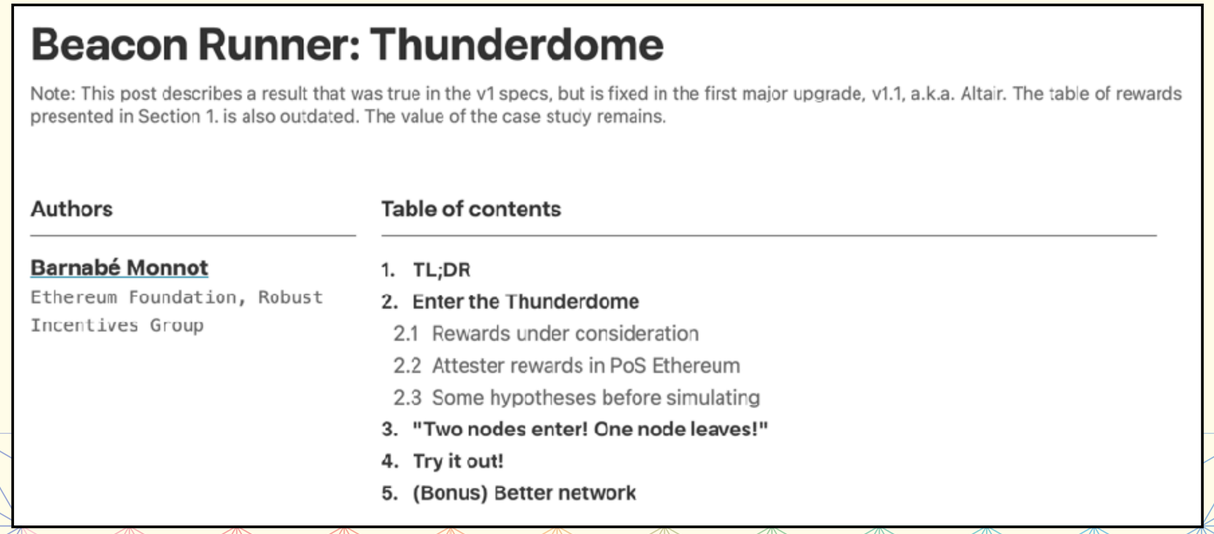
1. How to use
2. Obtaining rewards per duty

1. How to use

In this notebook we test the rewards given out by the protocol to different types of validators. Our `fast` config reduces the size of most constants to avoid allocating more memory than necessary (we'll only test with a few validators). We also reduce the number of slots per epoch to speed things up. All these changes are without loss of generality.



Beacon Runner: Thunderdome

Note: This post describes a result that was true in the v1 specs, but is fixed in the first major upgrade, v1.1, a.k.a. Altair. The table of rewards presented in Section 1. is also outdated. The value of the case stucy remains.

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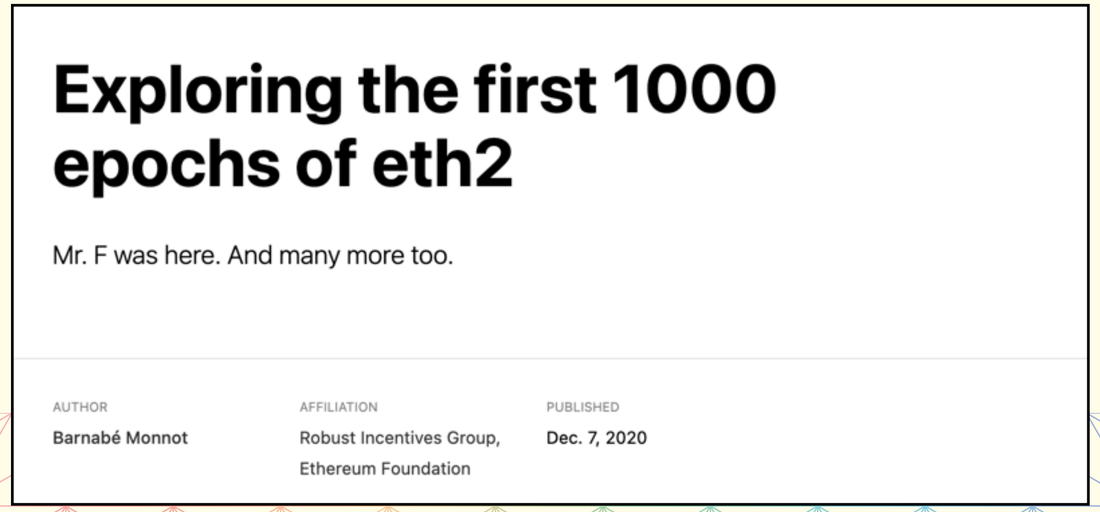
1. TL;DR
2. Enter the Thunderdome
   2.1 Rewards under consideration
   2.2 Attester rewards in PoS Ethereum
   2.3 Some hypotheses before simulating
3. "Two nodes enter! One node leaves!"
4. Try it out!
5. (Bonus) Better network

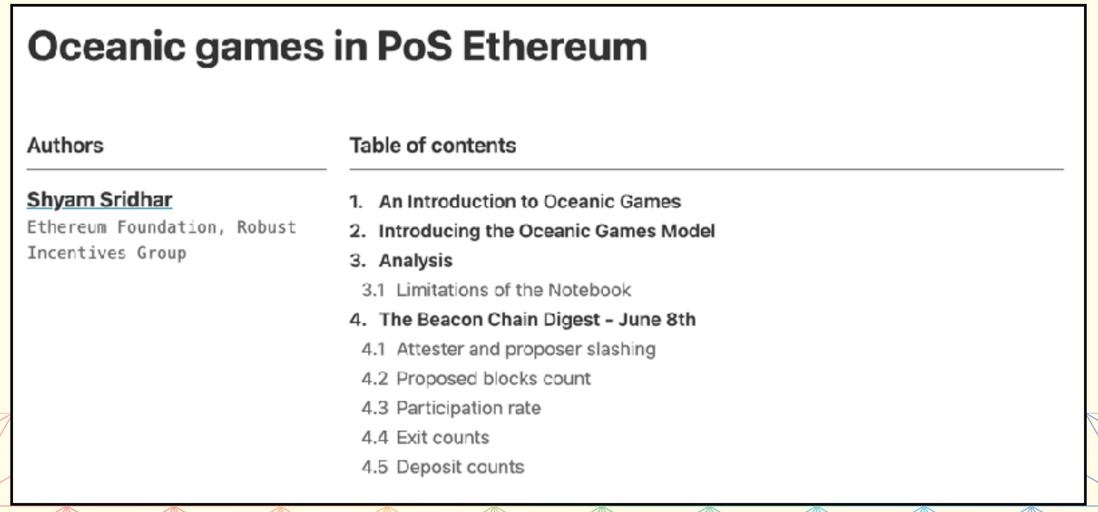
Data analysis

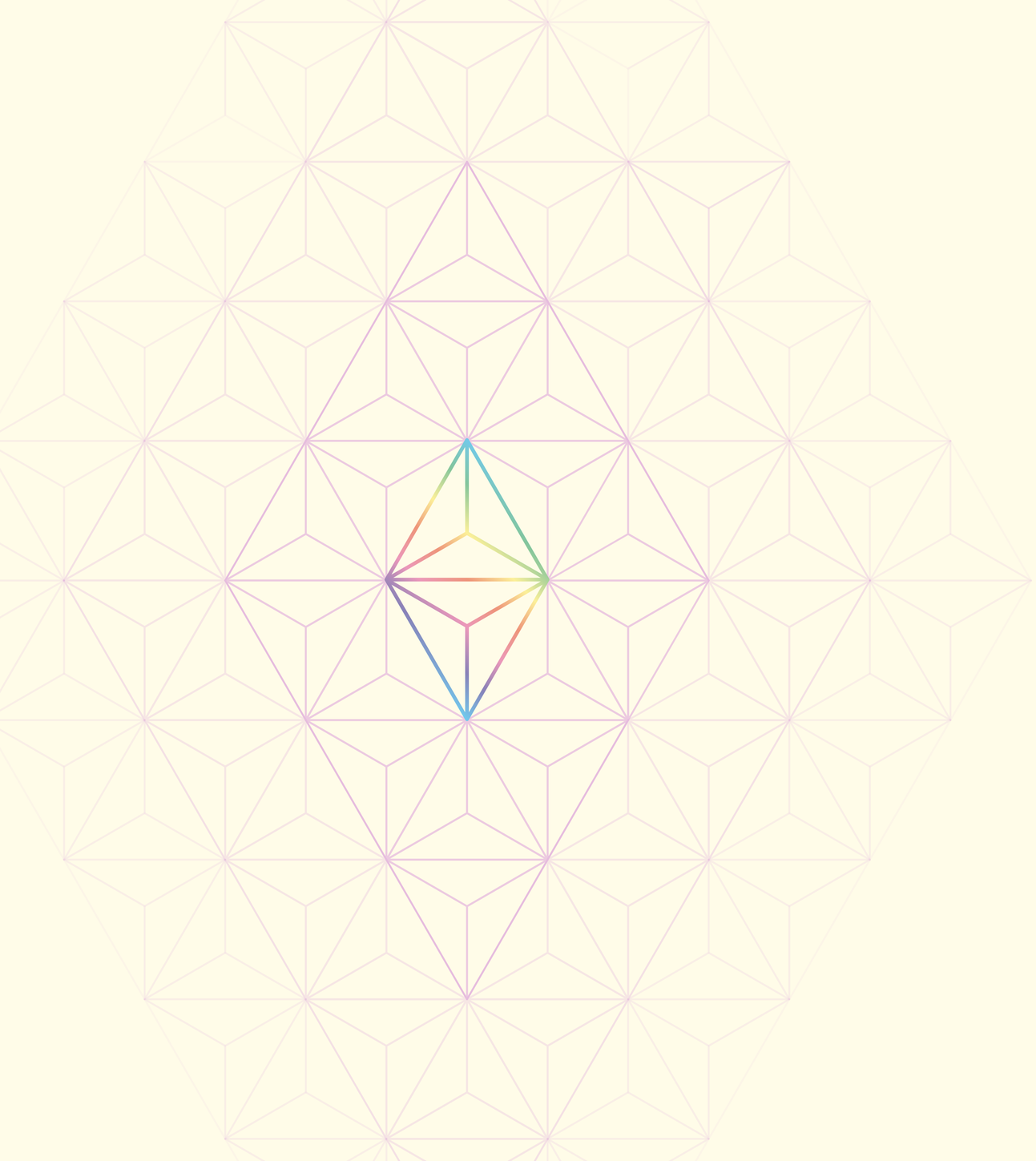
https://ethereum.github.io/rig/posdata

New! https://shsr2001.github.io/beacondigest

- Monitor beacon chain metrics
- Study dynamics as they play out
- Diagnose issues





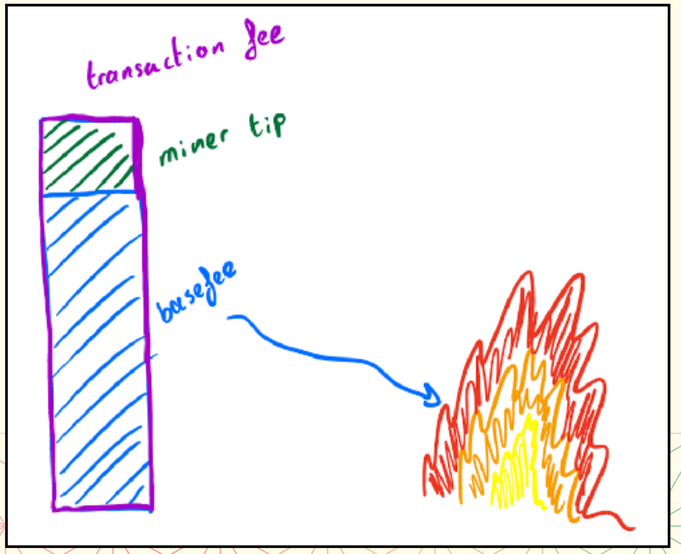


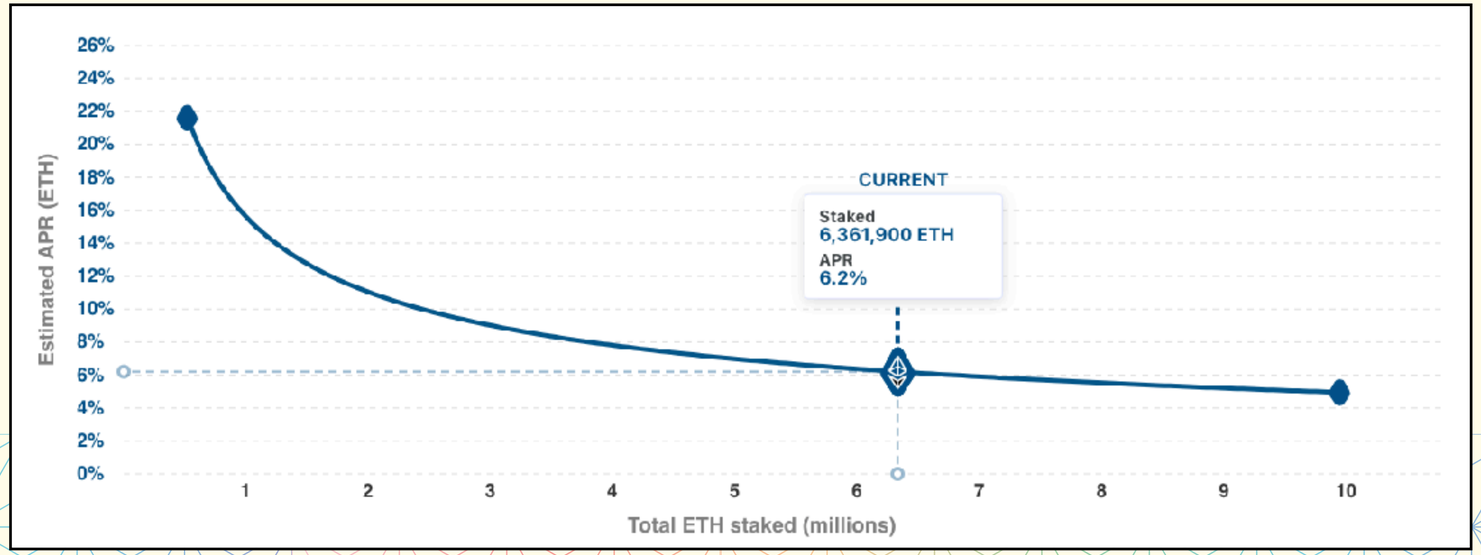
Modelling Ethereum economics

Future economics

- EIP-1559 adds a sink to the ETH asset
  - Basefee paid by users is burned (removed from supply)
- Proof-of-Stake considerably reduces the cost of securing Ethereum
  - Issuance reduced almost ten-fold compared with Proof-of-Work

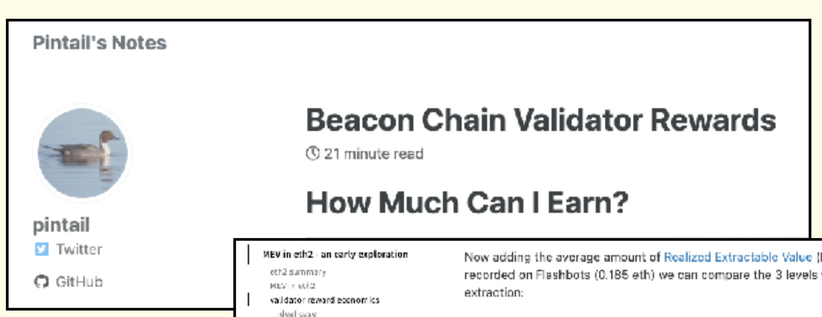
https://launchpad.ethereum.org

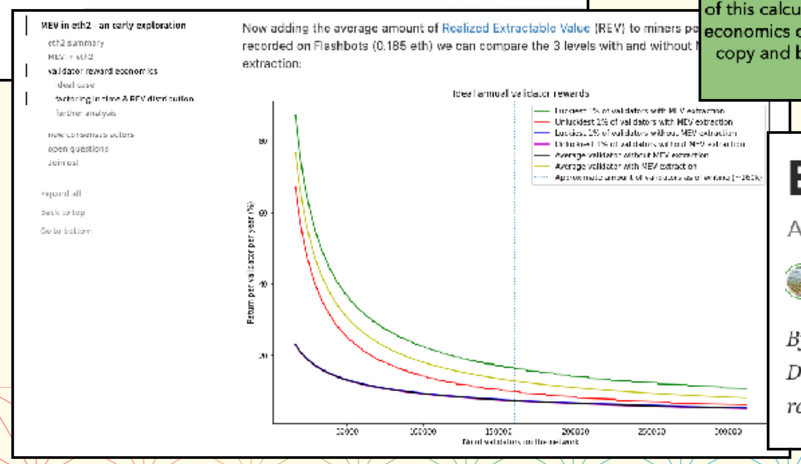


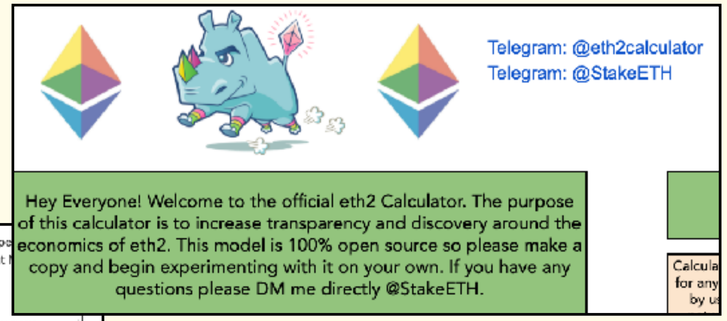


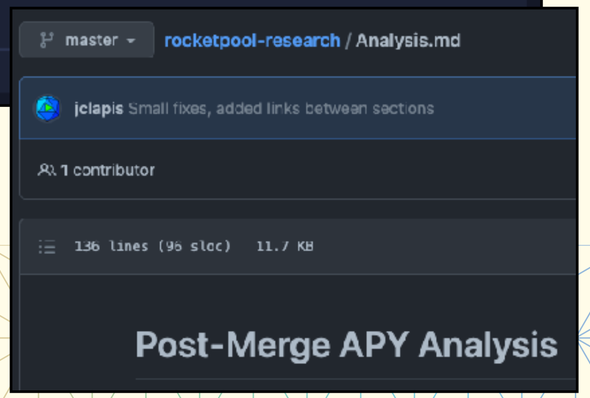
Open modelling

- Ethereum is a complex economic system, critical to model long-term effects and analyse impact scenarios + economic interactions
  - Community has already developed some of their own models!







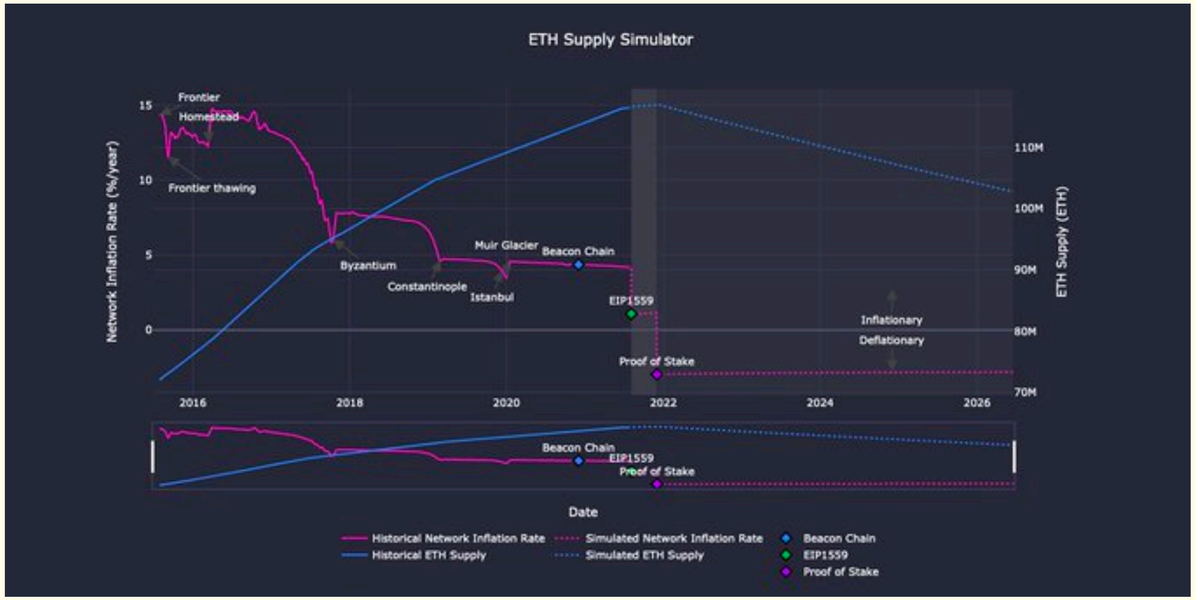


CADLabs Ethereum economic model

Python-based model for basic protocol dynamics

- PoS validator rewards/costs, EIP-1559 fee market, validator adoption, price models
- Designed for modularity and extensibility
- Fully documented + Notebooks available
- Built on cadCAD / radCAD
- Online masterclass to follow

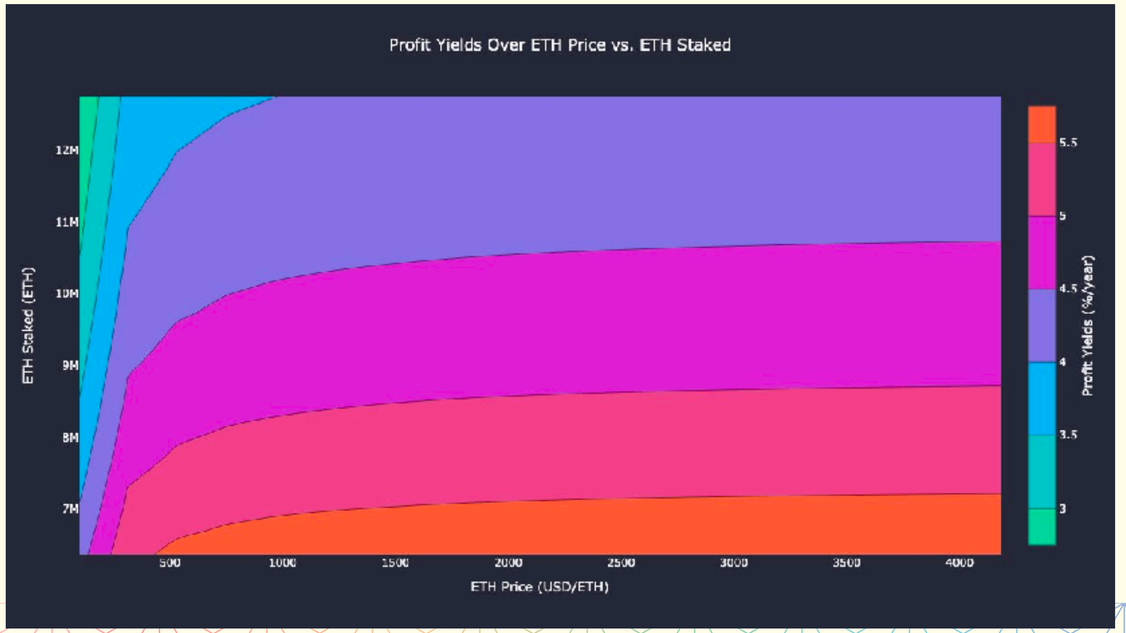
  Learn about PoS and use the model



Try it out!

Call to action

- Find the repo at https://github.com/cadlabs/ethereum-economic-model
- Model overview and contact: @CADLabs_org
- Or find me on Twitter, @barnabemonnot



Enjoy Paris!

Thank you for tuning in!

https://ethereum.github.io/rig