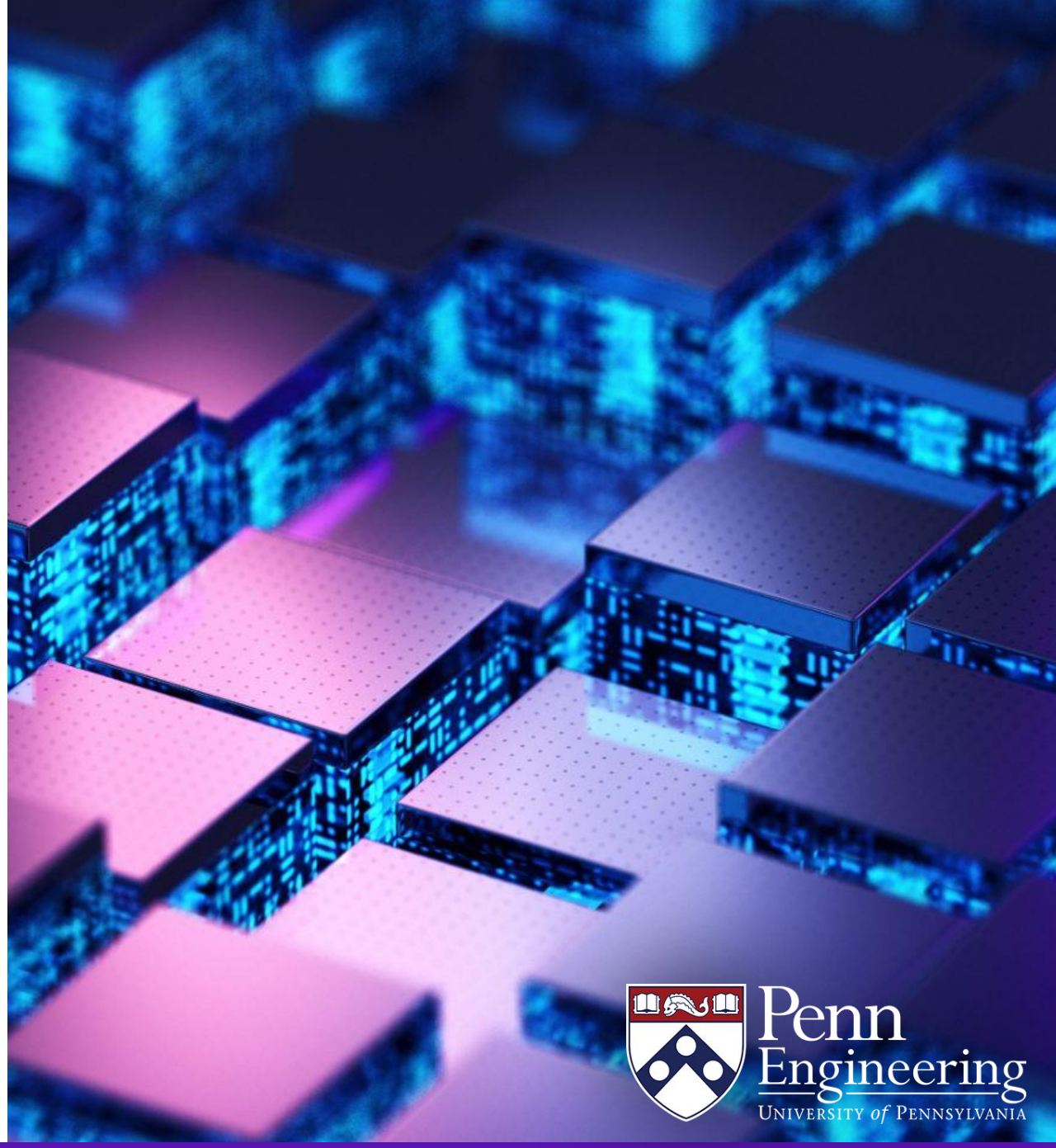
EAS 5830: BLOCKCHAINS

# Uniswap v3

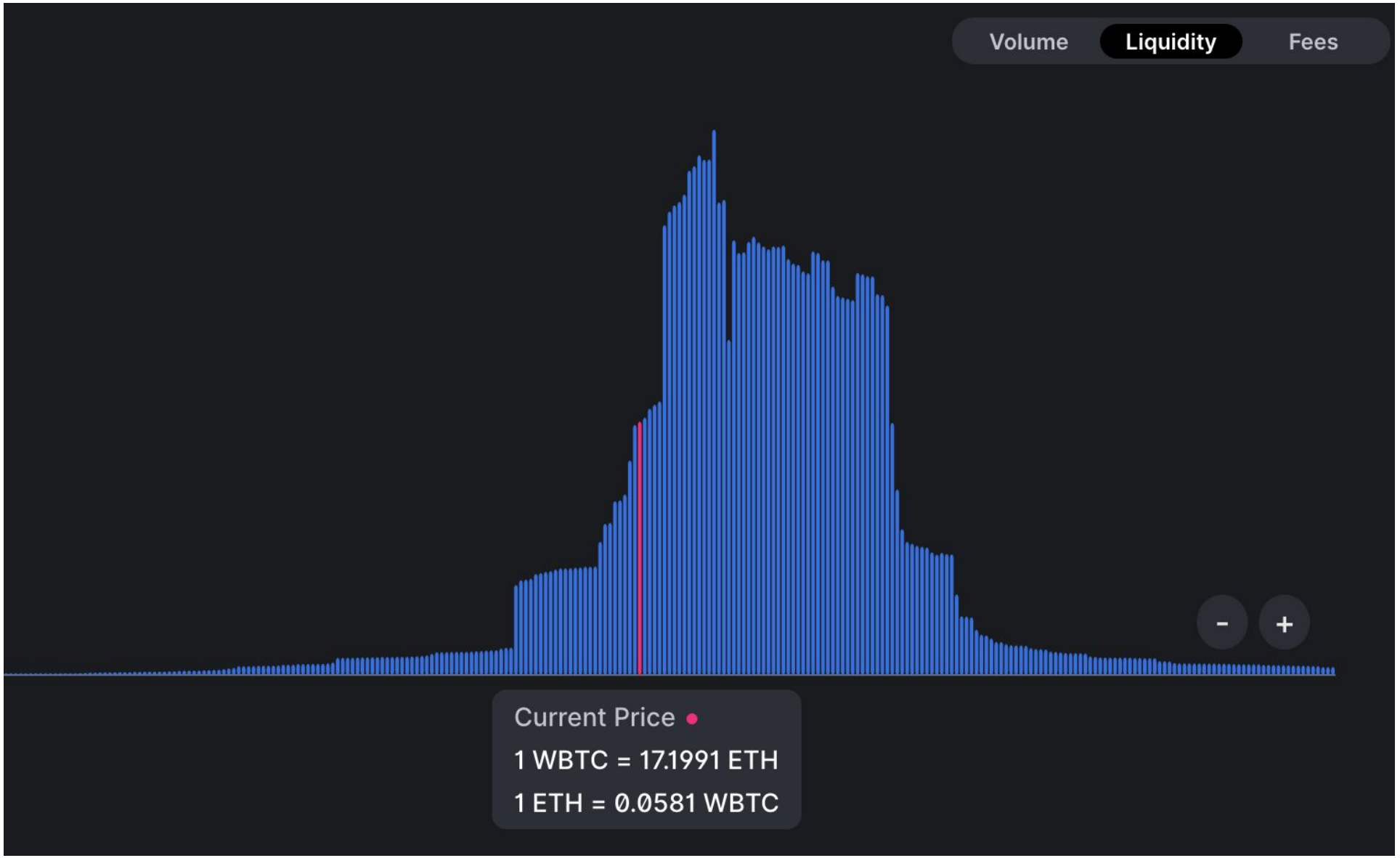
Professor Brett Hemenway Falk



Penn Engineering
University of Pennsylvania

# Uniswap V3

- Concentrated liquidity
  - LPs set upper and lower bounds on price
  - Trades using this liquidity only happen within this price range
- Variable fees:
  - Uniswap V1 and V2 had fixed fees of .3%
  - V3 has 3 different contracts per pair, each with different fees
    - .05%
    - .3%
    - 1%
- Governance token (UNI)


Volume
Liquidity
Fees
-
+
Current Price
1 WBTC = 17.1991 ETH
1 ETH = 0.0581 WBTC

# Concentrated Liquidity

- In Uniswap, when balances are $X,Y$ instantaneous price is $Y/X$
- Initial deposit is $X_o$, $Y_o$
  - $k = X_o Y_o$
- To provide liquidity in the price range $p_a$ to $p_b$
  - What are X and Y values at these points?

$$\frac{Y}{X} = p_b \Rightarrow \frac{k}{X^2} = p_b \Rightarrow X = \sqrt{\frac{k}{p_b}}$$

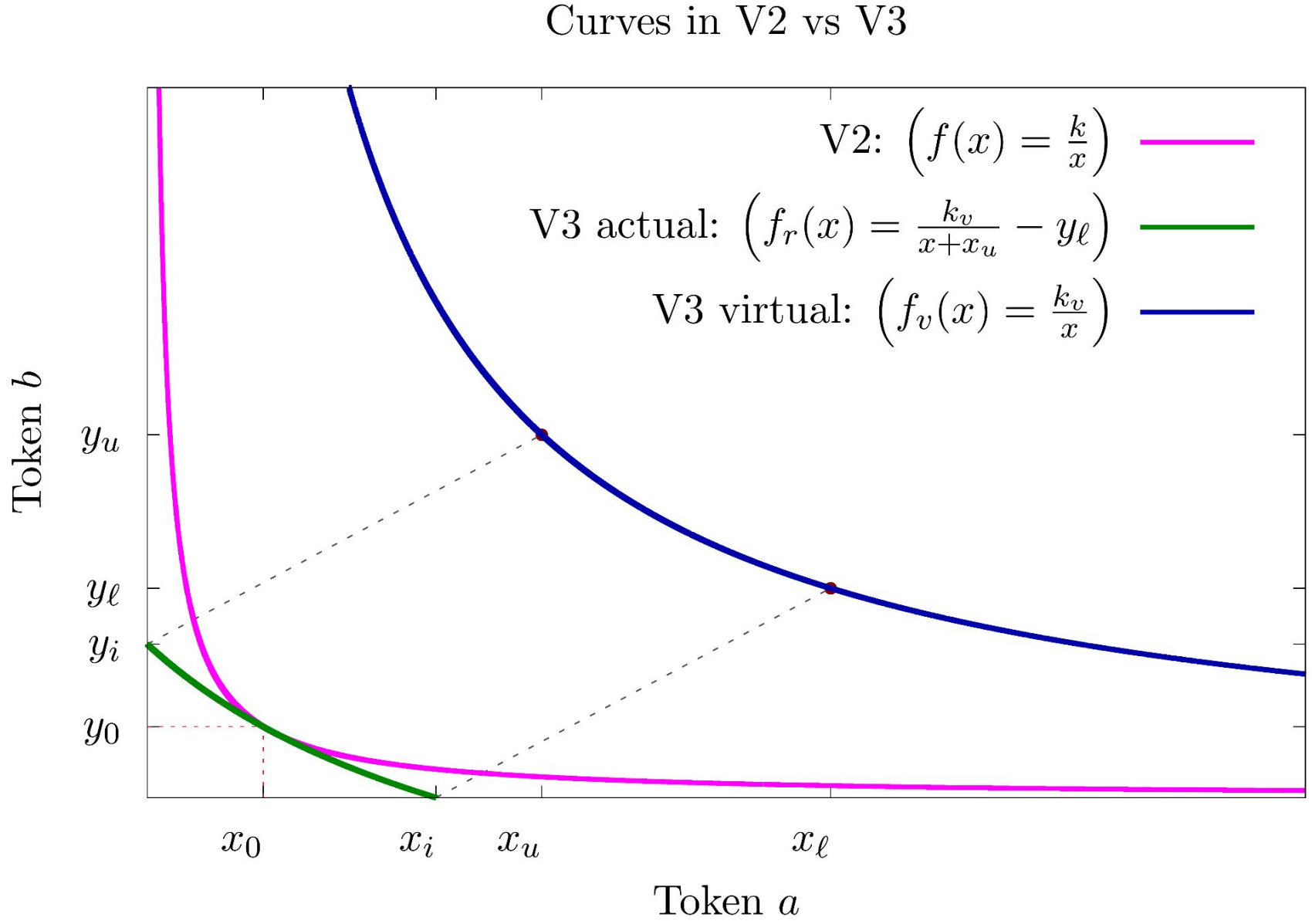
$$\frac{Y}{X} = p_a \Rightarrow \frac{Y^2}{k} = p_a \Rightarrow Y = \sqrt{k p_a}$$

# Concentrated Liquidity

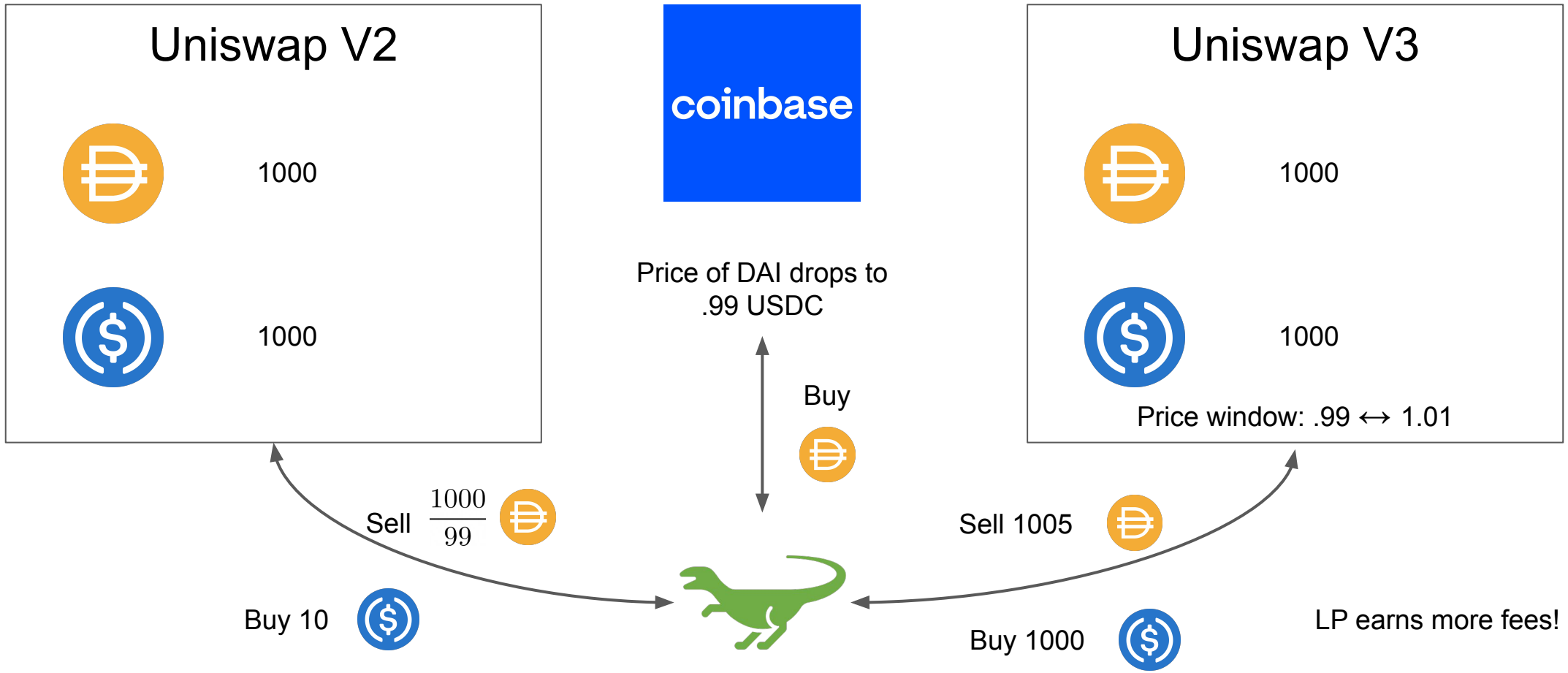
Shifting $X$ and $Y$ gives the "virtual" liquidity curve

$$k_v = \left( \frac{\left(x_0\sqrt{p_\ell} + \frac{y_0}{\sqrt{p_u}}\right) + \sqrt{\left(x_0\sqrt{p_\ell} + \frac{y_0}{\sqrt{p_u}}\right)^2 + 4\left(1 - \sqrt{\frac{p_\ell}{p_u}}\right)x_0 y_0}}{2\left(\sqrt{\frac{p_\ell}{p_u}} - 1\right)} \right)^2$$

When $p_u = \infty$, and $p_\ell = o$, this is the old uniswap curve $XY = X_o Y_o$


Curves in V2 vs V3
V2: $\left(f(x) = \frac{k}{x}\right)$
V3 actual: $\left(f_r(x) = \frac{k_v}{x+x_u} - y_\ell\right)$
V3 virtual: $\left(f_v(x) = \frac{k_v}{x}\right)$
Token $b$
$y_u$
$y_\ell$
$y_i$
$y_0$
$x_0$
$x_i$
$x_u$
$x_\ell$
Token $a$

# Concentrated liquidity



# Many new technical complications

- LPs must provide price ranges
  - How do you figure out a good price range?
- LP tokens are no longer fungible
  - LP tokens are now NFTs
- Trading fees are no longer deposited in the pool
- Trades now cross multiple liquidity positions
  - Similar to a central limit order book

# Providing Liquidity in Uniswap v3

- Uniswap v3 whitepaper
- Strategic liquidity provision in uniswap v3
- Risks and Returns of Uniswap V3 Liquidity Providers
- Concentrated Liquidity in Automated Market Makers
- Differential Liquidity Provision in Uniswap v3 and Implications for Contract Design

# Uniswap V3 Positions

| 66.9K | 23.3K | 1.09 | 36.9 |
|---|---|---|---|
| items | owners | average price | volume traded |

Welcome to the home of Uniswap V3 Positions on OpenSea. Discover the best items in this collection.

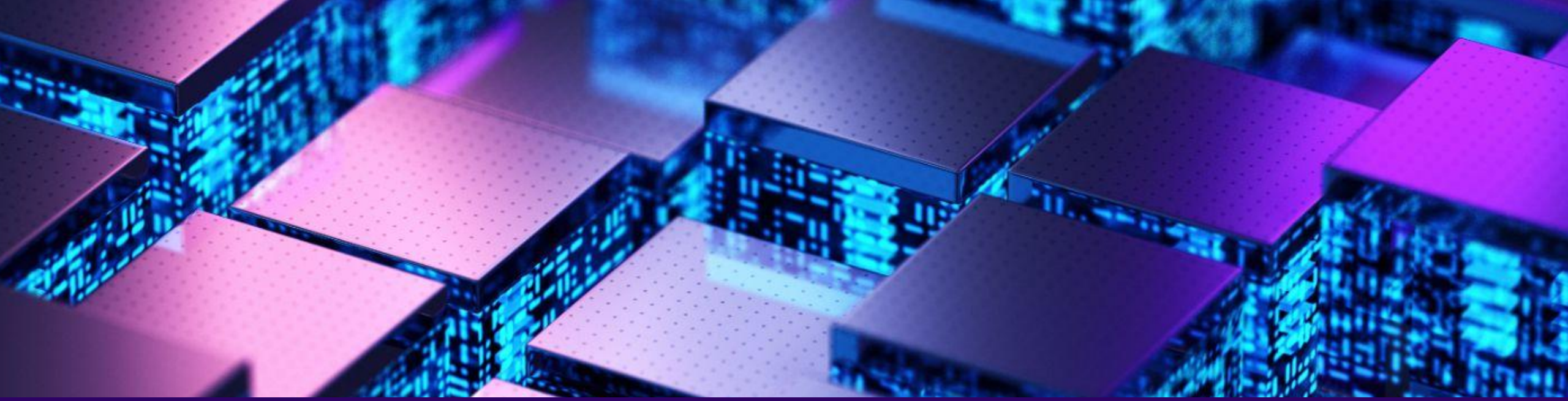
RECENTLY LISTED VIEW ALL >


Uniswap V3 Positions
Uniswap - 0.3% - ETH2x-FLI/WETH - 24.043<>...


Uniswap V3 Positions
Uniswap - 0.3% - DAI/WETH - 1907.6<>2701.6


Uniswap V3 Positions
Uniswap - 0.3% - UNI/WETH - 118.60<>121.48


Uniswap V3 Positions
Uniswap - 0.3% - USDT/FNK - 17.018<>24.984



# Initial DEX Offerings

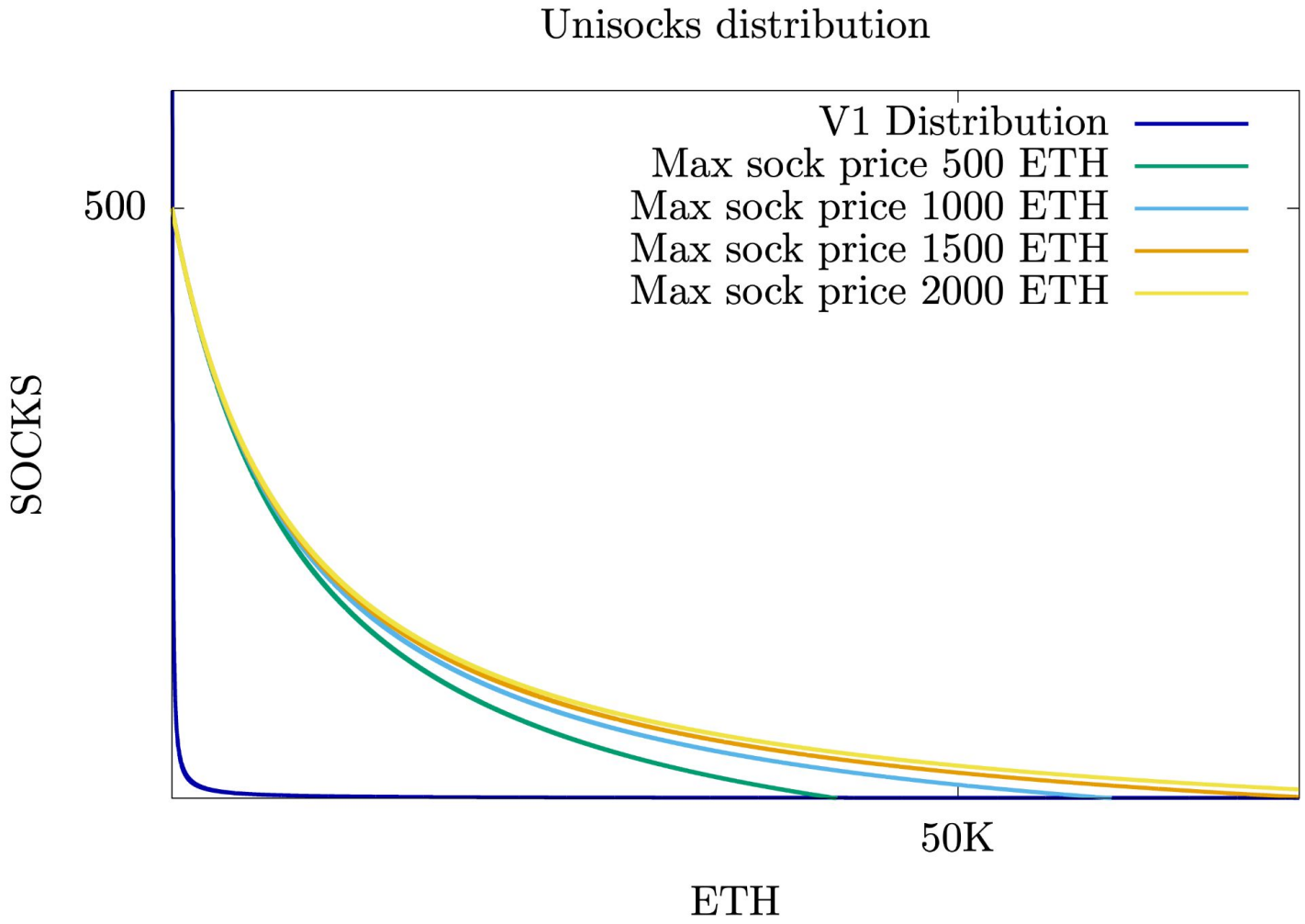
**Leshner** @rleshner · Apr 6

Uniswap v3 is phenomenal for token launches; set an initial liquidity range above the starting price, no ETH needed.

Can this approach be used for price discovery of a non-fungible asset? what about if it's @fractional_art shares?

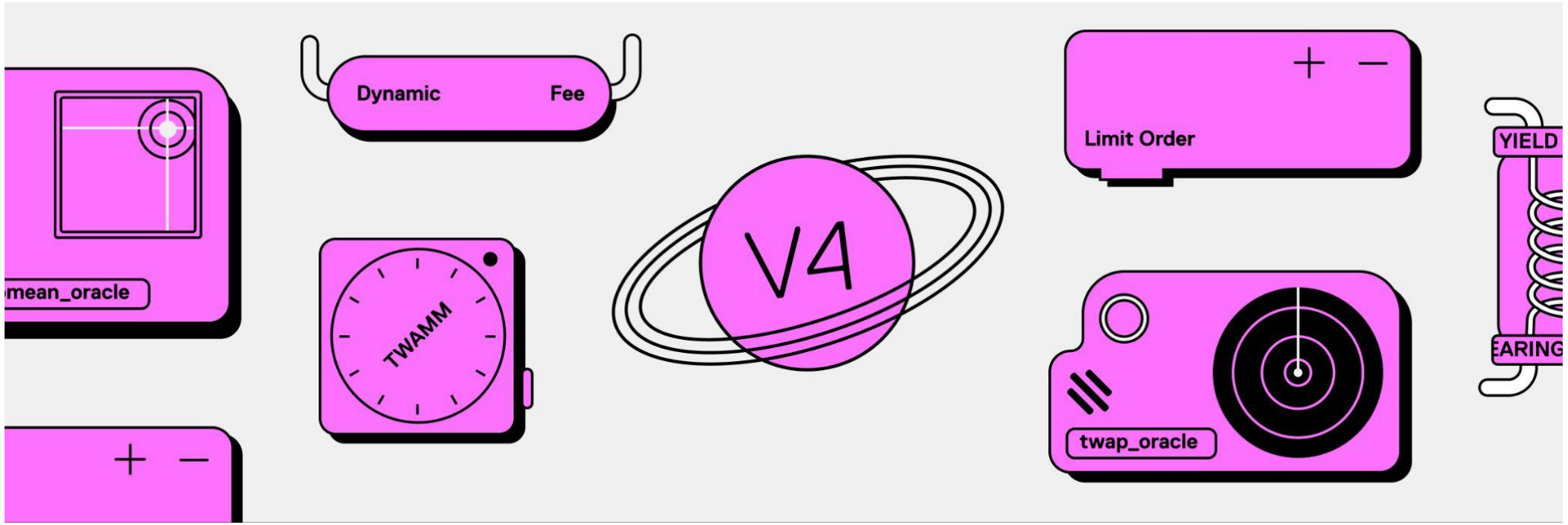
19 46 373

# Unisocks on Uniswap v3



# Licensing

- Uniswap v1 is licensed under GPL 3.0
- Uniswap v2 is licensed under GPL 3.0
  - Sushiswap copies Uniswap in 2020
  - Sushiswap mounts a “vampire” attack
- Uniswap v3 is licensed under Business Source License
  - Aims to prevent future clones
  - BSC copies Uniswap anyway


Dynamic Fee
mean_oracle
TWAMM
V4
Limit Order
twap_oracle
YIELD
EARING