Partial Liquidation Zap: Evaluation and Results

The Partial Liquidation Zap is designed to autonomously enhance the health of on-chain lending positions by leveraging arbitrage incentives. Rather than liquidating an entire position, the zap mechanism targets small fractions (*frac*) of unhealthy positions and applies a strategic debt-to-collateral swap to boost resilience.

A central component of this mechanism is the **ratio**, defined as the value of collateral received per unit of repaid debt. Experimental results show that when the position's health is near **1%**, the ratio remains remarkably stable around **1.074**. This consistency enables the system to operate efficiently without requiring dynamic tuning of the input parameters. The expected value from the liquidator is calculated directly as:

```
expected_from_liquidator = debt × ratio
```

```
ratio = all_get_x_down / all_debt
```

Mechanism Formulas:

```
debt = frac × all_debt
to_repay = debt - xy[0]
received_collateral = xy[1]
surplus = expected_from_liquidator - to_repay

health_after = ((1 - liq_discount) × get_x_down / debt) - 1
```

The collateral received from partial liquidation exceeds the amount needed to repay the debt due to the position having health > 0. The excess value (surplus) is used to reduce the remaining debt of the user, thus increasing the health of the position. This self-reinforcing loop stabilizes the lending market while incentivizing arbitrageurs through profit.

Experimental Results

Across more than 50 positions with health values near 1%, partial liquidations (~5% of the position) led to consistent health improvements. On average, health increased by ~30% (e.g., from 1.0 to 1.3), confirming the viability of the mechanism in live conditions.

User	Initial Health	Final Health	Arbitrageur Profit (% of Position)
0x0477…	0.98	1.00	0.36%
0x1C79…	1.03	1.39	0.33%
0x1CB8…	0.97	1.29	0.16%
0x1d04…	1.04	1.29	0.18%
0x1E26…	0.99	1.38	0.26%

Conclusion

The Partial Liquidation Zap provides a self-correcting, decentralized mechanism for improving position health. By locking in a stable ratio (~1.074), arbitrageurs can confidently engage in partial liquidations that generate surplus. This surplus is used to repay debt and heal the user's position, enabling more efficient and safe DeFi lending markets.