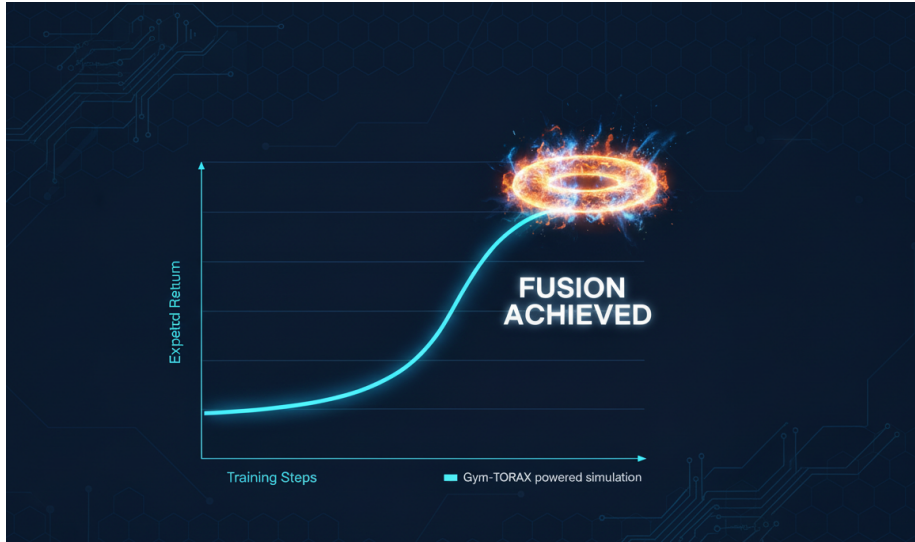# Gym-TORAX: Breaking Fusion Energy "30 Years Away" Curse with Reinforcement Learning

There is a saying in energy research: **fusion power** is always 30 years away. For decades, scientists have inched closer to making it real, but the timeline keeps slipping forward. The reason is not a lack of effort or brilliance, the challenge is that keeping a plasma stable for long periods of time inside a **tokamak**, a donut-shaped magnetic confinement machine which is the most prominent technology to achieve fusion, is one of the **most complex control problems** humanity has ever faced.

We believe this curse does not have to last forever. **Reinforcement Learning** (RL) has mastered complex games, taught robots how to walk, and cars how to drive. Now, it is being applied to fusion research, where it shows great promise for stabilizing plasmas and exploring new control strategies. But until now, a major bottleneck has been the lack of accessible software providing plasma control environments compatible with RL frameworks.

That is where **Gym-TORAX** comes in. Our **open-source Python package** provides a ready-to-use interface between RL algorithms and plasma simulations. With just a few lines of code, researchers can design **Gymnasium**

environments (one of the most popular RL frameworks) simulating plasma control scenarios. These environments are powered under the hood by the open-source **TORAX** plasma simulator. By bridging the gap between RL and plasma control, Gym-TORAX opens the door for both AI experts and physicists to collaborate on cracking one of humanity's biggest scientific challenges.

Fusion may still be years away, but if we can speed up research and spark new ideas through tools like Gym-TORAX, perhaps the old joke will eventually stop being true.

👉 Read the full paper here: https://hdl.handle.net/2268/336745