

## Introduction

Minimized linear-motor type HTS flux pump devices were designed and built. This flux pump is based on linear motor. The newly mini-type flux pump device generates continuous AC travelling wave by nine solenoid copper coils under a DC-biased field. In this study, we first performed the electromagnetic design of the mini linear-motor flux pump with the COMSOL Multiphysics, the numerical results agree with experimental measurements. And we discuss the effect of magnetic field on pumping current and compare with different wavelengths at the same magnetic field. The maximum of pumping current will be larger when the wavelength is smaller, in which the maximum of pumping current is 55 A.

## Experiment Configuration

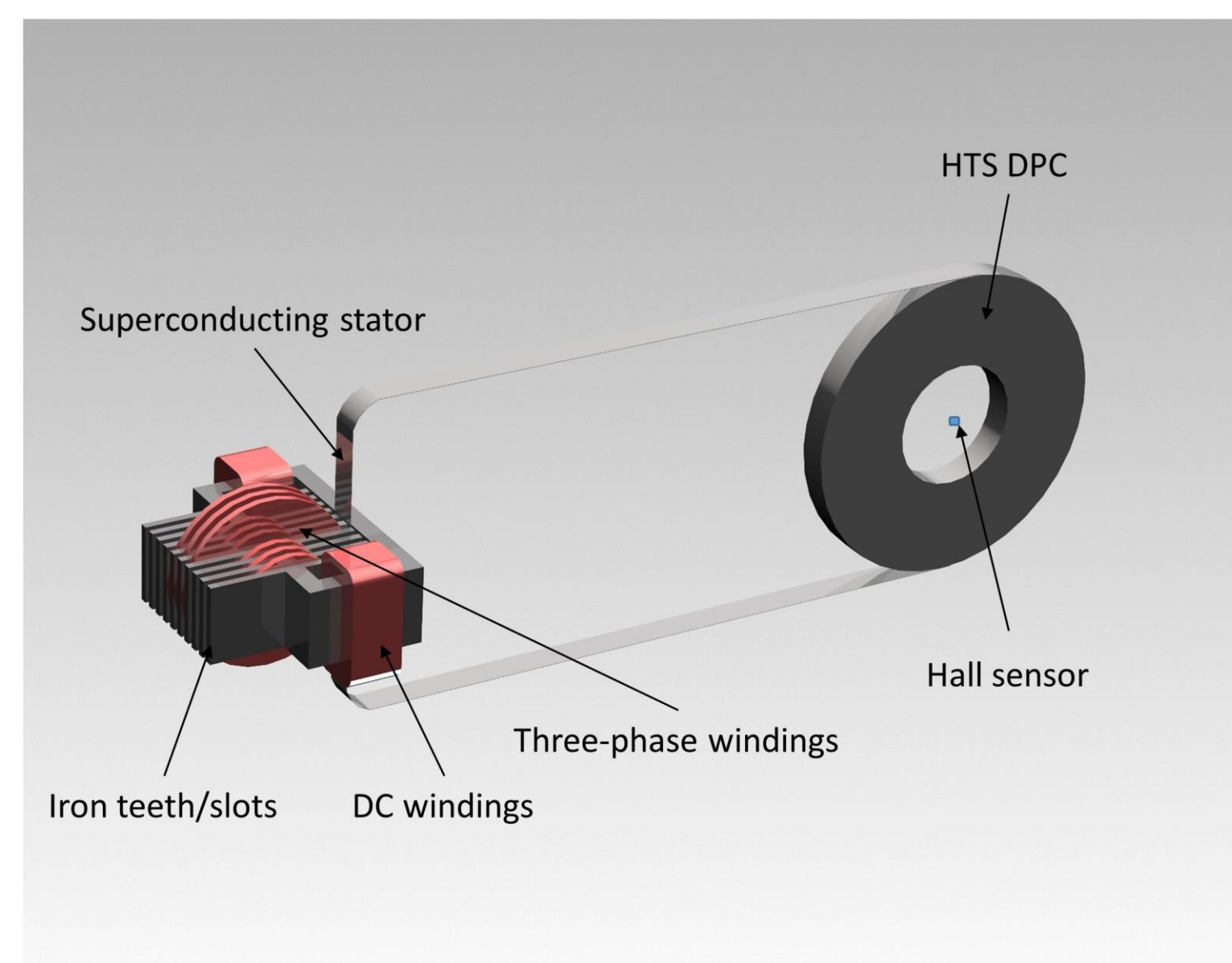


Fig. 1. A schematic view of the newly mini-type HTS flux pump device.



Fig. 2. The experimental setup of the newly mini-type HTS flux pump device.

The system comprises of three parts: mini-type HTS flux pump, superconducting stator, second-generation (2G) HTS double pancake coil (DPC). The newly mini-type HTS flux pump is 106.5 mm in length, 74 mm in highness and 30 mm in thickness.

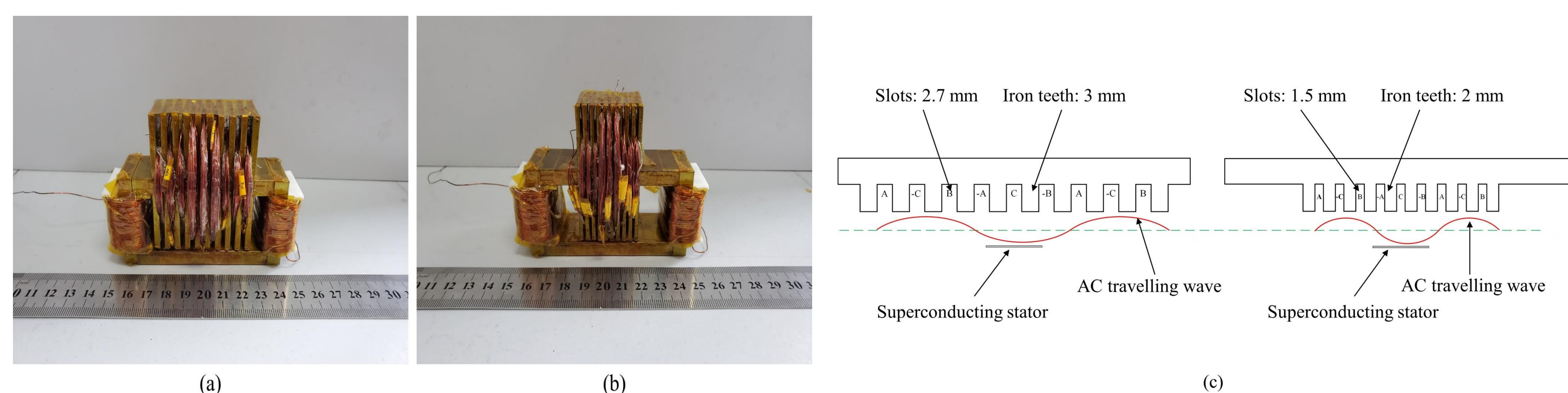


Fig. 3. (a) is the wavelength of 34.2 mm, (b) is the wavelength of 21 mm, (c) is comparison of wavelength.

The wavelength is changed by the width of iron teeth and slots. The wavelengths of 34.2 mm and 21 mm are used.

## Simulation and Experiment results

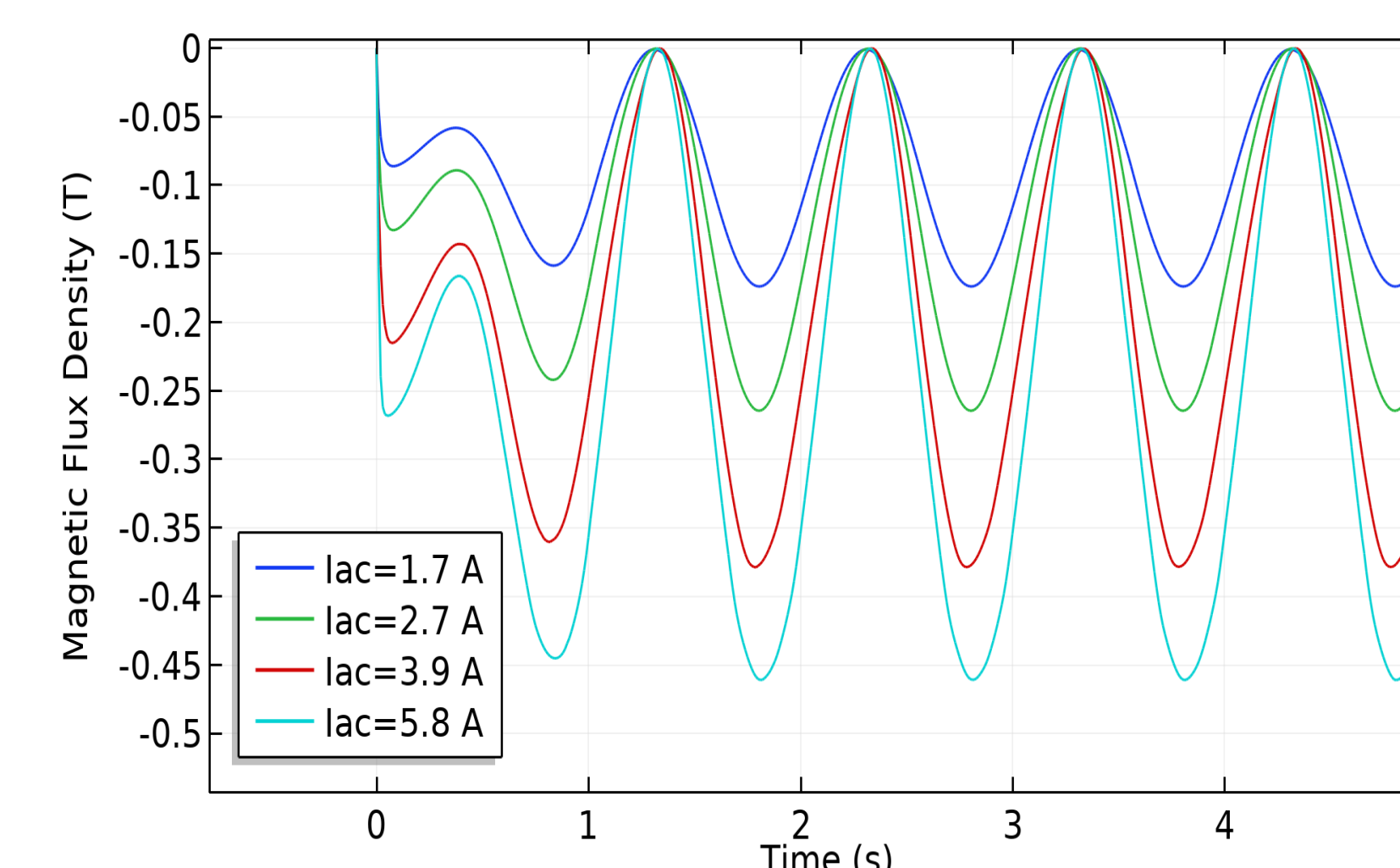


Fig. 4. The calculated magnetic flux density at the center point of the superconducting stator by COMSOL 5.4.

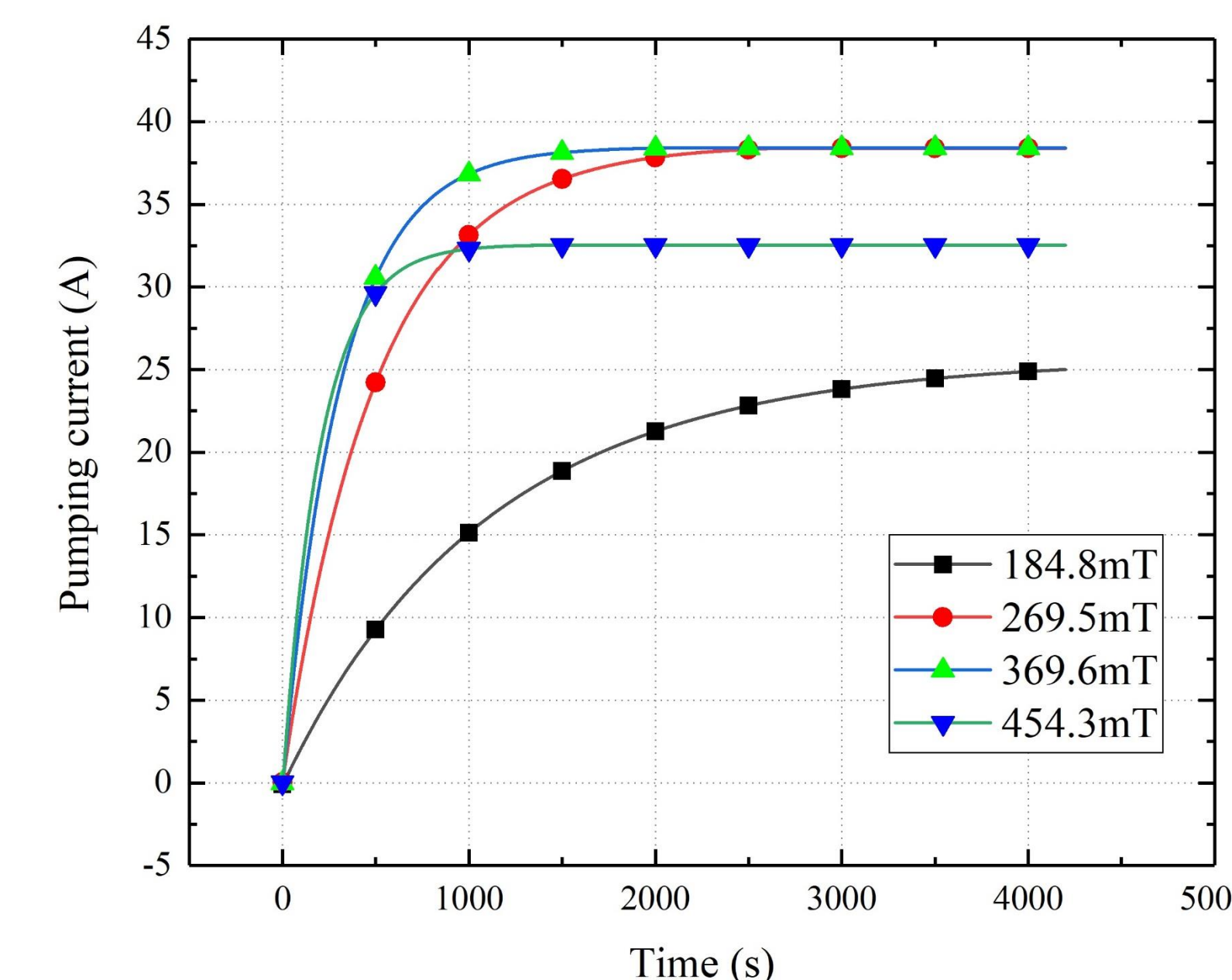


Fig. 6. Comparison of different magnetic fields perpendicularly to the superconducting stator at the same wavelength of 34.2 mm.

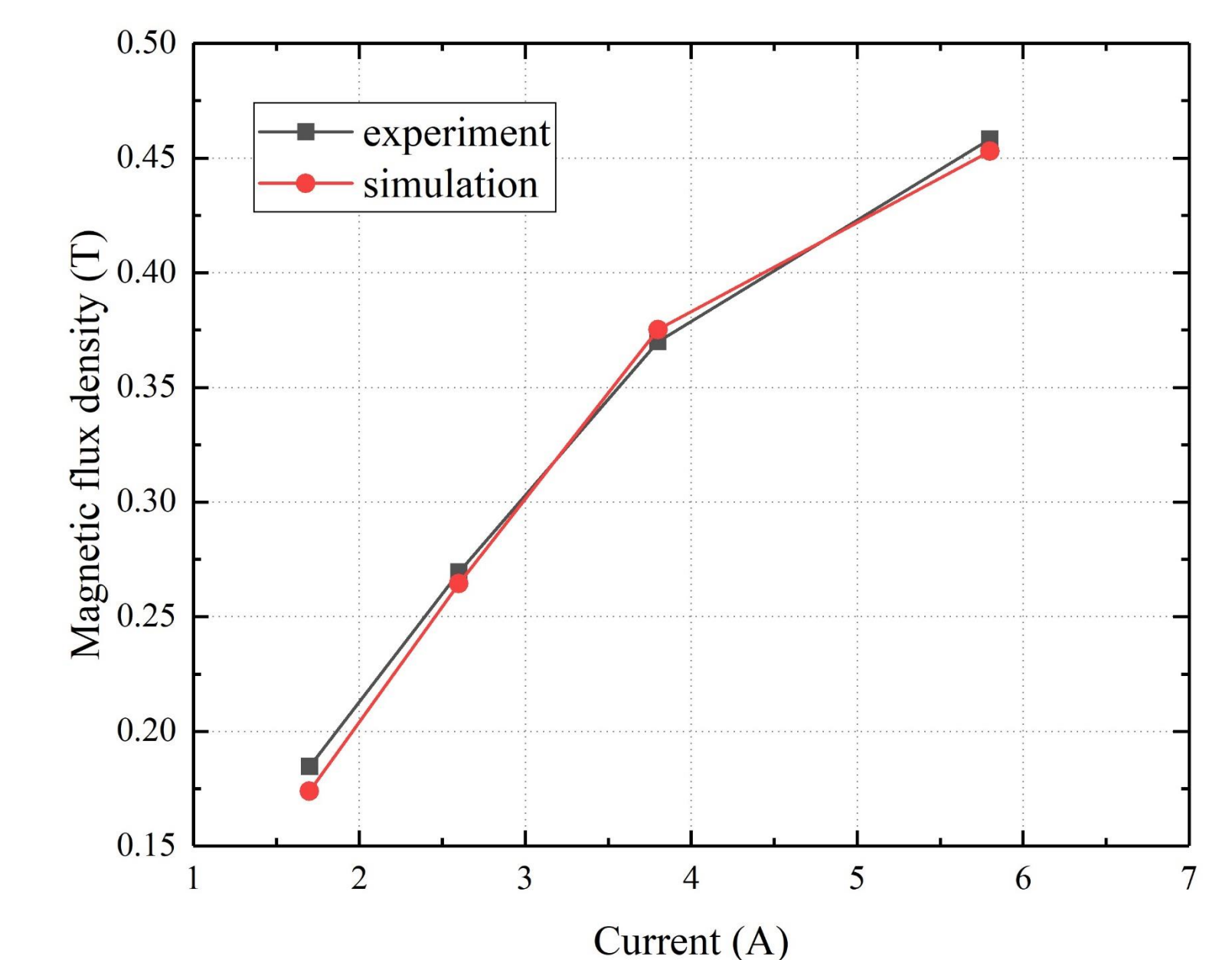


Fig. 5. Comparison between experimental results and simulation at the center point of the superconducting stator.

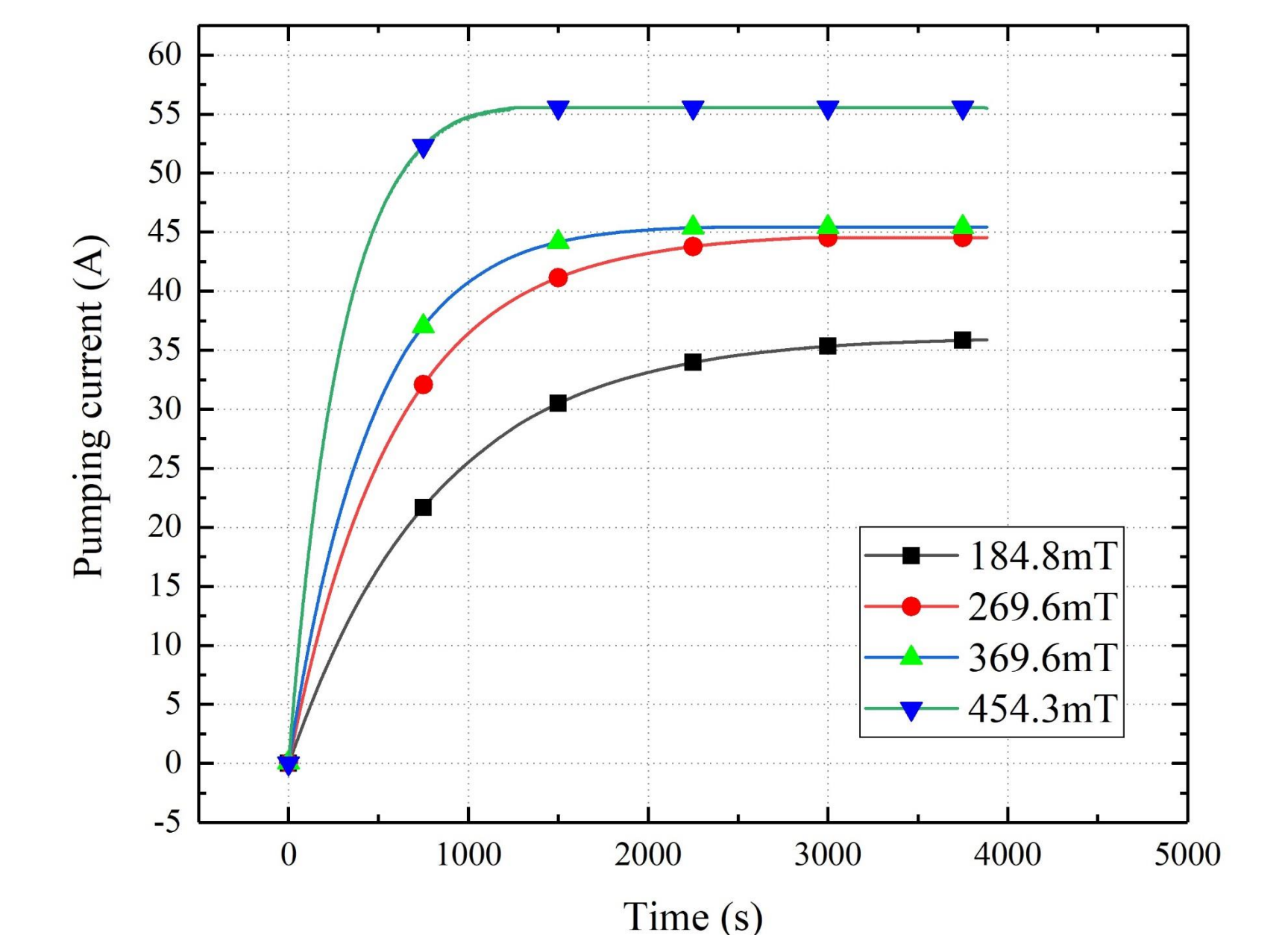


Fig. 7. The wavelength of 21 mm, the pumping current at the same magnetic field.

Analytical results of applied magnetic field on superconducting stator by the COMSOL 5.4 are proved to nearly agree with experimental ones. The maximum of pumping current reach 55 A.

## Conclusion

A newly mini-type flux pump device based on linear motor was built to compensate current decayed by flux creep and joints resistance in the superconducting closed loop. The maximum of pumping current is 55 A. The initial pumping current rate can reach 0.1393 A/s.