



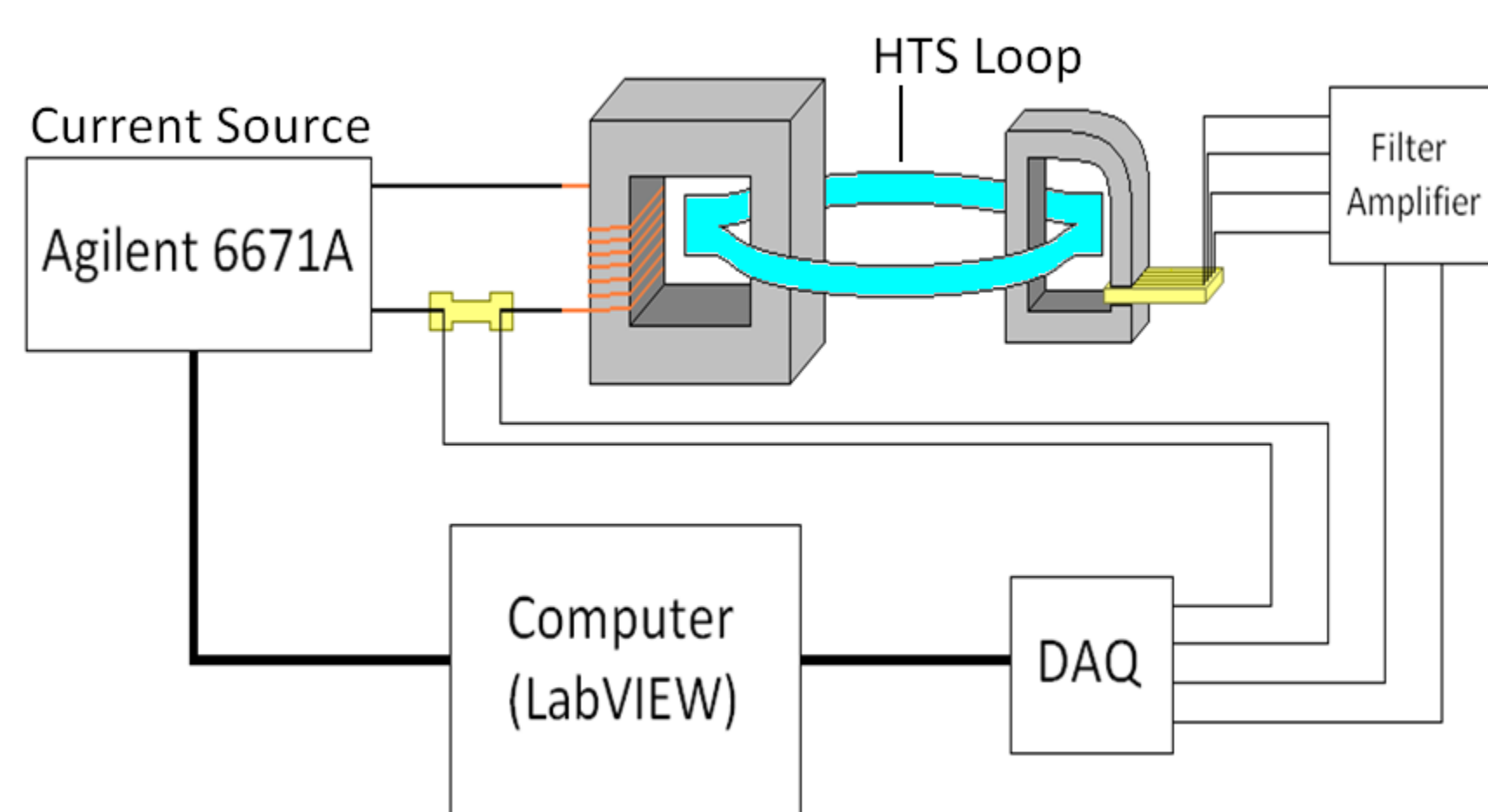
Pulse Magnetization of Jointless Superconducting Loops for Magnetic Bearings Height Control

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ABSTRACT

Superconducting materials have the property of expelling magnetic flux from their interior, giving rise to reaction forces that allow their use for applications such as magnetic levitation. The Maglev Cobra project, developed at the Federal University of Rio de Janeiro uses superconducting bulks to promote its levitation. However, these bulks have the disadvantage of being produced in a partially industrial process, which does not guarantee homogeneity for large scale production. In addition, since these bulks operate passively, levitation height control is not possible. Concerning superconductor magnetic bearings, recent research has demonstrated the technical feasibility of replacing these blocks with superconducting tapes, whose production is carried out on a large scale with homogeneity. The current pulse magnetization of jointless superconducting loops, which are made out of partially slit tapes, allows active control of the levitation height. This compensates the heights decay and eventual load changes and avoids long interruptions in operation due to a new field cooling process. In this work, the superconducting loops were exposed to different values of current pulse width and intensity, by means of a transformer. The induced current in the tape was then measured. With this, the behavior of the persistent current in the superconductor could be observed. Preliminary results show a correlation between the persistent current and the applied current pulse width and intensity. As expected, saturation of the current in the superconductor was observed above certain values of applied current, due to the critical current value of the superconducting tape. Furthermore, it has been found that as the width of the current pulse increases, the persistent current increment decreases. According to these results, an optimum point can be observed, in which the ratio between the persistent current and the energy used is maximized. In order to operate at the optimum point, the current pulse width must decrease as its intensity increases.

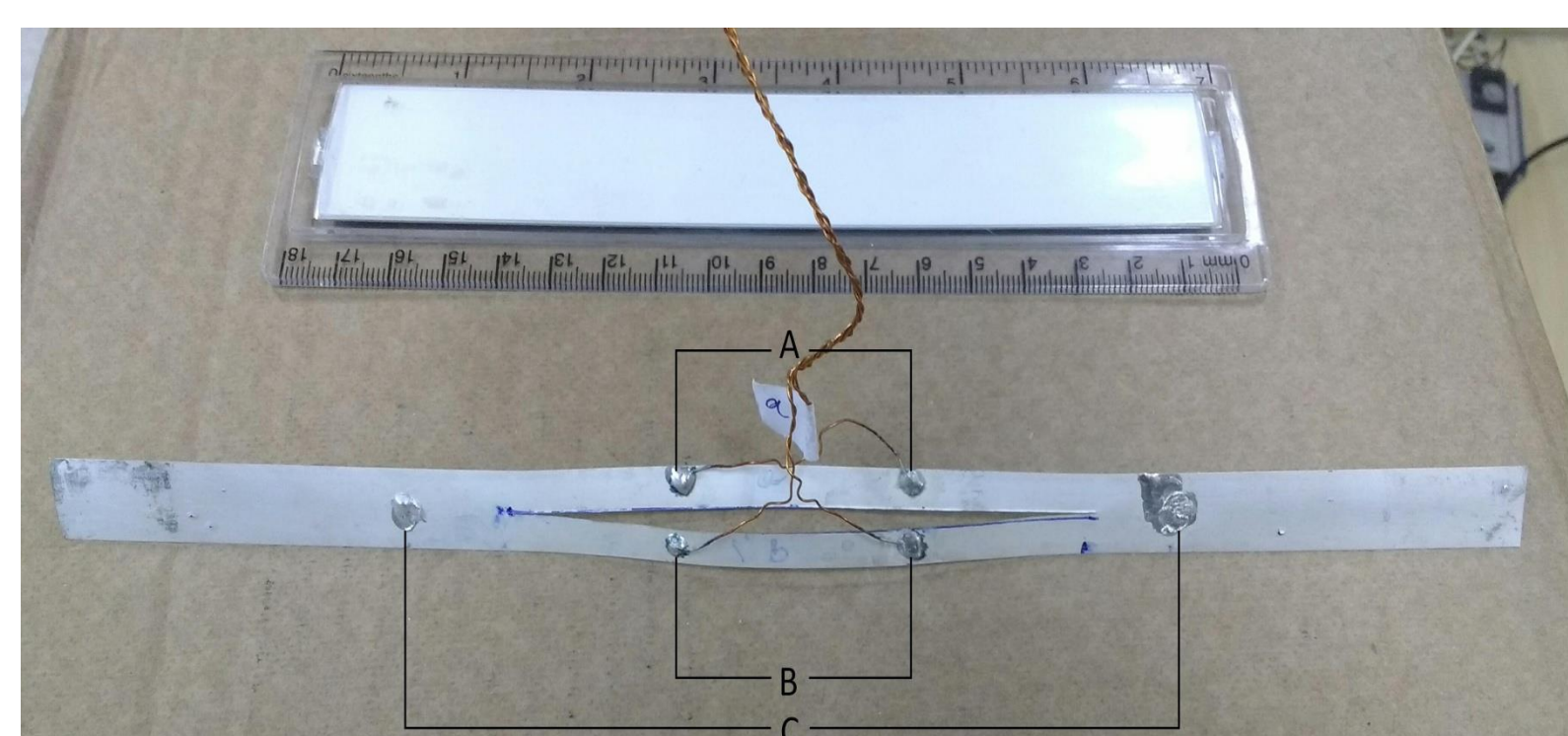
Methodology



- Fed with transformer;
- Measured by Hall sensor;
- Colled with LN_2
- Pulses varying:
 - Width;
 - Quantity;
 - Interval;
 - Intensity.

SUPERPOWER SF12050 2G WIRE:

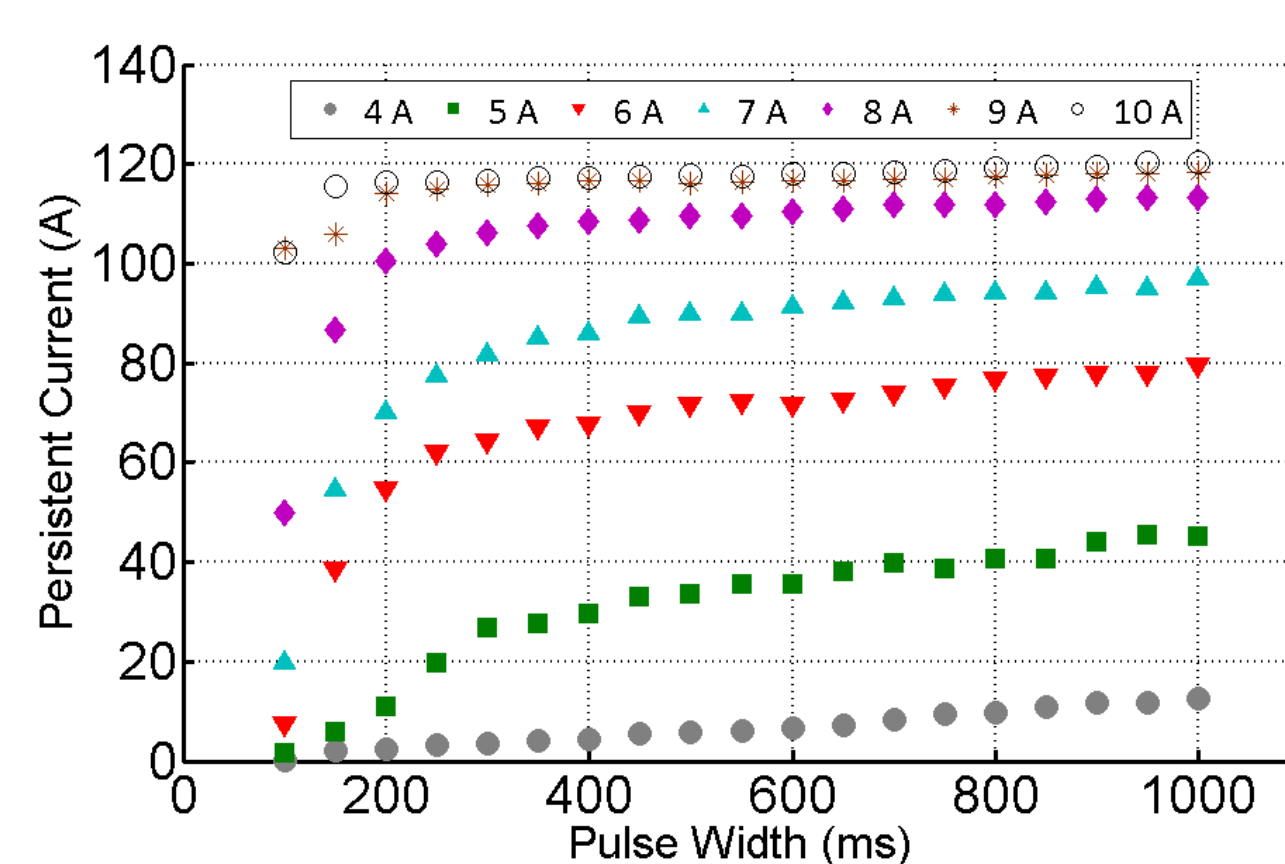
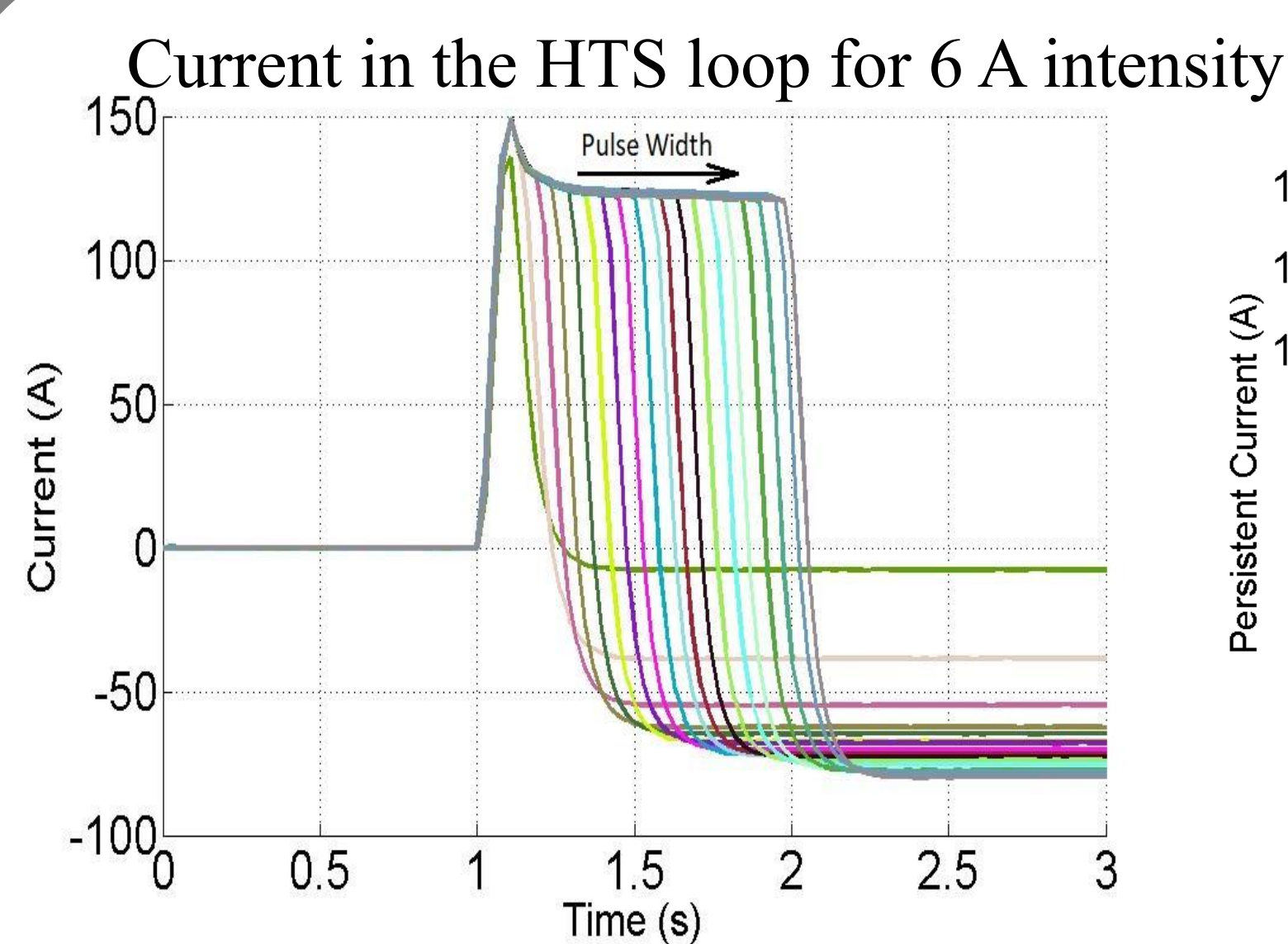
- 100 mm long cut at center;
- Shaped as a loop;
- Critical Current < 129 A.



Critical Current (A)

Terminal C before Cut	329
Terminal C after Cut	275
Terminal A	290
Terminal B	258

Results – Single Pulse – Pulse Width

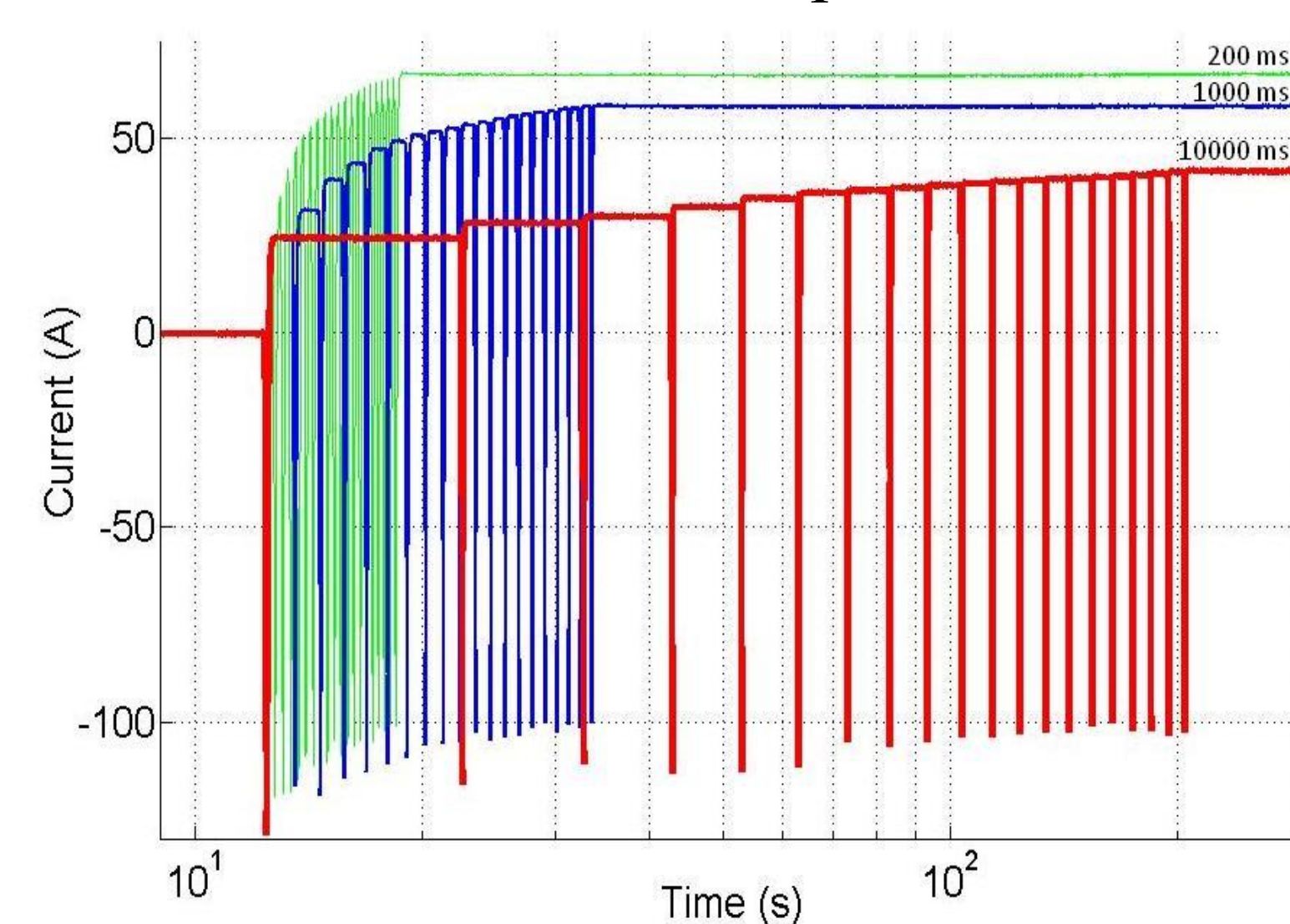


- Pulse Intensity: 4 to 10 A;
- Pulse Width: 100 to 1000 ms

- Tendency to saturation:
 - Intensity and Width.
- Optimum Point (Energy):
 - 5 A < I < 8 A and
 - Width < 300 ms.

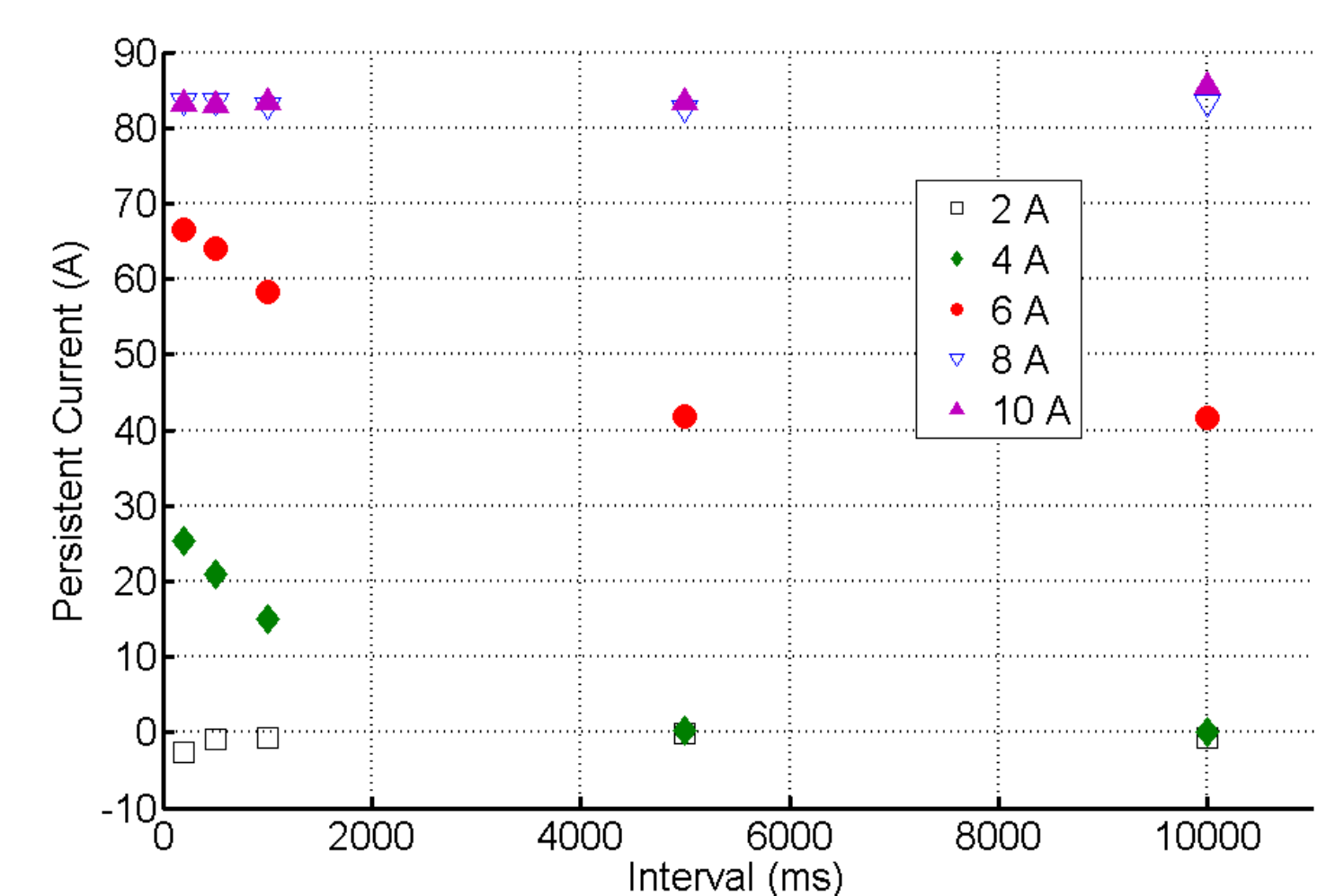
Results – Multiple Pulse - Pulse Interval

Current in the HTS loop for 6 A intensity

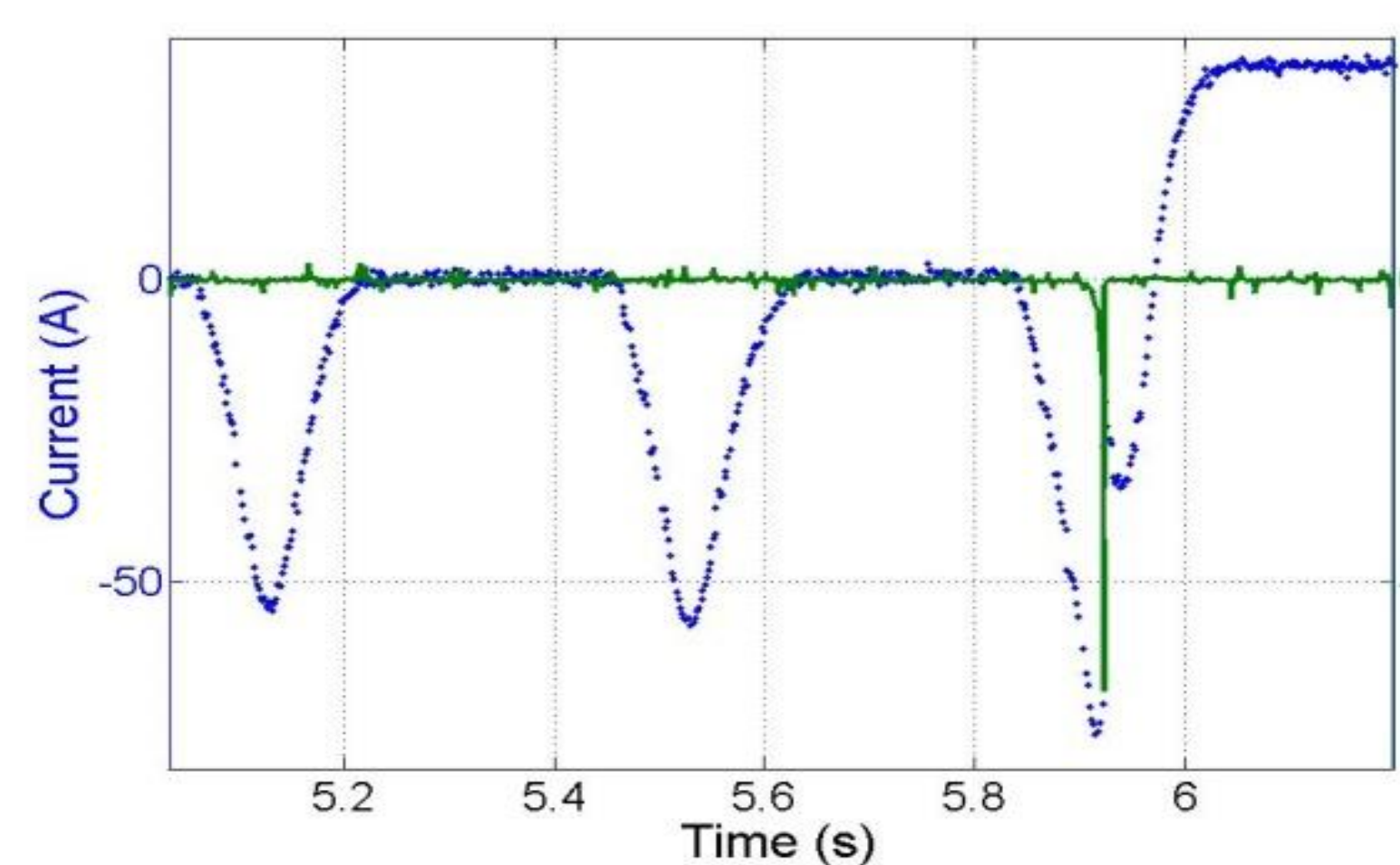


- Pulse Intensity: 2,4,6,8 and 10 A
- Pulse Interval : 200, 500, 1000, 5000, 10000 ms
- 20 pulses and duration of 200 ms each

- The values of persistent current grow as the interval lessens, even if the energy consumption remains the same.
- Saturation due to intensity



Results - Electric Field Behavior



- Persistent current after large voltage peak and sharp current variation;
- Brief transition and resistance increase.

Conclusions

In this work the influence of different parameters was investigated in pulse magnetization of jointless superconducting loops. Different experiments were performed, in which pulse intensity, length, interval and quantity were varied. From the obtained results, it was possible to conclude that there is a operational range in which the process is more efficient. Indeed, the parameters variation have great effect on the persistent current in the superconducting loop, even when the energy input was the same. It was possible to conclude that larger values of interval between pulses, pulse length and number of pulses increasingly diminished the efficiency of the process, while the advantageous range of pulse intensity values has not only a lower limit but also an upper one. Since this was the lowest reachable value with the equipment used, the development of a new system for investigating pulse influence with less than 100 ms length in the persistent current has begun.

Acknowledgments

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