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MAGNETIC RESONANCE
Discussions

Interactive comment on "Highly Stable Magic Angle Spinning Spherical Rotors Lacking Turbine Grooves" *by* Thomas M. Osborn Popp et al.

Anonymous Referee #1

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General Comments:

The authors discuss eight different turbine groove designs for spherical magic angle spinning rotors. They find that deep turbine grooves do not allow stable spinning, and that some shallow groove designs allow modest increases in spinning speed compared to a groove-free surface. The stability of these spherical ring rotors is discussed in terms of the rotor's principle moments of inertia, and compared to the situation for more conventional cylindrical MAS rotors.

The paper reports progress on the optimization of the very novel magic angle spinning rotor system design that has come out of this laboratory in recent years, and gives a theoretical basis for why the stability of this design is so robust.

The results reported here represent a necessary step in the evolution and optimization of this new spinning system design. While the community of researchers who build their own magic angle spinning systems is rather small, and those who spin with spherical rotors is smaller still, this work represents what I hope will be one of many modest forward steps that will eventually make spherical rotors a compelling alternative to conventional designs.

The paper is logically organized and easy to follow.

Specific comments:

The title seems inappropriate for the work described. While I understand that the fact that grooveless rotors perform nearly as well as the best grooved design is one of the significant results, the title ignores most of the experiments described.

In considering moments of inertia, the authors consider empty rotors: spherical rings or cylindrical shells. But some conventional cylindrical rotor designs do not spin well empty - the sample matters. The addition of the sample is considered only cursorily at the end of the manuscript. Presumably if the sample density is much less than the density of the rotor itself things aren't changed much by the sample, but maybe something more could be said?

The discussion of the stability of rotation is somewhat unsatisfying. There is a commonly known theorem about rotation that for objects with three distinct moments of inertia, rotations about the axes having the largest and smallest moments are stable, while rotation about the intermediate axis is not (tennis rackets are a prototypical example). That theorem would suggest that cylinders rotating about their long axes should be stable, as long as both energy and angular momentum are conserved. The situation with both spherical rings and cylinders might be a little different because of the cylindrical symmetry, where there is no intermediate axis. I'd like to see a bit deeper discussion of the stability criteria. While this represents old physics, it would be nice to see a sound discussion in the context of magic angle spinning systems.

I wonder if the statement on line 108, that rotation about any axis is stable if there is no energy dissipation, is actually helpful in understanding stability issues?

Minor issues:

pg 2 line 46. What is meant by 4.7 M-ohm transimpedance amplifier? Does that mean a 4.7 M-ohm resistor in series with the photodiode?

line 51 reference should be parenthesized.

line 162, 175 and others: links to cited doi's appear twice in a number of the references.

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