

## Response to Robert Tycko (Editor)

Reviewer comments are in black, responses are in blue

This manuscript is potentially suitable for publication in Magnetic Resonance after the authors make revisions that fully address the comments of the two anonymous reviewers as well as the following points:

1. The "tennis racquet theorem" says that any object in free space will rotate stably about axes close to its smallest and largest principal axes of inertia, but not stably around the middle axis of inertia. This is also mentioned by one of the anonymous reviewers. The authors should explain how this relates to their statement that "an object is capable of spinning stably about ANY axis ... as long as there are no avenues to dissipate rotational energy." The authors' statement seems erroneous, except perhaps because they are discussing situations where the object is not in free space. Their later statement that "a high aspect ratio cylindrical MAS rotor requires active stabilization...in order to spin stably about its axis of symmetry" also appears to contradict the tennis racquet theorem.

This statement was in error. This was meant to say "an axially-symmetric object is capable of spinning stably about any axis," but it turns out that this statement is also erroneous. We have removed this statement and instead included in the manuscript a discussion with respect to the conditions of stability associated with axially symmetric objects. Using Euler's equations, one can show that a rigid, axially-symmetric object spins stably about its axis of symmetry regardless of whether the moment of inertia about that axis is the greatest or smallest moment. However, due to energy dissipation phenomena, objects tend to prefer to rotate about the axis with the highest moment of inertia.

2. The examples of satellites and asteroids may not be relevant to an MAS rotor. I suspect the behavior of satellites and asteroids may be affected by INTERNAL dissipation (movement of internal material), which is not an issue for an MAS rotor. This may need clarification.

Avenues to dissipate energy in the vacuum of space must necessarily concern internal dissipation, as there is no surrounding medium to which the rotational energy can be dissipated. However, in the MAS stator, the surrounding gas dissipates rotational energy. The operating principle of pneumatic MAS depends on energy transfer between the gas and the rotor. We have clarified this point in our discussion.

3. A potential problem with spherical rotors may be that the magic angle needs to be readjusted for each sample, in other words the final direction of the axis of rotation may depend on the mass distribution within the rotor or on imperfections in the rotor itself. Is this true? The authors should comment on this issue, one way or the other.

Once adjusted to the proper angle for one rotor, a second rotor will spin at an angle very close to the magic angle, but not exactly. This is definitely a current challenge with the method, and something we are currently working on addressing. For now, it is recommended that all samples include some KBr to readjust the angle as needed, but we plan to solve this issue in an upcoming manuscript.

4. The description that "the nozzle aperture is placed at the complement of the magic angle in order to tilt the spinning axis of the rotor to a value near the magic angle" needs further clarification. A more detailed drawing of the stator in Figure 1 might help.

Figure 1 has been updated to show a cross section of the stator from another angle. We hope this addresses the concern.