

Reversals of acoustic radiation force and torque in a single Bessel beam:

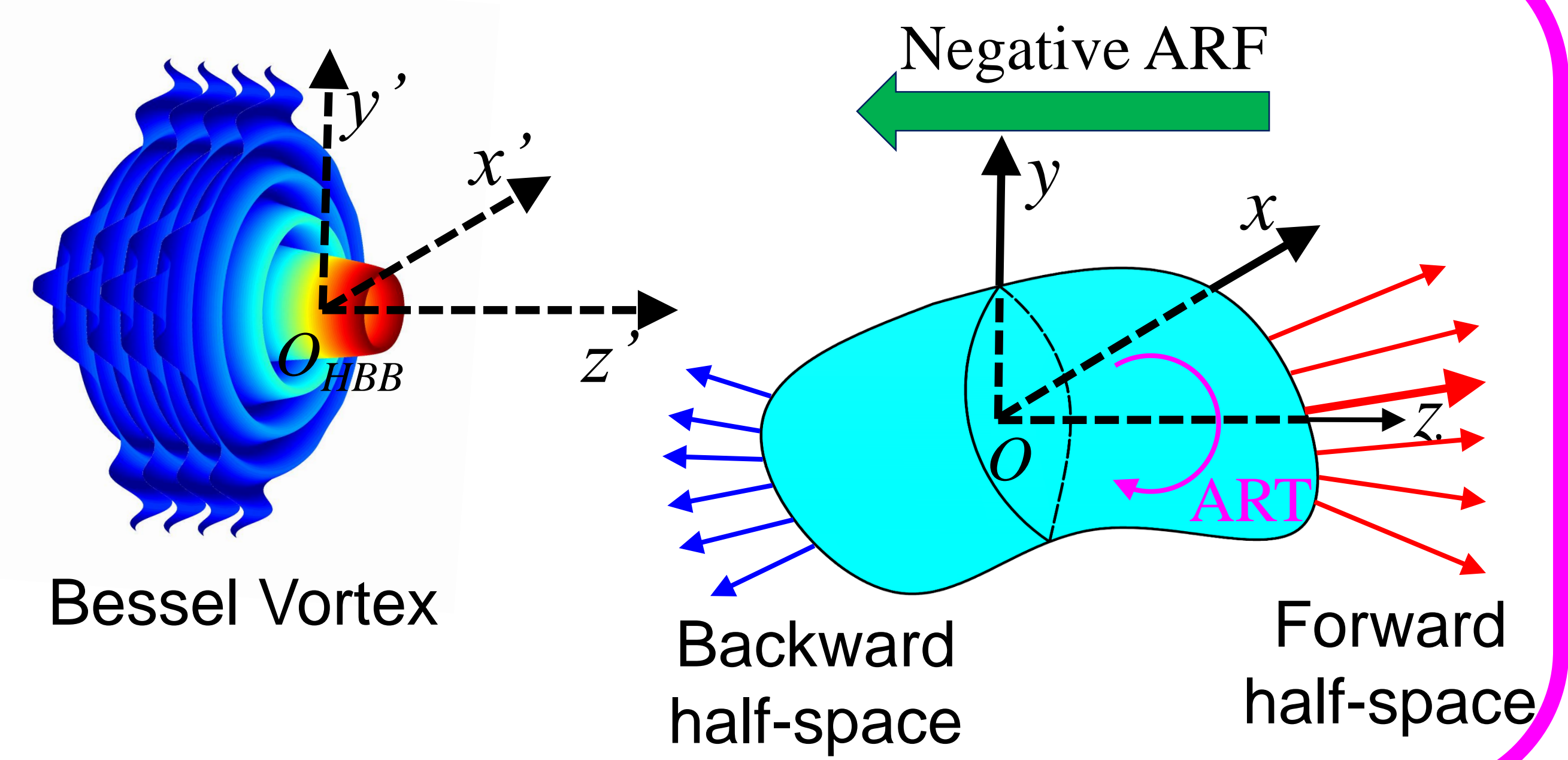
Acoustic Tweezers Numerical Toolbox

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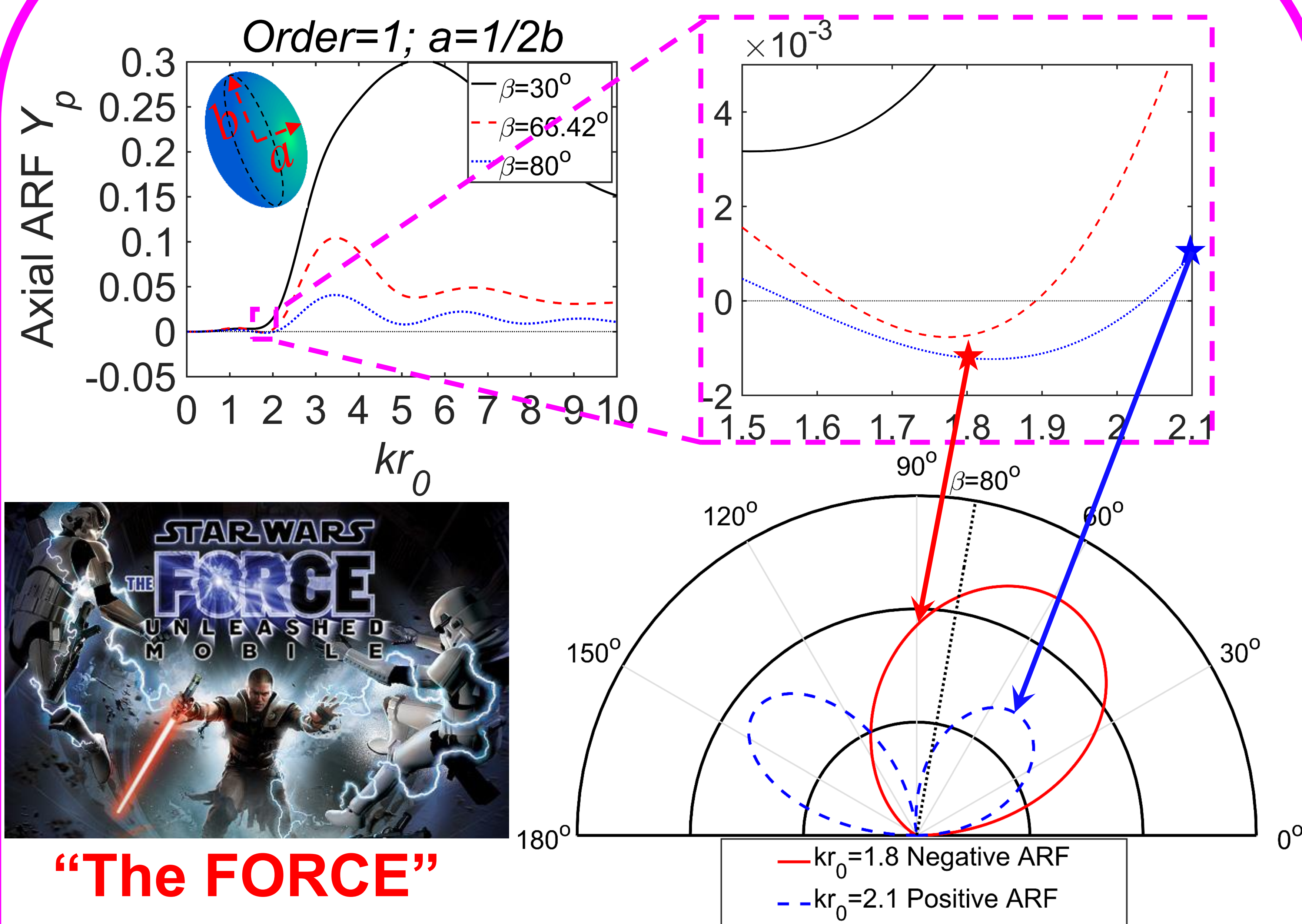


Introduction

- Acoustic tweezers is an alternative to optical tweezers;
- 3D acoustic radiation forces (ARFs) and torques (ARTs) are important for particle manipulations (Six degrees of freedom);
- 2D Standing Surface Acoustic Waves techniques are well developed, which may be, however, limited for 3D manipulations;
- Existed studies on 3D Single-beam acoustic Tweezers are mainly for simple objects and conditions.



Results: ARF Reversal-Rigid Spheroid



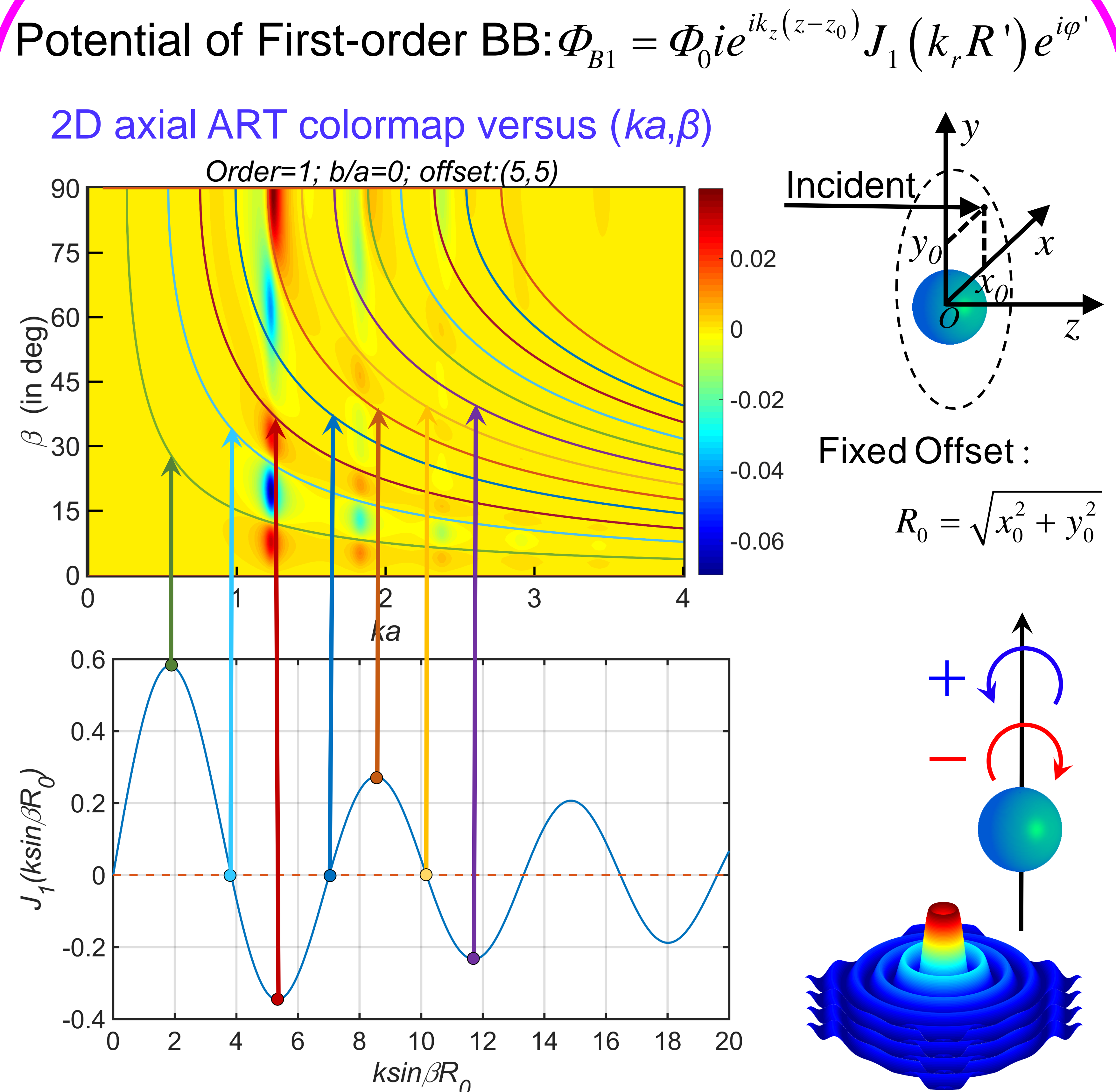
"The FORCE"

$$F_z = P_{sca} c^{-1} \cos \beta - P_{sca} c^{-1} \langle \cos \theta_s \rangle$$

(+) (+ / -)

- Plane wave: Axial ARF $F_z \geq 0 \rightarrow$ NO reversal;
- Bessel beam: Forward scattering dominates \rightarrow The second-term negative force is relatively larger than the first-term positive force.

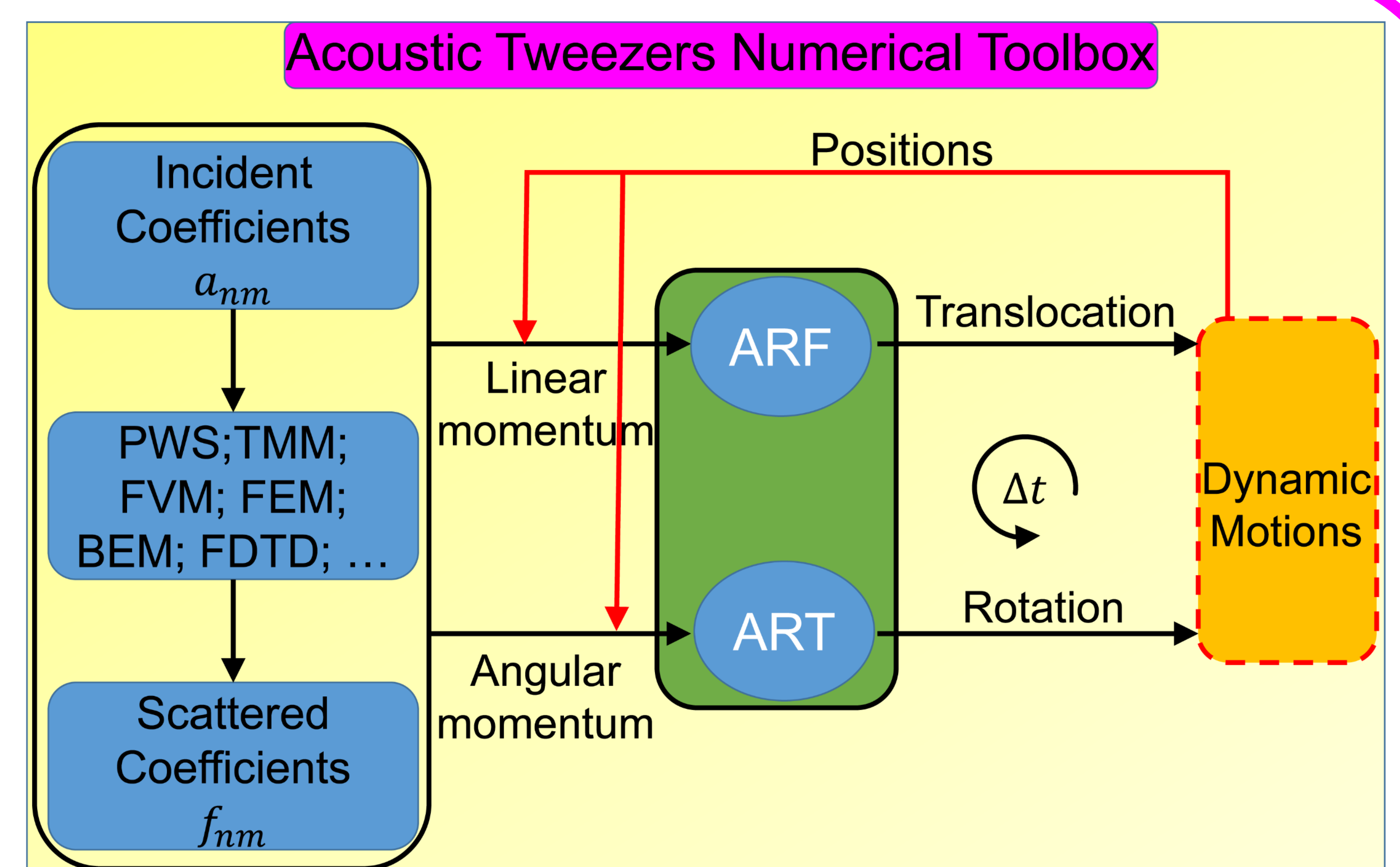
Results: ART Reversal-VE Sphere



Parameter conditions for axial ART reversal:
Dimensionless frequency ka and cone angle β are selected to make $J_1(k \sin \beta R_0)$ the peak or zero values.

Conclusions & Perspectives

- Physical phenomena and mechanisms Of the reversals of ARF and ART from different shapes are observed and discussed;
- Using both theoretical and numerical methods to investigate six degrees-of-freedom manipulations;
- Develop 3D Acoustic Tweezers Numerical Toolbox (ATNT) software packages.



Potential schematic of ATNT

References & Acknowledgement

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