# Distributed Coupling Linac for Efficient Acceleration of High Charge Electron Bunches

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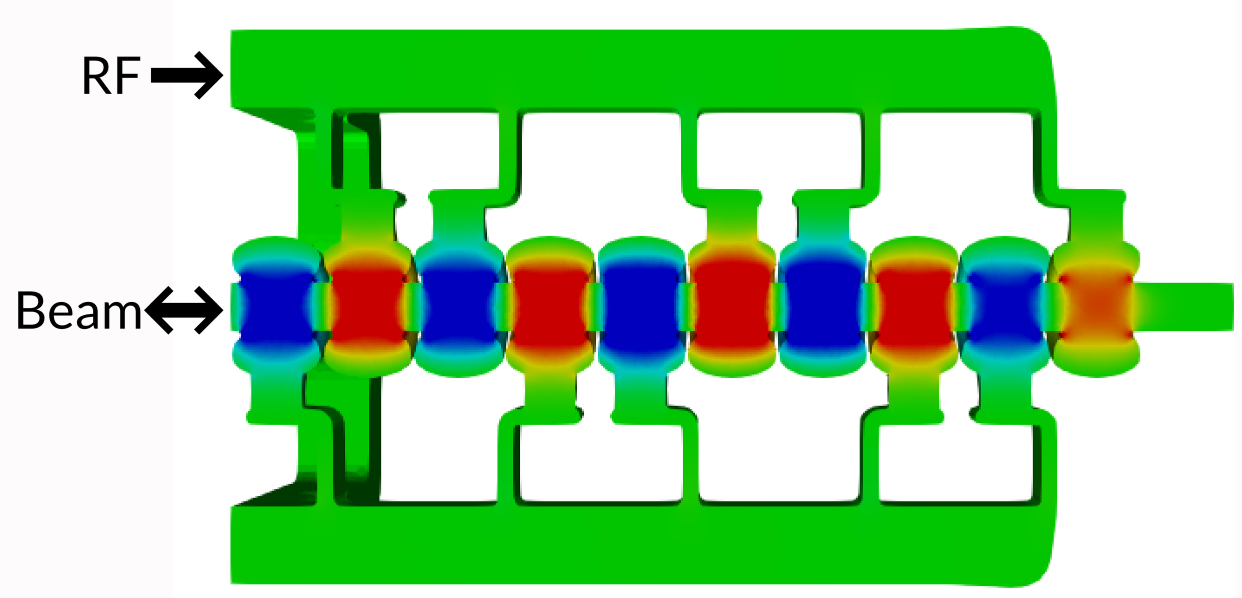
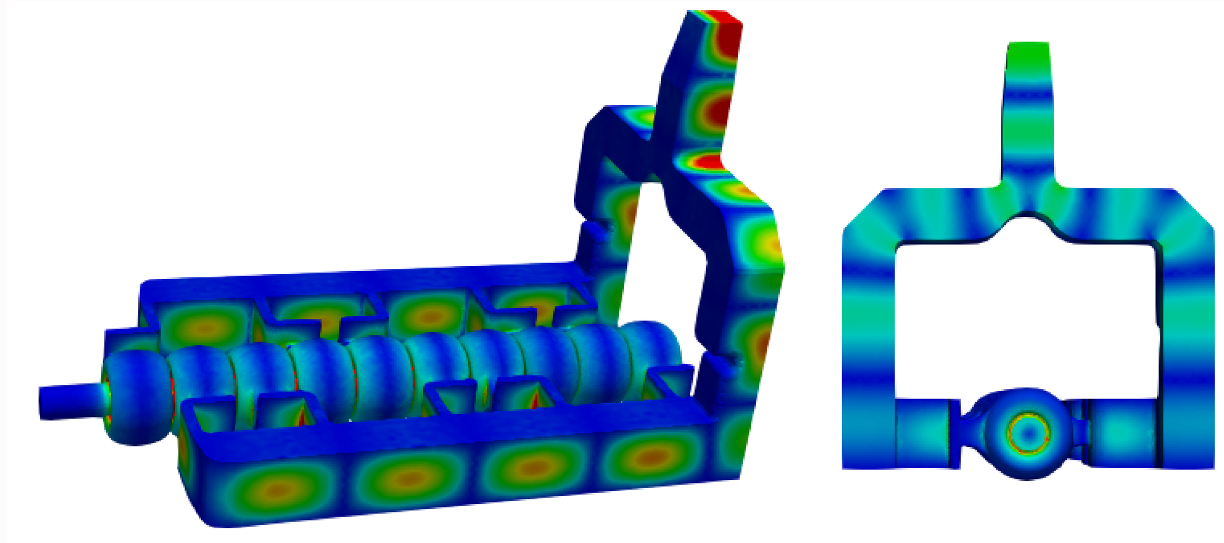
**Motivation** Future colliders will require injector linacs to accelerate large electron bunches over a wide range of energies [1]. We propose the use of distributed coupling designs as an efficient means of achieving high gradient acceleration.

## Distributed Coupling



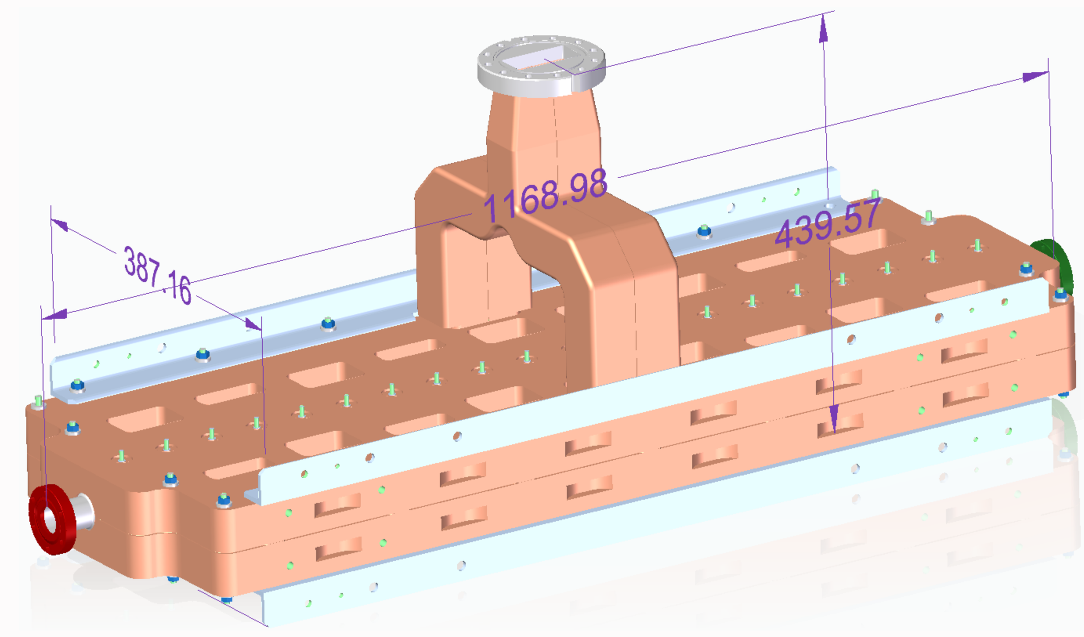

Distributed coupling uses unique waveguide and coupler design to power each cavity individually [2].

## Electromagnetic Simulation



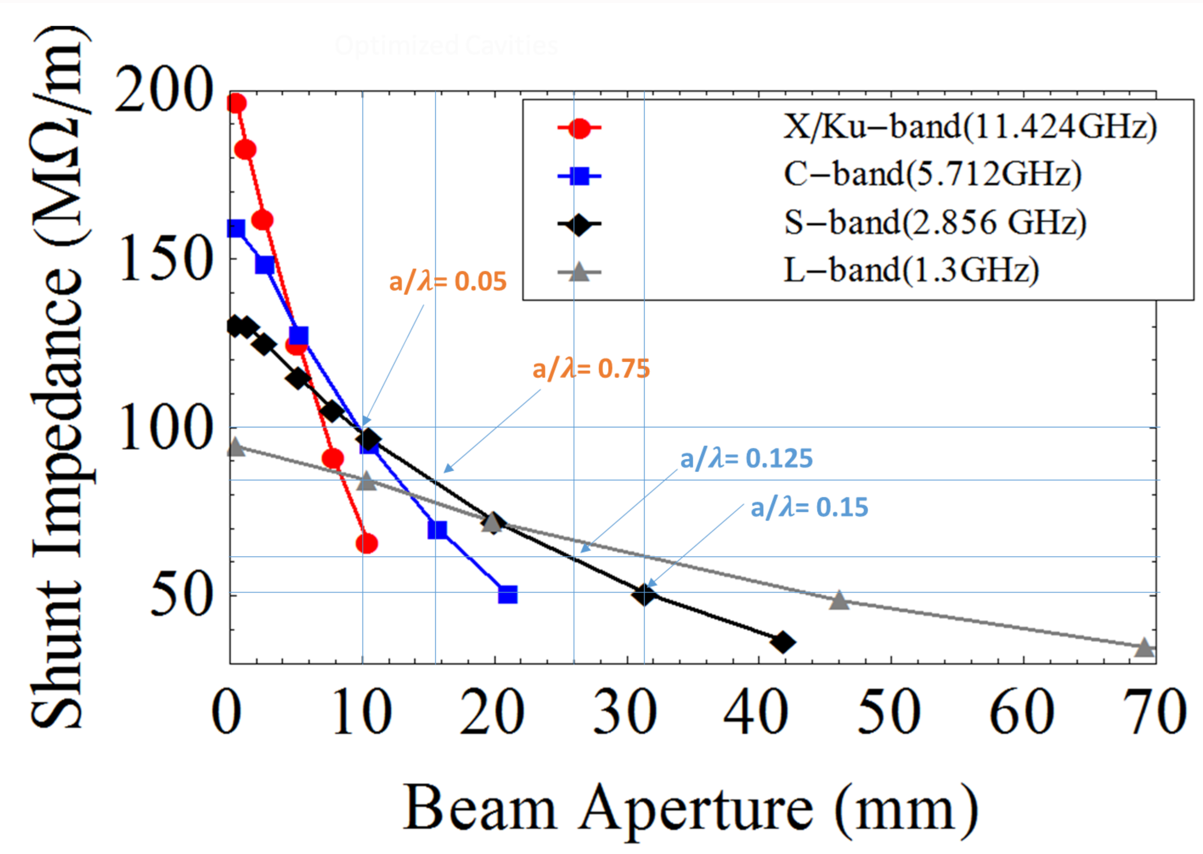
Simulations in HFSS and ACE3P verify the distributed power, with a π phase shift between successive cavities [3].

## Mechanical Design

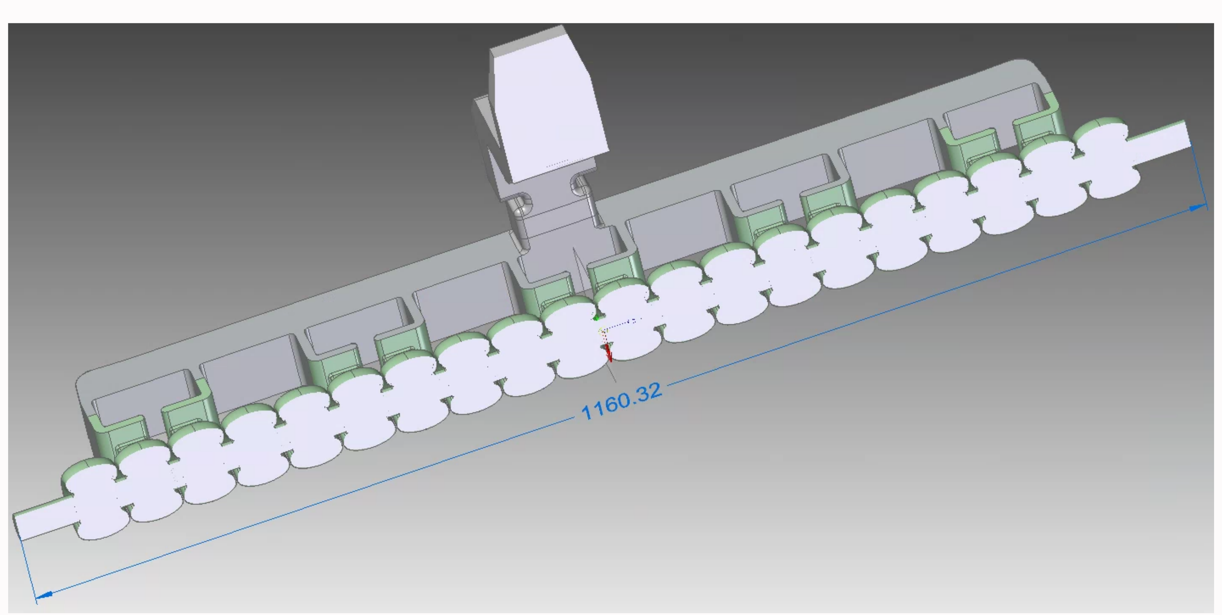



Current design uses two slabs to form the vacuum region in a meter-long structure, with a Y-coupler to distribute power.

## Linac Design




S-band cavities with a reentrant cell design feature a good balance of aperture radius and shunt impedance.



Linac Properties at 5 MW

| | |
|---|---|
| Frequency | 2.856 GHz |
| Aperture | 14.12 mm |
| a/λ | 0.135 |
| $E_{max}/E_{acc}$ | 2.63 |
| $E_{acc}/Z_0H_{max}$ | 0.995 |

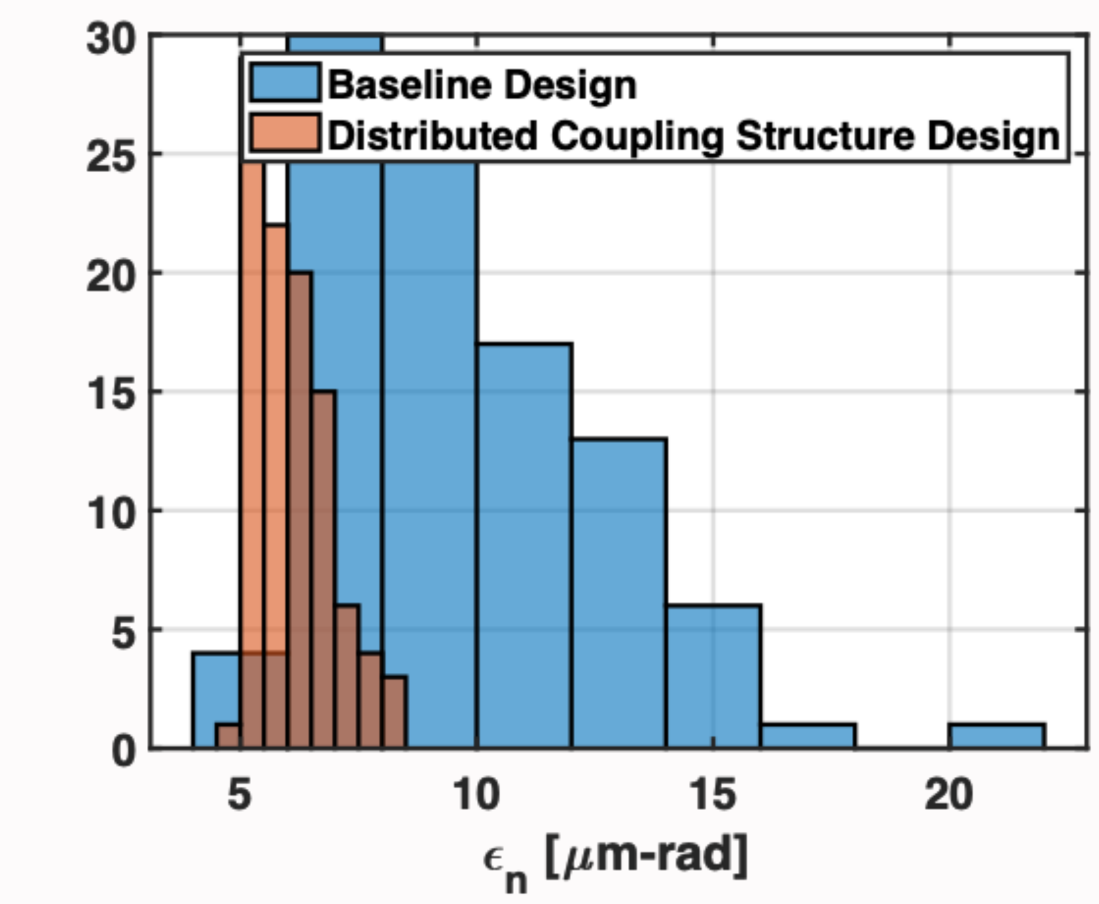
At 300K

| | |
|---|---|
| $R_s$ | 60 MΩ/m |
| $E_{acc}$ | 16 MV/m |

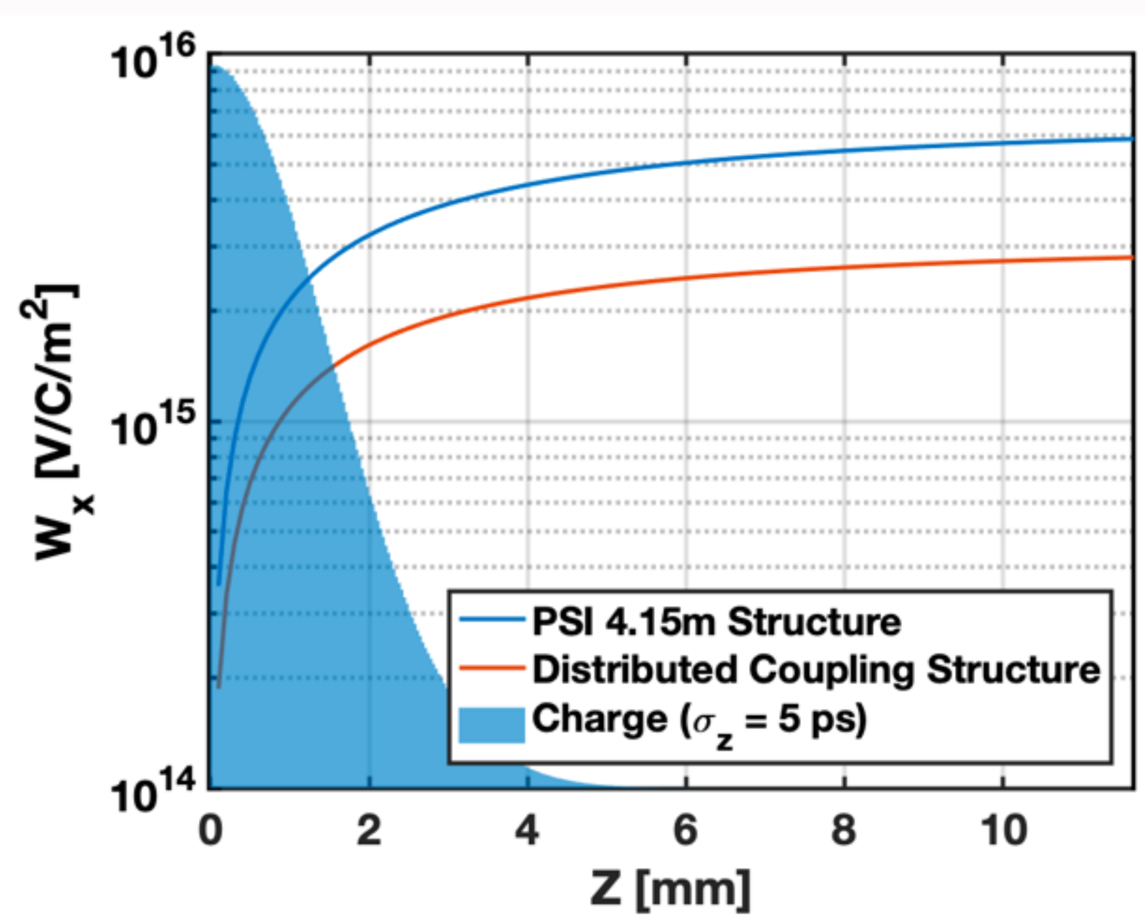
At 80K

| | |
|---|---|
| $R_s$ | 210 MΩ/m |
| $E_{acc}$ | 30 MV/m |

## Beam Dynamics Simulations

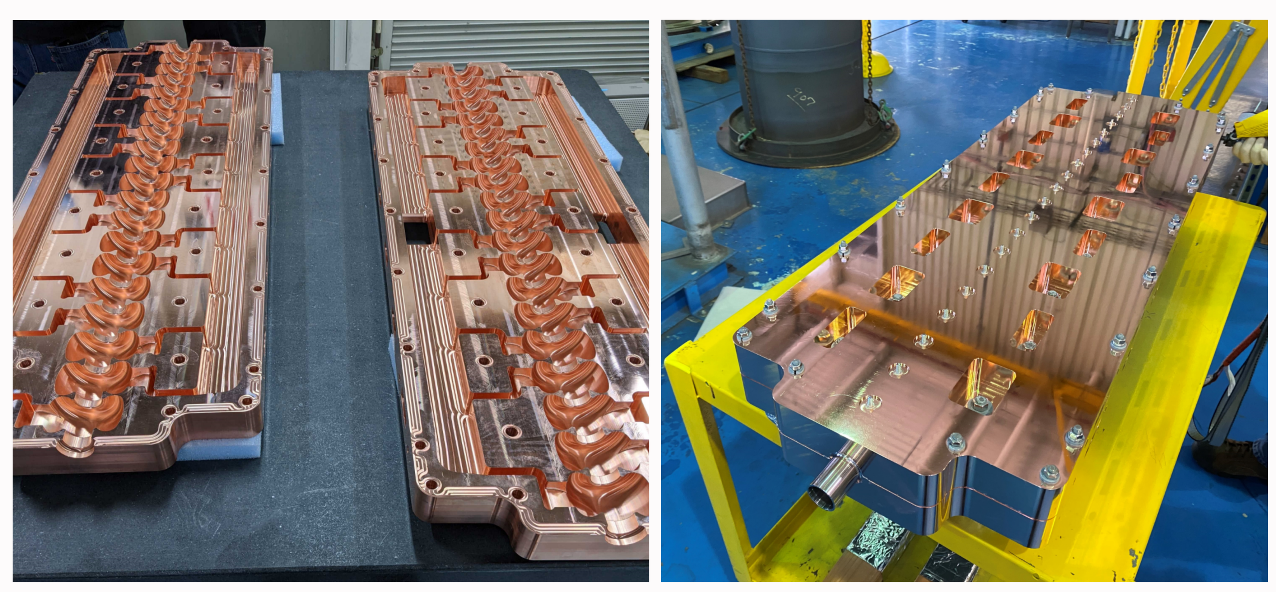



Compared to baseline traveling wave structures, our design maintains better output emittance for 14 nC bunches.



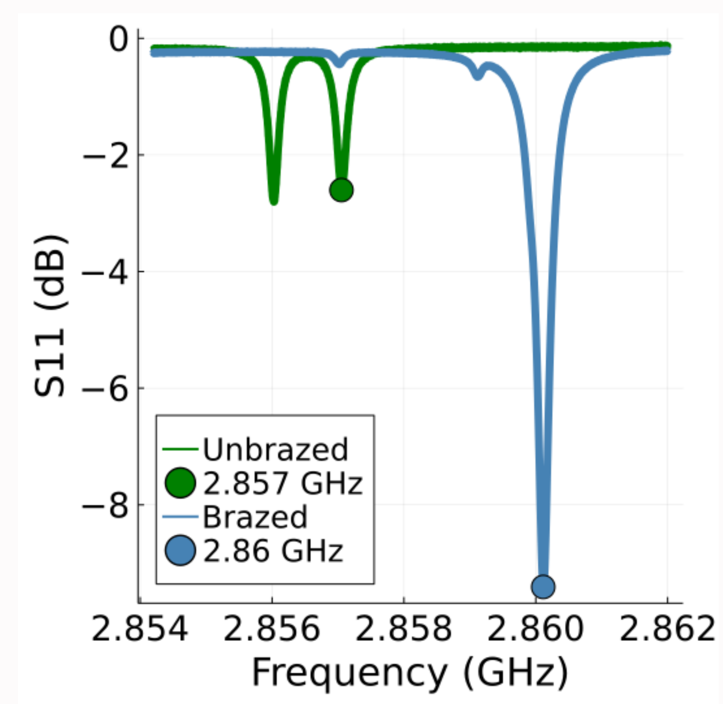

Similar comparisons to a traveling wave structure from PSI show better handling of wakefields too.

## Initial Characterization



Assembly of one structure is underway, with cold tests tracking the π mode throughout the process.

The π mode remains within tuning range after the first braze process




## Acknowledgements

[1] F. Willeke, "Electron ion collider conceptual design report" 2021,tech. rep., 2021.
[2] S. Tantawi et al., Phys. Rev. Accel. Beams, vol. 23, p. 092001, Sep 2020.
[3] Li, Zenghai et al. AIP Conference Proceedings , Vol. 1507, No. 1 p. 837-842

We'd like to acknowledge support from Andy Haase, Muhammad Shumail, and Matt Boyce. This work was supported by the Department of Energy Contract No. DE-AC02-76SF00515. ACE3P used resources of NERSC, a DOE user facility operated under contract No. DE-AC02-05CH11231