Research Challenge

- Transient multiphase flow phenomena should be better understood in order to reduce the problems that introduce defects during continuous casting.
- The modeling results should be validated with plant measurements and applied to find optimal process conditions, including nozzle port angle, nozzle submergence depth and EMBr field strength.

Methods & Codes

- ANSYS Fluent is used to implement Large-Eddy Simulations (LES) coupled with Volume of Fluid (VOF) models.
- Use of GPU-based in-house code, CUFLOW, to create LES coupled with Lagrangian particle capture and MagnetoHydroDynamics models.

Results & Impact

- These studies have enabled better understanding of the complex multiphysics phenomena related to defect formation.
- This better understanding has led to suggestions of nozzle geometry/casting condition combinations that lead to fewer defects, and, consequently, to significant savings to the steel plants.

Why Blue Waters

- Blue Waters enabled high-resolution multiphase flow simulations of the continuous caster needed for accurate predictions.
- Blue Waters resources (both ANSYS Fluent HPC on XE nodes and our in-house multi-GPU code CUFLOW on XK nodes) showed speed-up breakthroughs (e.g., over 3000x with ANSYS Fluent HPC on BW) needed to provide this modeling capability for the steel continuous casting process.

Acknowledgements

- Continuous Casting Consortium and NSF (Grant CMMI 15-63553) support