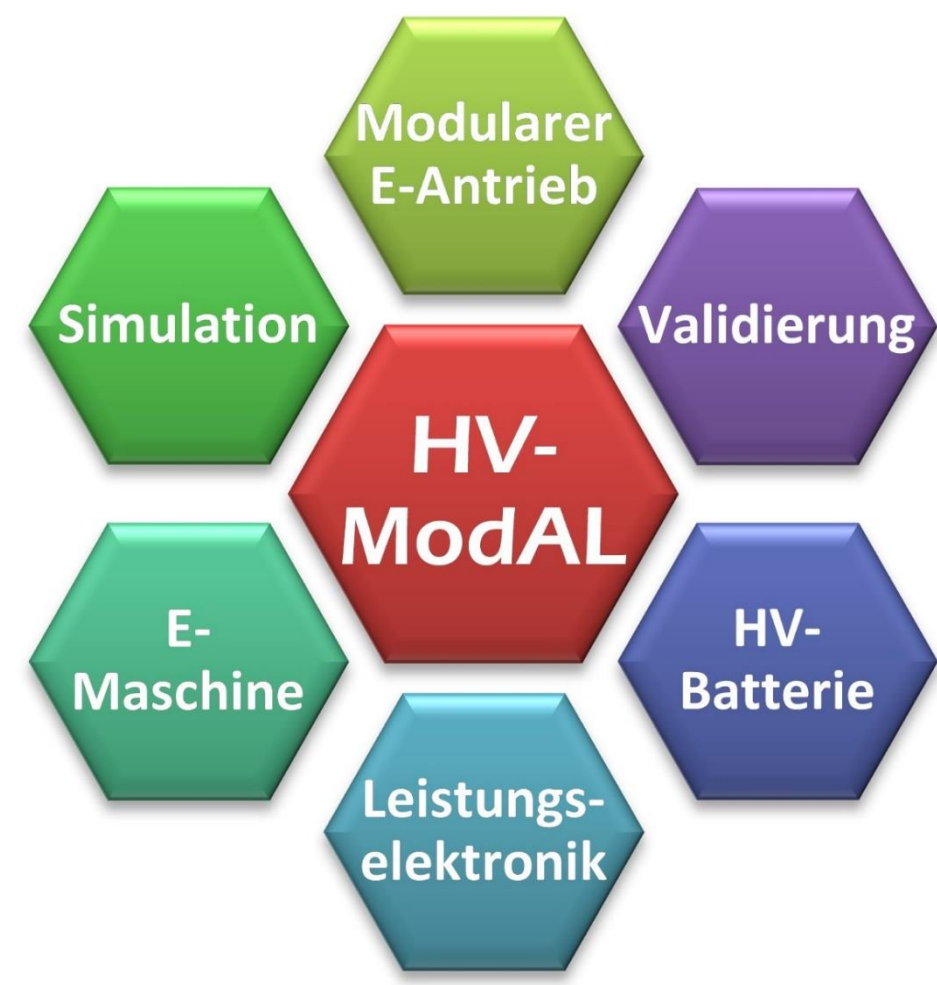


Influence of the Modeling Depth and Voltage Level on Circulating Currents in Parallel Conductors of a Permanent Magnet Synchronous Machine

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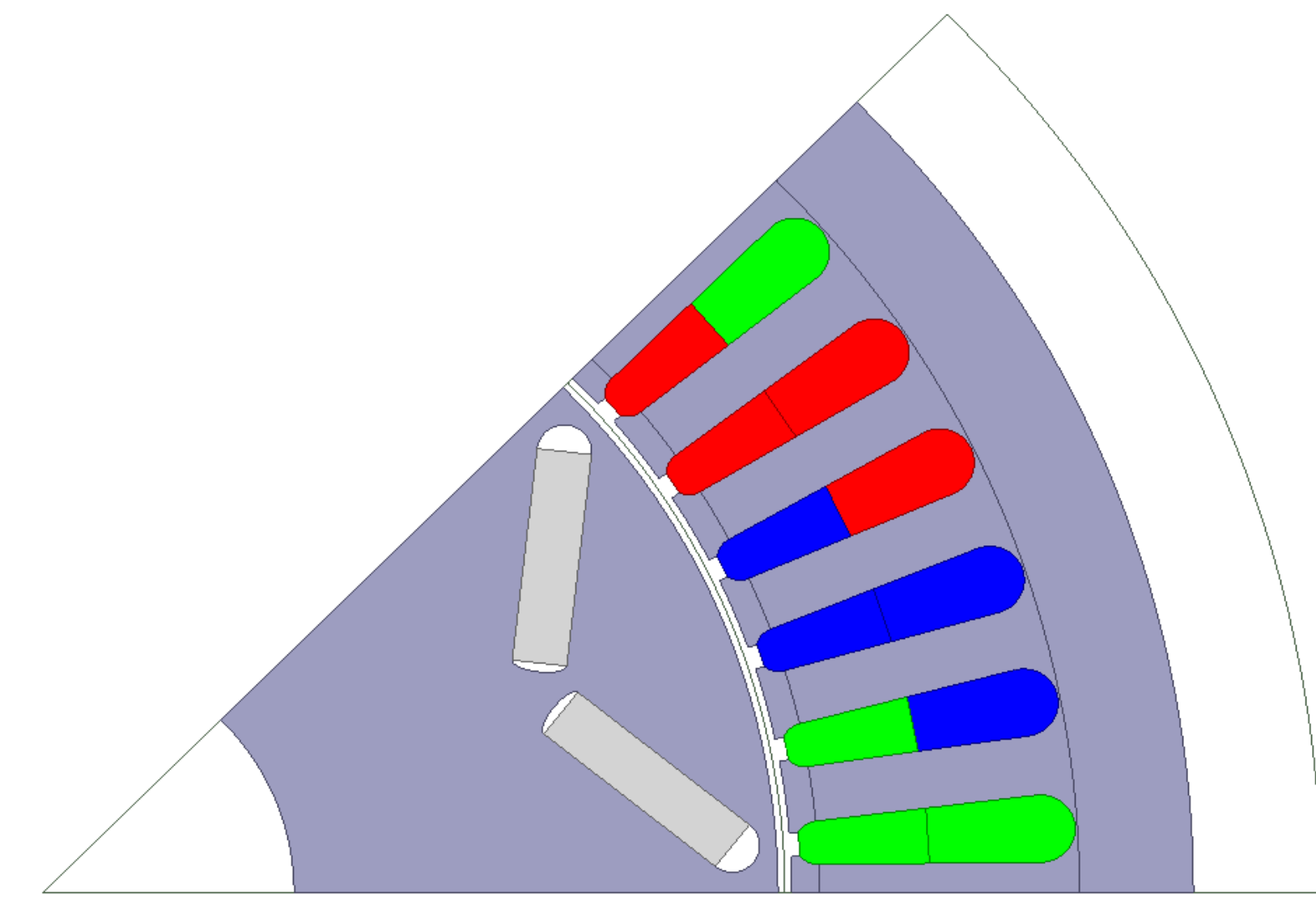
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Objectives

- ▶ Find a FEA setup with minimum computational demand to calculate AC losses of a PMSM including circulating currents
- ▶ Investigate the influence of unknown strand positions on the AC losses
- ▶ Analyze the influence of the voltage level on the AC losses

Machine Characteristics



- ▶ Nominal Power 160 kW
- ▶ Maximum Power 250 kW
- ▶ Nominal Speed 3000 rpm
- ▶ Maximum Speed 9000 rpm
- ▶ Voltage Level 800 V
- ▶ Coil Turns 8
- ▶ Strands in Hand 12
- ▶ Strand diameter 0.75 mm

Winding Modeling Depth

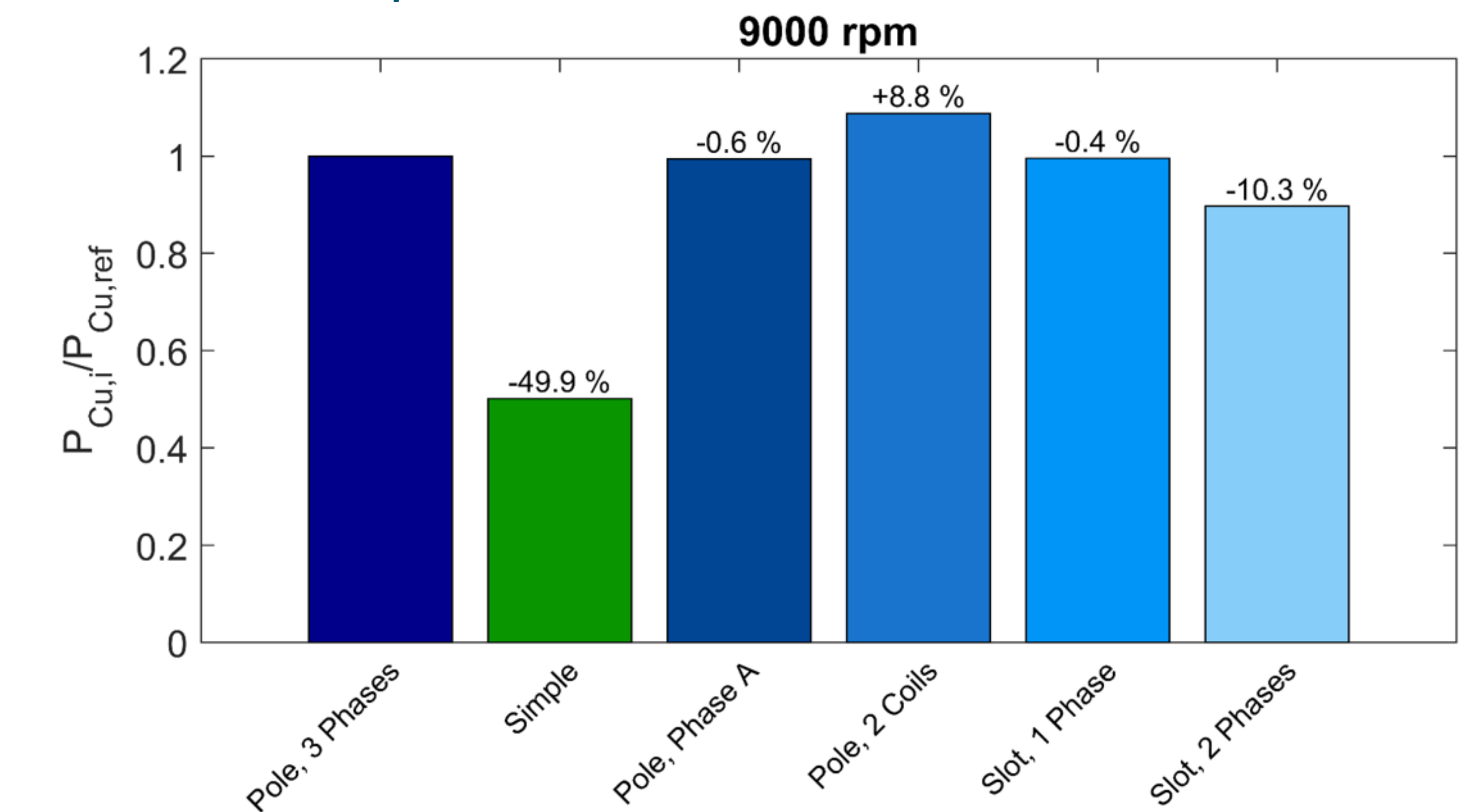
- ▶ Single strands modeled in...

Pole model

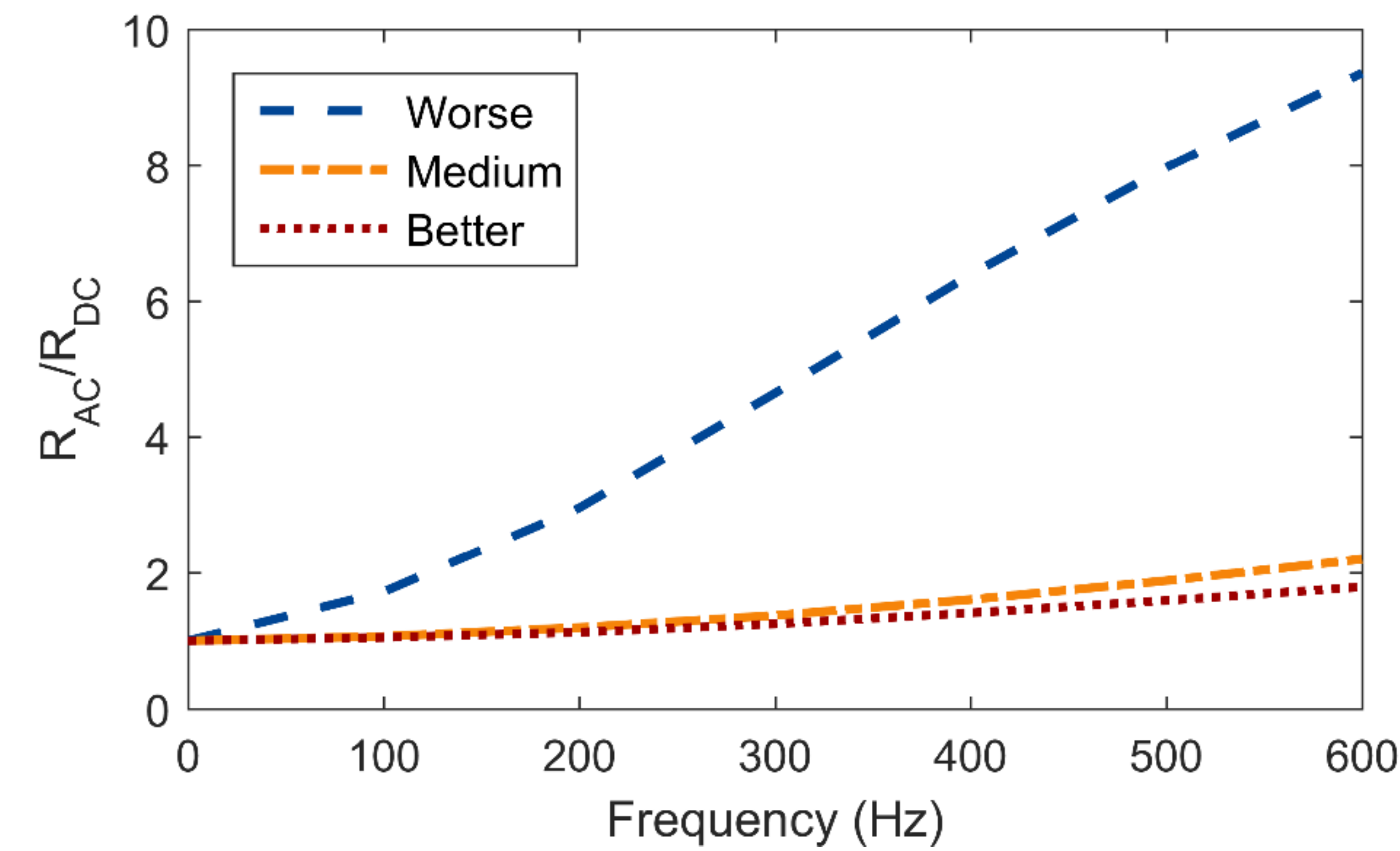
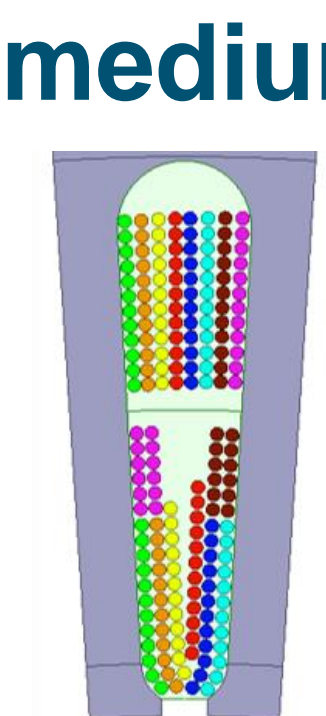
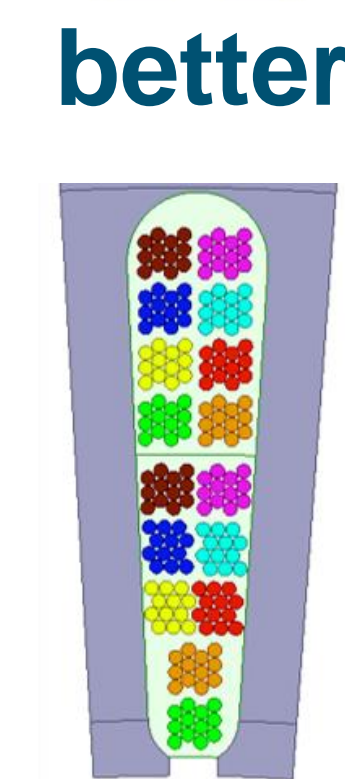
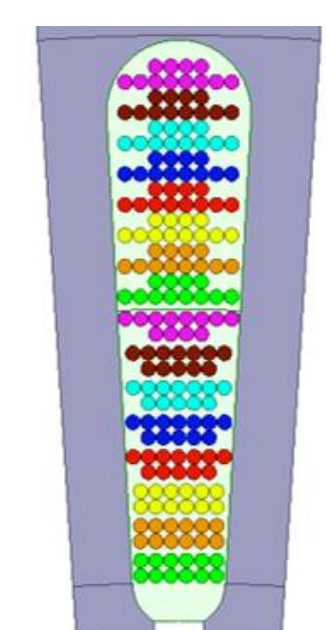
- ▶ three phases
- ▶ one phase
- ▶ half phase

Slot model

- ▶ one phase
- ▶ two phases

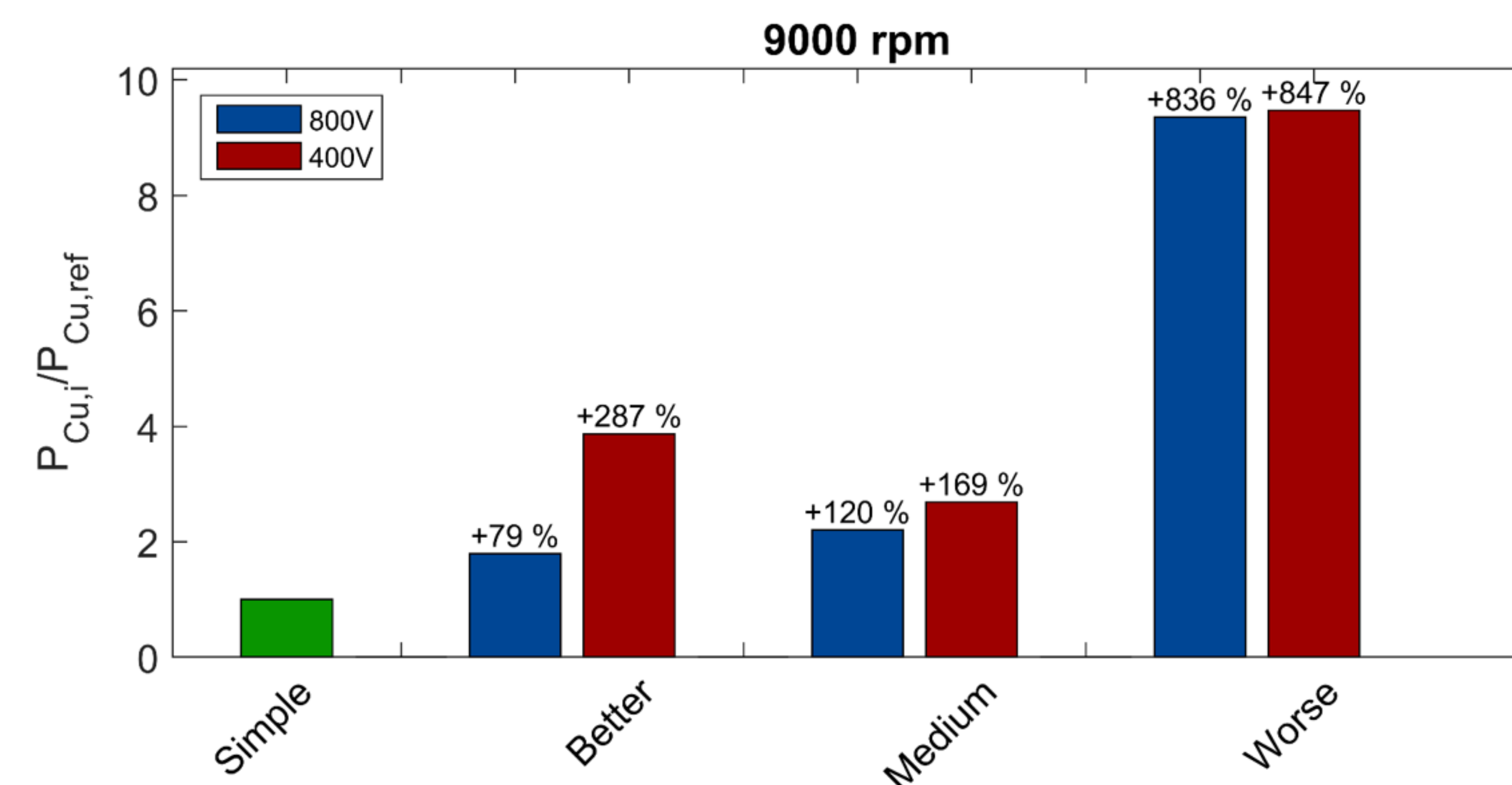


Strand Positions



- ▶ Unknown strand positions
- ▶ Worse/Medium/Better-Case comparison

Voltage Level



- ▶ Increased copper cross section at 400 V
- ▶ Increased sensitivity to AC effects

Conclusion

- ▶ Pole model with single strands in two coils of one phase is sufficient to calculate the losses
- ▶ Significant influence of strand position on the copper loss
- ▶ Tendency to higher AC losses at lower voltage levels