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Scaling Algebraic Multigrid to over 287K processors

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We present a parallel algebraic multigrid method based on aggregation. The parallel aggregation algorithm is based on a greedy heuristic. It allows for aggressive coarsening while keeping the stencil size of the coarse level matrices at a minimum. The method is very robust when solving elliptic problems on bounded domains Ω in 2D and 3D

$$-\nabla \cdot (K \nabla u) = f \text{ on } \Omega$$

with highly variable or discontinuous coefficients $K(x)$.

We will discuss challenges we overcame while porting our method to the Blue Gene / P.

Finally we will show the good scalability of the method for solving subsurface flow problems on Europe's fasted supercomputer JUGENE (an IBM Blue Gene / P). For the largest problem we solve a system with 150 billion unknowns using more than 187K processors.