

# NODAL AUXILIARY SPACE PRECONDITIONERS FOR MIXED VIRTUAL ELEMENT METHODS

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ABSTRACT. This work extends the Hiptmair-Xu nodal space preconditioner for  $H(\text{div})$  and  $H(\text{curl})$  conforming finite elements to the virtual element framework. For its construction, we first derive regular decompositions of the virtual element spaces on polytopal grids using (tuples of) nodal virtual element spaces. Canonical projection operators are introduced to map from these spaces to facet and edge virtual element spaces. Using the framework of auxiliary space preconditioning, combined with suitable multigrid methods, we derive efficient preconditioners for problems posed in  $H(\text{curl})$  and  $H(\text{div})$ . The preconditioners are particularly robust if elements with large aspect ratios are present in the mesh.

**Keywords:** Virtual Element Methods, preconditioning, robustness

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