

Abstract Submitted
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The Virtual Casing Principle and Helmholtz's Theorem¹ JAMES HANSON, Auburn University — The virtual casing principle is derived for a general vector field with arbitrary divergence and curl. There is no restriction to curl-free or divergence-free fields. The virtual casing principle is shown to be closely related to Helmholtz's theorem. The virtual casing principle [Shafranov V D and Zakharov L E *Nucl. Fusion* **12** 599-601 (1972), Lazerson S A *Plasma Phys. Control. Fusion* **54** 122002 (2012)] is used in plasma physics to convert a Biot-Savart integration over a current distribution into a surface integral over a surface that encloses the current. In many circumstances, use of virtual casing to convert a volume integral into a surface integral can significantly speed up the computation of magnetic fields. The virtual casing principle is commonly used for plasma equilibrium computations, magnetic field line tracing, and magnetic diagnostic response calculation. Previous discussion of the virtual casing principle has been specialized to magnetic (divergence-free) fields, and the argumentation has often relied on properties of a virtual superconductor surrounding the volume in question. Extension to vector potentials will also be discussed.

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