

## 7.1: Importance of Symmetries - Noether's theorem

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There are important physical consequences of symmetries in physics, especially if the dynamics of a system is invariant under a *symmetry transformation*. There is a theorem, due to Emily Noether, one of the most important (female) mathematicians of this century:

### Noether Theorem

For any *continuous* symmetry there is a conserved quantity.

So what is a continuous symmetry? Think about something like spherical symmetry – a sphere is invariant under any rotation about its centre, no matter what the rotation angle. The continuity of choice of parameter in a transformation is what makes the set of transformations continuous. Another way of saying the same thing is that the transformation can be arbitrarily close to the unit transformation, i.e., it can do almost nothing at all.

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