

## 1. Walk, don't run! – A Story of Broken Symmetry (Presented in Technicolour) .....

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For decades, much of particle physics research has been searching to understand the mechanism behind electroweak symmetry-breaking. The Standard Model explanation is most prominently attributed to Higgs: the  $W$  and  $Z$  bosons acquire a large mass via interactions with a scalar condensate.

It is possible that this condensate is the result of some undiscovered strong dynamics. By analogy with QCD and the colour force, candidate theories of this type are called technicolour models.

The essay should touch upon the following questions: Why must there be (at least) 2 scales, the technicolour and extended technicolour scales? Why cannot technicolour be simply a scaled-up version of QCD? How would a *walking* coupling constant generate the necessarily large ratio of these 2 scales? The essay should go into some depth regarding one aspect of technicolour.

There are many papers on technicolour theories, some with pedagogical introductions emphasizing various aspects. Some searching on [arXiv.org](http://arXiv.org) or [inspirehep.net](http://inspirehep.net) is unavoidable. A good place to start is [1] which cites many of the original papers. A comprehensive review, for its time, was given in [2].

### Relevant Courses

*Essential: Standard Model*

*Useful: Statistical Field Theory*

### References

- [1] G Fleming, “Strong Interactions for the LHC,” [arXiv:0812.2035](https://arxiv.org/abs/0812.2035)
- [2] C T Hill and E H Simmons, “Strong dynamics and electroweak symmetry breaking,” *Physics Reports* 381, 235 (2003).