

# BSM physics in 2018: status and outlook

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Particle physics day, Jyväskylä, 23.11.2018

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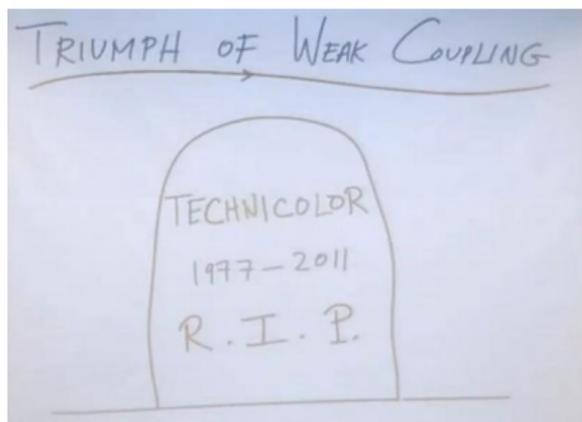
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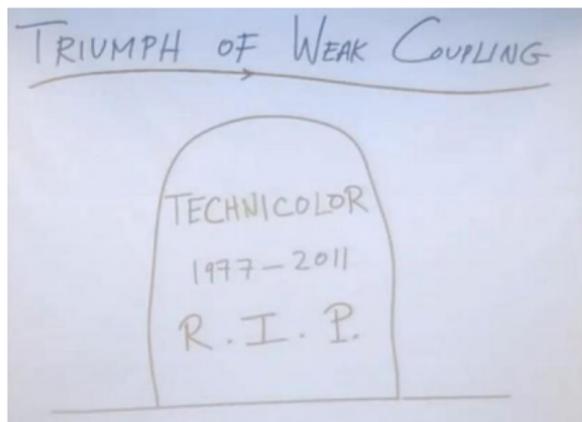


Nima Arkani-Hamed, 2013

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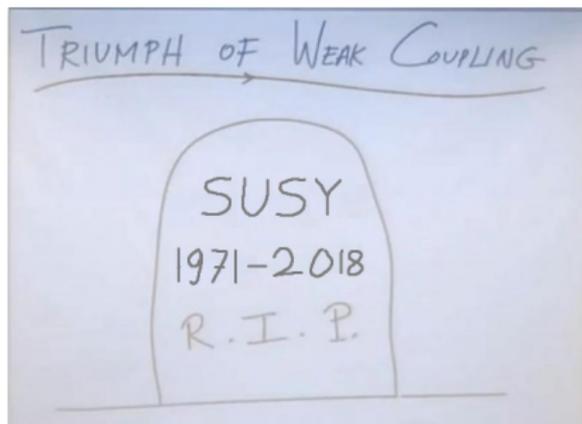


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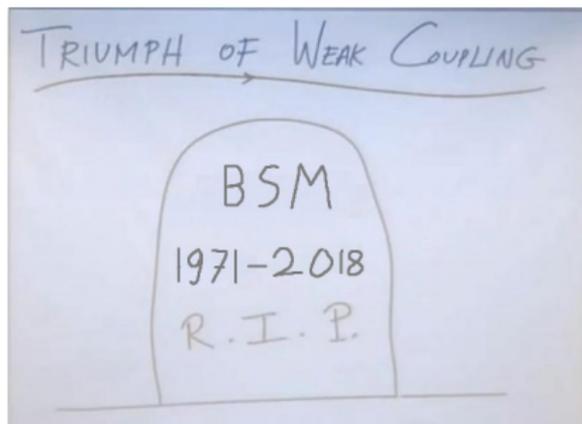
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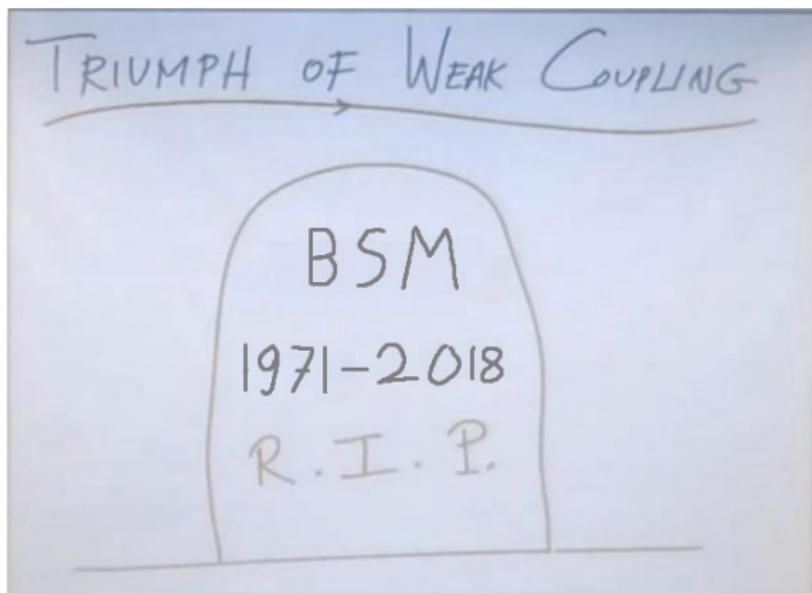
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- ▶ Neutrino oscillations.

How did we get here?



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- ▶ Either the  $\mu$ -term arises as an effective operator from the UV-theory at the TeV scale (technicolor, compositeness...)
- ▶ Or the smallness of the  $\mu$ -term compared to a higher cut-off scale  $\Lambda \gg \text{TeV}$  is explained by a cancellation enforced by a symmetry (SUSY). Then the symmetry breaking scale must not be far above the TeV scale.

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Still, the Standard Model was condemned to be “unnatural” and “fine-tuned”

unnatural 

[uhn-**nach**-er-uh l, -**nach**-ruh l]

[Synonyms](#) [Examples](#) [Word Origin](#)

[See more synonyms on Thesaurus.com](#)

adjective

1. contrary to the laws or course of nature.

whereas the theories with low energy SUSY, composite Higgs or large extra dimensions are called “natural”

natural 

[**nach**-er-uh l, **nach**-ruh l]

[Synonyms](#) [Examples](#) [Word Origin](#)

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adjective

1. existing in or formed by nature (opposed to **artificial**):  
*a natural bridge.*
2. based on the state of things in nature; constituted by nature:

A slide from Mikhail Shaposhnikov's talk at Tallinn 2018 conference

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- ▶ The quantum theory of gravity is unknown. There doesn't have to be a particle with a mass  $\sim M_P$ , that would contribute to the trace anomaly by an amount  $\sim M_P$ .
- ▶ Scale invariant gravity is actually renormalizable (Stelle 1976), but has ghost degrees of freedom. There are many attempts to formulate a satisfactory theory of classically scale invariant gravity...

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Cosmology and astroparticle physics is essential for finding the correct path in BSM physics!

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- ▶ + many more I have forgotten to include...

Keep calm and carry on!

SCIENTIFIC AMERICAN MAY 2014

## Supersymmetry and the Crisis in Physics

END OF PHYSICS near as  
physicists reach their limit on  
understanding the Universe

**nature**  
International Journal of science

The New York Times

## A Crisis at the Edge of Physics

How the belief in beauty has triggered a crisis in  
physics

## Is Particle Physics in Crisis?

After the success of the Standard Model, experiments have stopped answering to grand theories.

Back to (Action)

The present phase of stagnation in the foundations  
of physics is not normal

**Forbes**

Is Theoretical Physics Wasting  
Our Best Living Minds On  
Nonsense?



Dear Dr B: Can you think of a single advancement in  
theoretical physics, other than speculation, since the  
early 1980's?

## Is theoretical physics in crisis?

Has physics entered the nightmare scenario?

The end of physics?

The End of Theoretical Physics As We  
Know It

PARTICLE PHYSICS

## What No New Particles Means for Physics