Report from the

Brainstorming & Calculationshop The Physics Case for a Low Energy Frontier

Last week@DESY

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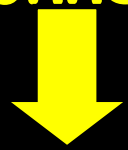
Motivation

Last few years have shown:

- Low energy experiments, in particular those with photons can search for new physics in `hidden sectors'
- Can `see' physics with extremely weak coupling missed in conventional colliders
- Tests physics connected to ultrahigh energy scales



Complementary to colliders!
New window to fundamental physics!

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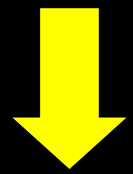


Complementary to colliders!
New window to fundamental physics!

- Price to pay: Particles must be light!

Goal

- Make compelling `physics case' for particles and phenomena detectable in such experiments

- Combine and strengthen existing efforts
- Recruit new forces

- Write White Paper

Brainstorming

Calculating

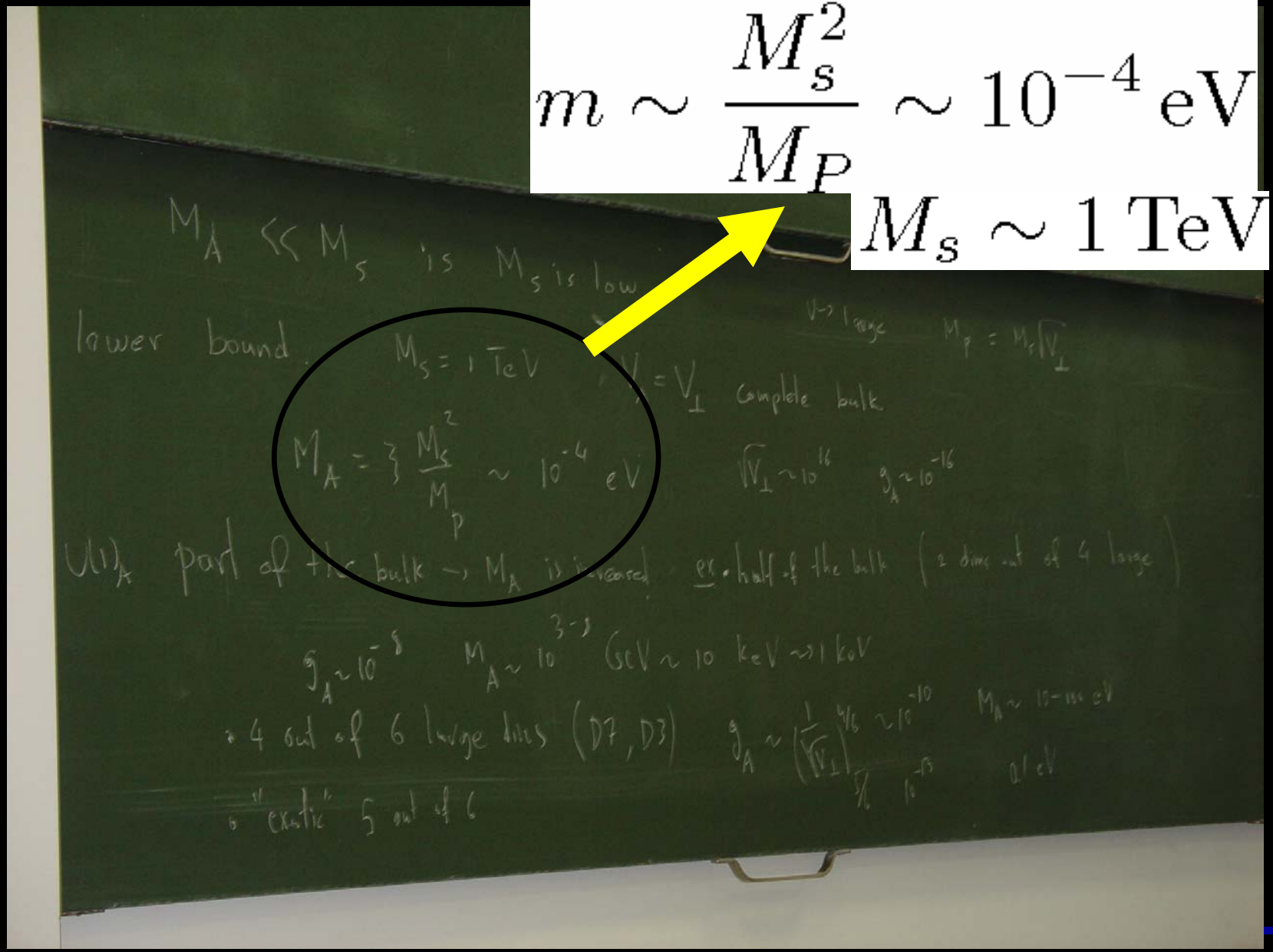
Joining forces

The Mystery of the meV Scale

Why the meV scale is interesting

- Dark energy $\rho_\Lambda \sim (\text{meV})^4$
- Neutrino mass ~meV
- Experiments are sensitive in this regime
- Not extremely well tested for many particles

Masses for hidden sector particles



A mass generation mechanism

- For hidden gauge bosons such a mass could arise from anomalies
- It is a Stueckelberg mass
  ((hopefully) stable against quantum corrections)
- Connected to large volume V of extra dimensions

$$m \sim \frac{M_s^2}{M_P} \sim \frac{M_P}{V/l_s^6}$$

Large volumes

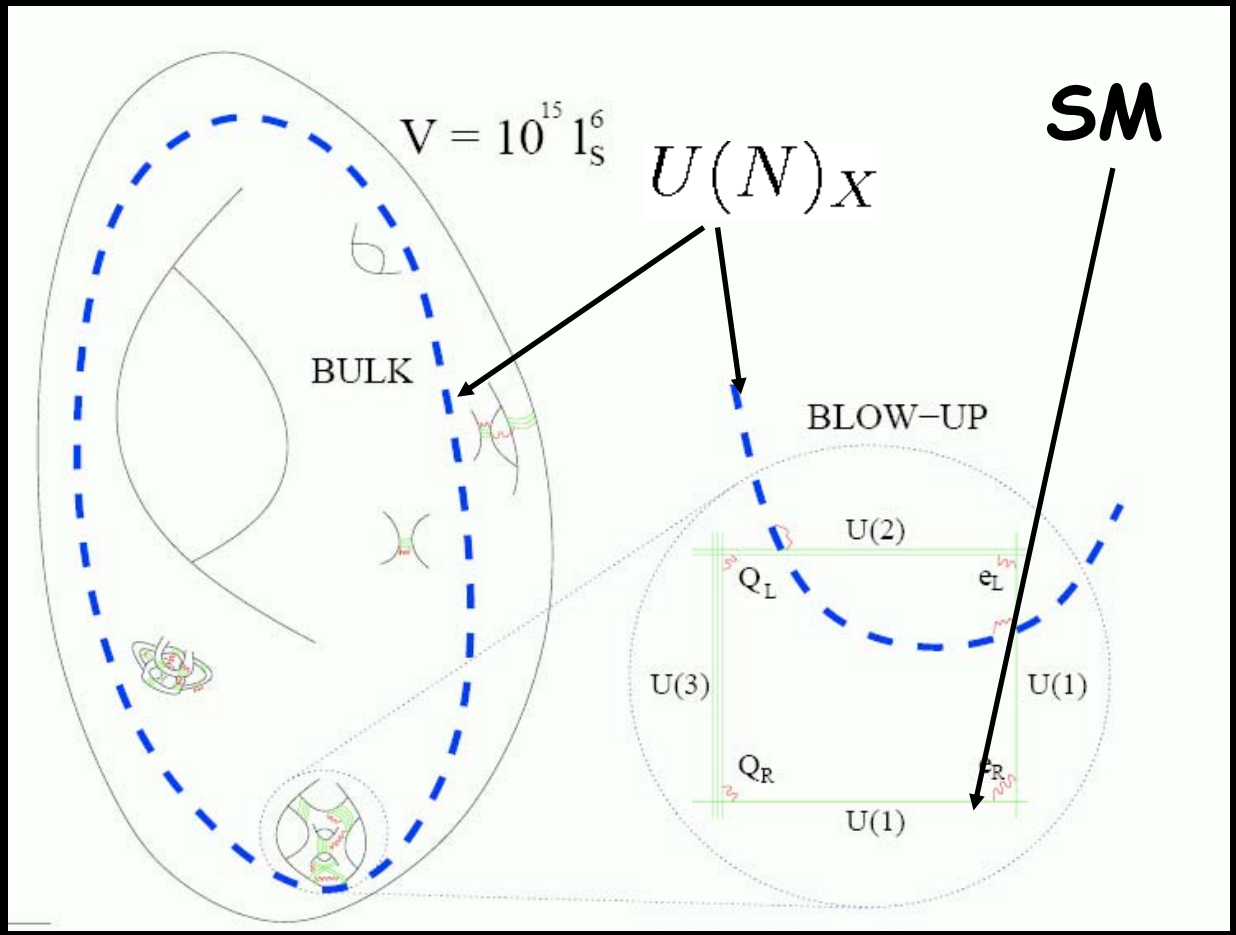
- May solve the hierarchy problem:
  the goal is to make the string scale small

$$M_s \sim \frac{M_P}{\sqrt{V}}$$

- Can be generated dynamically… in some models

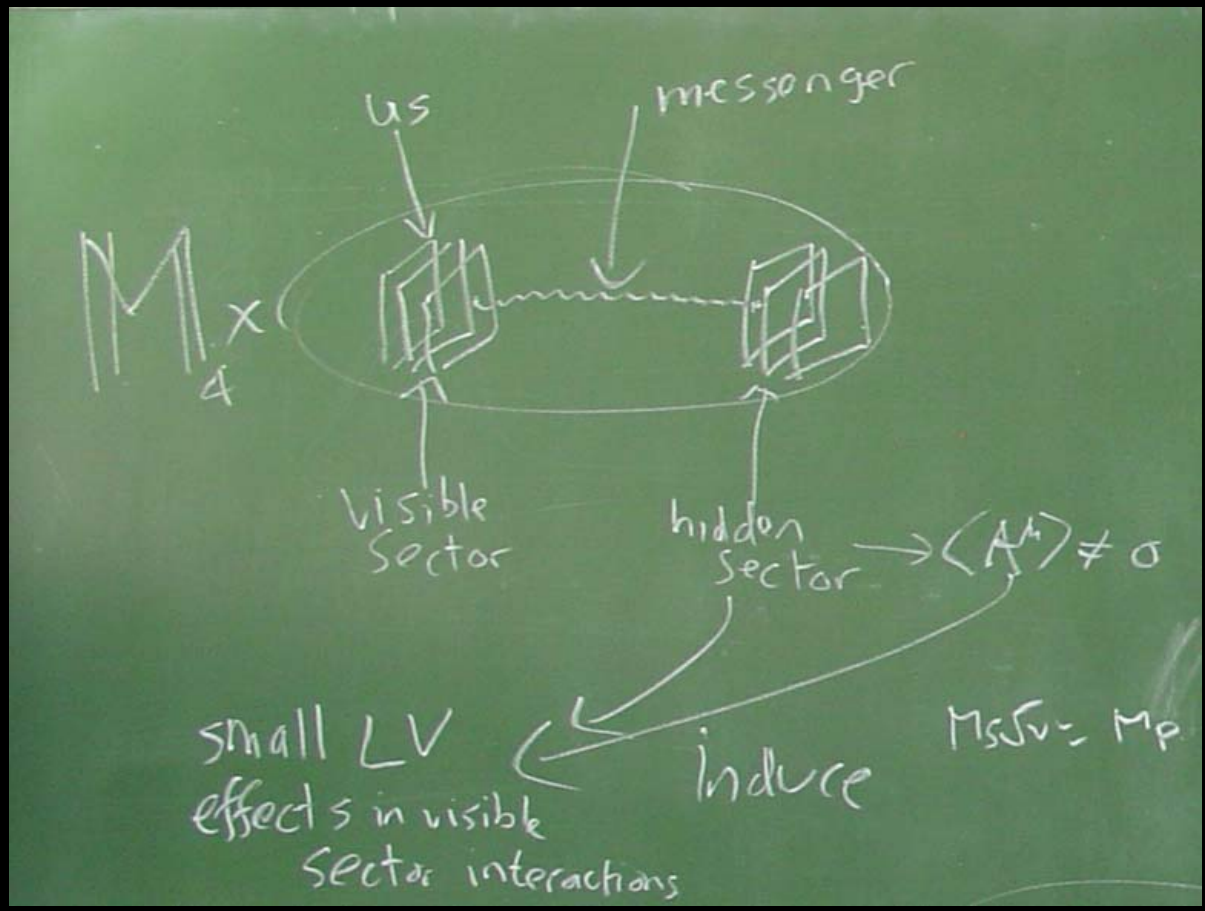
...and other small effects

Hyperweak gauge interactions



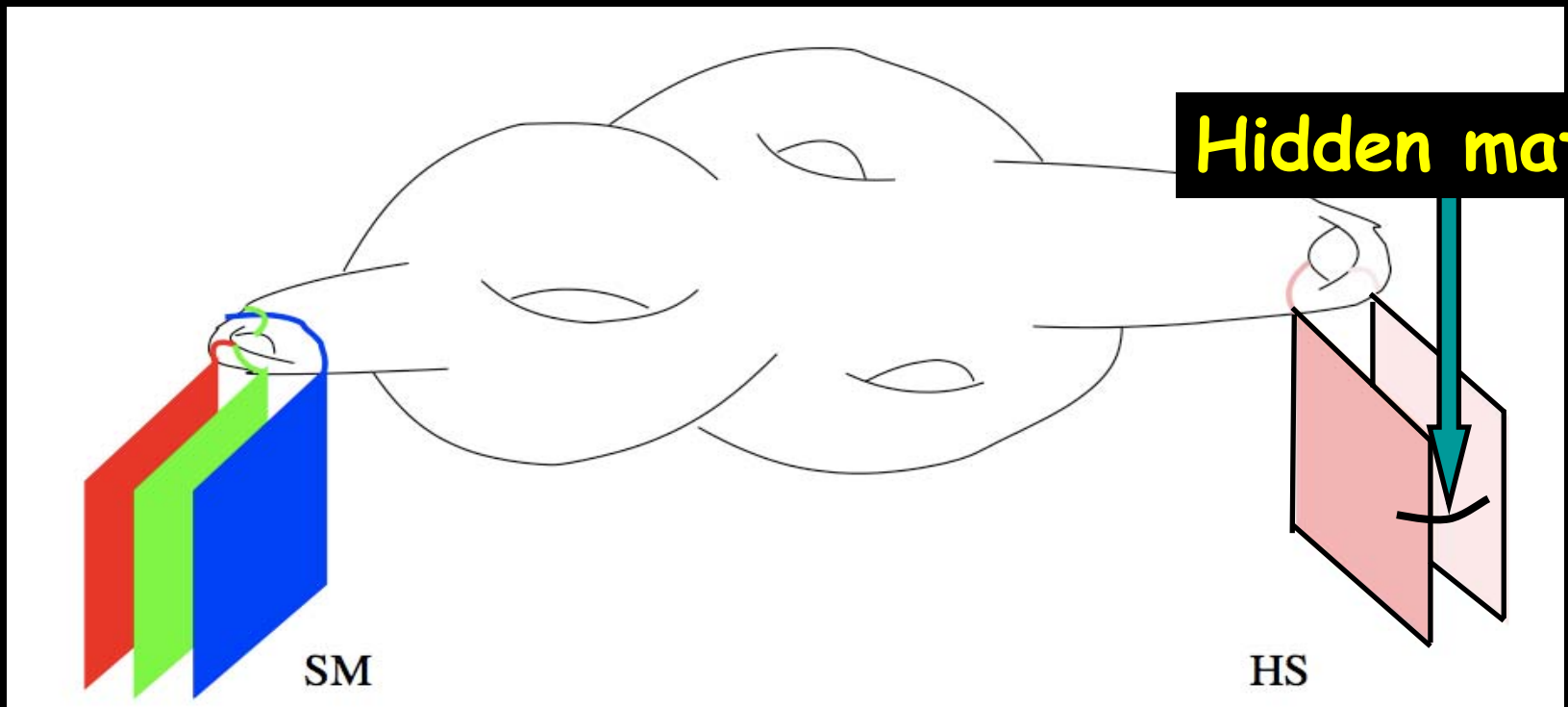
$$g^2 \sim \frac{1}{V^{\frac{2}{3}}}$$

Lorentz symmetry violation



$$\frac{\langle C^{\mu\nu} \rangle}{(V/l_s^6) M_s} \bar{\psi} D_\mu \gamma_\nu \psi$$

Mixing with hidden photons



$U(A) \times U(B) \times U(C)$

$U(A) \times U(B)$

$$\text{mixing} \sim \frac{l_s^4}{V}$$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wiki

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Motivation [edit]

In the last years it became clear that a variety of low energy experiments , in particular optical experiments, can search for new physics related to a hidden sector that is extremely weakly coupled to the standard model. Due to their extremely weak interactions, particles in such a hidden sector would be invisible to conventional collider detectors. Moreover, these experiments can often indirectly probe processes associated to energy scales much higher than those experiments at the current high energy frontier. In this way, these experiments complement conventional collider searches. The price to pay is that a detection in low energy experiments typically (not always) requires that some hidden-sector particles are light. These particles might have something to say about important open fundamental questions like the hierarchy problem, unification, dark energy

Special thanks to Javier and Markus!!


More soon at
http://alps-wiki.desy.de/e13/e42

Details will follow soon…

White Paper:

The Physics case for...

The participants of the Brainstorming&Calculationshop

Table of Contents

- I. Overview of experimental situation (for theorists)

- II. `Bottom-up' approach
  - Axions
  - General scalar fields (ALPs, chameleons, quintessence)
  - Extra `hidden' photons
  - Higher spin particles?
  - LV violating effects

Can we accommodate?
Is it possible?

III `Top-down' approach
- string theory
- anomalies
- loop quantum gravity

Is it possible?
Is it natural?
Is it unavoidable?

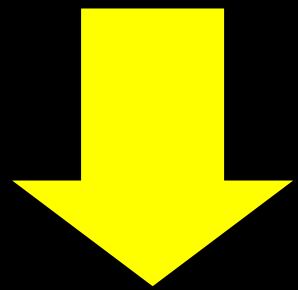

More soon at
http://alps-wiki.desy.de/e13/e42

- bla

Original speaker

- Alessandro Mirizzi

- Has job interview



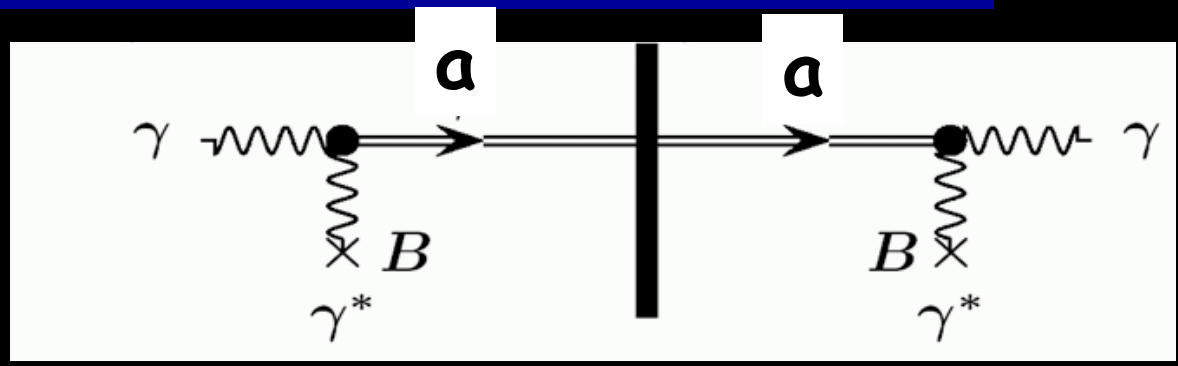
Good Luck!!!

Of course he doesn't need it!

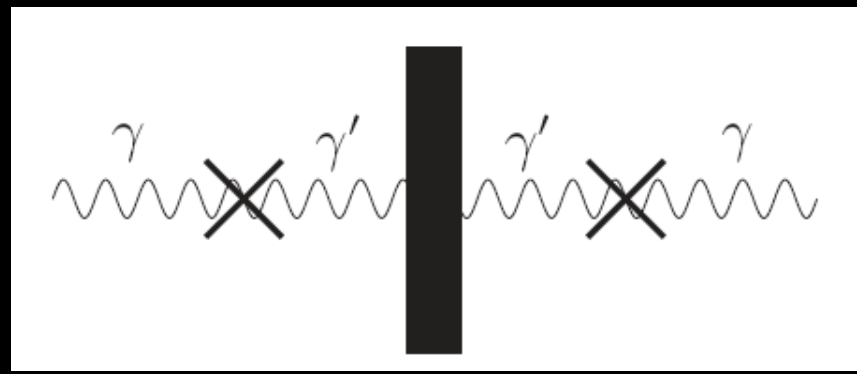
WISPS=Weakly interacting sub-eV particles

- **Axions**

$$\frac{1}{M} a \tilde{F} F$$



- **Massive hidden photons (without B-field) =analog ν-oscillations**



- **Hidden photon + minicharged particle (MCP)**