

Theory Perspective

ECFA {*higgs, top, electroweak*}-FACTORY

WG1-SRCH

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MORE TEXT THAN USUAL, TO EASE OFFLINE “ATTENDANCE”



Intro



01 **General philosophy**
What should we keep as target and why

02 **Possible studies**
Just my personal and partial view on a few concrete items

03 **Your input**
We want to get a map of ideas and interests in the community



“Ideology” for BSM

Meter stick of our understanding of Nature

In order to understand how well the SM describes observed phenomena **we need alternative theories to compare.**

These theories can, and better be, motivated alternatives which allow us for instance to solve some puzzle of the SM (e.g. why mass ν is so small), fix some apparent shortcoming (e.g. what is dark matter), or simply “measure” how well we can test our assumptions (e.g. the Higgs boson is point-like)

If we understand (even a little bit of) the inner workings of Nature we can formulate sensible options for what Nature can look like in places we have not looked for yet (e.g. at shorter distance=higher energy or more “exotic” searches).

You may have no idea of special relativity but, if you know Galilei’s relativity you can motivate a Michelson-Morely experiment (1880s)



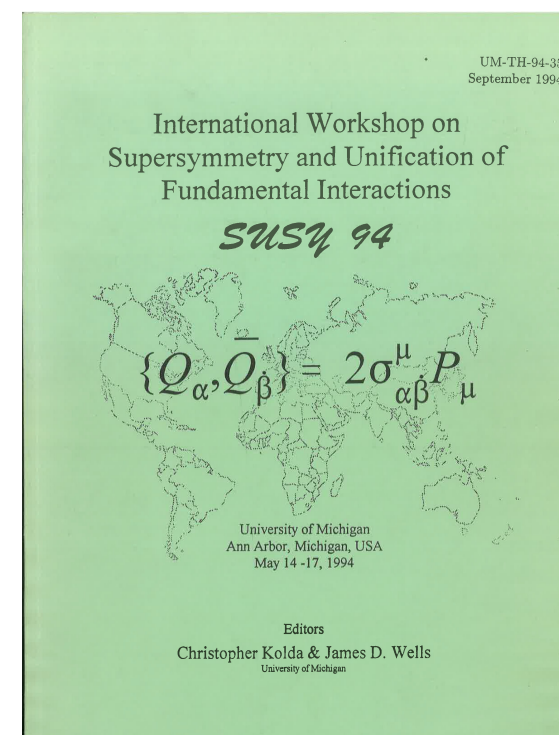
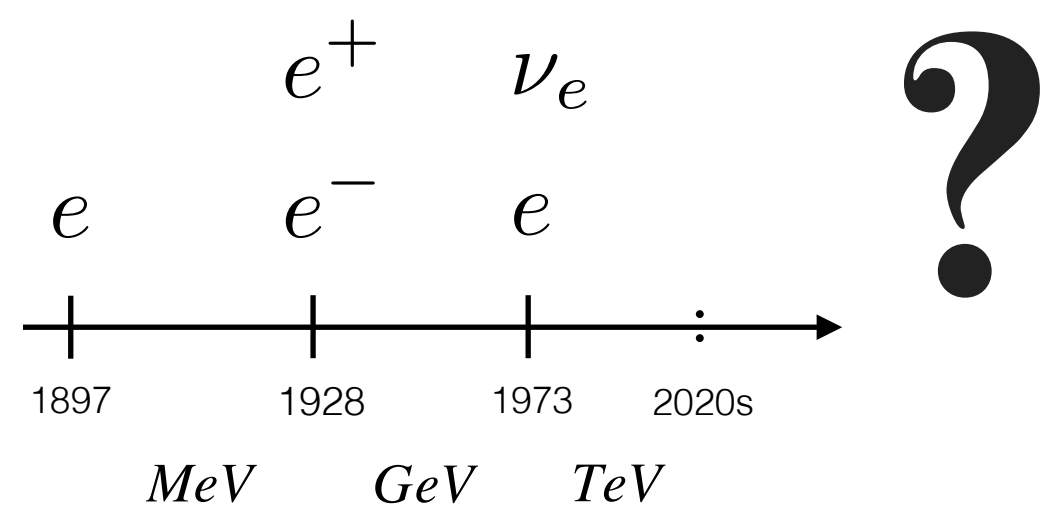
“Ideology” for BSM

Set the path to discovery

Thinking what Nature can be beyond the domain of the currently known has lead, and will always lead, to very **suggestive scenarios** for what Nature could be.

e.g. Nature can be SUSY at short distance

Symmetries and particles



The prevalent view in past decades, including up to the time of operation of LHC, has been that such a *grand scheme* existed and we had probably figured out its coarse grained picture, *i.e.* we had to “just” work out the details*.

For right or wrong, the current prevalent view is less sharp on the resemblance of the grand scheme and even on its very existence.

For sure we are (and we will not be for the foreseeable future) in the position to have a “forecast” for discovery as we had for the Higgs boson or its replacement new physics below the TeV

* often said before revolution

BACK TO NORMAL
“SCIENCE AS
EXPLORATION”



next

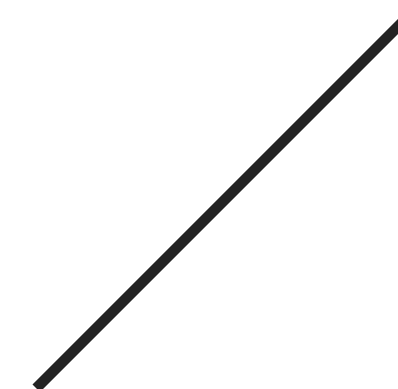
Exploration at the HTE factory

01

Perspiciatis unde.



- This does not mean “anything goes because we have no guidance anyway”.



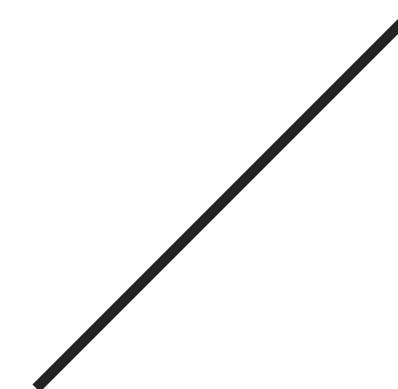
Exploration at the HTE factory

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Perspiciatis unde.



- We do have experience, we do have models, we do have QM/QFT rules.



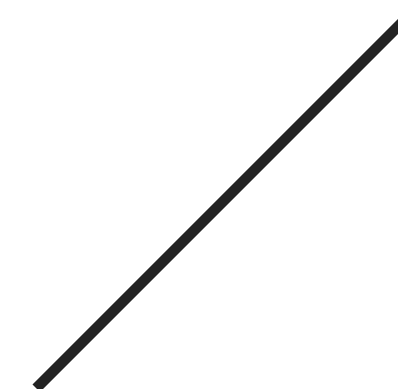
Exploration at the HTE factory

01

Perspiciatis unde.



- We have open issues in the SM on which we need to make progress!



We will investigate the landscape of new physics, striking a balance between the test of the specific answers to the open issues of the SM coming from the “grand picture” and the more exploratory approach.



next

Concrete directions to explore

- signals of (light) new physics that may be hard to observe at LHC (reach at HTE-factory and projection for HL-LHC)

02



2HDM

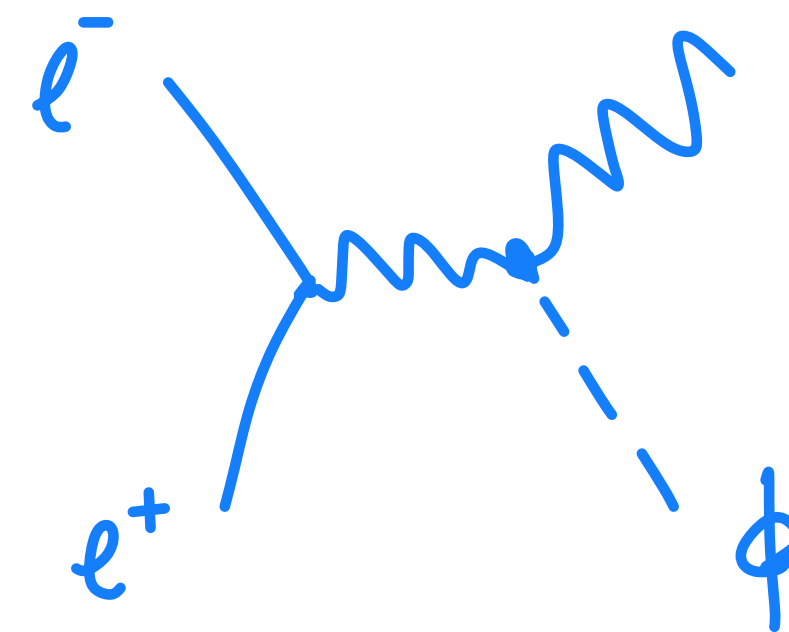
$$V(h_1, h_2)$$

HIGGS PORTAL

$$h^2 \phi^2$$

higher-order

$$(h \partial h) (\phi \partial \phi)$$



Concrete directions to explore

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02



2HDM

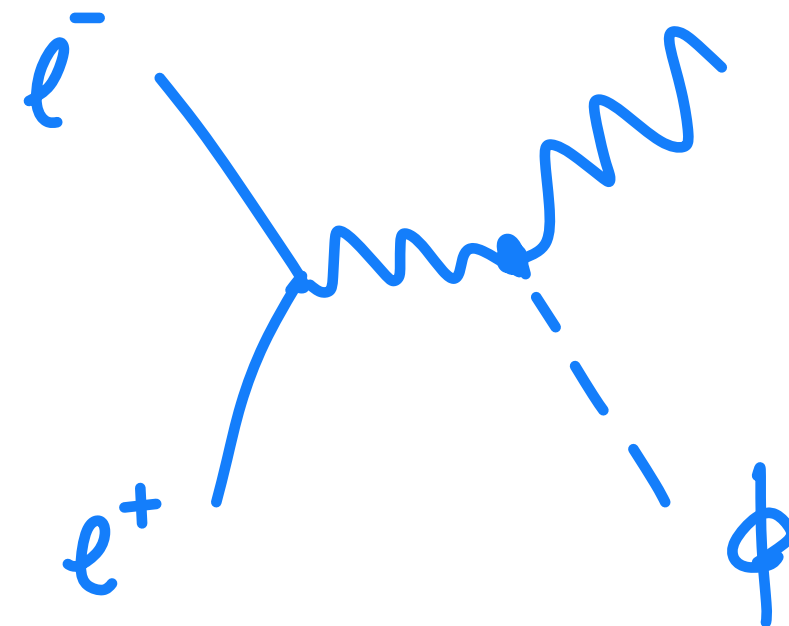
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HIGGS PORTAL

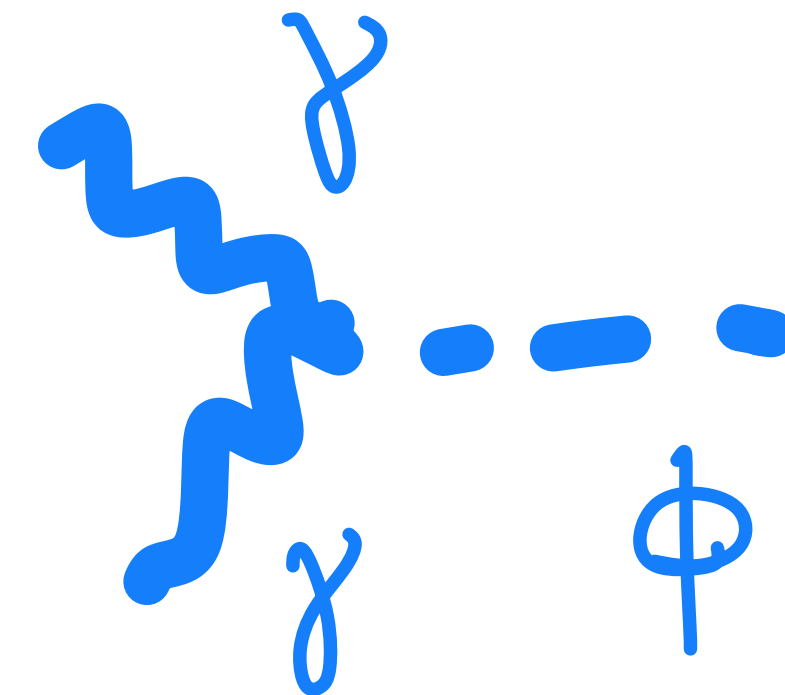
$$h^2 \phi^2$$

higher-der

$$(h \partial h) (\phi \partial \phi)$$



“standard” ϕ -strahlung

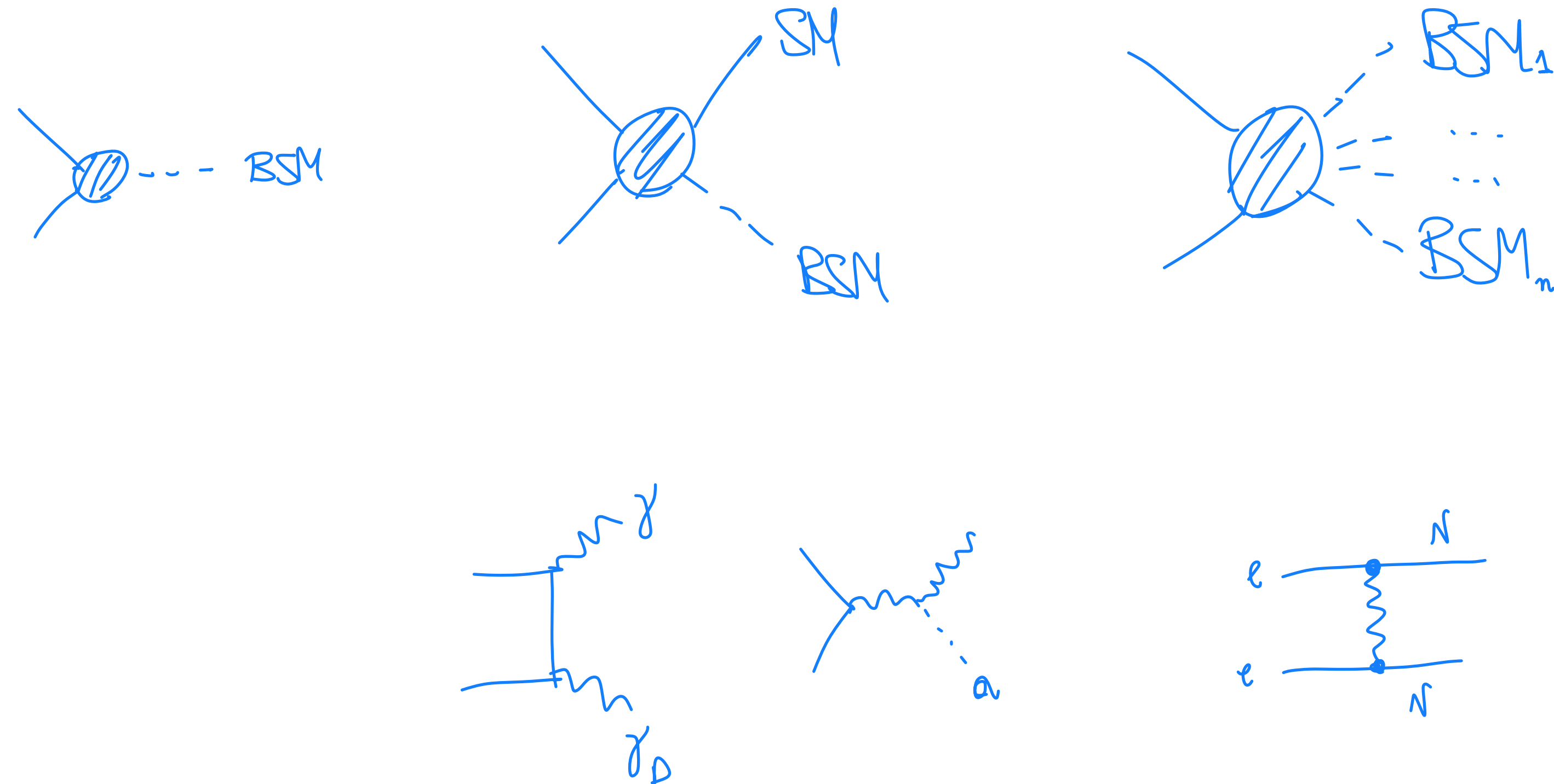


“fusions” (e.g. for ultralight ϕ)

Concrete directions to explore

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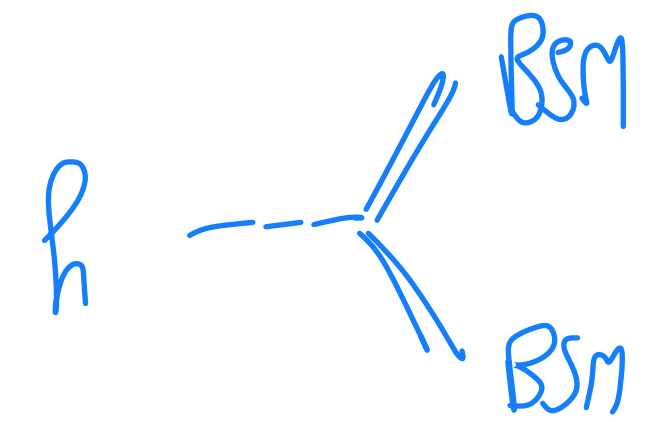
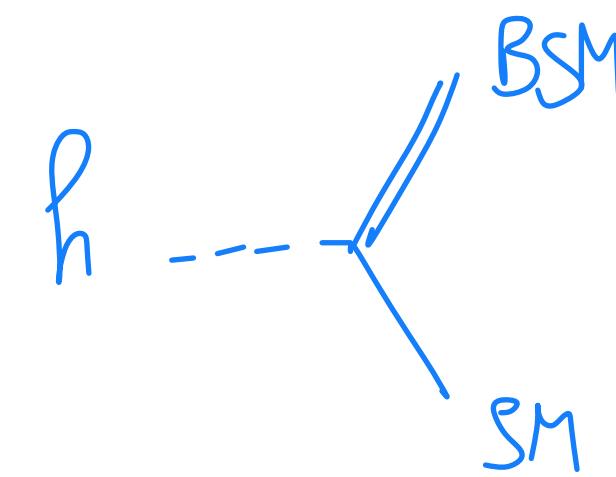
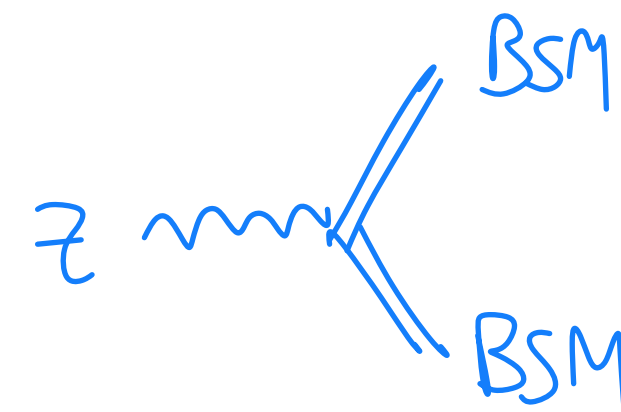
- ... and beyond



Concrete directions to explore

02

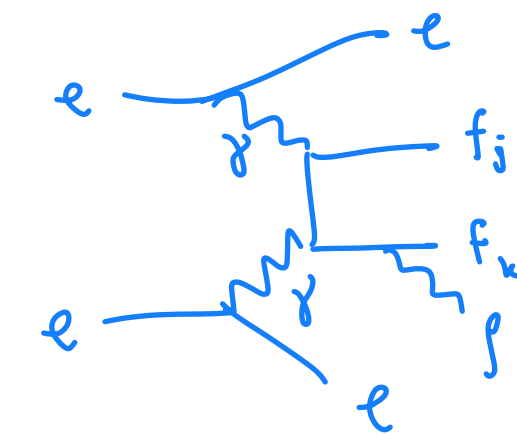
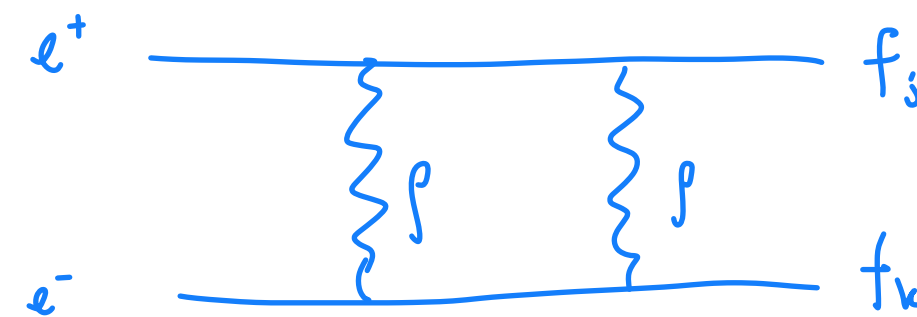
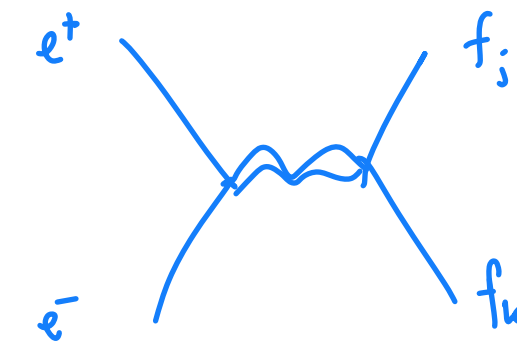
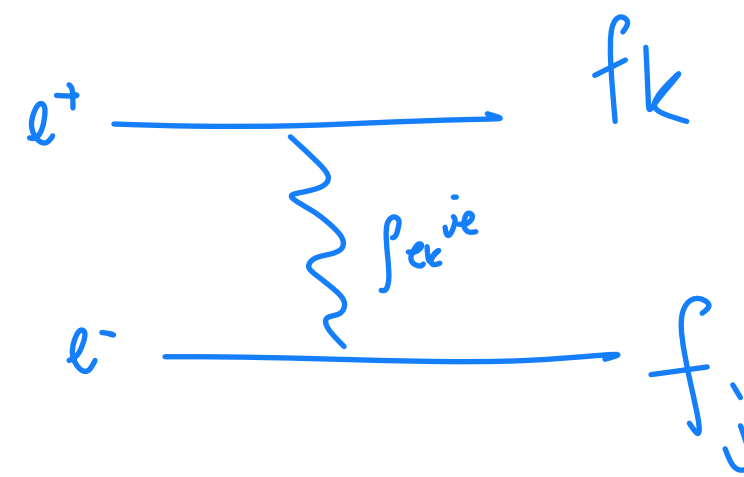
- ... and beyond



Concrete directions to explore

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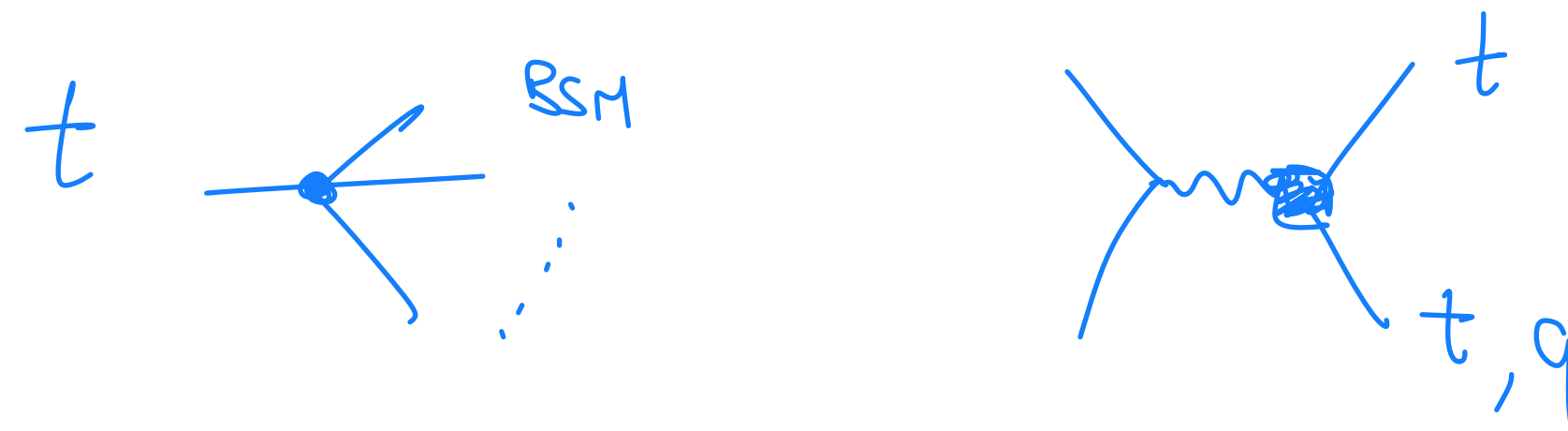
- possible flavor-specific signals*



Concrete directions to explore

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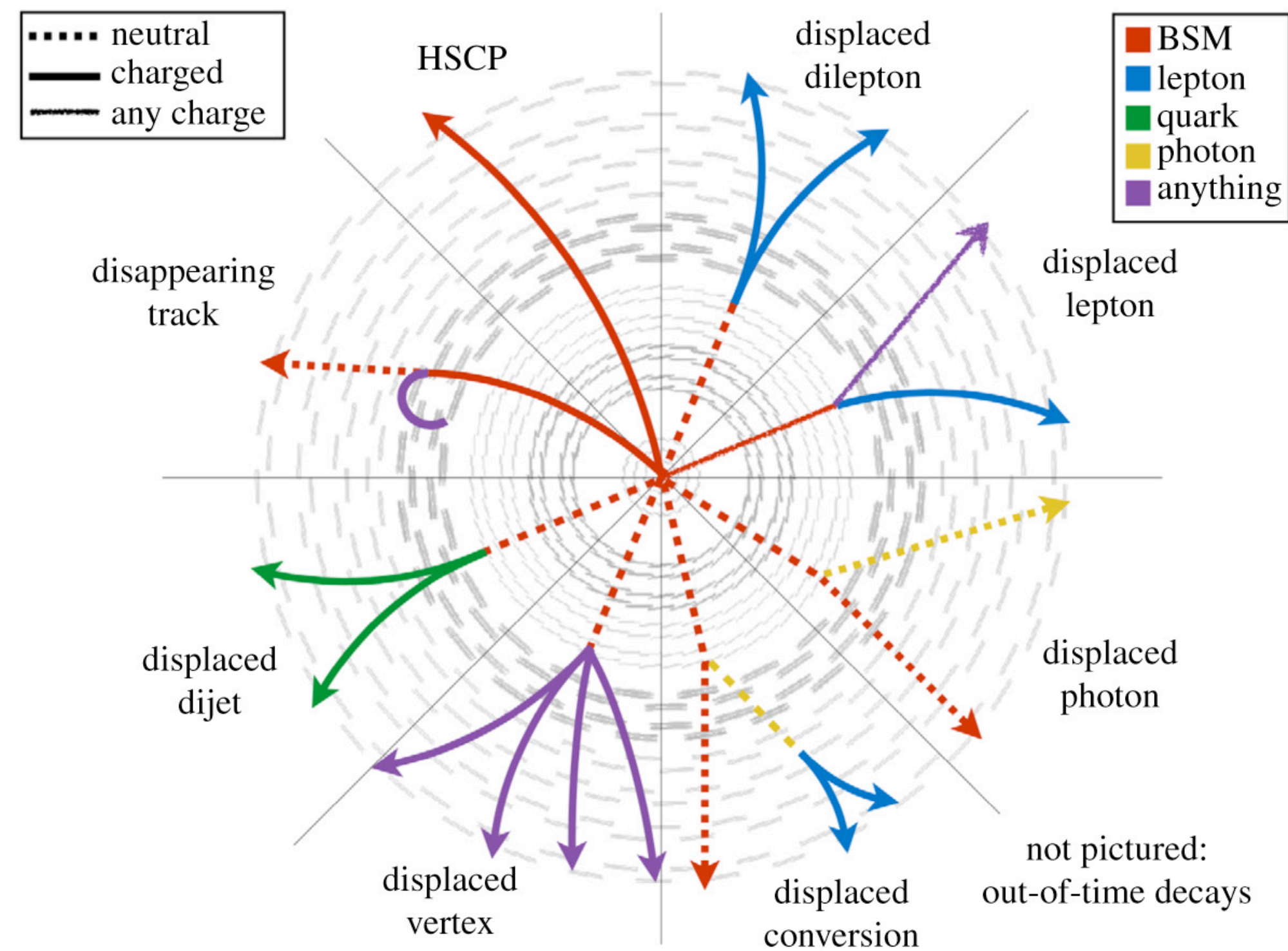
- new physics linked to the top quark* (including top quark properties, e.g. m_{top})



Concrete directions to explore

- non standard-signatures motivated by the exploratory spirit and also in some “grand picture” models

02



Concrete directions to explore

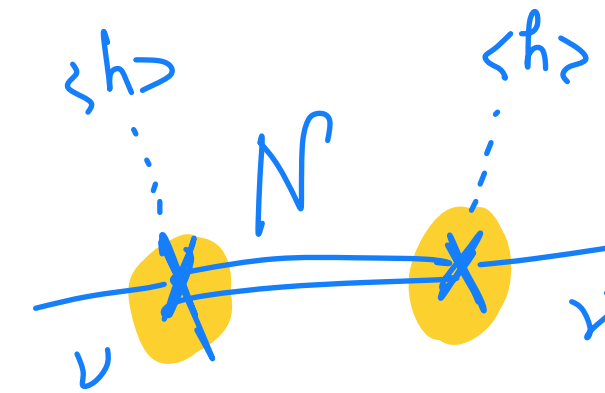
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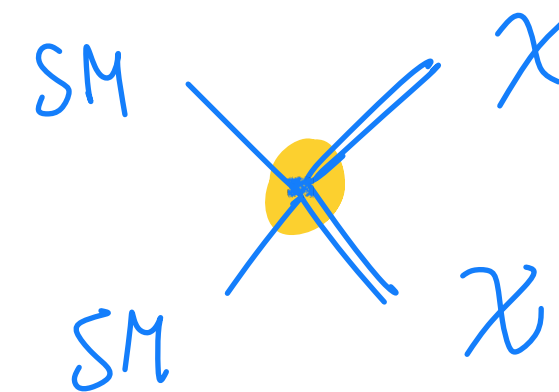


tiny

couplings



TYPE 1 SEE-SAW



FREEZE-IN DM

...

Concrete directions to explore

- relation to other type of searches and in general to non-collider

02



03



your input

