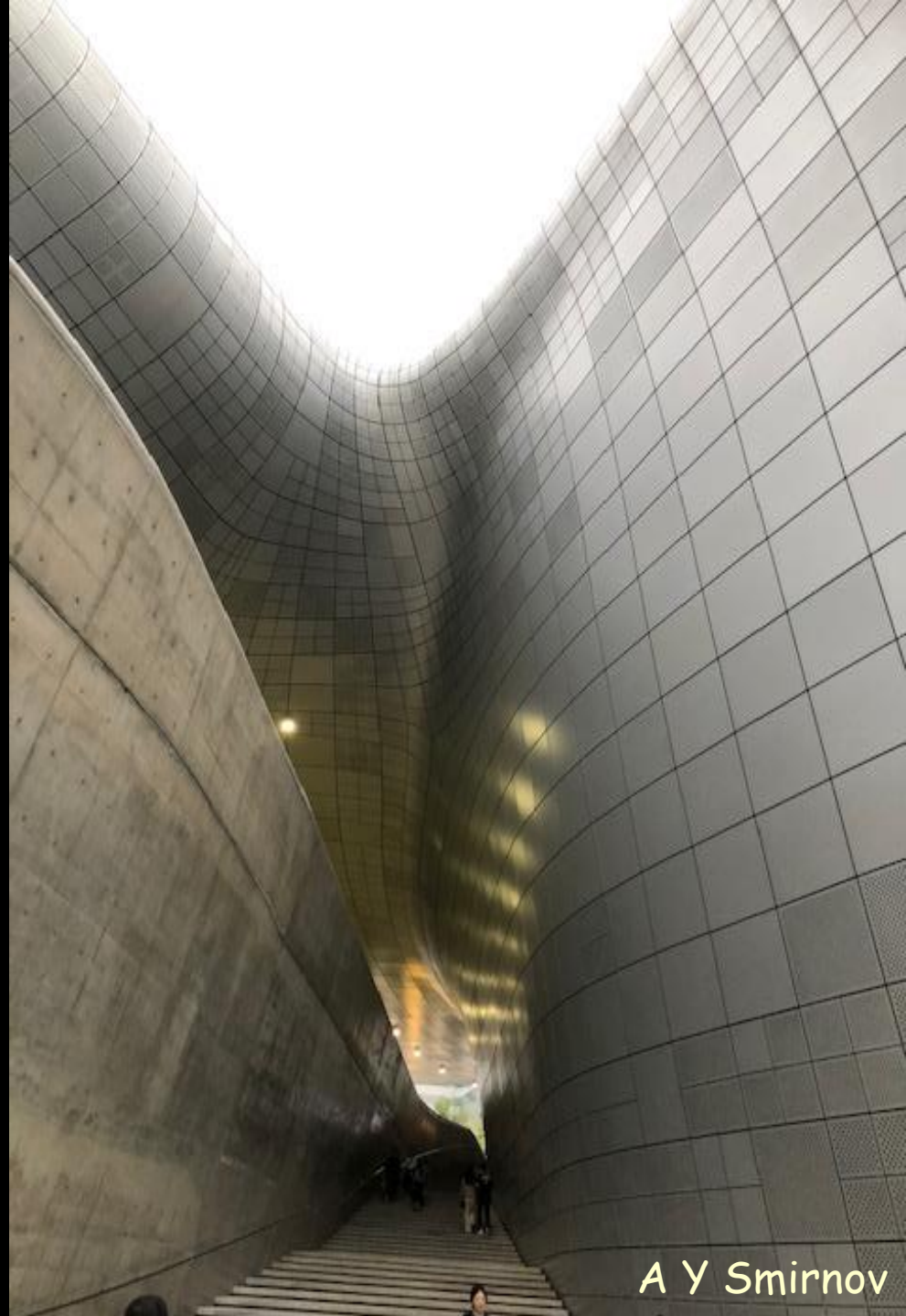


NEPLES 2019

New Physics at the Low Energy Scales

*KIAS, Seoul
September 23 - 27, 2019*



A Y Smirnov

TOPLESS 2019

Theoretical and Observational Physics at the Low Energy Scales

sounds better

covers not only light BSM
particles but also
new SM physics



... reflects the change of the paradigm



Reflects the present situation when nothing is found (well established) above the electroweak scale at the LHC and other experiments

Nothing on the top?

This changes the paradigm of searches for new physics from High to Low and Very low energy scales.

With new (yet relatively inexpensive) experiments

Explosion of activity in the last 5 - 6 years

with key notions

Portals, Mediators & Hidden worlds



New field of research?

Key notions and topics

Dark photons

Axions

ALP's

**Light, ultralight
scalars**

Sterile neutrinos

Dark neutrinos

Portal and Mediators

Dark, Hidden sectors

Various topics are not new being "invented"
and discussed 30-40 years ago

Interesting and rich physics, new phenomena

Motivations: Experimental hints



Evidences of low scale physics?

Dark Matter

CDM- problems

Axions, keV steriles,
fuzzy DM ...

EDGES

Dark Energy

indeed indicates
small energy scale

ANITA

Neutrino Anomalies

LSND
MiniBooNE

Reactor
neutrino
anomaly

Gallium
anomaly

KamLAND-
Solar tension

5 MeV
bump

Origins of
 ν - mass

neutron
lifetime

B-decays

Be anomaly

$g_\mu - 2$

Motivations: Theory?



Second desert?

Strange pattern
of masses

Why not worry about
the low scale desert?

Hierarchy
problem?

High scale desert
14 - 17 orders

Standard masses
of the SM particles

BSM origins?

Low scale desert
> 40 orders

M_{Pl}
 M_{GUT}

V_{EW}
 m_e

$V_{\text{EW}}^2/M_{\text{Pl}}$
 Λ
 m_ν

m_γ

Γ_p

$1/t_U$

10^{20}

10^{10}

10^0

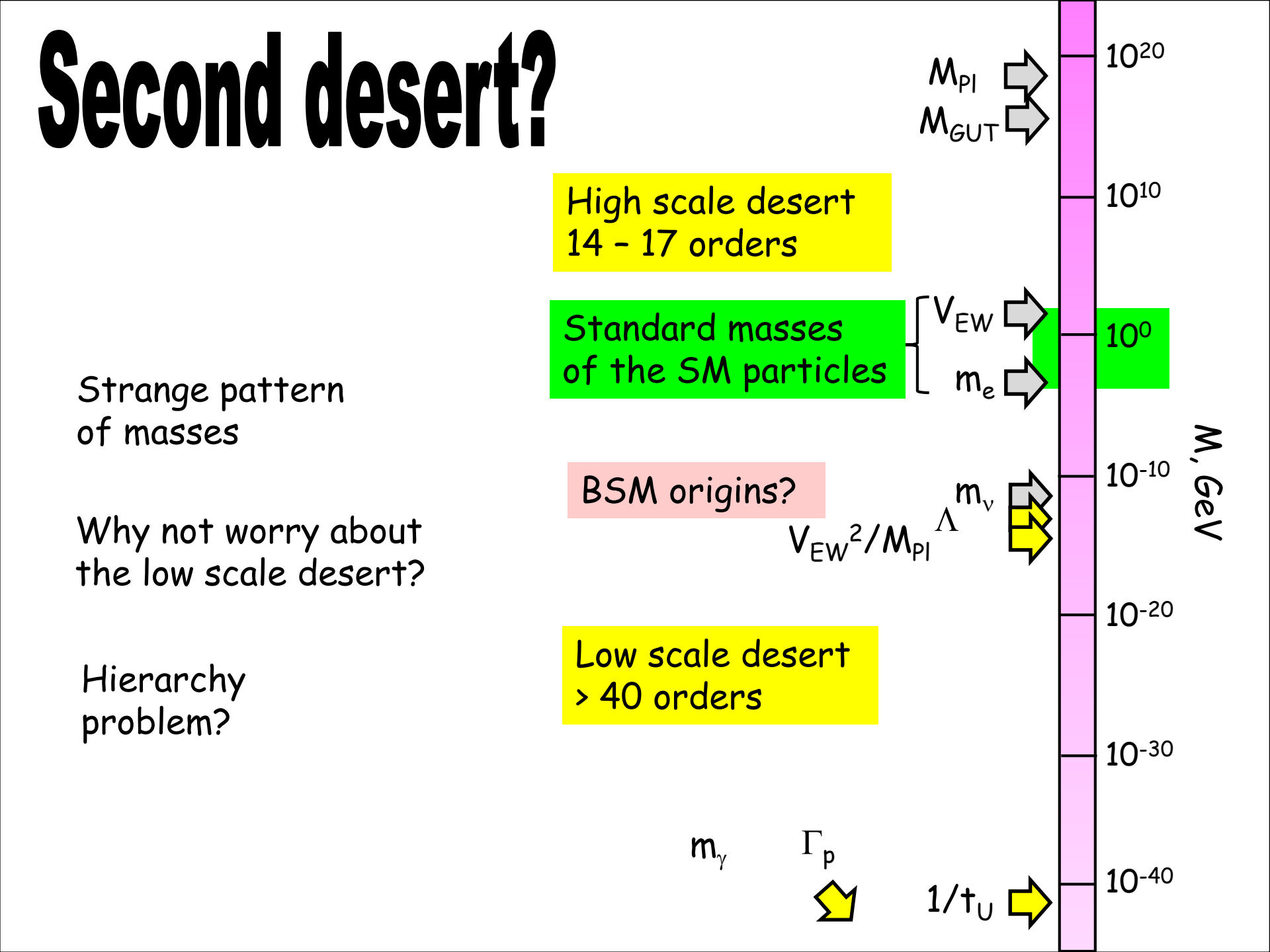
10^{-10}

10^{-20}

10^{-30}

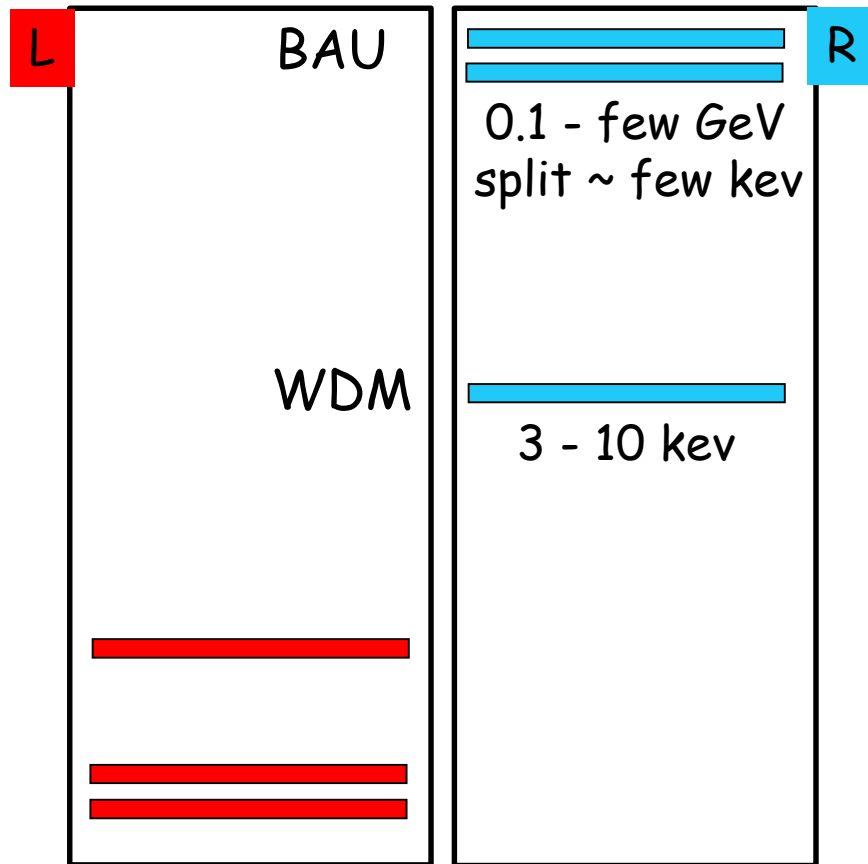
10^{-40}

M, GeV



ν MSM and nothing more?

nuMSM with UV completion at the string-Planck scale



- small neutrino mass, seesaw,
- lepton asymmetry via oscillations
- can be produced in B-decays ($BR \sim 10^{-10}$) etc., SHiP

- decouples from generation of neutrino mass, RHN?

- radiative decays \rightarrow 3.5 keV line?

- one active neutrino is massless

Connections

Strong CP problem, Axions

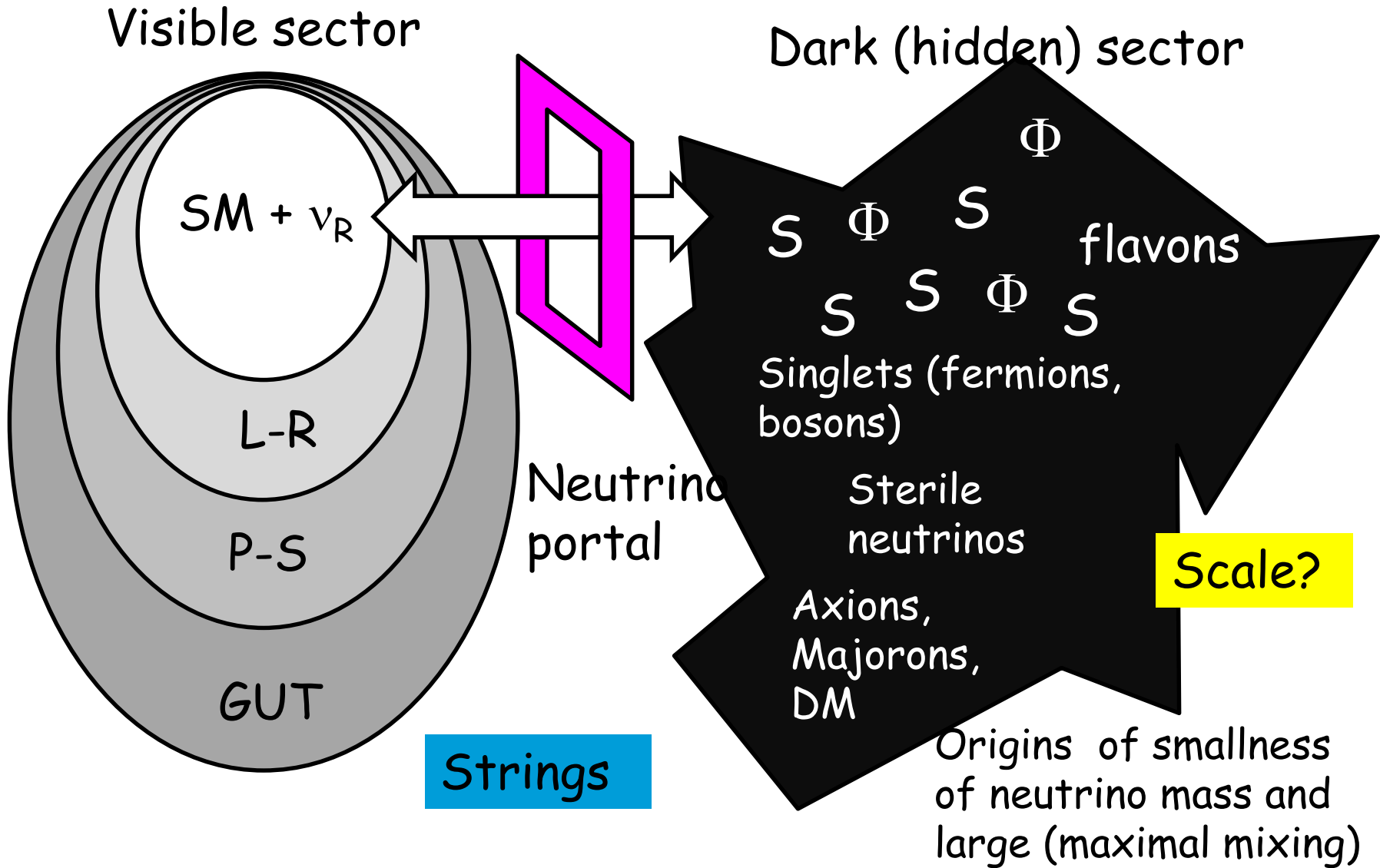
Gauge Hierarchy?

Extra Dimensions

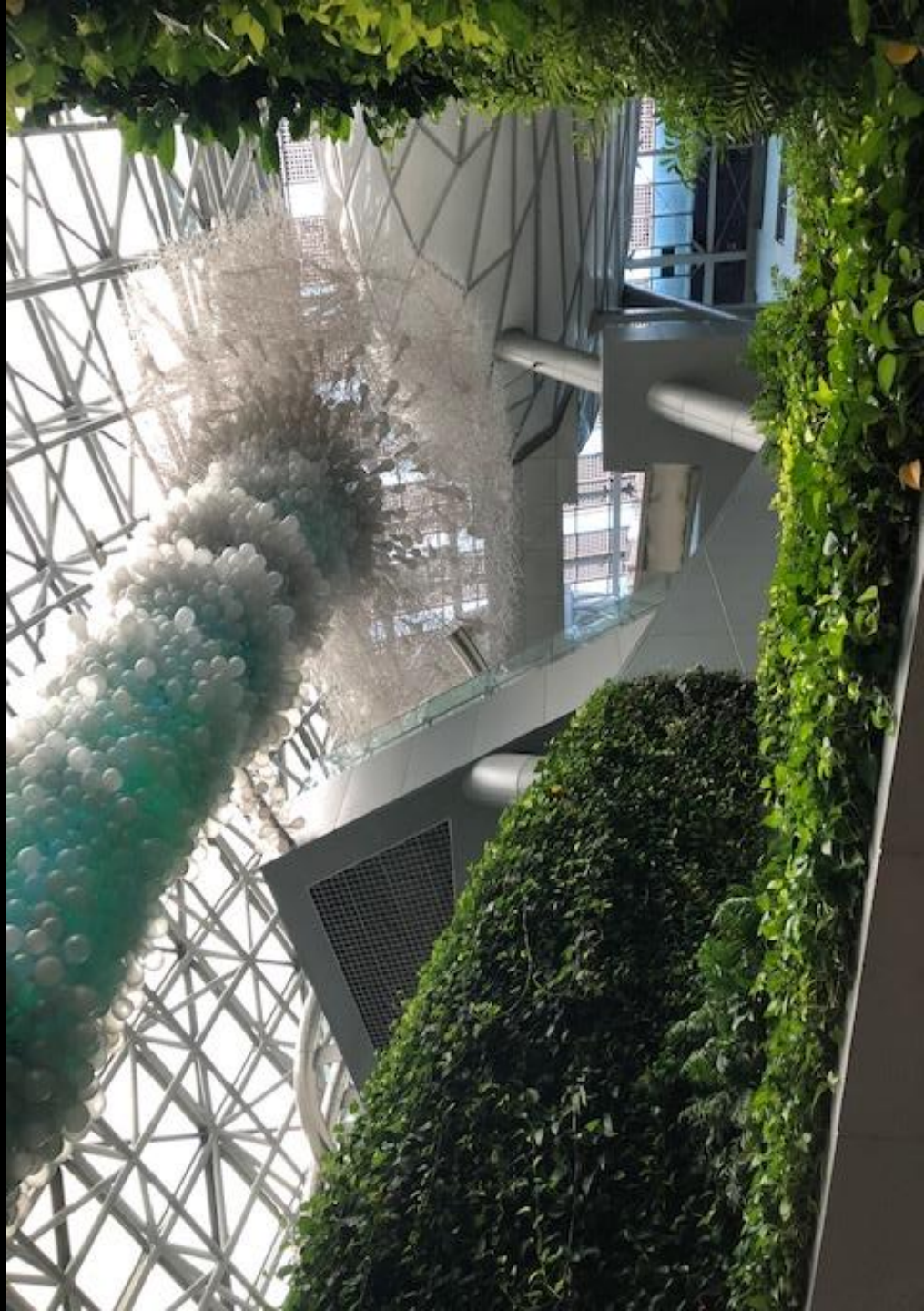
Modulinos



Neutrino mass and mixing from the Dark sector



Questions



SM new physics - impressive progress in detection of small recoils, momenta transfer - new capacities

Is detection of relic neutrinos feasible?

Concerning new physics BSM at low scales

Are we looking for nothing?
- just move borders of unexplored territory without clear indications where to look for?

What are real evidences of low scale new physics?

What is the status of various anomalies and their interpretation in terms of sterile neutrinos or other light particles?