

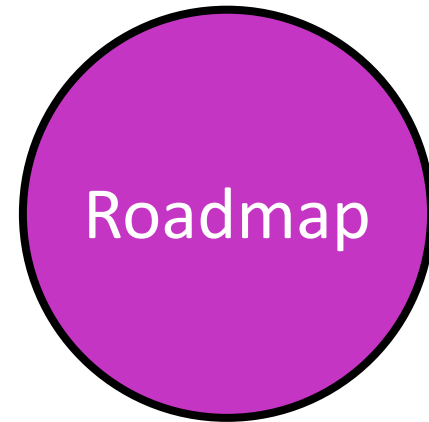
# Pillar 1 contributions to SERI Roadmap

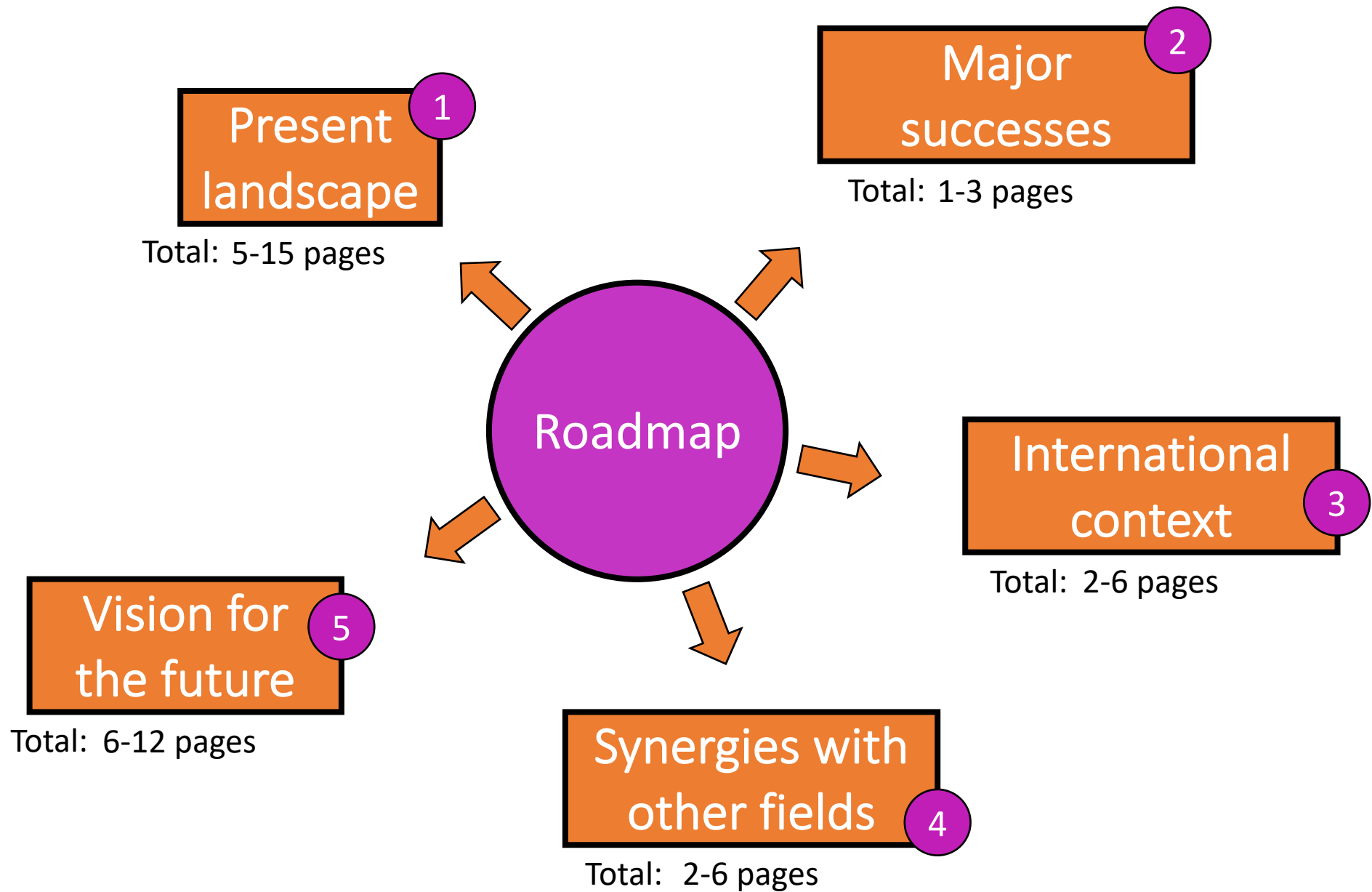
For discussion at Kandersteg Workshop

27-28 August 2020

Anna Sfyrla, UniGe







Based on guidelines received; listing here items related to Pillar 1 specifically

# What follows?



Goal of the Pillar-1 editing sessions:

- 1 Discuss and agree on content at “high level”
- 2 Proceed to detail editorial discussion in groups
  - a Thursday: Items 1-4
  - b Friday: Item 5
- 3 Review what has been produced in the end

## Agenda

Thu 13:45-15:15
1 2a
Fri 09:15-10:45
1 2b
Fri 11:15-12:15
3

In what follows, the contents of the document that was circulated on Monday are presented in summary to discuss point 1 from the list above.

- Hoping everyone has read the document and knows the contents in more detail than what is presented here
- Please discuss!

# What follows?



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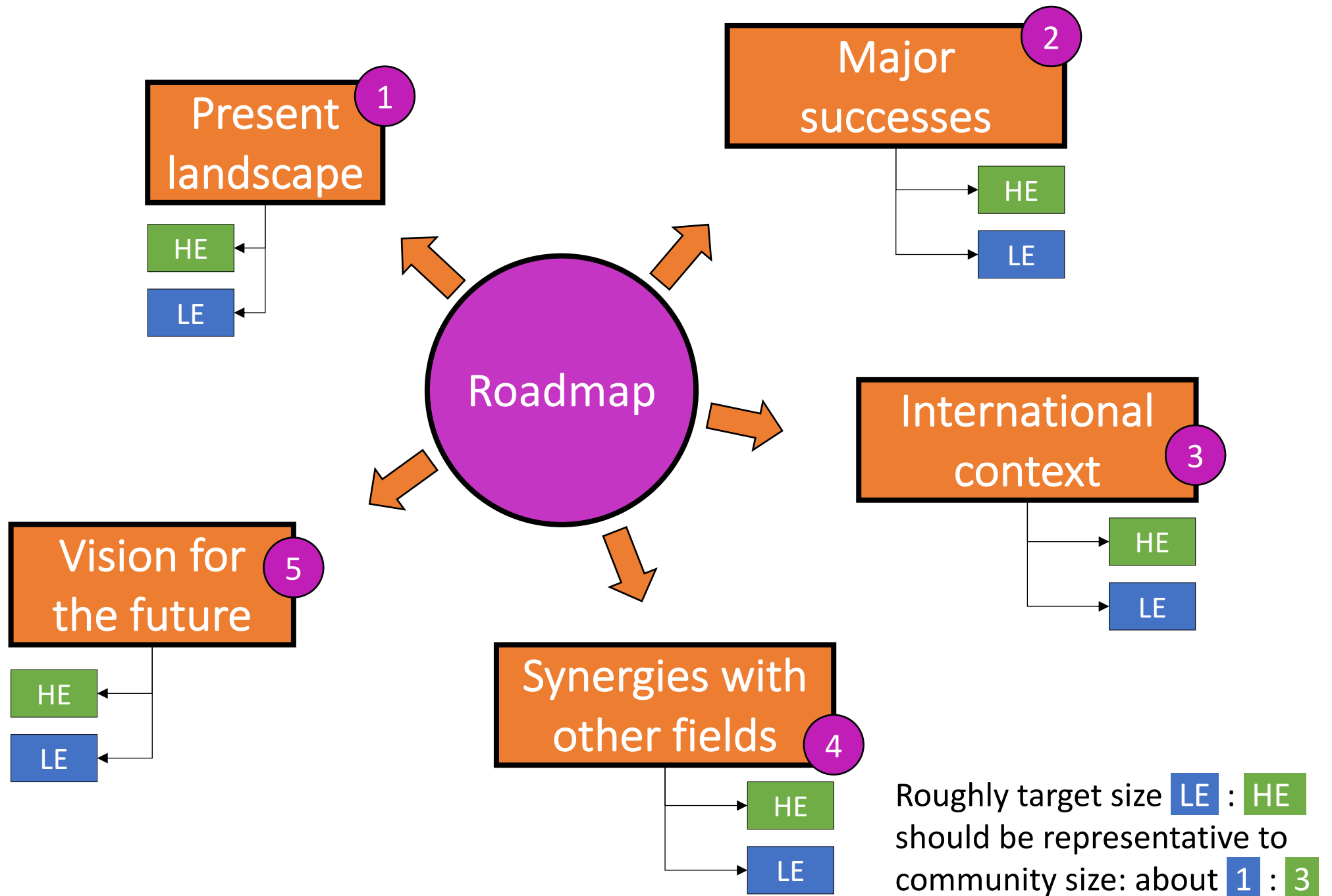
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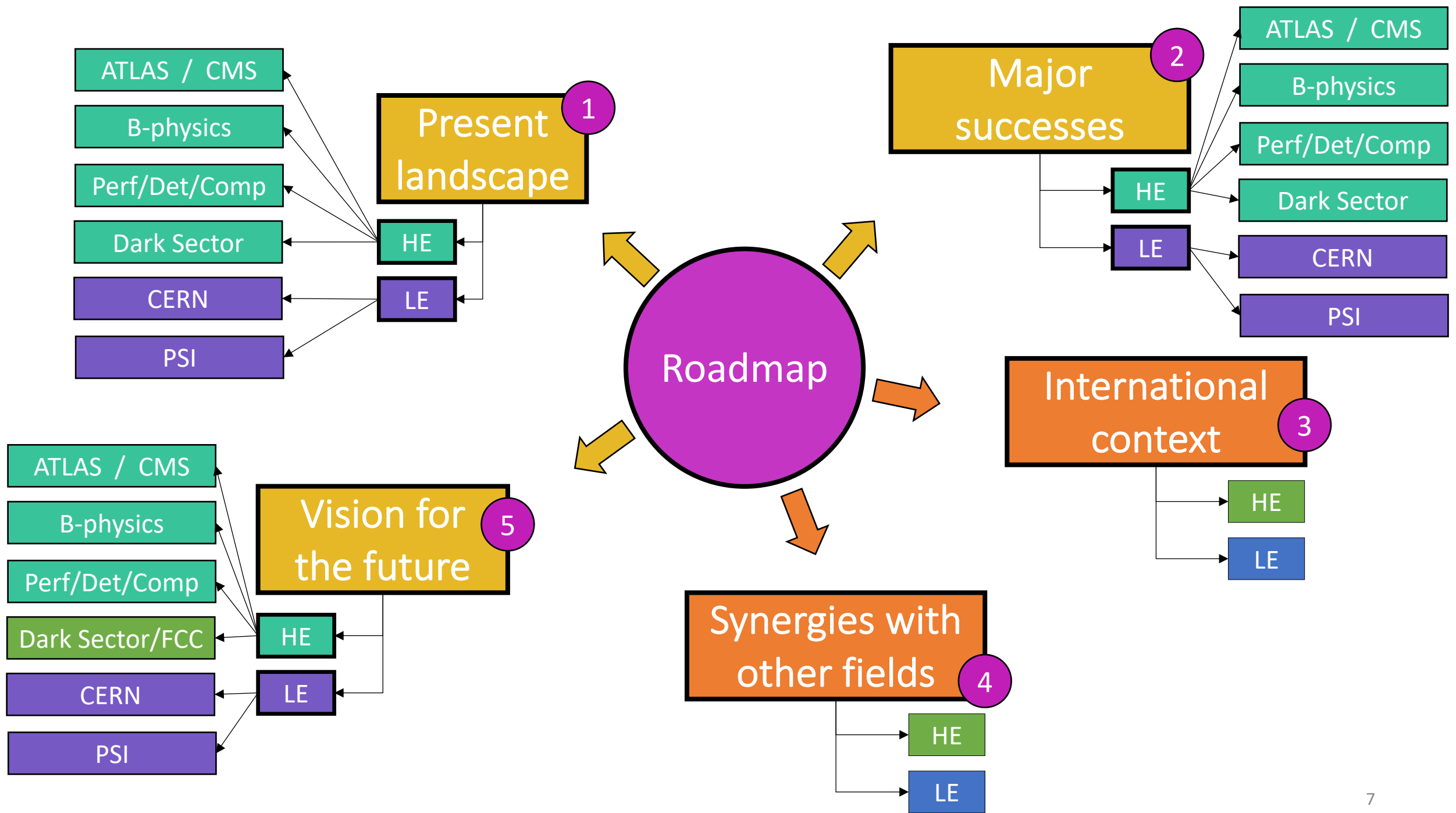
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1

+ theory

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ATLAS / CMS

B-physics

Perf/Det/Comp

Dark Sector

CERN

PSI

All ATLAS / CMS physics except B-physics

B-physics (and other HF – except top) at CMS and LHCb

Performance, detector, computing, for all HEP experiments

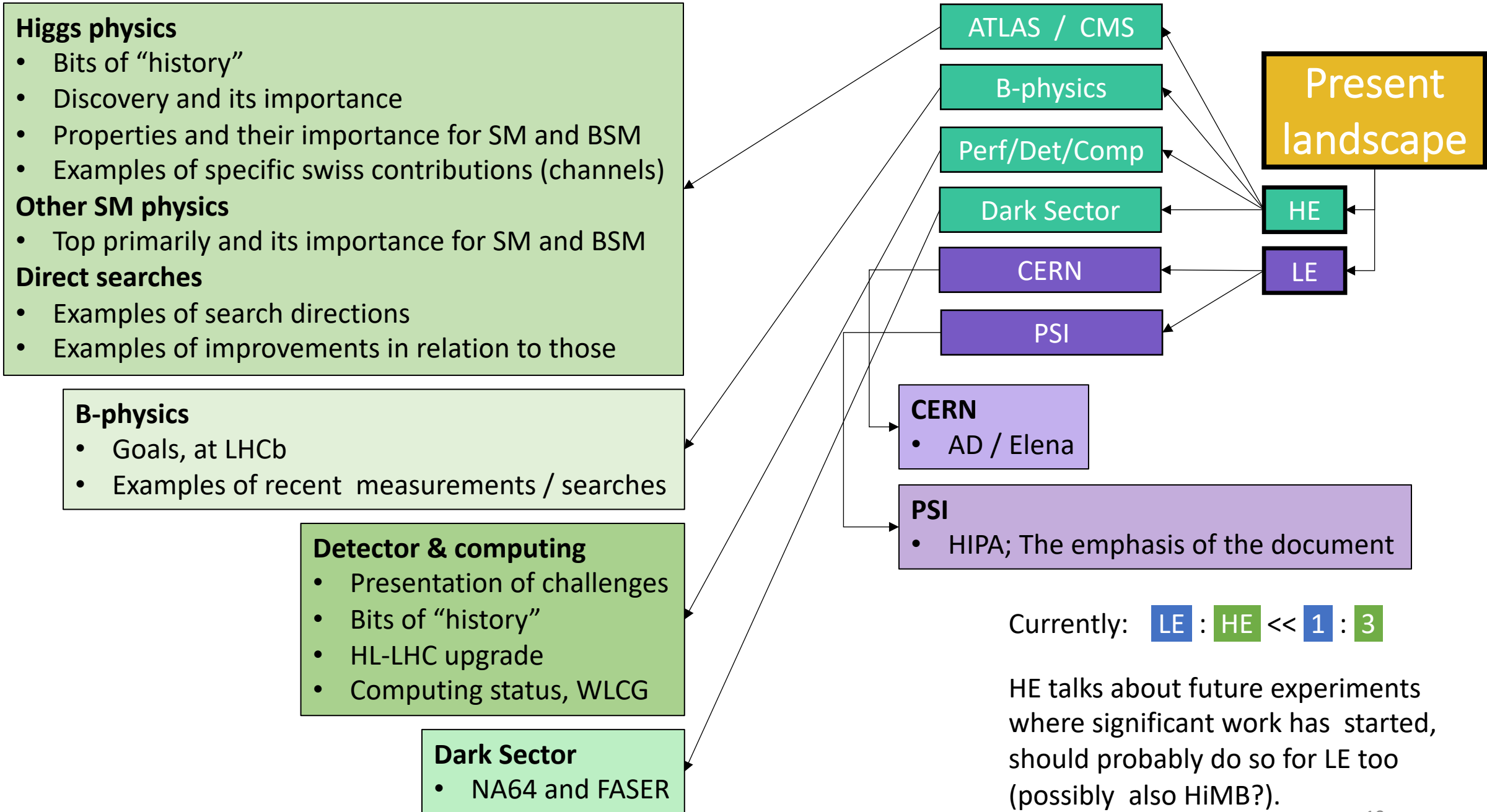
Experiments beyond BSM searches at ATLAS, CMS, LHCb

Disclaimer:  
These are not chapters in the roadmap, just the topics treated in the document, categorized under these labels and with this sequence



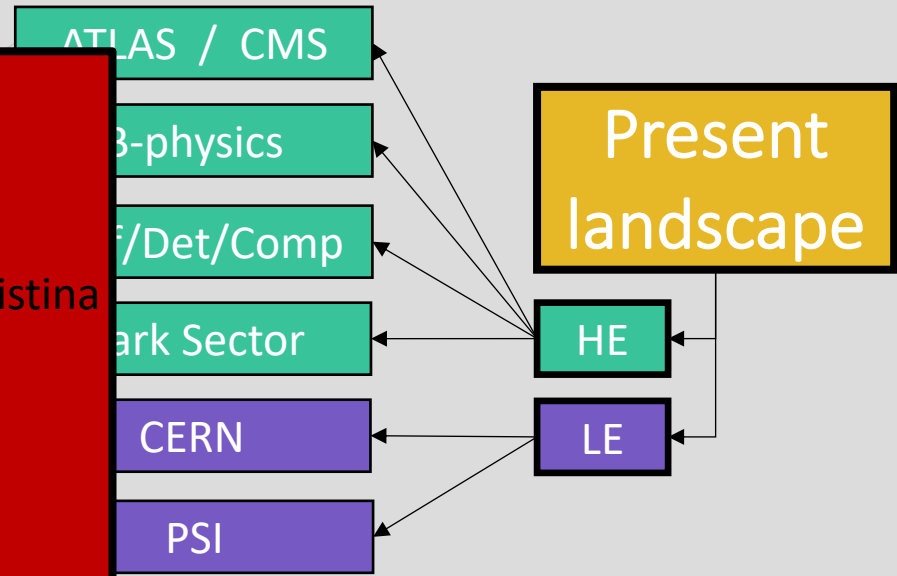
## General editorial actions:

- 1. In any further editing, remember to keep the level to ~ outreach**
- 2. Make text more concise and brief**
3. Add short introductions / summaries to all chapters
4. Where possible, merge HE and LE
5. Consider whether dark sector parts should include current LHC (ATLAS and CMS) status or whether dark-sector-related discussion is OK left together with other BSM for ATLAS and CMS
6. Make more clear the swiss contributions (as a final review step)
7. We need to point out synergies between all pillars (intro/summary)



## Primary actions:

1. Reduce (significantly) detail in Higgs Ben
2. Add concrete summary of results of searches Cristina
3. Add motivation to recent B-physics excitement (flavor anomalies and pentaquarks) Olivier
4. Add efforts on B-physics from CMS Olivier
5. Balance NA64/FASER and introduce back SHiP at high level, i.e. as enabler of dark sector program (e.g. PBC at CERN) with important swiss contributions Anna - Nico



- Bits of "history"
- HL-LHC upgrade
- Computing status, WLCG

- Dark Sector**
- NA64 and FASER

Currently: **LE** : **HE** << **1** : **3**

HE talks about future experiments where significant work has started, should probably do so for LE too (possibly also HiMB?).

(2017-2020)

# Major successes

HE

LE

ATLAS / CMS

B-physics

Perf/Det/Comp

Dark Sector

CERN

PSI

## Higgs physics

- $H \rightarrow \gamma\gamma, \tau\tau, bb; ttH$
- Connection to BSM via detailed measurements

## Other SM physics

- Top: 4-top, tt+jets

## Direct searches

- SUSY and dark-matter searches

## B-physics

- Reference to  $B_s \rightarrow \mu\mu$

## Detector & computing

- Detector performance
- Progress in upgrade
- Computing infrastructure

## Dark Sector

- NA64 results
- FASER approval

## CERN

- Should GBAR be mentioned here?
- Anything else?

## PSI

- Results reported for nEDM, MEG, CREMA, Mu-MASS, muX
- HiMB introduction and muCool

Currently: **LE** : **HE** = **1** : **2**

(2017-2020)

## Major successes

HE

LE

ATLAS / CMS

B-physics

Perf/Det/Comp

Dark Sector

CERN

PSI

## Primary actions:

1. Reduce Higgs Ben
2. Enhance B-physics, also adding CMS contributions now limited to BSM B-physics (if needed!) Lesya
3. Add something on GBAR milestone Paolo
4. Add something on MICE, maybe linked to results from muCool (think how) Alain

### CERN

- Should GBAR be mentioned here?
- Anything else?

### PSI

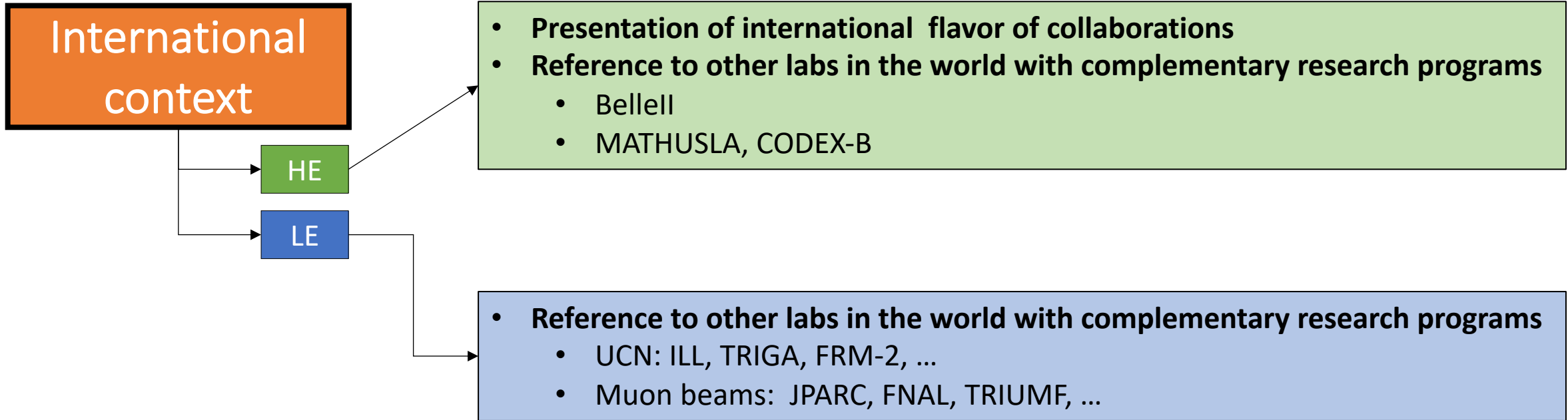
- Results reported for nEDM, MEG, CREMA, Mu-MASS, muX
- HiMB introduction and muCool

- Progress in upgrade
- Computing infrastructure

### Dark Sector

- NA64 results
- FASER approval

Currently: LE : HE = 1 : 2



Currently: **LE** : **HE** = **1** : **1**

## Synergies with other fields

HE

LE

- **Higgs physics**
  - detector technology, methodology, theory (solid state, cosmology)
- **Data analysis (machine learning) and modern engineering**
- **Detector development**
  - Material science and engineering
  - Medical imaging
- **Computing, networks**

- **Technology transfer**
  - Use of technology and know how to other applications
- **Particles as probes**
  - Material science, chemistry, medical physics, ...
- **Transfer of technology from other fields**
- **Examples given for each of the three categories**

Currently: LE : HE = 1 : 1

## Synergies with other fields

HE

LE

### Primary actions:

1. Merge HE and LE, removing specific connections to Higgs. Use categories introduced at LE and use examples in a way that makes the case strongest (per category). No need to keep LE:HE ratios here. Do this merging globally for all pillars, when each individual contribution is mature enough.

Annapaola

- Use of technology and know how to other applications
- **Particles as probes**
  - Material science, chemistry, medical physics, ...
- **Transfer of technology from other fields**
- **Examples given for each of the three categories**

Currently: LE : HE = 1 : 1



**Higgs physics**

- Emphasis to HH and H->fermions. Also BSM, e.g. H->μτ

**Indirect searches**

- Top and EFTs in connection to BSM

**Direct searches**

- Examples of search directions

**Detector upgrade in connection to physics goals**

- Examples of timing detector and tracking at trigger

**Performance improvements**

- Trigger, reco, simulation
- Mention of machine learning as a tool

**B-physics**

- A potential HL-LHC upgrade introduced and motivated

**Detector & computing**

- Focus: commissioning, operation and RnD for beyond
- Potential HL-LHC Run5 upgrades
- Heterogeneous computing, ML and HSF

**Probing particle physics further**

- NA64 upgrade, FASER2
- FCC

- ATLAS / CMS
- B-physics
- Perf/Det/Comp
- Dark Sector/FCC
- CERN
- PSI

Vision for the future

- HE
- LE

**CERN**

- AD / Elena
- GBAR

**PSI**

- UCN
- HiMB: most important facility project
  - MEGII and mu3e

Currently: LE : HE = 1 : 3

## Primary actions:

1. Add an extended introduction / global vision that outlines the complementarity of all machines (HL-LHC, FCC and at PSI, primarily HiMB). Add a timeline for facilities/projects. Think if SHiP is to be included here. Gino/Klaus
2. Condense Higgs (e.g. remove details in channels) and add FCC prospect. Mention importance of top Yukawa measurement beyond HH.  
Complementarity of machines Ben
3. Strengthen EFTs (beyond just top) Florencia
4. Reduce detail in how detector connects to physics, possibly merging with other performance-related text Anna
5. Add b-physics program in Run4 for CMS and LHCb Lesya
6. Review Run5 prospects for LHCb Olivier
7. Give the importance/prospect of a SHiP-like experiment Nico
8. Add FCC detector RnD prospects and challenges Alain
9. Add CERN BASE experiment in the LE part Anna (LE)

