PerMaACC

Accelerator’s Magnets using Permanent Magnets and Recycled Magnetic Material.

A proposal from the PerMaLIC collaboration

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LEAPS League of European Accelerator-based Photon Sources

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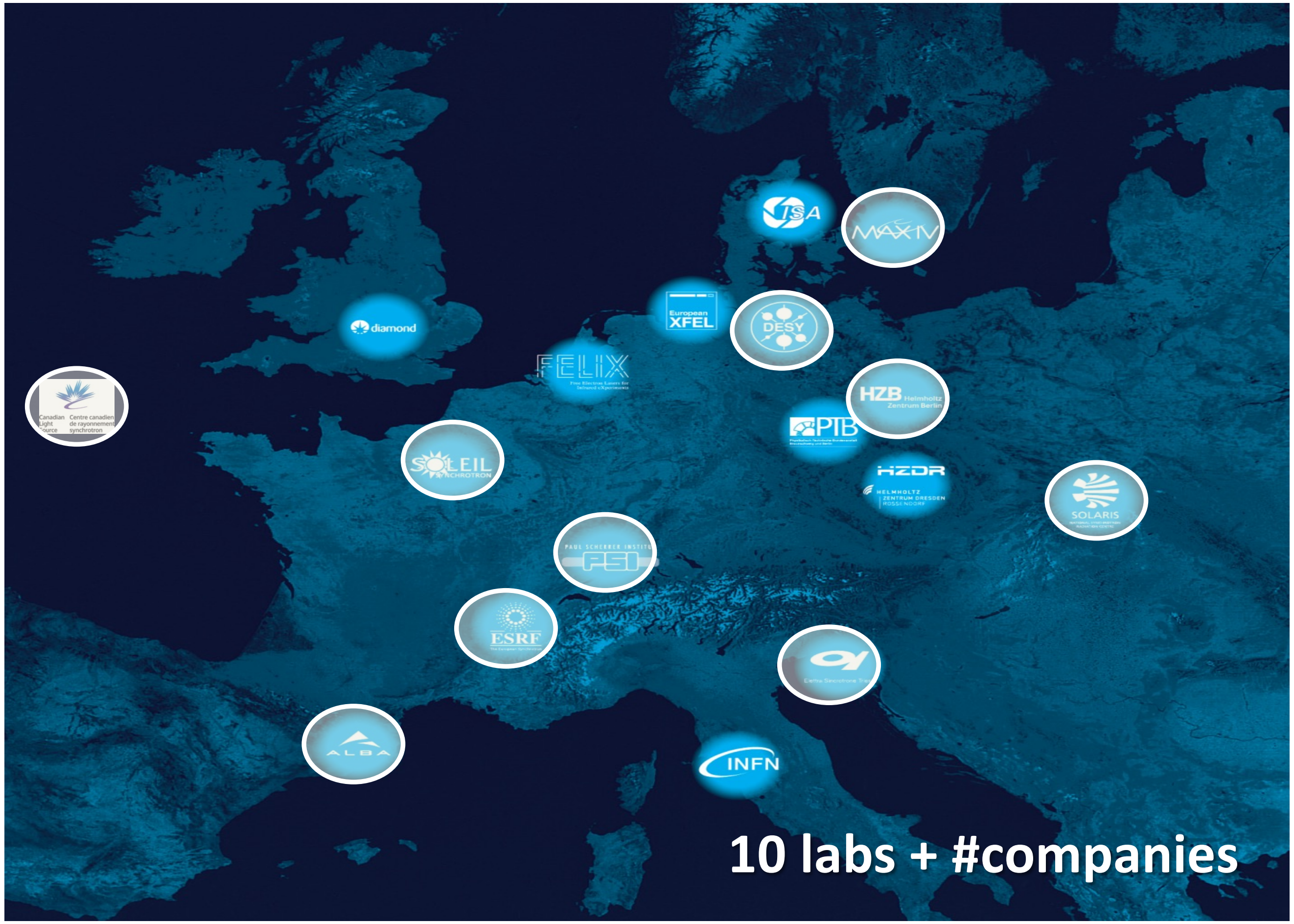

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Motivation

The **use of permanent magnets in the new light sources** has mainly two advantages: in the one hand, it allows a more compact distribution of magnets, since there is no need of coils and water cooling; in the other hand, it allows to reduce the running costs and the carbon footprint of the facility thanks to the removal of the power supplies associated to conventional electromagnets.

However, **the use of permanent magnets also presents some serious challenges**. These challenges include the loss of flexibility for some fine tuning of the beam optics and the correction of errors, needed to ensure proper beam dynamics and guarantee highest performance and stability, and the long term stability of the magnets themselves due to the risk of radiation-induced demagnetization. In order to deal with these issues the production of prototypes is mandatory.

In addition, the raw material required for the production of the permanent magnets comes from mining facilities in China, and requires a heavy process of chemical processing, solvent extraction, electrolysis and casting to produce the powder used for sintering the magnets, a process with very large environmental cost. In this sense, the possibility of **using recycled magnetic material from used magnets, to produce new ones**, shall be a goal in a Circular Economy.

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Goals

The goal of the proposal is two-fold, from one side, **to produce prototypes** which would validate the techniques required for series production of the magnets needed for new accelerators, which need to comply with the required magnetic quality specifications, including long term stability, and which shall have built-in tunability to cope with the required flexibility for tuning and error correction.

On the other hand, **to establish the methodology to produce magnets from recycled material**, and validate the process with a “green magnet” prototype, by comparing it with an identical magnet from standard production processes.

In addition, **developments on the measurement system set-ups, and on tools for safely manipulate permanent magnets**, will be jointly pursued in order to ensure proper measurement of small bore combined function accelerator’s magnets, and safe assembly of series of permanent magnets.

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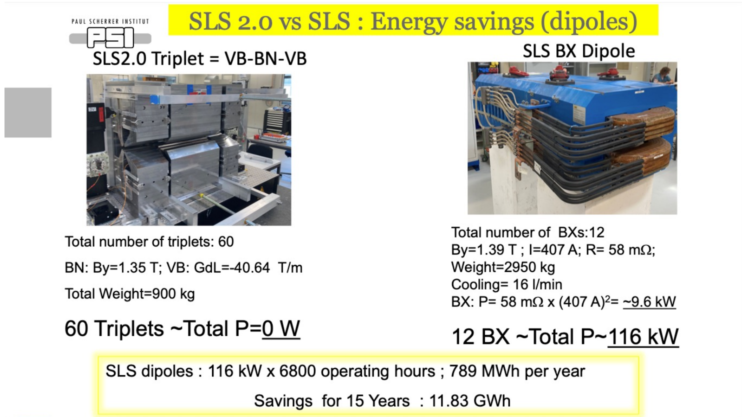
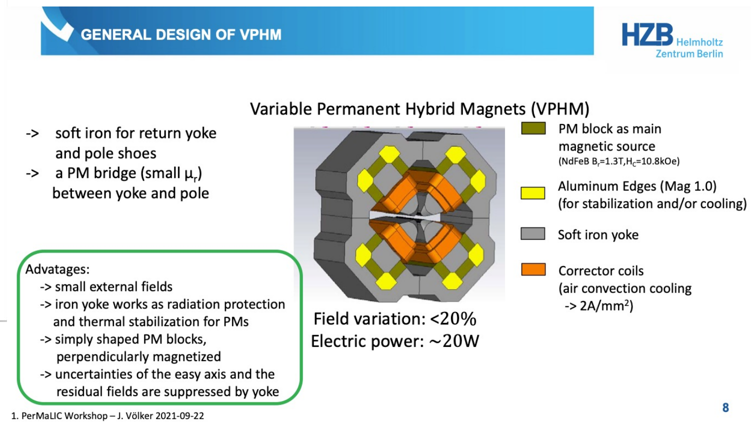
Objective 1. **Design of accelerator's magnets**

This objective will be covered by the research labs, with **several designs** to be developed, covering different aspects and kinds of Accelerators Magnets.

Combined function



Hybrid, PM + tunning coils



Partners: ALBA, CLS, DESY, ESRF, HZB, MAXIV, SOLARIS, SOLEIL

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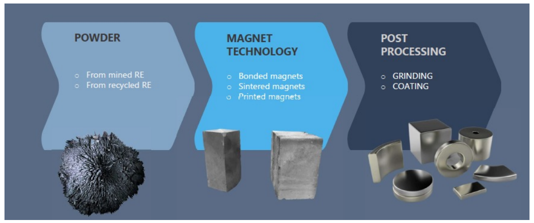
Objective 2. Production of permanent magnets from recycled material and customization of fabrication procedures

This objective will be covered mainly by industrial partners, with the following two aspects:

- **Recycle material**: Collect permanent magnets from the partner labs and recover the rare earth through a hydrogen-based technology.
- **Produce permanent magnets** by sintering it **out of the recycled material**.



Partners: MagREEsource (https://www.magreesource.org) , Vacuumschmelze, CLS, ELETTRA, ESRF

Other possible partners, not yet contacted: Urbanmining (http://www.urbanminingco.com) , RockLink (https://www.rocklink.de/en/), https://passenger-project.eu

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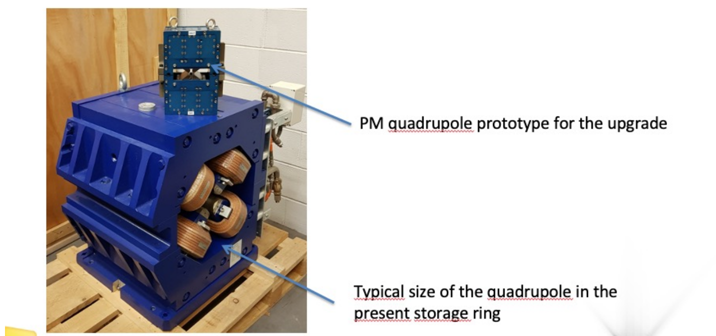
Objective 3. **Production of accelerator's magnets prototypes**

This objective will be covered mainly by industrial partners, with the **production of several prototypes**, with and without recycled material, **including twin magnets with each kind of material to compare performances**.

SOLEIL SYNCHROTRON UPGRADE

V-Quadrupole prototype



Partners: *Usual magnet companies, to be contacted.*
ALBA, CLS, HZB, MAXIV, SOLEIL

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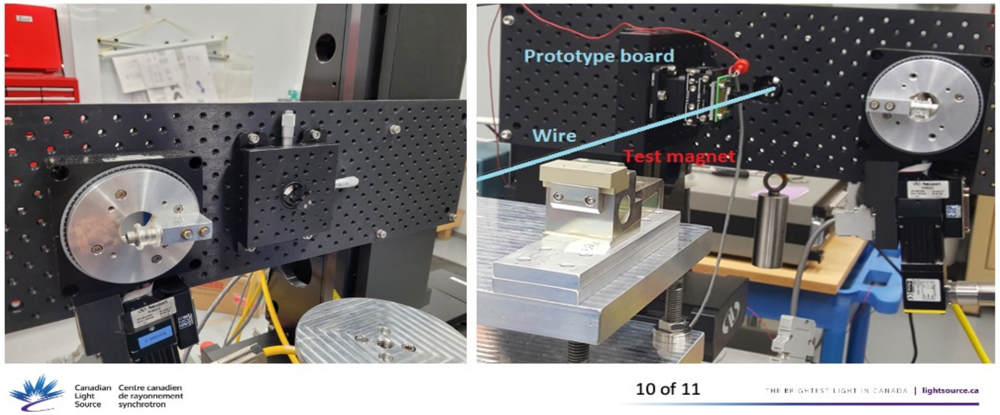
Objective 4. **Magnetic testing**

This objective will be covered mainly by research labs, with the magnetic characterization of the prototypes. This will also require **developments in the actual magnetic labs** in order to deal with **small aperture combined function magnets**, and with the **safe manipulation and assembly of series of permanent magnets**.

Vibrating Wire (VW) Prototype



Partners: *ALBA, CLS, ELETTRA, ESRF, HZB, MAXIV, SOLARIS, SOLEIL*

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Duration and budget

The duration shall be of **four (4) years**.

Budget still to be determined:

- *Several M€, depending on the final number of prototypes and companies involvement*.
- *Shall include a number of extra personnel.*

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Thanks!

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