Towards a Hamburg Haloscope.

Application for funding Andrei Lobanov to perform a feasibility study and to prepare direct WISPy Dark Matter searches in the few hundred MHz (micro-eV mass) regime.

Andreas Ringwald, DESY

SFB Block Meeting,
Geomatikum, Hamburg, 24 February 2012

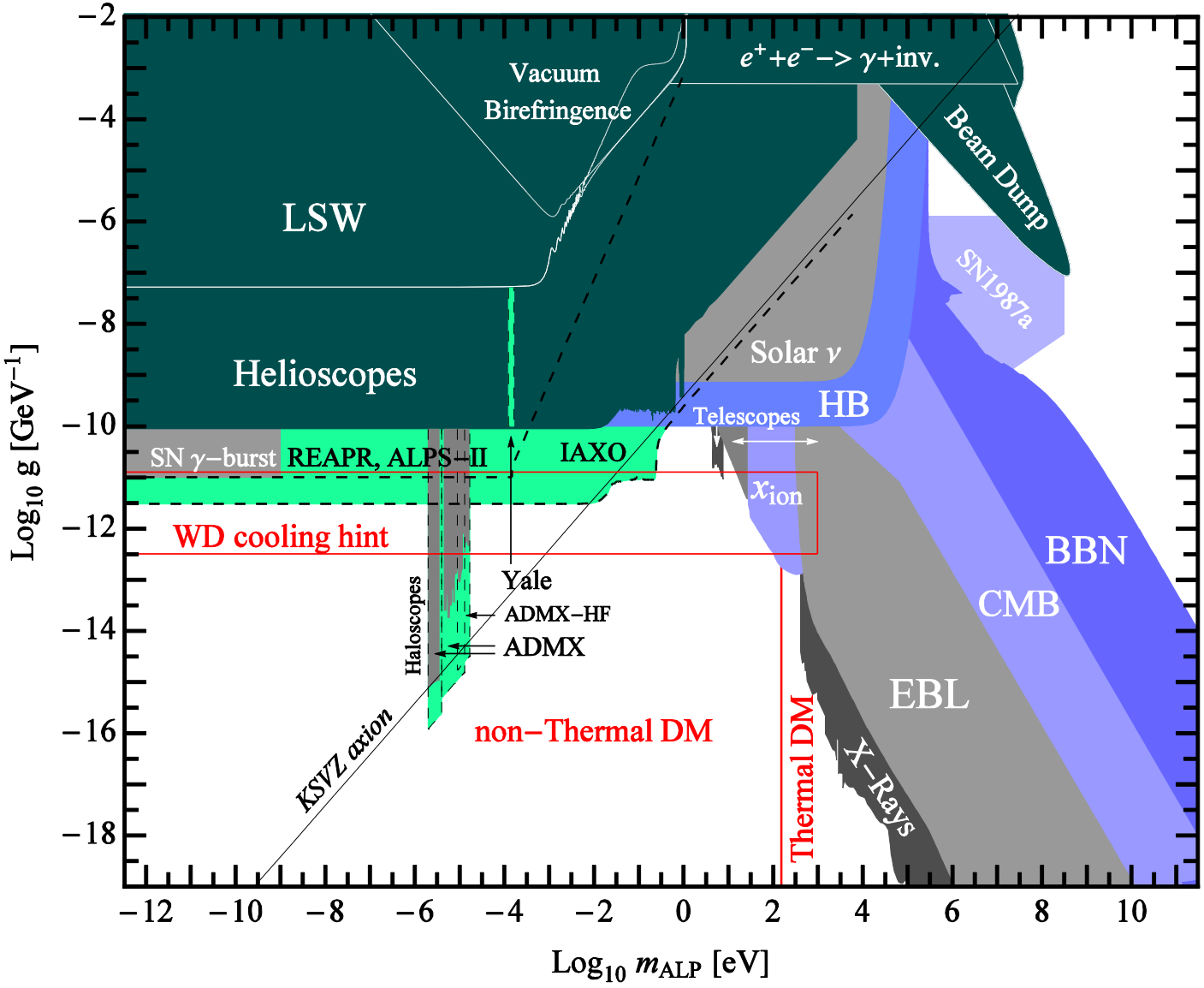
HELMHOLTZ ASSOCIATION

DESY

Scientific outline of project

- Dark Matter (DM) may consist of very Weakly Interacting Slim Particles (WISPs), produced non-thermally in the early universe: [Arias et al, 1201.5902]
  - Axions
  - Axion-like particles (ALPs)
  - Hidden sector photons (HPs)
- A wide range of WISP searches, exploiting their very weak couplings to photons, could probe large parts of the parameter range of interest for WISPy DM in the foreseeable future:
  - Light-shining-through-walls experiments (ALPS II, REAPR, …)
  - Helioscopes (SHIPS, IAXO, …)
  - Haloscopes (ADMX, …)

Scientific outline of project



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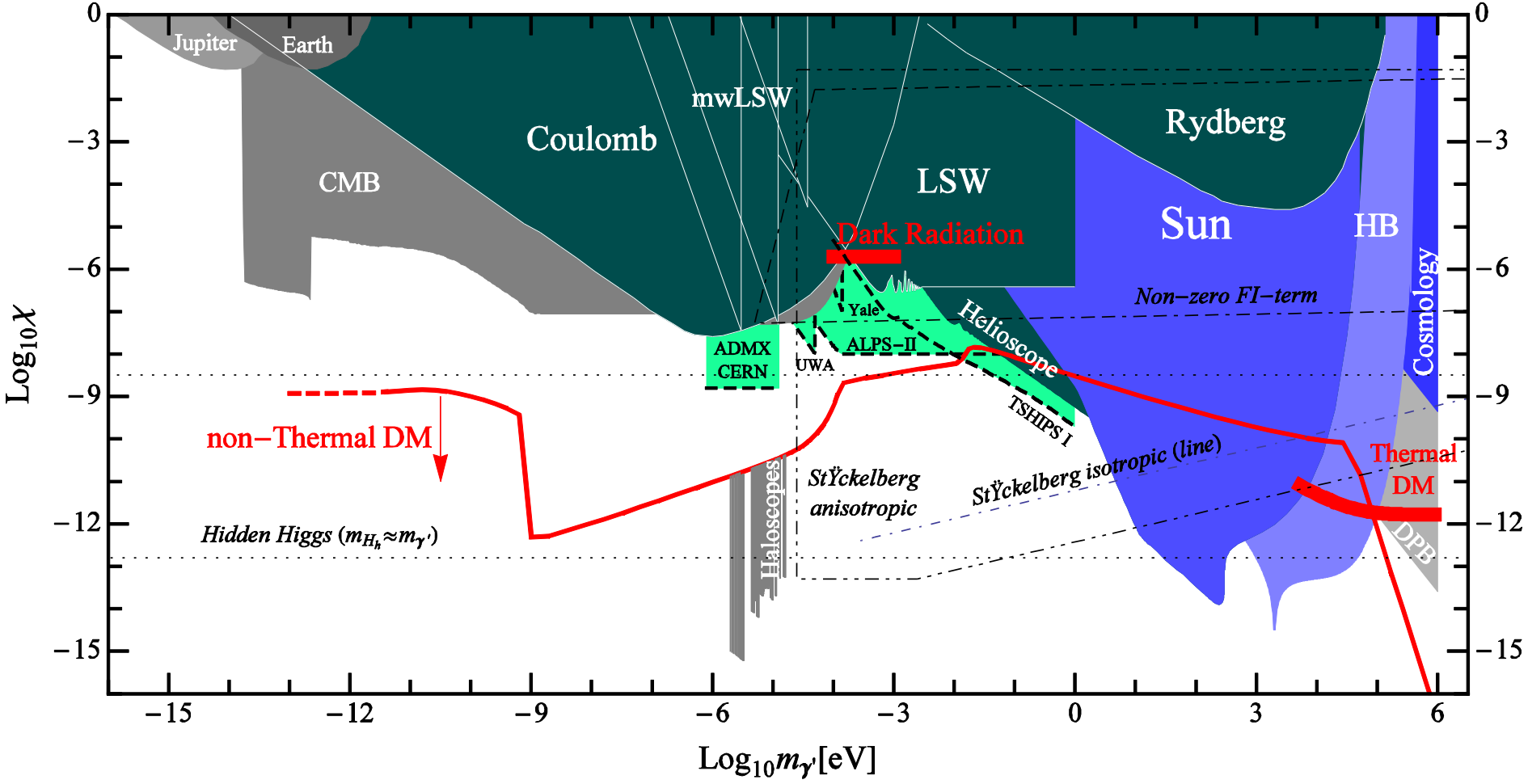
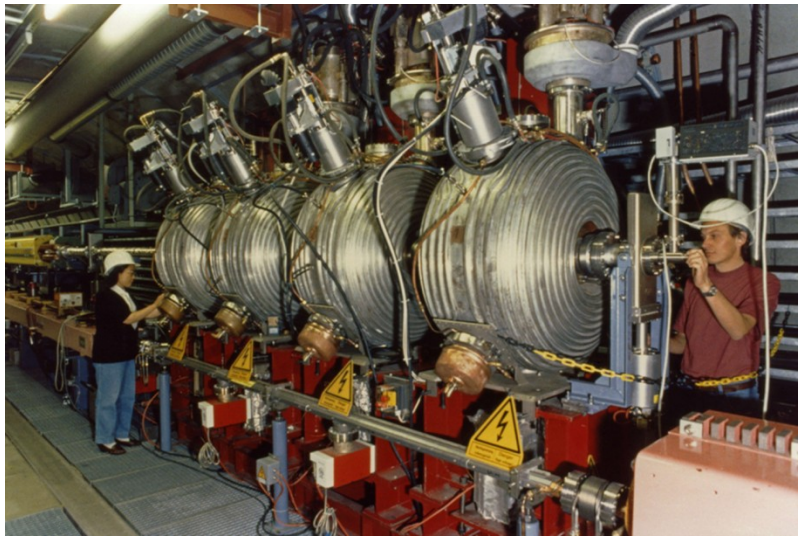
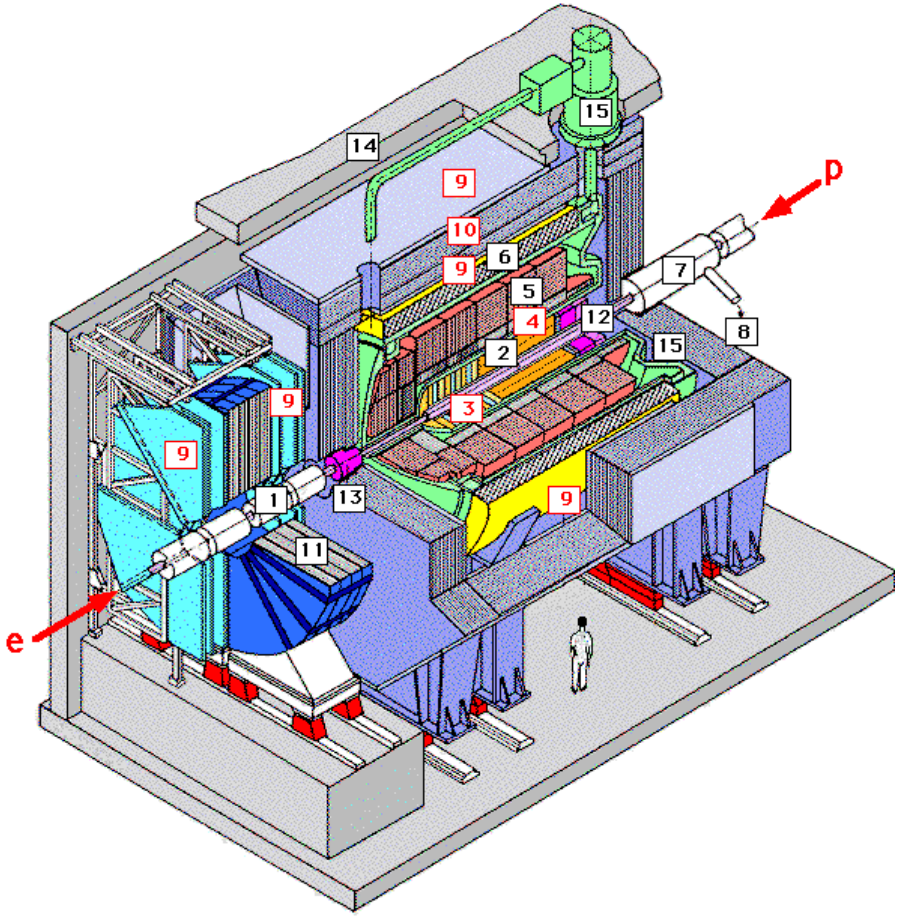


Scientific outline of project

- Towards a Hamburg Haloscope (HH)?
  - recycle HERA proton ring cavities
  - recycle H1 superconducting solenoid
  - build receiver, amplifier (MPIfR)





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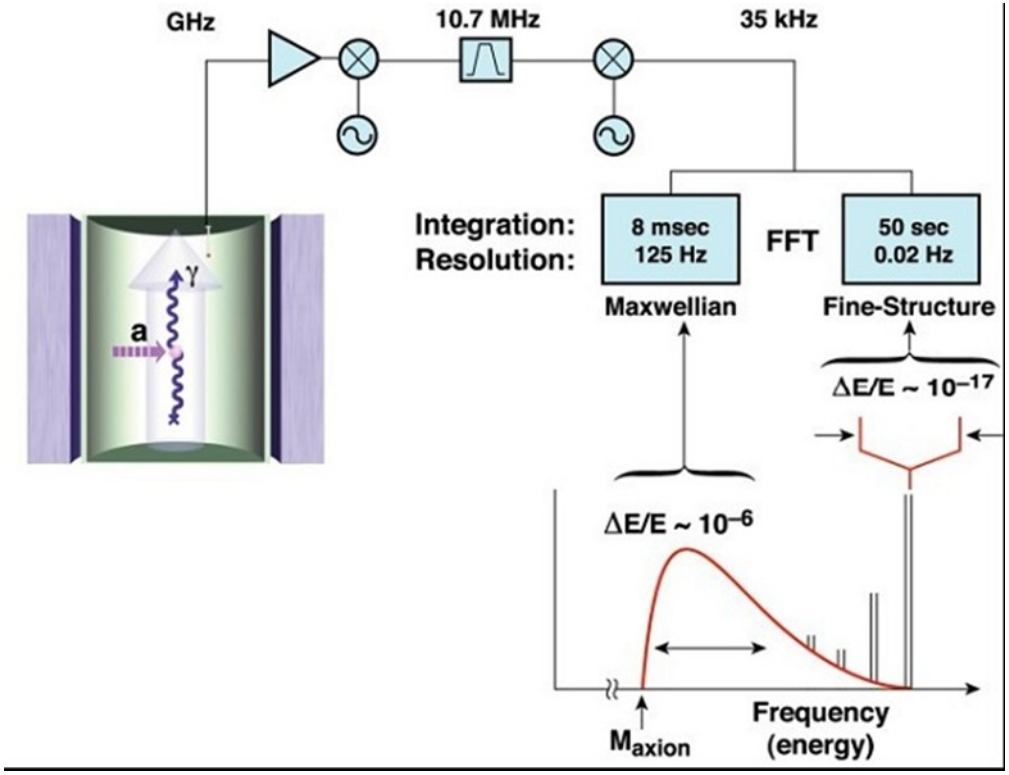
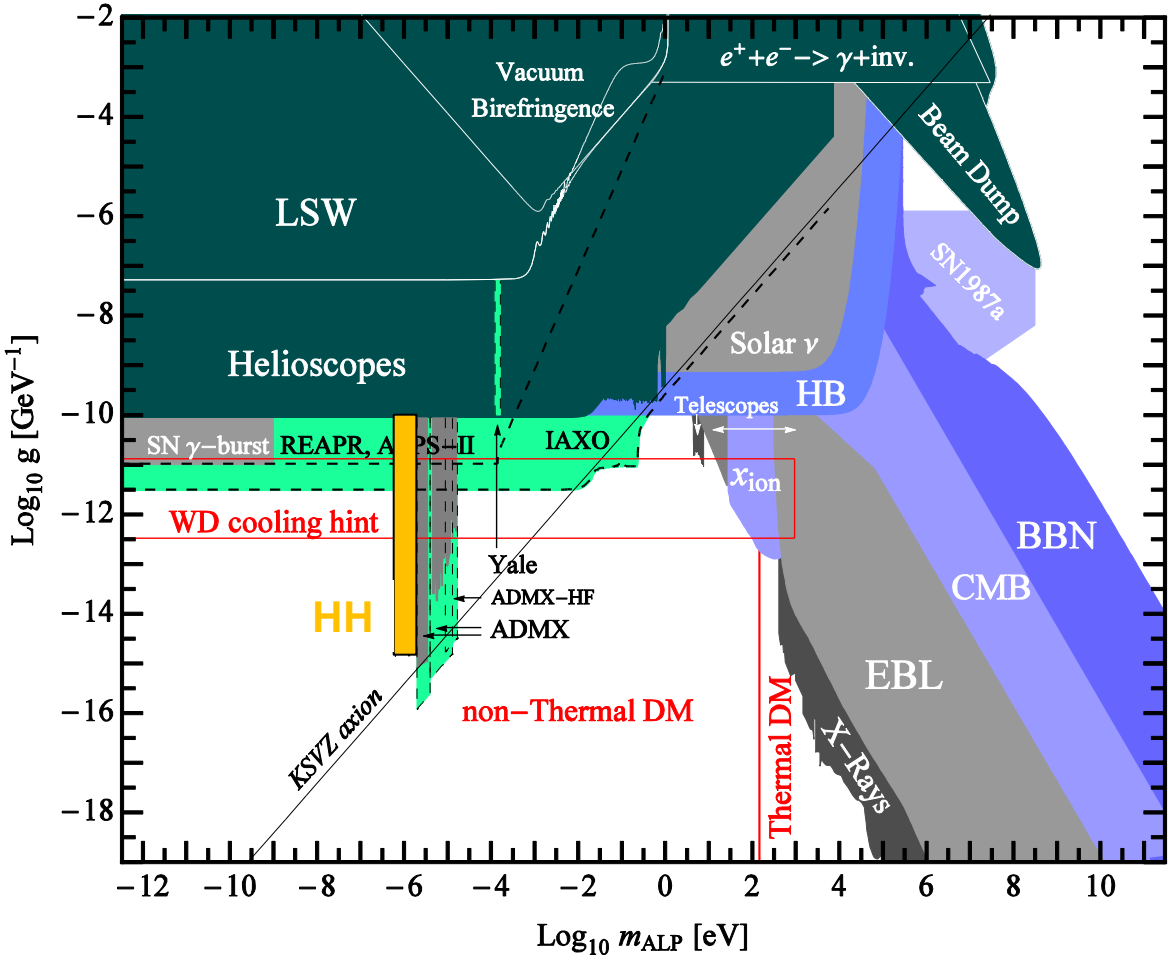


Scientific outline of project

- Can probe, at m~1e-6 eV, axion or ALP DM with g ~ 1e-15/GeV, or HP DM with chi ~ 1e-15 [Jaeckel,Lindner,Lobanov,Möller,AR,Sekutowicz,Trines,Westphal]



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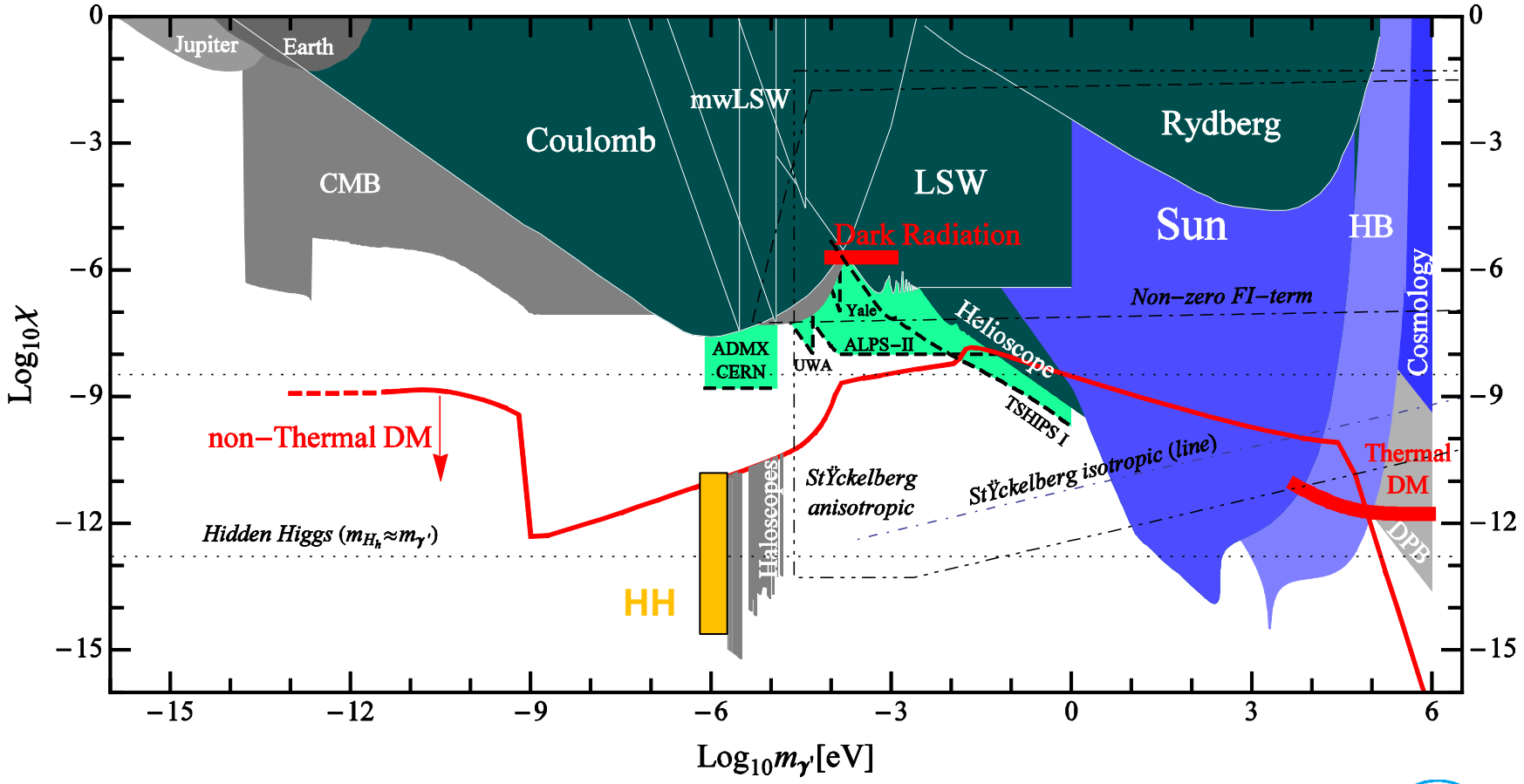

Scientific outline of project

- Aim of project: Comprehensive feasibility study for Hamburg Haloscope (HH), together with first experimental tests, carried out by Andrei Lobanov from the MPIfR in Bonn
  - collaboration with him started during his SFB fellowship and his time as guest of project C2
  - design and preparations for the first experiments will take about 9-12 months in total and will require Andrei Lobanov to invest 6 months of his working time in the project
  - During this period, Andrei Lobanov will have to give away part (50%) of his duties and responsibilities within the MPIfR, and this will require the MPIfR to fund substitute manpower for these tasks. The LSF funding at a half-position level is therefore needed for Andrei Lobanov to be able to work on the project and also to coordinate the project activities in Bonn related to providing a radio frequency detector setup for the measurements. The anticipated involvement of other MPIfR staff (Electronic Division) in the project activities will be fully funded by the MPIfR.
- Budget: One Year funding for 50% of TVöD 15/4, approx. 41.000 €
- Travel costs (Bonn-Hamburg; BahnCard25; 24 x 138 €) …. 3.312 €
- Start: April 2012

Compatibility with SFB/LEXI and relations to other SFB/LEXI projects

- The project proposed brings crucial experimental information for particle physics beyond the Standard Model (most notably for string theory) and for cosmology (addressing the issues of the dark matter) – the central areas of research in the SFB 676 and LEXI.
- The project will complement and enhance the SFB/LEXI research, in particular the SFB projects A1, A3, A4, B1, B2, B8, C1, and C2.
- The regions in parameter spaces to be explored are complementary to the ones probed by the local light-shining-through a wall experiment ALPS II and the helioscope SHIPS.

Further statements and infos

- **Clearly all of the following criteria are fulfilled:**
  - added value for the SFB clearly visible
  - scientific topic should be central to the SFB
  - new /strengthened connection between projects and/or topics
  - high risk project
- **Possible continuation after this funding terminates:**
  - Andrei Lobanov and myself have submitted an ERC-Synergy proposal for WISP searches in the radio regime (if accepted, the funding would begin in mid 2013).
  - Andrei Lobanov is also preparing an application for a Heisenberg Fellowship with the University of Hamburg, to engage in WISP searches.
  - The result of the proposed project will be technically sound proposals for experiments. DESY is already engaged in this research field and activities in other laboratories including CERN are strengthening.
  - Recent theoretical considerations have identified WISPs as an interesting alternative to the standard picture of WIMPs as components of the DM. Hence experimental efforts to search for WISPy DM should be strengthened.
- **The LSF would be an ideal vehicle to trigger new activities in this field at the right time!**