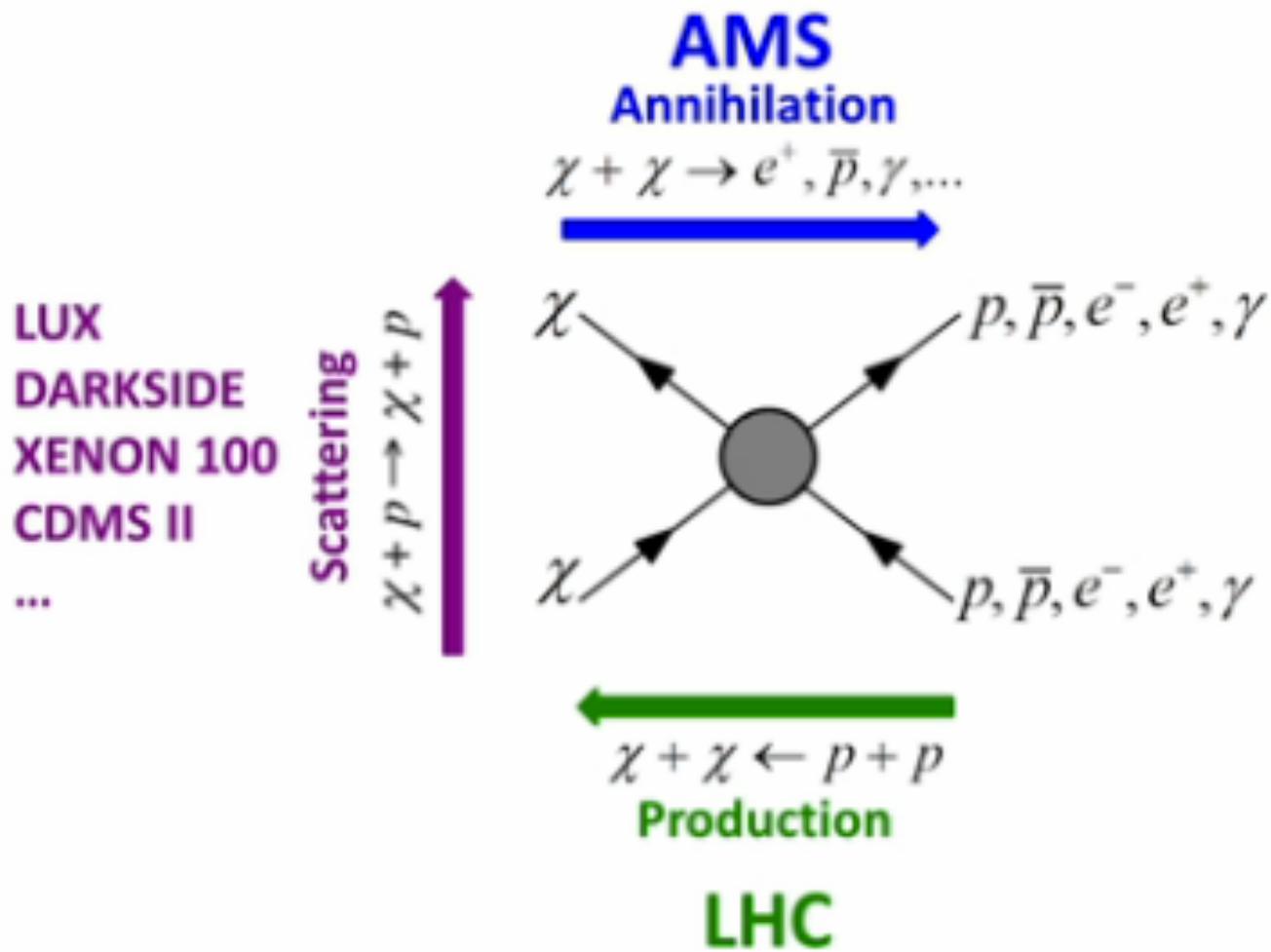


Brainstorming meeting DARK MATTER (direct search) @ LPNHE

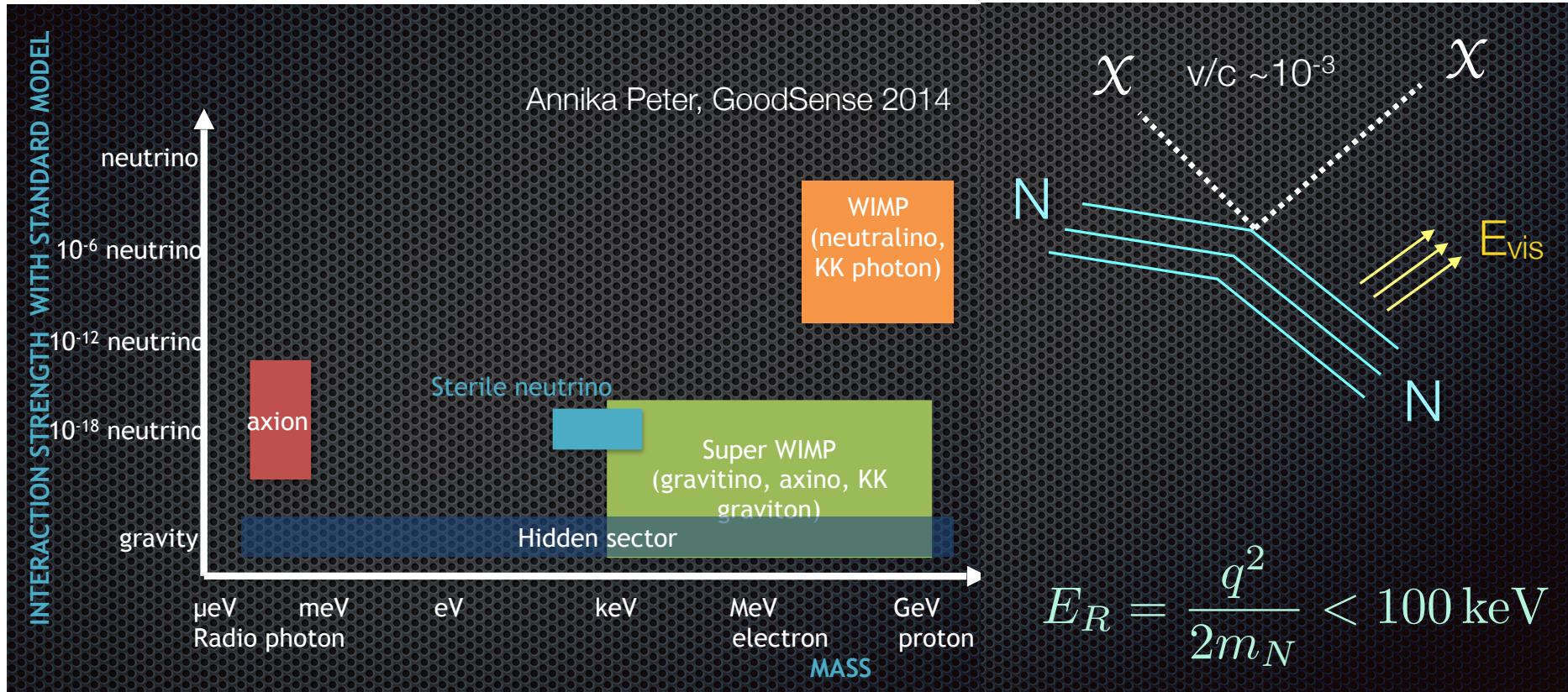
Monday September 22nd 2014

Sandro De Cecco

Three independent methods to search for Dark Matter



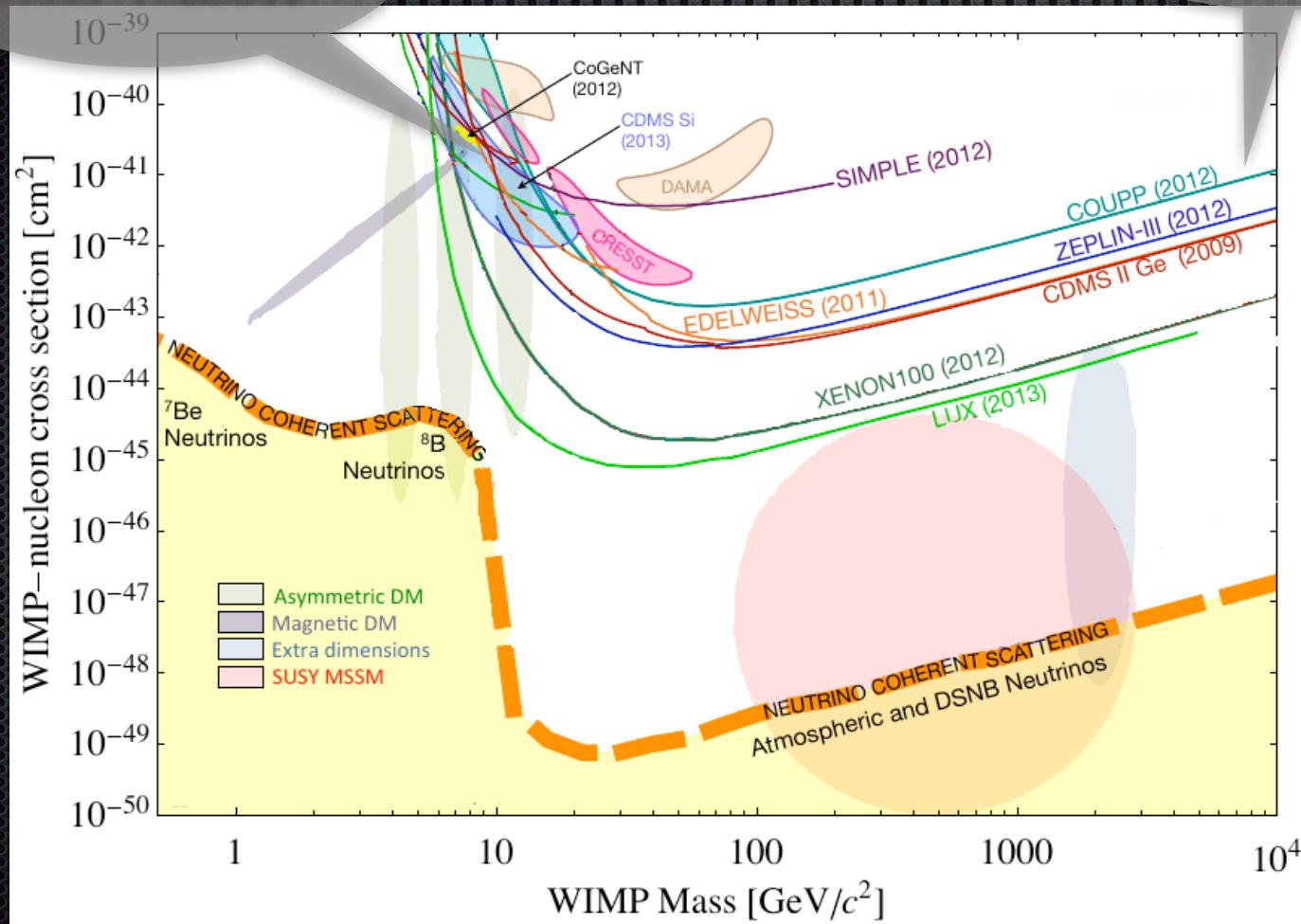
not only WIMPs DM candidates



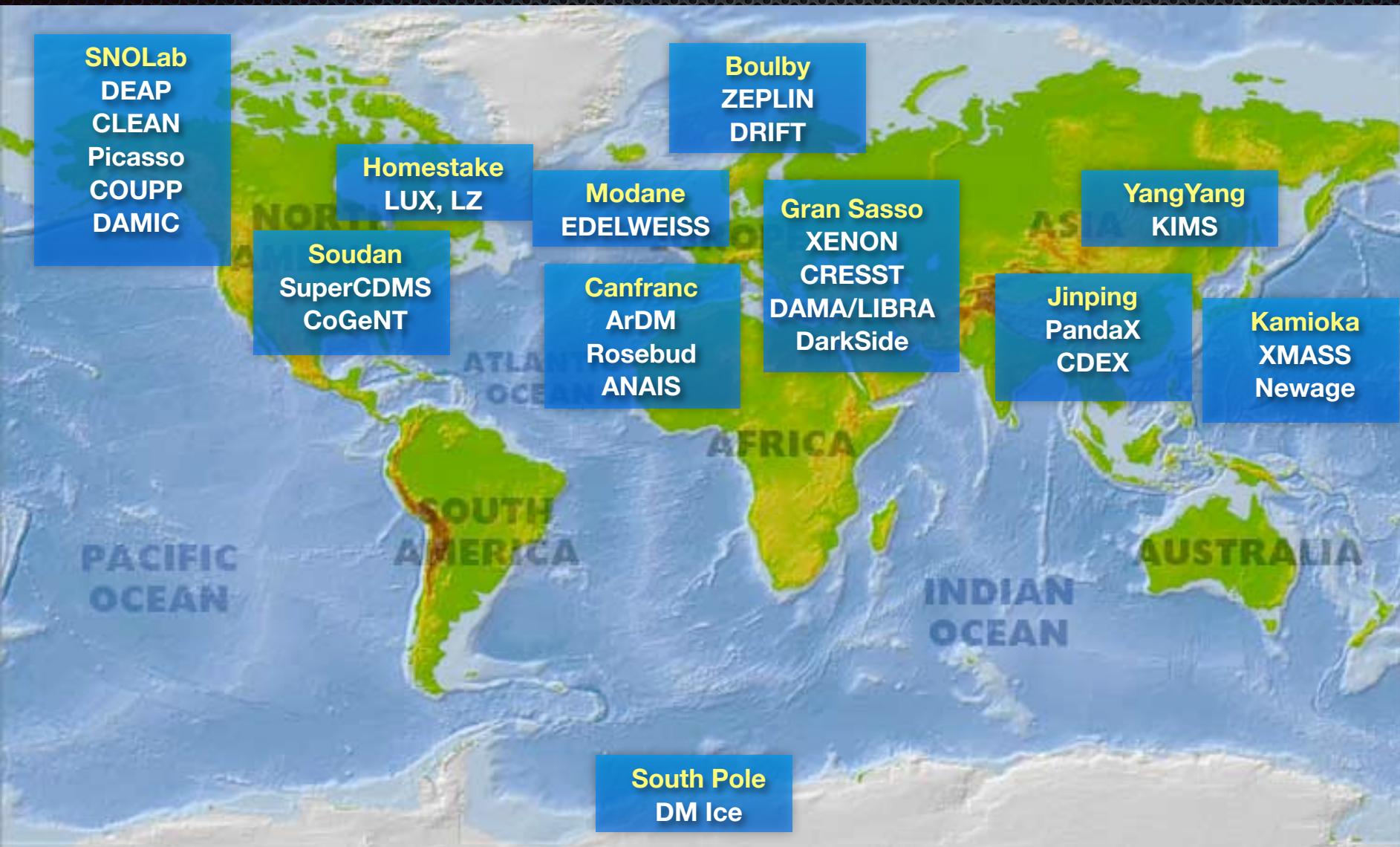
The WIMP landscape in 2014

“Anomalies” at low WIMP masses

Sensitivity to masses up to 10 TeV and above!



What next? We need a *variety* of techniques to convincingly discover and constrain WIMPs!



New data from cryogenic experiments

- Absorber masses from ~ 100 g to 1400 g



SuperCDMS

new, leading results at low masses

proposed for SNOLAB:
Std: ~92 kg Ge, 11 kg Si
Lite: 5 kg Ge, 1.2 kg Si

CRESST

18 CaWO₃ detector modules (5 kg) installed at LNGS in 2013

low-background run in 2014, recent results and taking more data

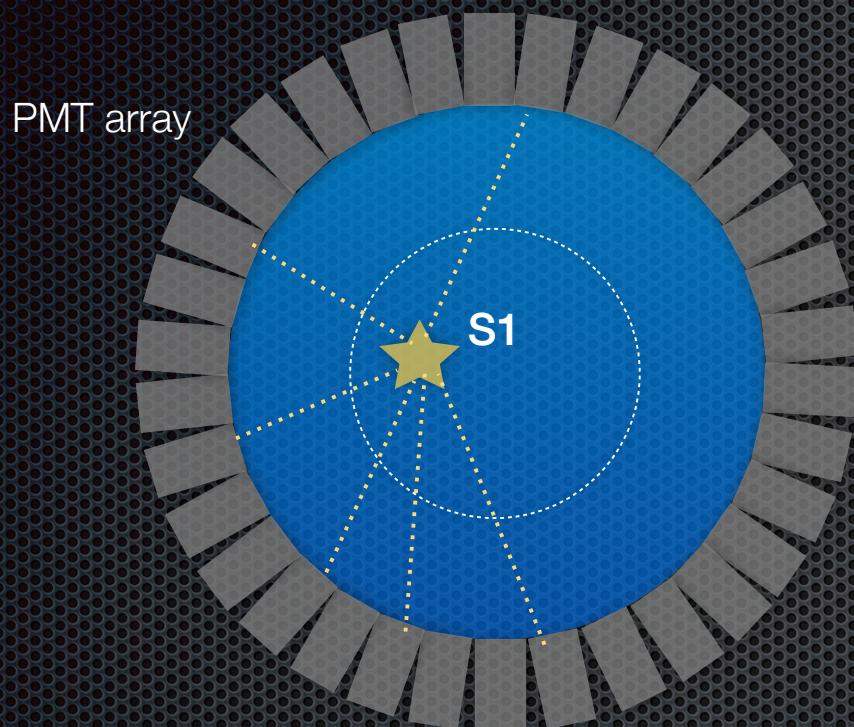
new run with 36 Ge FID800 (~30 kg) detectors since June 2014

End 2014/early 2015: reach 3000 kg x d (125 live days)

2016: reach 1.2 ton x days (500 live days)

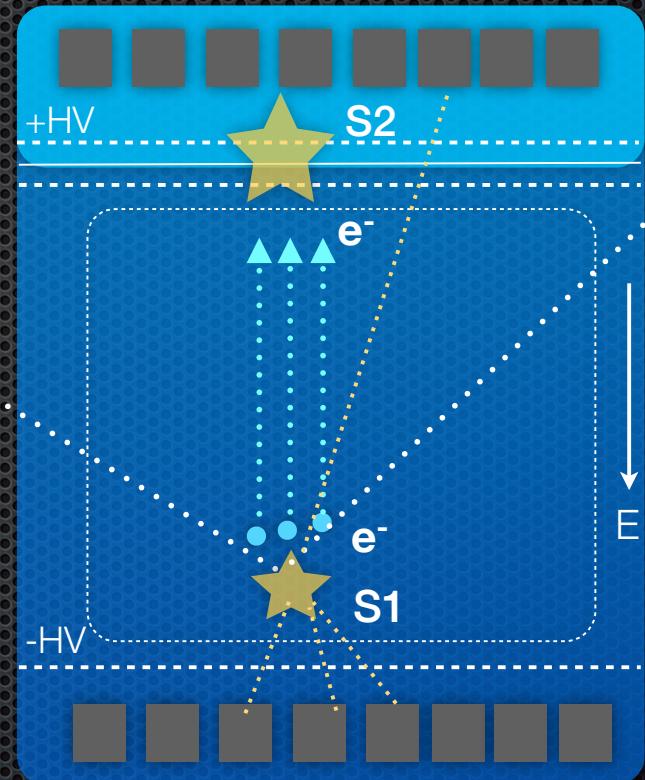
Noble liquid detector concepts

Single phase



+ PSD

Double phase (TPC)



PMT array



see talk Y. Guardincerri



XENON100 at LNGS:

161 kg LXe
(~50 kg fiducial)

242 1-inch PMTs
close to unblinding of new data set

LUX at SURF:

370 kg LXe
(100 kg fiducial)

122 2-inch PMTs
physics run and first results in 2013
new run in 2014

PandaX at CJPL:

125 kg LXe
(37 kg fiducial)

143 1-inch PMTs
37 3-inch PMTs
first results in August 2014

ArDM at Canfranc:

850 kg LAr
(100 kg fiducial)

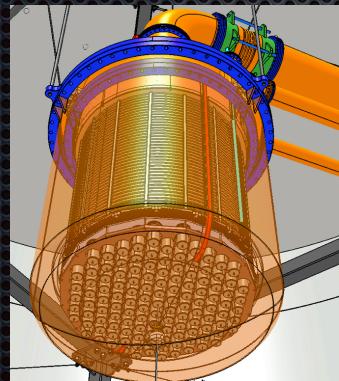
28 3-inch PMTs
in commissioning
to run 2014

DarkSide at LNGS:

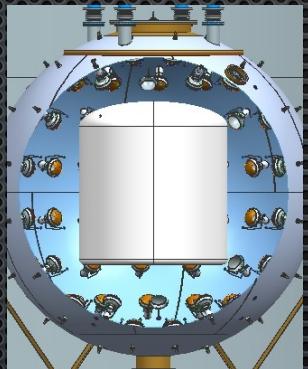
50 kg LAr (dep in ^{39}Ar)
(33 kg fiducial)

38 3-inch PMTs
first data with non-depl Ar in 2014

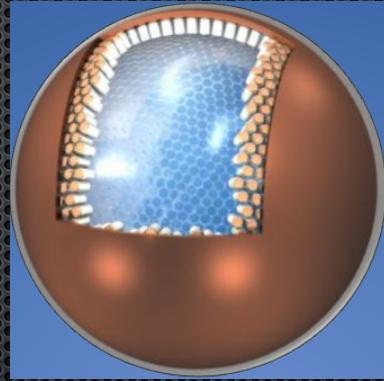
- **Under construction:** XENON1T at LNGS, 3.1 t LXe in total
- **Future:** LUX-ZEPLIN (7 t LXe) (approved by NSF&DoE), XENONnT ($n=6-7$ t LXe) (to be proposed), XMASS (5 t LXe), DarkSide (5 t LAr) (R&D funds)
- **Design and R&D:** “ultimate detector” DARWIN (~ 20 t LXe and/or 50 t LAr)



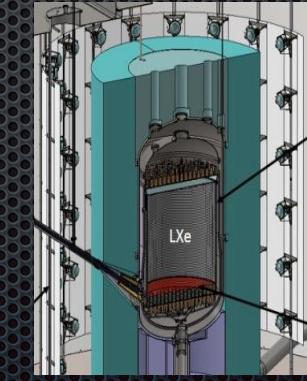
XENON1T: 3.3 t LXe



DarkSide: 5 t LAr



XMASS: 5t LXe

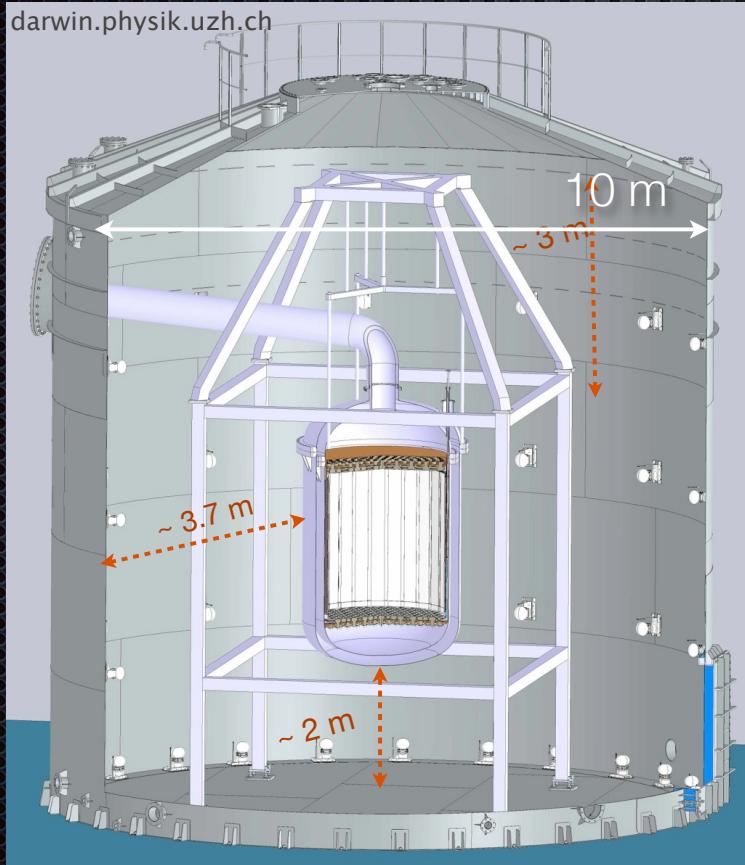


LZ: 7t LXe

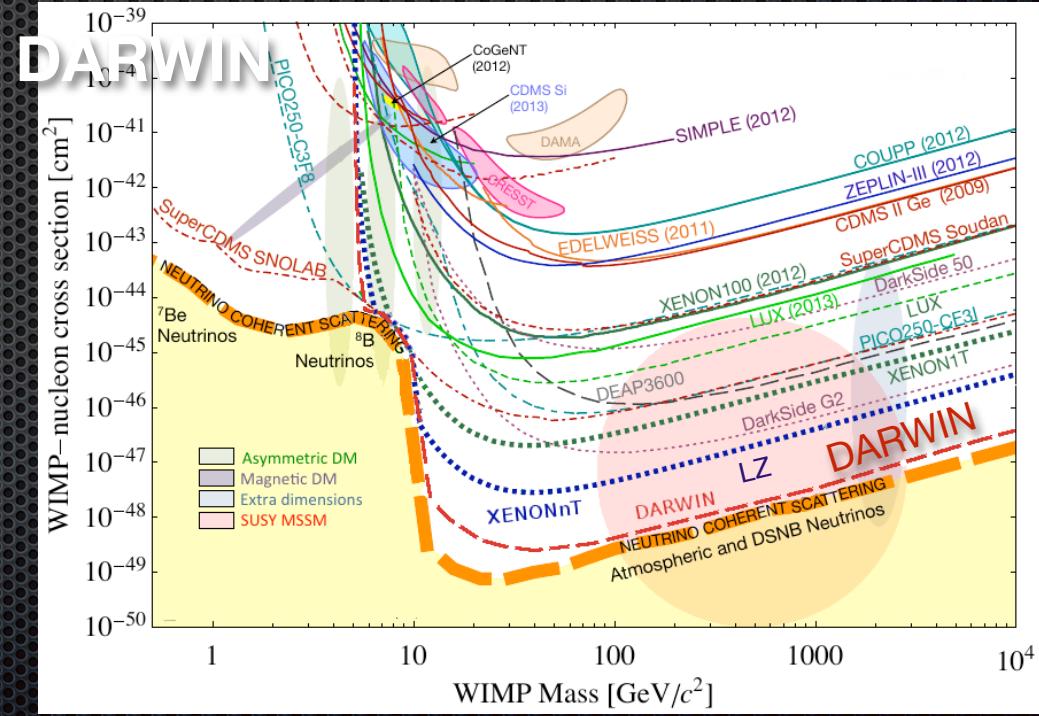


DARWIN: 20 t LXe/LAr

- R&D and design study for next-generation noble liquid detector for $m_W > 6 \text{ GeV}$
- Physics goal: build the “ultimate WIMP detector”, before the possibly irreducible neutrino background takes over; probe WIMP cross sections down to $\sim 10^{-49} \text{ cm}^2$



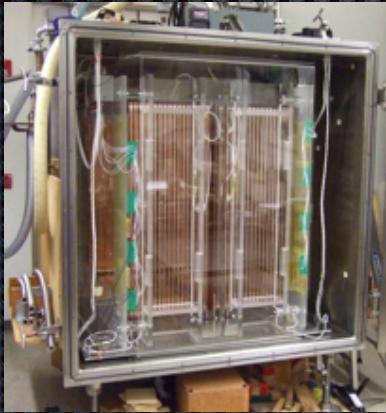
DARWIN: 25 groups from 9 countries



~20 t LXe (and/or 50 t LAr) cryostat in large water Cherenkov shield

Directional detectors

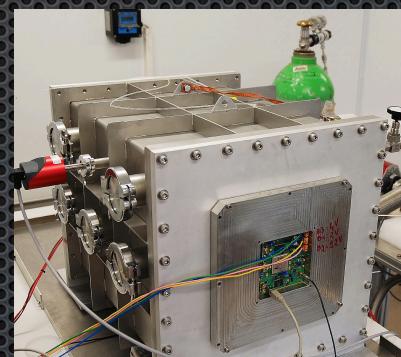
- R&D on low-pressure gas detectors to measure the recoil direction, correlated to the galactic motion towards Cygnus
- Challenge: good angular resolution + head-tail at E_{thr} ($\sim 30\text{-}50$ keV)



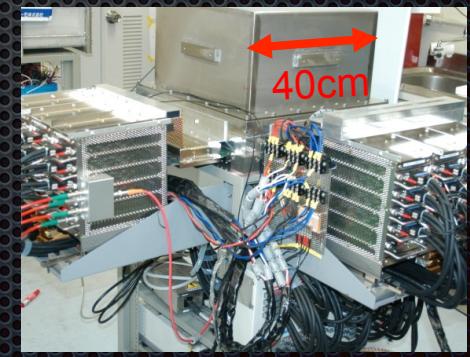
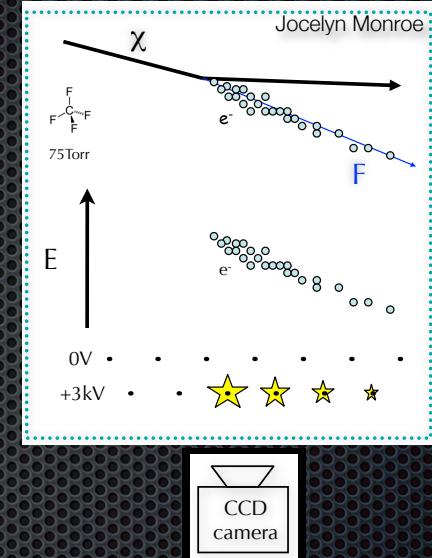
DRIFT, Boulby Mine
1 m³, negative ion drift
CS₂, CF₄, O₂ gas
DRIFTIII plans:
24 m³ (3 x 8 m³ cells)
at Boulby
4 kg target mass



DMTPCino TPC at MIT
CCD readout
1 m³ prototype, CF₄ gas
commissioning fall 2014



MIMAC 100x100 mm²
5l chamber at Modane
CF₄, CHF₃, H gas



NEWAGE, Kamioka
CF₄ gas at 0.1 atm
50 keV threshold

today's Agenda

Monday, 22 September 2014

- 11:00 - 12:45 Review of DM direct detection experiments - part I
- 11:00 **Introduction 10'**
 Speaker: Sandro De Cecco (University of Paris VI and VII - LPNHE)
- 11:10 **Search for WIMPs with Liquid Argon: the Darkside experiment 35'**
 Speaker: Dr. Claudio Giganti (LPNHE IN2P3/CNRS)
- 11:45 **The Ship experiment 35'**
 Speaker: Prof. Jacques Chauveau (LPNHE Paris 6-7)
- 12:45 - 14:00 Déjeuner
- 13:55 - 15:30 Review of DM direct detection experiments - part II
- 14:00 **The dark side messengers 20'**
 Speaker: Witek Krasny (LPNHE)
- 14:20 **PQ axions searches 20'**
 Speaker: Dr. antoine letessier-selvon (LPNHE)
- 14:40 **CCD based DM direct detection experiments 35'**
 Speaker: Xavier Bertou (Centro Atomico Bariloche)
- 15:30 - 16:00 Final discussion and future plans @ LPNHE
- 15:30 **Discussion and plans 30'**

Goals of the brainstorming

- LPNHE is not (yet) involved in direct search for dark matter but we feel it is important to understand if we have the will/forces to enter in this relevant domain
- We start an overview of the current/future projects which could match our lab skills and expertises in detector R&D.
- Today's meeting is not a comprehensive panorama but a good starting point to keep going in our collective reflection.
- A good timeline would be to be ready for a consensus for the end of the year.