



New Experiments With Spheres

Light dark matter search : NEWS_SNO

Introduction to spherical gaseous detectors
Physics reach at SNOLAB
HQP
Canada vs International
Resources, planning

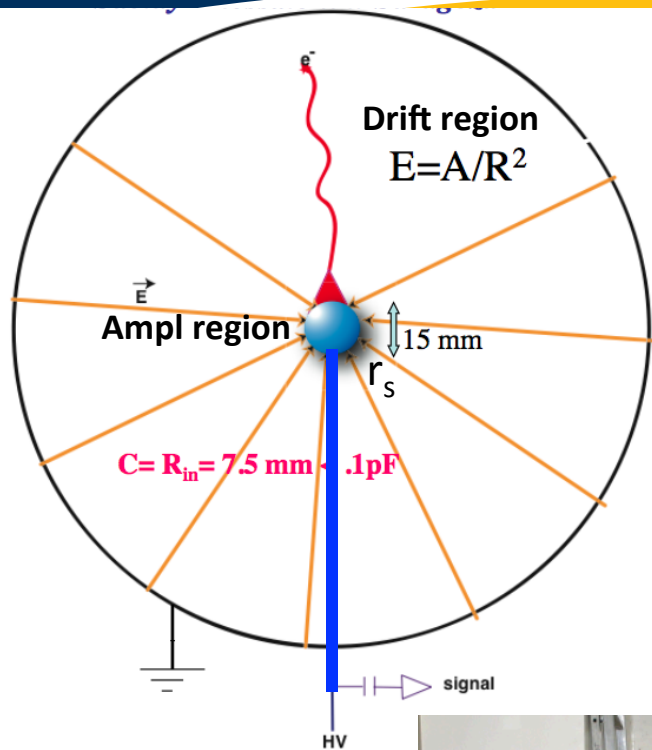
Gilles Gerbier
Queen's University
IPP meeting june 14th 2015



Canada Excellence
Research Chairs
Chaires d'excellence
en recherche du Canada

Spherical gas detectors

New Experiments With Spheres



- Sphere vessel+ spherical sensor + HT
- Large drift volume + amplification/avalanche
- => Low threshold (low C), does not depend on size
- Fiducial volume selection by risetime
- Flexible (P, gaz), low mass targets : Ne He H
- Large mass / large volume (30 kg) with single channel
- Simple, sealed mode
- 2 LEP cavity 130 cm Ø tested
- 1 low activity 60 cm Ø run w Ne @ LSM shows sensitivity around 2 times better than DAMIC

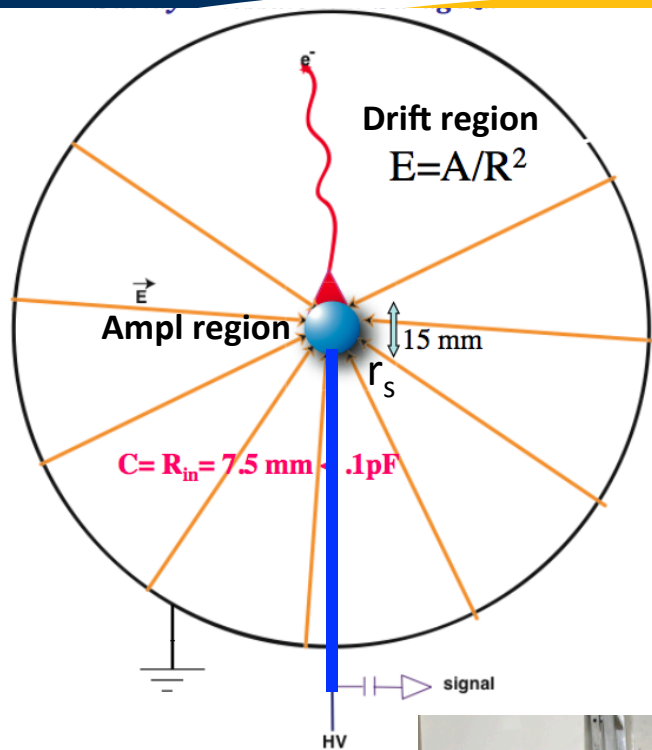
$$E \approx V/r^2 * r_s$$

for $r_c \gg r_s$



Spherical gas detectors

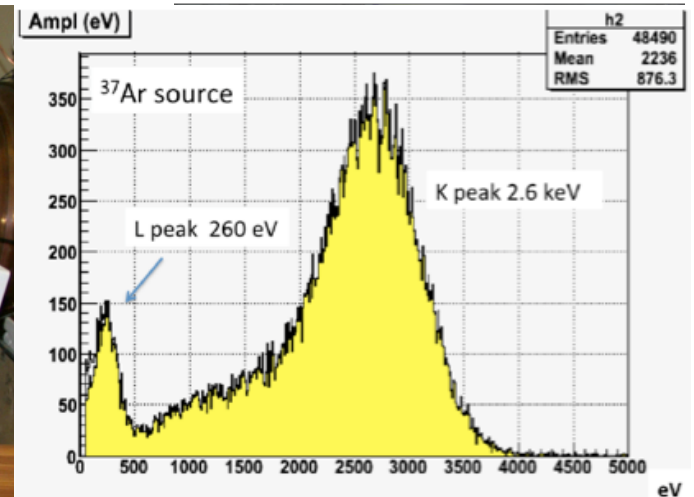
New Experiments With Spheres



- Sphere vessel+ spherical sensor + HT
- Large drift volume + amplification/avalanche
- => Low threshold (low C), does not depend on size
- Fiducial volume selection by risetime
- Flexible (P, gaz), low mass targets : Ne He H
- Large mass / large volume (30 kg) with single channel
- Simple, sealed mode
- 2 LEP cavity 130 cm Ø tested
- 1 low activity 60 cm Ø run w Ne @ LSM shows sensitivity around 2 times better than DAMIC

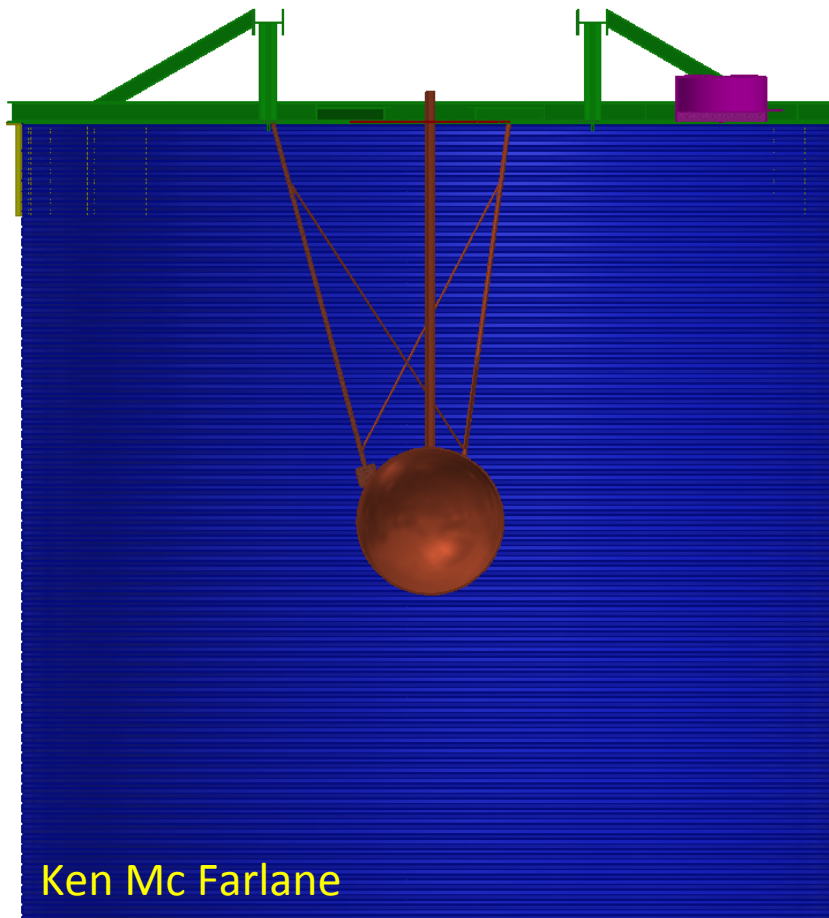
$$E \approx V/r^2 * r_s$$

for $r_c \gg r_s$

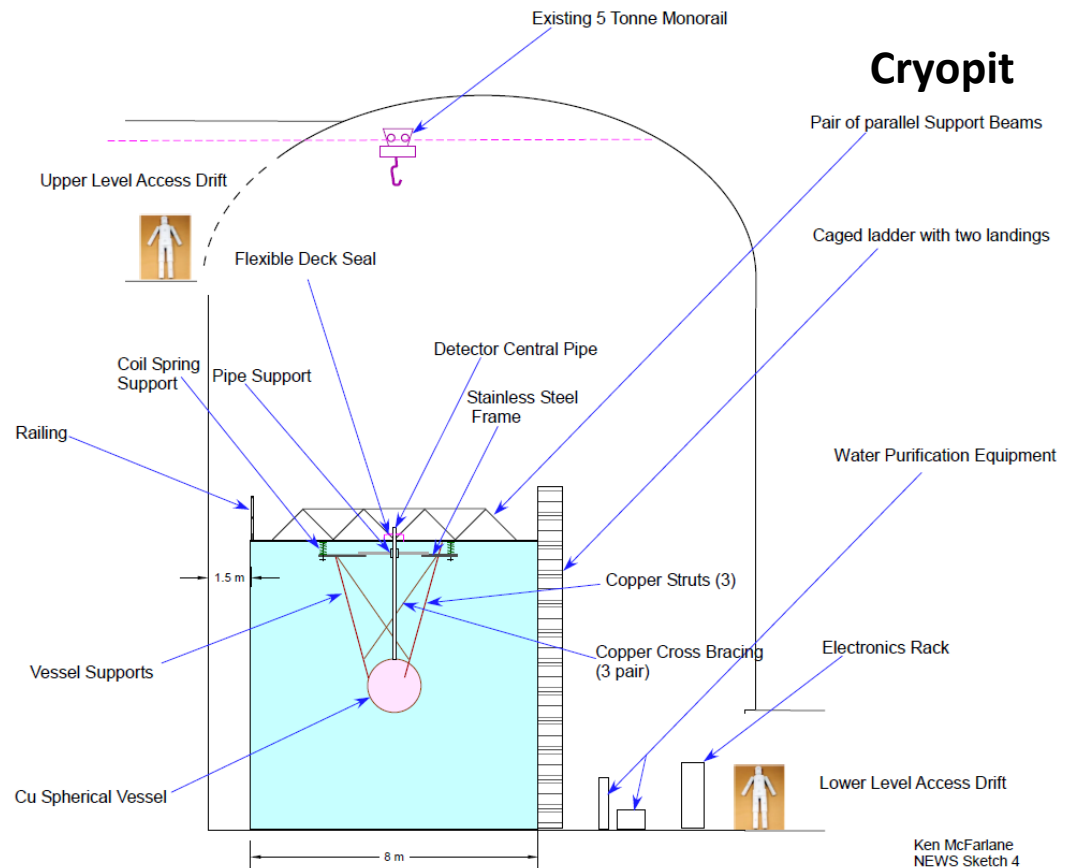


NEWS-SNO= 1.4 m sphere in 8m diam water tank @ SNOLAB

Use Ne, He, H (CH₄) gas as targets for light WIMP search

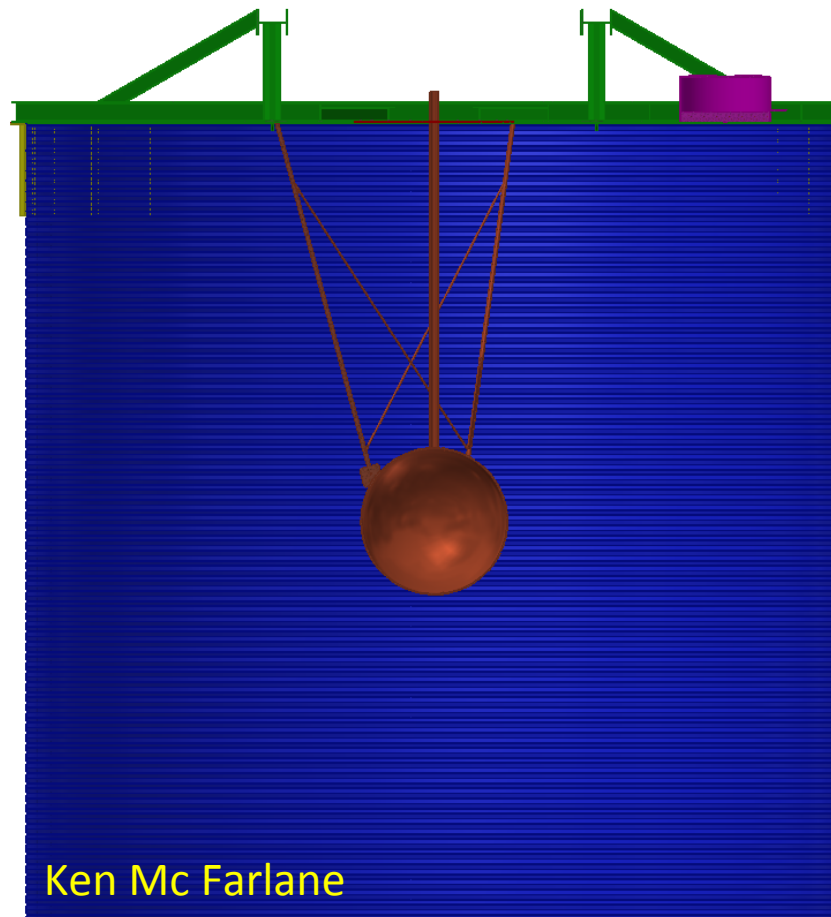


NEWS Water Shield Tank in SNOLAB Cryopit

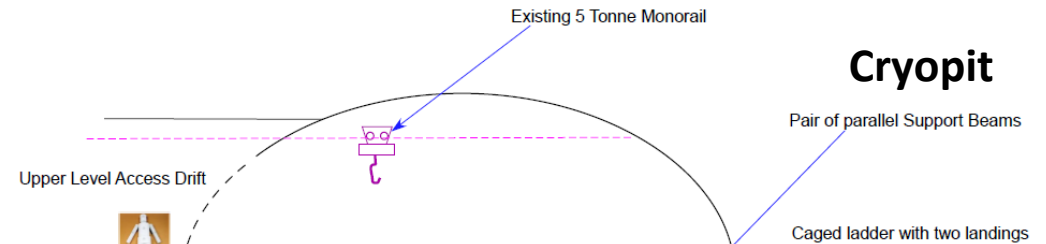


NEWS-SNO= 1.4 m sphere in 8m diam water tank @ SNOLAB

Use Ne,He, H (CH4) gas as targets for light WIMP search



NEWS Water Shield Tank in SNOLAB Cryopit



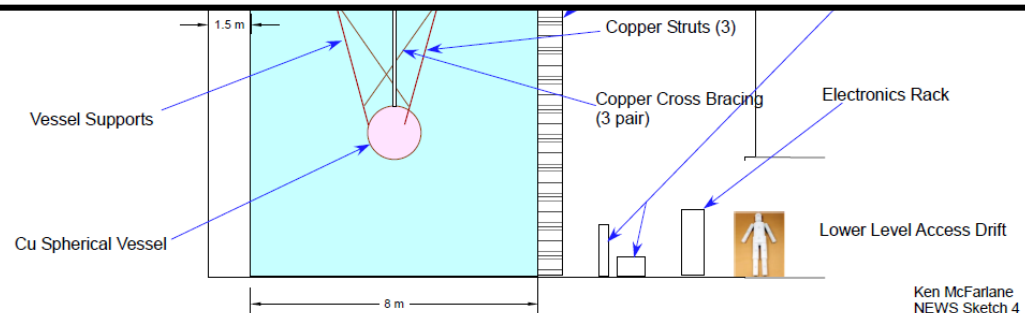
SNOLAB process

First presentation at EAC in march 2015

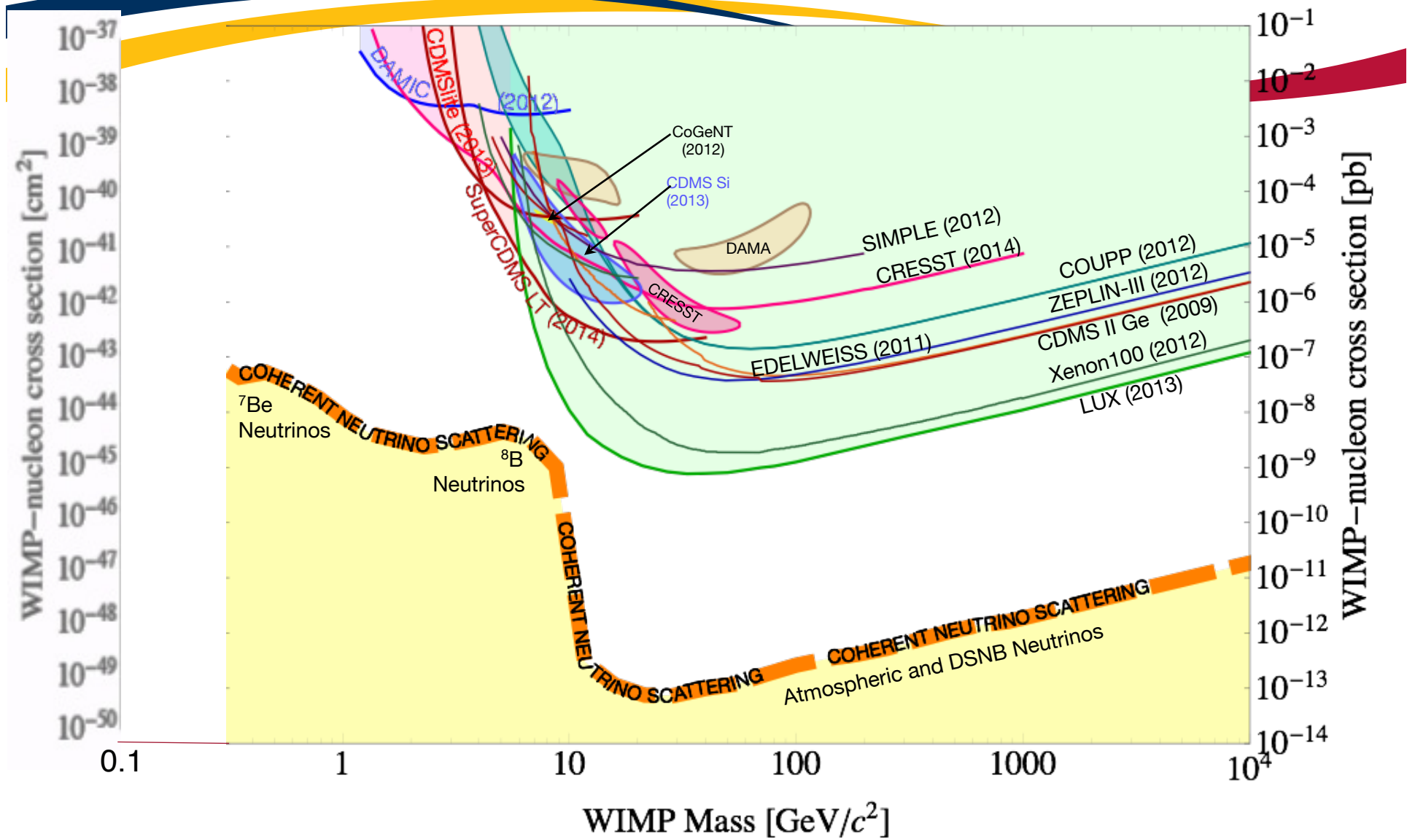
⇒ positive feedback

⇒ CDR by fall 2015, cost, planning

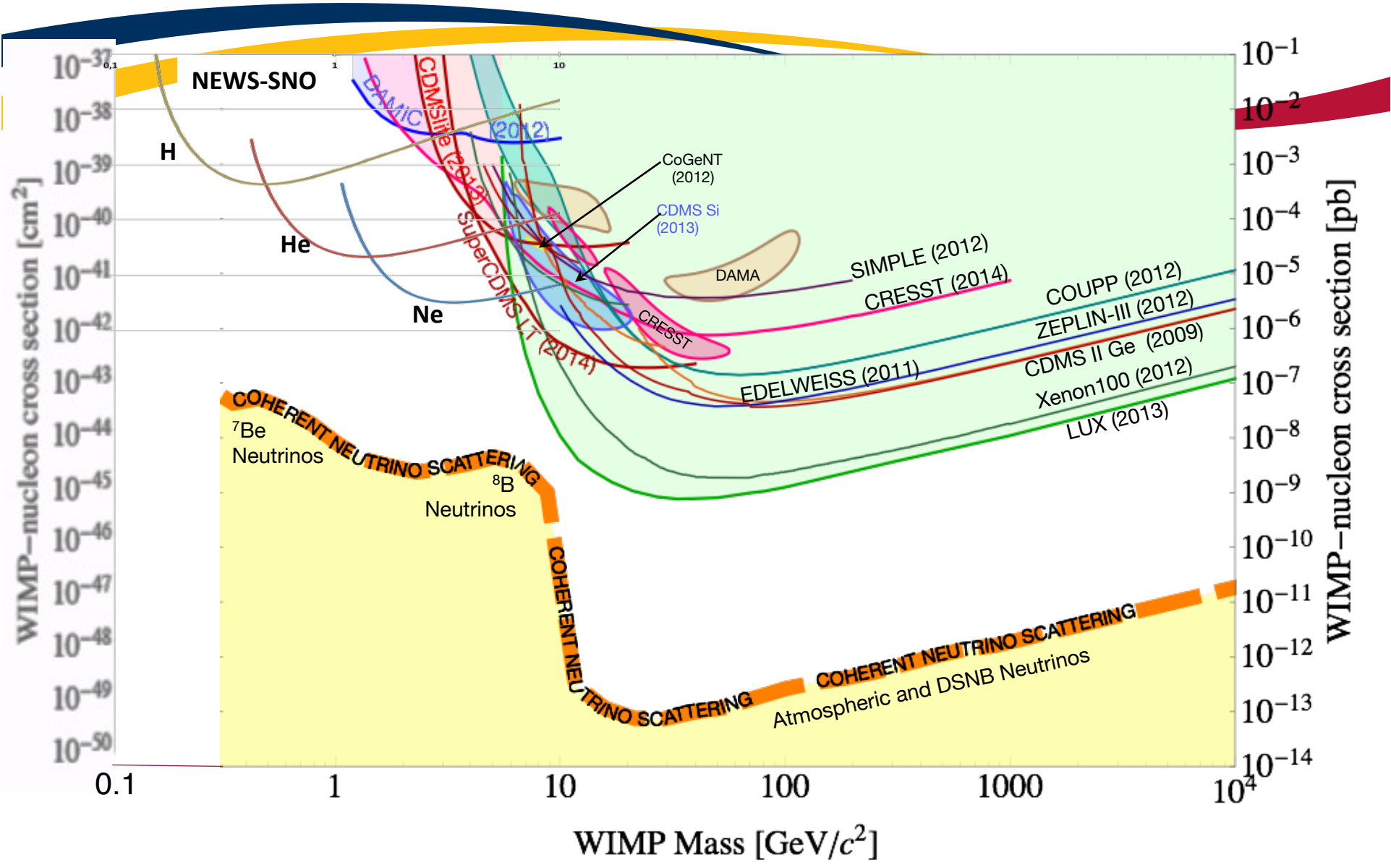
⇒ planning should allow completion before 2021



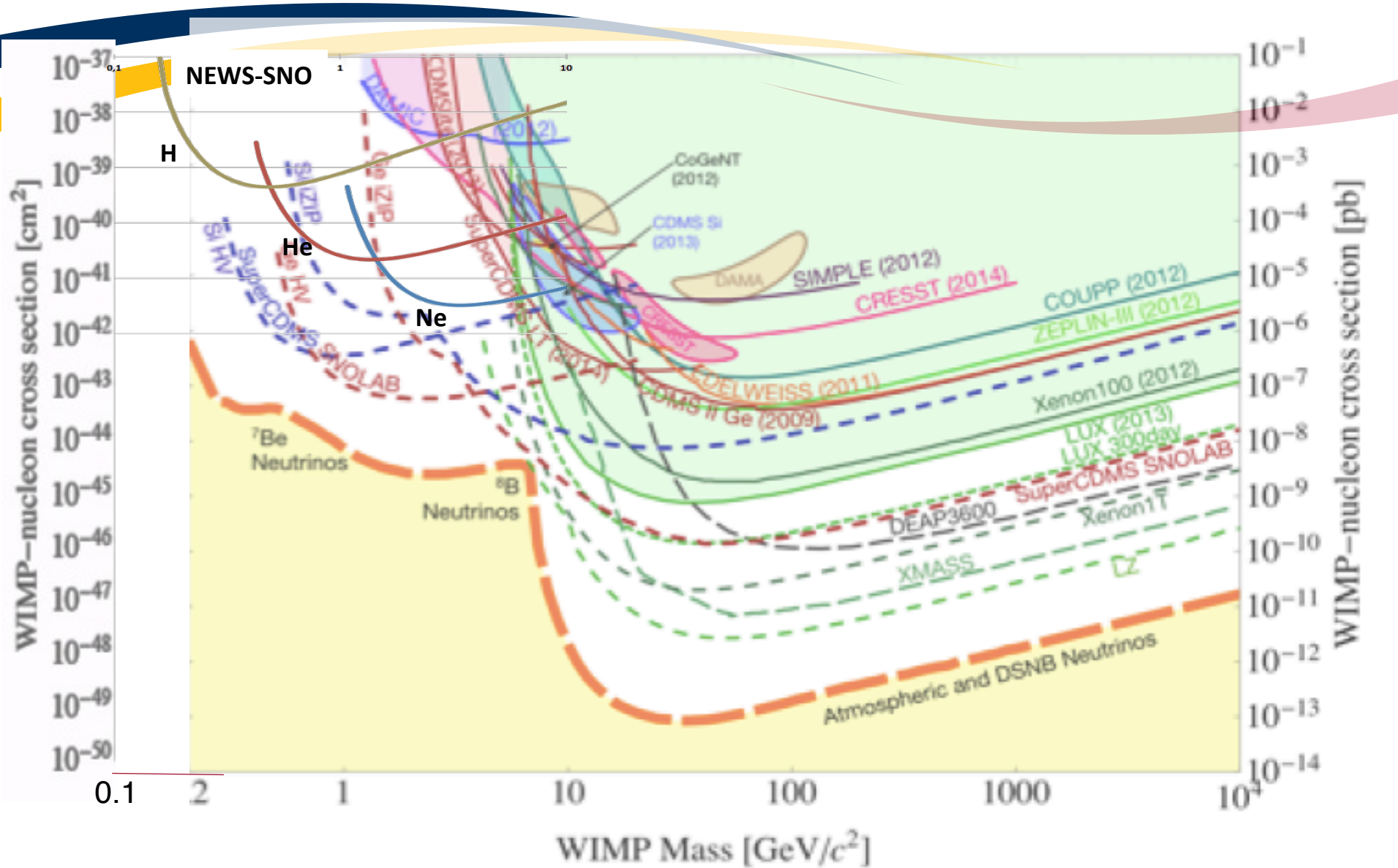
NEWS goal wrt current situation for SI interacting WIMPS



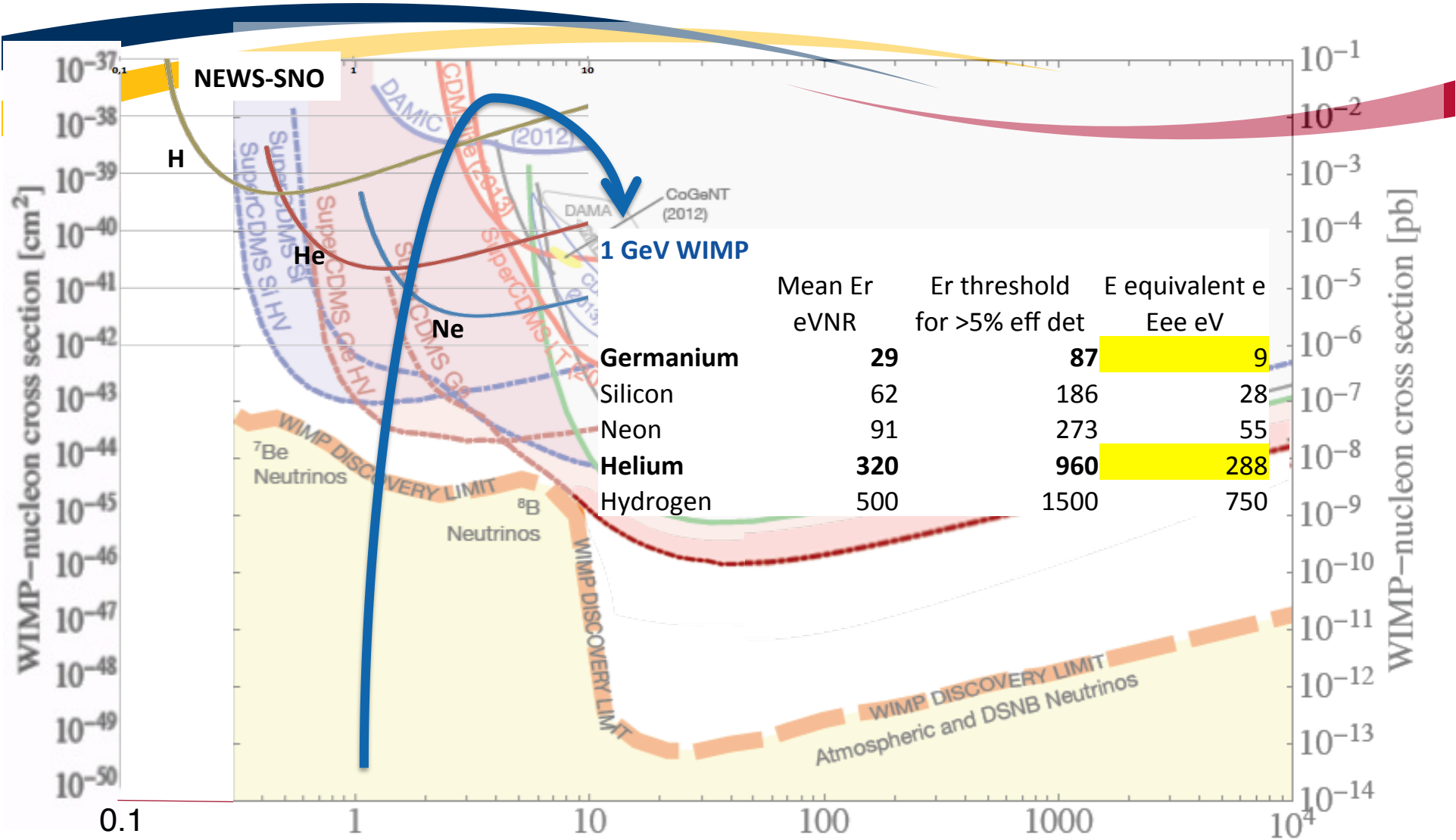
NEWS goal wrt current situation for SI interacting WIMPS



vs SuperCDMS goals using Ge and Si detectors

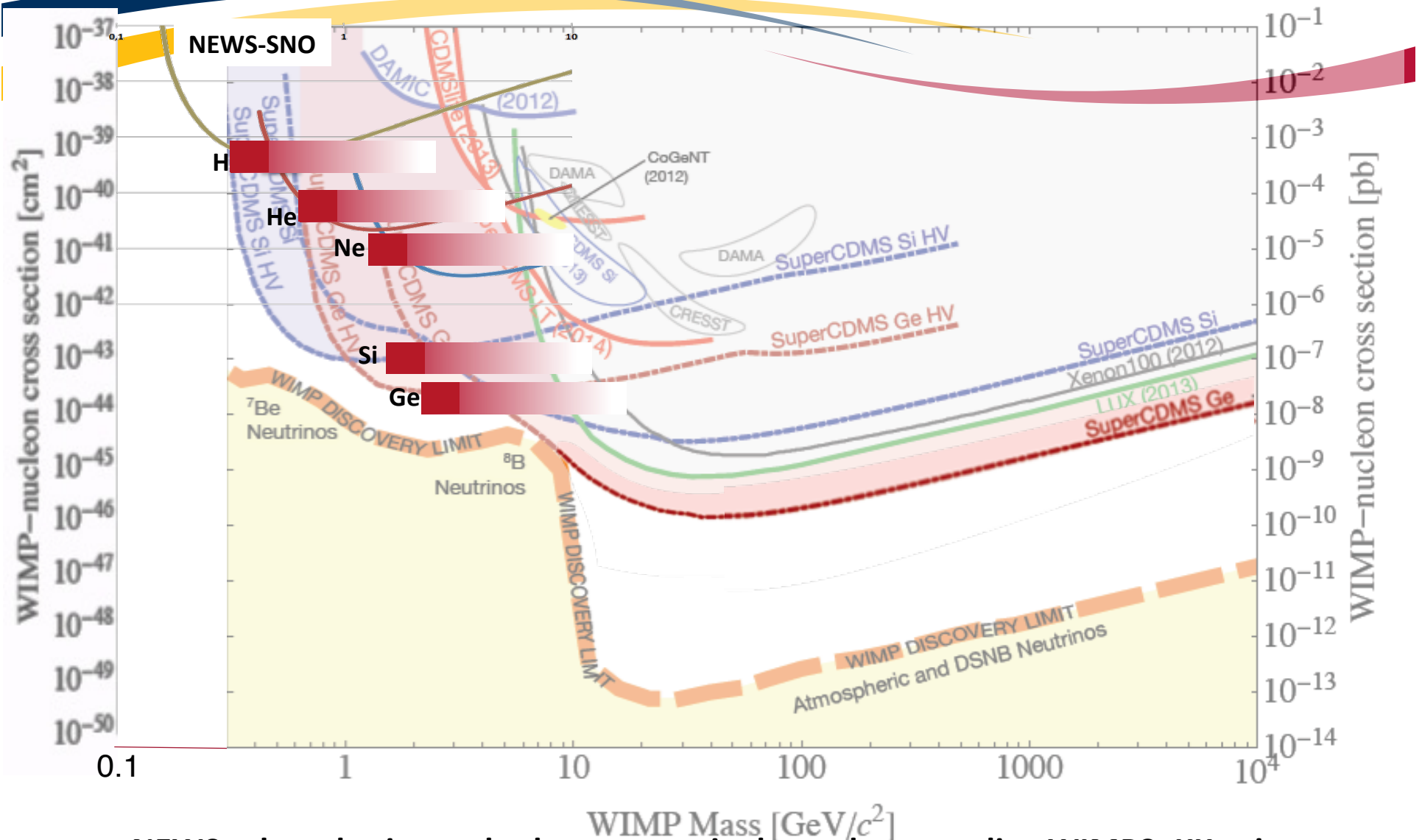


vs SuperCDMS goals



WIMP Mass [GeV/c^2]

Safe WIMP mass limits vs QF and electronic background



NEWS other physics goals : low mass spin dependent coupling WIMPS -KK axions

NEWS Collaboration : HQP in Canada

First collaboration meeting @ SNOLAB 27-28 May


- **Queen's** - Philippe di Stefano, Tony Noble, **Sabine Roth**, **Alexis Brossard**, **Alvine Akamaha**, **Paco Vasquez dS**, Philippe Camus + Connor, Sean, Jon, + **4 new MsC/PHD (2020)**, + **1-2 PDF**
 - Copper vessel and gas set-up specifications, calibration set up
 - Gas characterisation at Queen's, laser calibration,
 - Simulations/Data analysis
- **SNOLAB** – Ken Mc Farlane, Brian Morisette
 - Water shield and infrastructure at SNOLAB
- **(TRIUMF - Fabrice Retiere)** : cosmic ray protection for sphere fabrication at PAVAC



NEWS Collaboration : International

First collaboration meeting @ SNOLAB 27-28 May



- **Queen's** - Philippe di Stefano, Tony Noble, **Sabine Roth**, **Alexis Brossard**, **Alvine Akamaha**, **Paco Vasquez dS**, Philippe Camus + Connor, Sean, Jon, + **3 new MsC/PHD (2020)**, + **1-2 PDF**
 - Copper vessel and gas set-up specifications, project follow up, calibration set up
 - Gas characterisation at Queen's, laser calibration, on smaller scale prototype...
 - Simulations/Data analysis
- **SNOLAB** – Ken Mc Farlane, Brian Morisette
 - Water shield and infrastructure at SNOLAB
- **(TRIUMF - Fabrice Retiere)** : cosmic ray protection for sphere fabrication at PAVAC
- **IRFU/Saclay** -Ioannis Giomataris, Michel Gros, Thomas Papaevangelou, Patrick Magnier, Jean Paul Bard
 - Sensor/rod (low activity, optimised wrt field with 2 electrodes)
 - Electronics (low noise preamps, digitisation, stream mode)
 - DAQ/soft
- **LSM** (Laboratoire Souterrain de Modane) - **F Piquemal + M Zampaolo**, +Ali DastgheibiFard
 - Low activity archeological lead for close electronics/valve shield
- **Tessaloniki University** – I Savvidis + Ioannis Katsioulas
 - Simulations, neutron calibration
 - Studies on sensor
- **LPSC Grenoble** - **D Santos + JFrancois Muraz, Olivier Guillaudin**
 - Quenching factor measurements < 1 KeV with ion beams
- **TU Munich** – A Ulrich
 - Gas properties and ionisation process for Pening mixtures
- ... more  welcome : 

Equipment needs, cost estimates and time profile



- Major items -spherical vessels, gas system, water tank- from Canadian funds
- Secured funding on 6 years through CERC (3 M\$ people and partly equipment) and CFI (1.7 M\$)
- Time profile :
 - Design, construction, commissioning 2015-2017
 - Data taking : 2018-2020

Computing requirements – CPU and storage



- HPCVL for simulations
- Low needs vs data processing and storage

Expected calls on technical support from TRIUMF, SNOLAB or the MRS facilities

- SNOLAB
 - Being evaluated with Ken Mc Farlane
 - Mounting of water tank and structure @ SNOLAB
- TRIUMF
 - Help for protection against cosmic rays of sphere fabrication if PAVAC selected at Vancouver

Relationships with other projects being conducted by Canadian subatomic physicists



- Complementary to
 - SuperCDMS intermediate mass
 - DEAP high mass
 - DAMIC intermediate mass
 - PICO spin dependent
- Strong synergy between groups at Queen's