kton-scale Xe TPCs for $0\nu\beta\beta$

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- While ton-scale experiments have significant discovery potential, it is possible that detectors capable of reaching 10^{30} yrs will ultimately be needed to fully cover allowed parameter space
- An exposure of ~3 ktonne-yr is needed to observe 10 events if $T_{1/2} \sim 10^{30}$ yrs

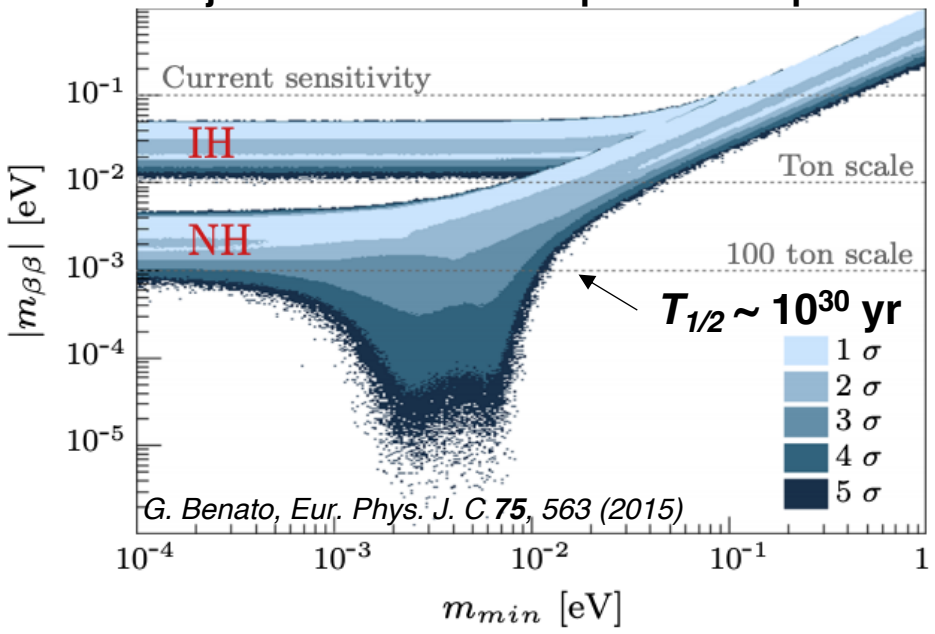
Primary challenge is to procure ^{136}Xe in required quantities:

- Existing supply chain (steel industry) suitable for ~5 ton, but not for 0.1-1 kton
- Direct capture from air (adsorptive techniques) may present alternative path
  - Xe market price >10^5 times minimum thermodynamic separation cost
  - Direct capture of Xe on small scale for tracking radioisotopes is standard technique
- R&D effort exists, but pace could be accelerated substantially (industrial production of adsorbents, leverage CO_2 capture developments)
- Could decouple scientific demand from industry, and enable medical technologies for lung imaging and anesthesia

Xe TPCs present an attractive path to reaching 10^{30} yr if Xe could be procured with viable cost:

- Advantages relative to liquid scintillators:
  - Energy resolution $\lesssim 0.5\%$ → avoid $2\nu\beta\beta$ backgrounds ~ σ^6
  - Detector fully consists of ^{136}Xe → avoid solar ν backgrounds
  - High purity of Xe (self-shielding) and in situ purification (^{222}Rn biggest challenge)

Majorana mass allowed parameter space:



Investments in Xe procurement technologies may provide path to 10^{30} yrs ($m_{\beta\beta}$~1 meV)!