NEXT

Ton scale and beyond

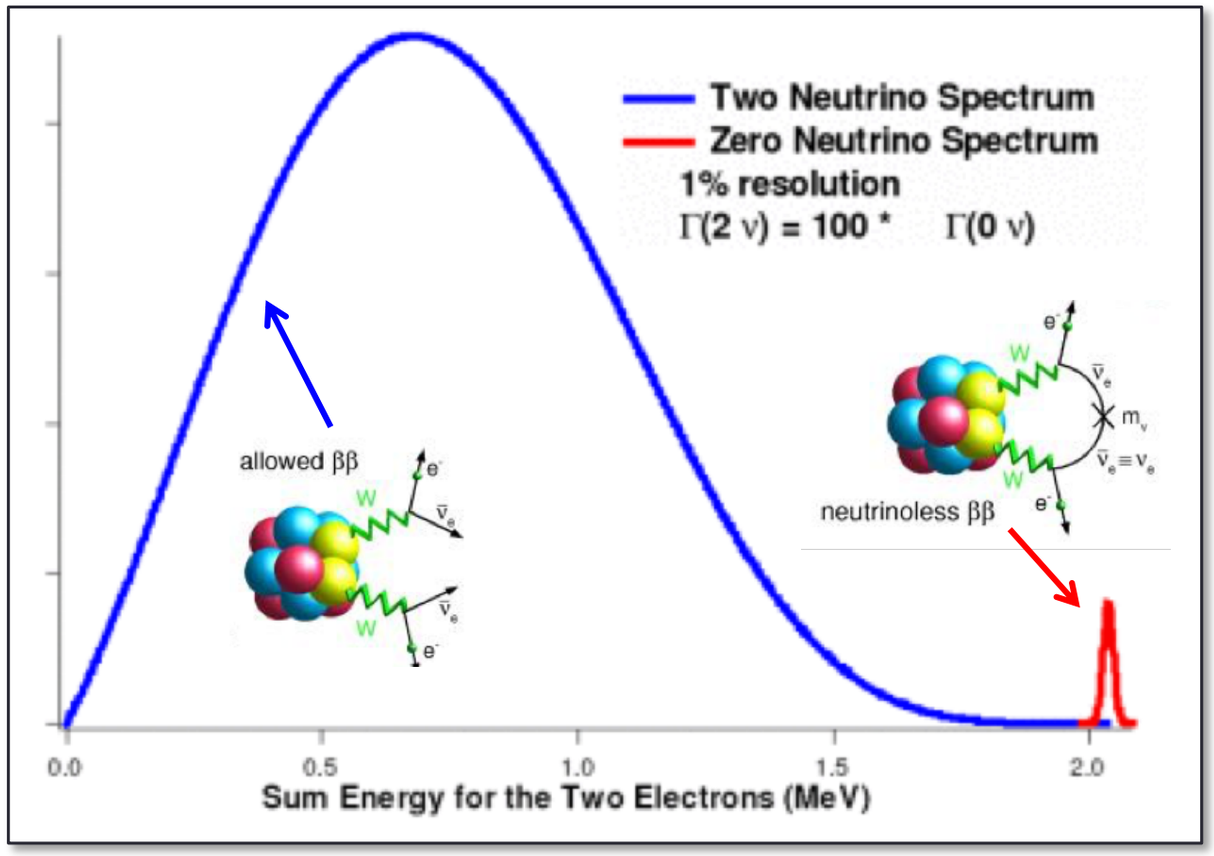
Roxanne Guenette
Harvard University

On behalf of the NEXT collaboration

RF Town Hall (RF4 session)
2 October 2020

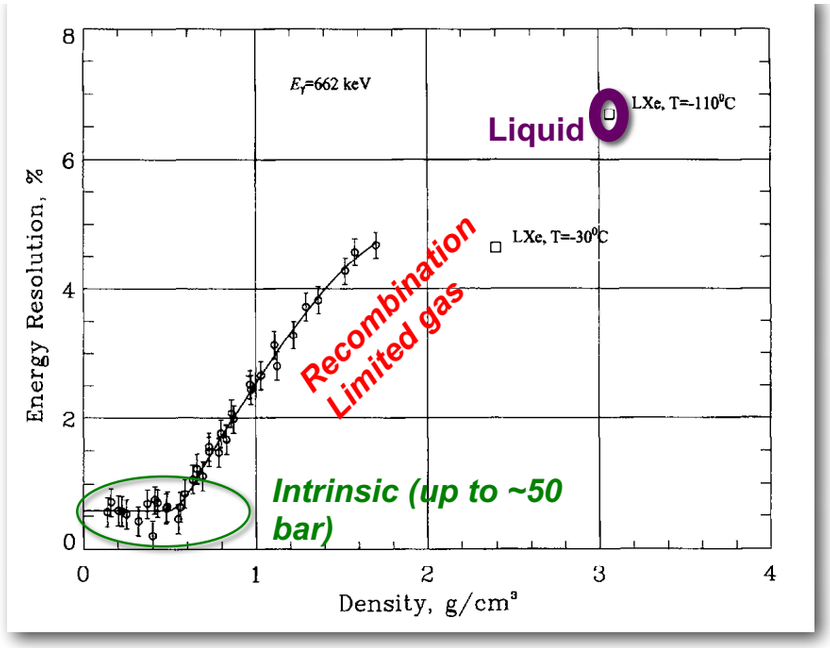
Motivation

- Detect neutrinoless double beta decay!
- Ultimately propose a solution that can reach the normal mass ordering



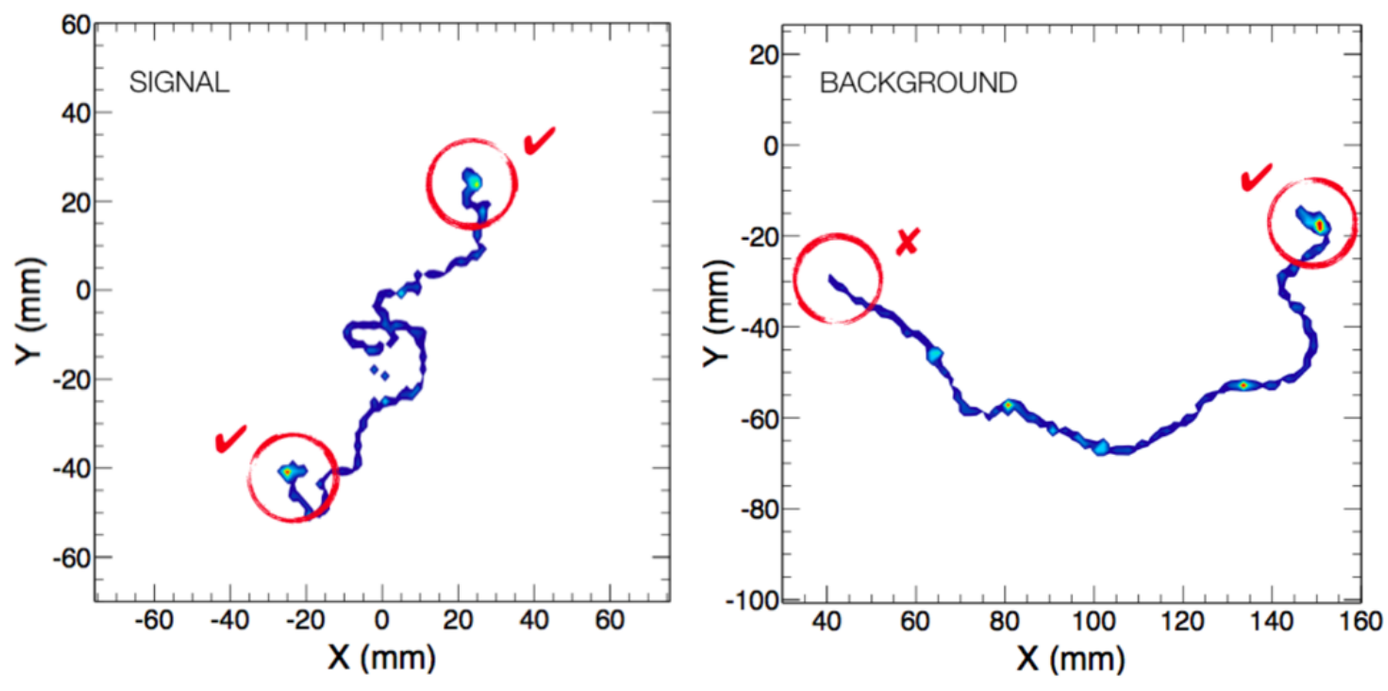
High-pressure Xe gas TPC

- Great energy resolution



Bolotnikov and Ramsey. "The spectroscopic properties of high-pressure xenon."NIM *A* 396.3 (1997): 360-370

- Imaging capabilities

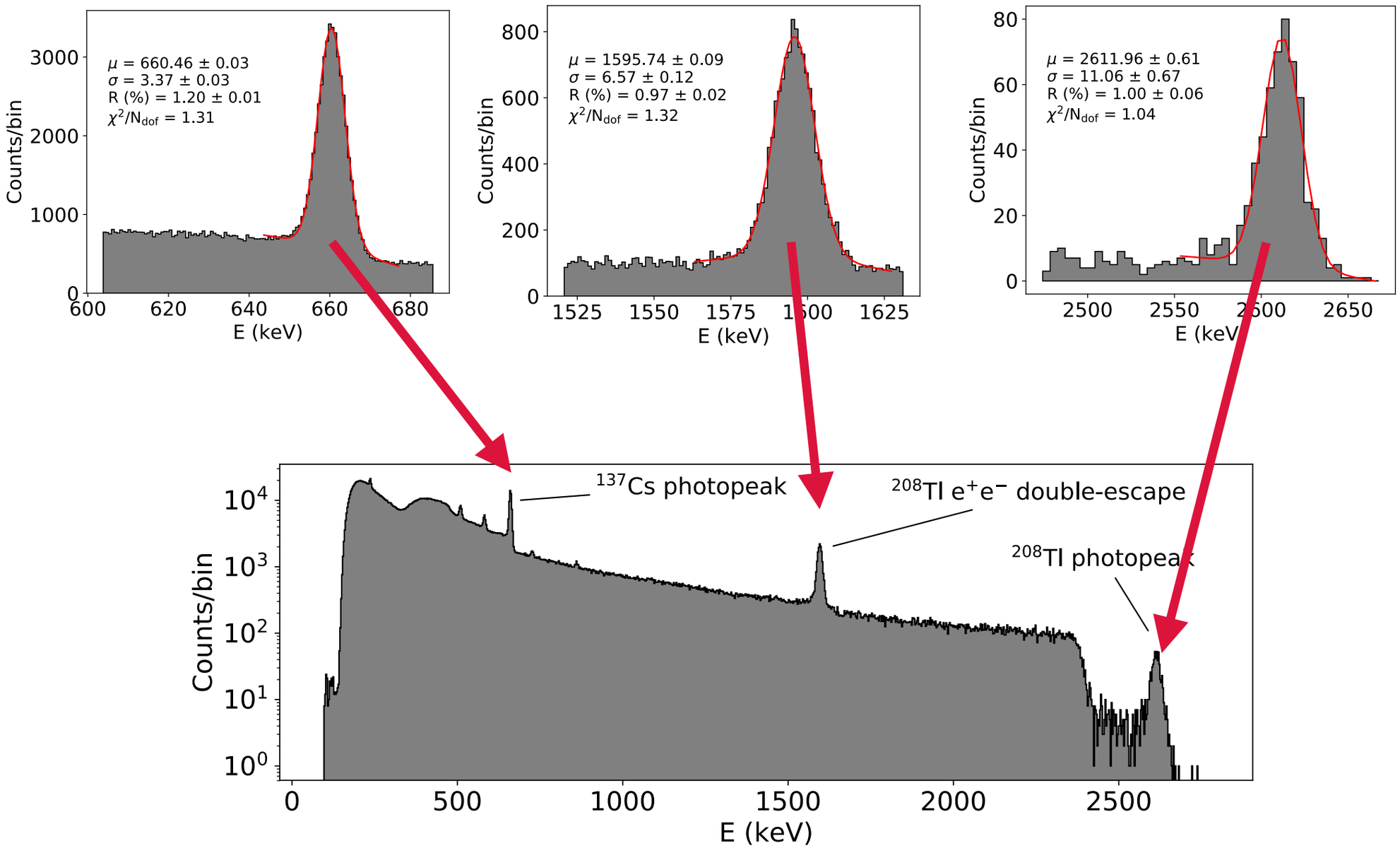


- Scalability

- Ba tagging? (see Ben Jones' talk later in this session)

High-pressure Xe gas TPC (The NEXT program)

- Great energy resolution (demonstrated by prototype and NEXT-White

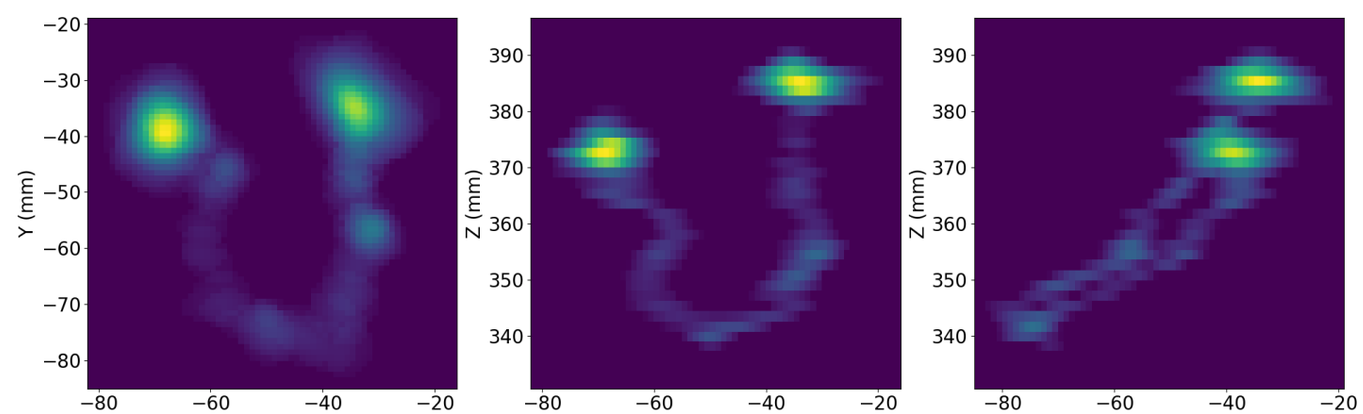


NEXT Collaboration, *JHEP* 10 (2019) 230

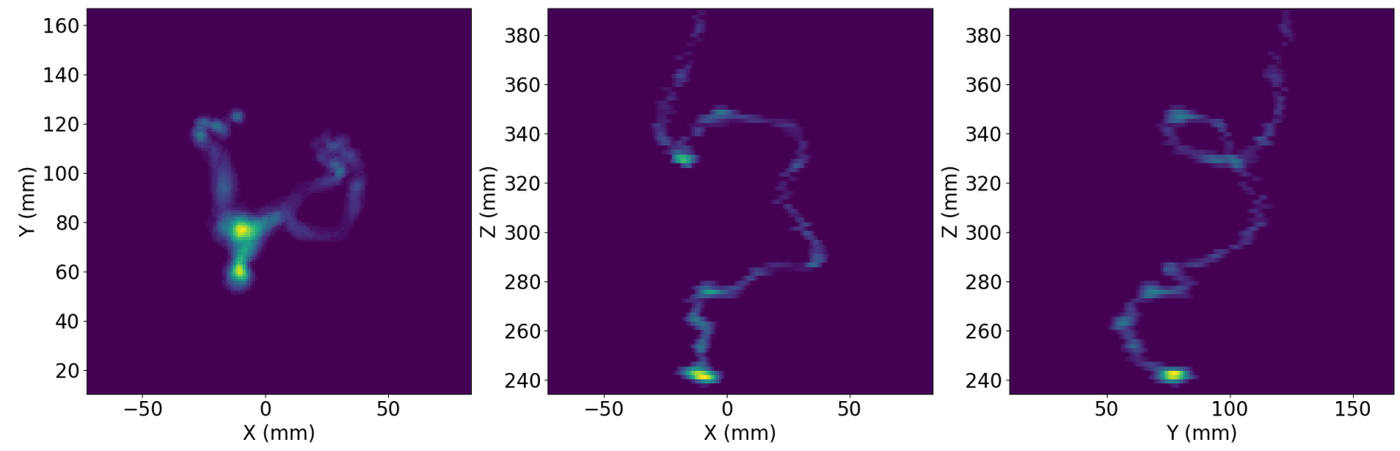
NEXT Collaboration, *JINST* 13 (2018) P10020
NEXT Collaboration, *JINST* 13 (2018) P10014
NEXT Collaboration, *NIM A708* (2012) 101

High-pressure Xe gas TPC (The NEXT program)

- Great energy resolution



- Imaging capabilities



<u>Traditional cut-base analysis</u>
~70% efficiency
~20% bkg contamination
NEXT Collaboration, *JHEP* 10 (2019) 052

<u>Improvement with DNNs</u>
~5% bkg contamination
NEXT Collaboration, *arXiv:2009.10783*

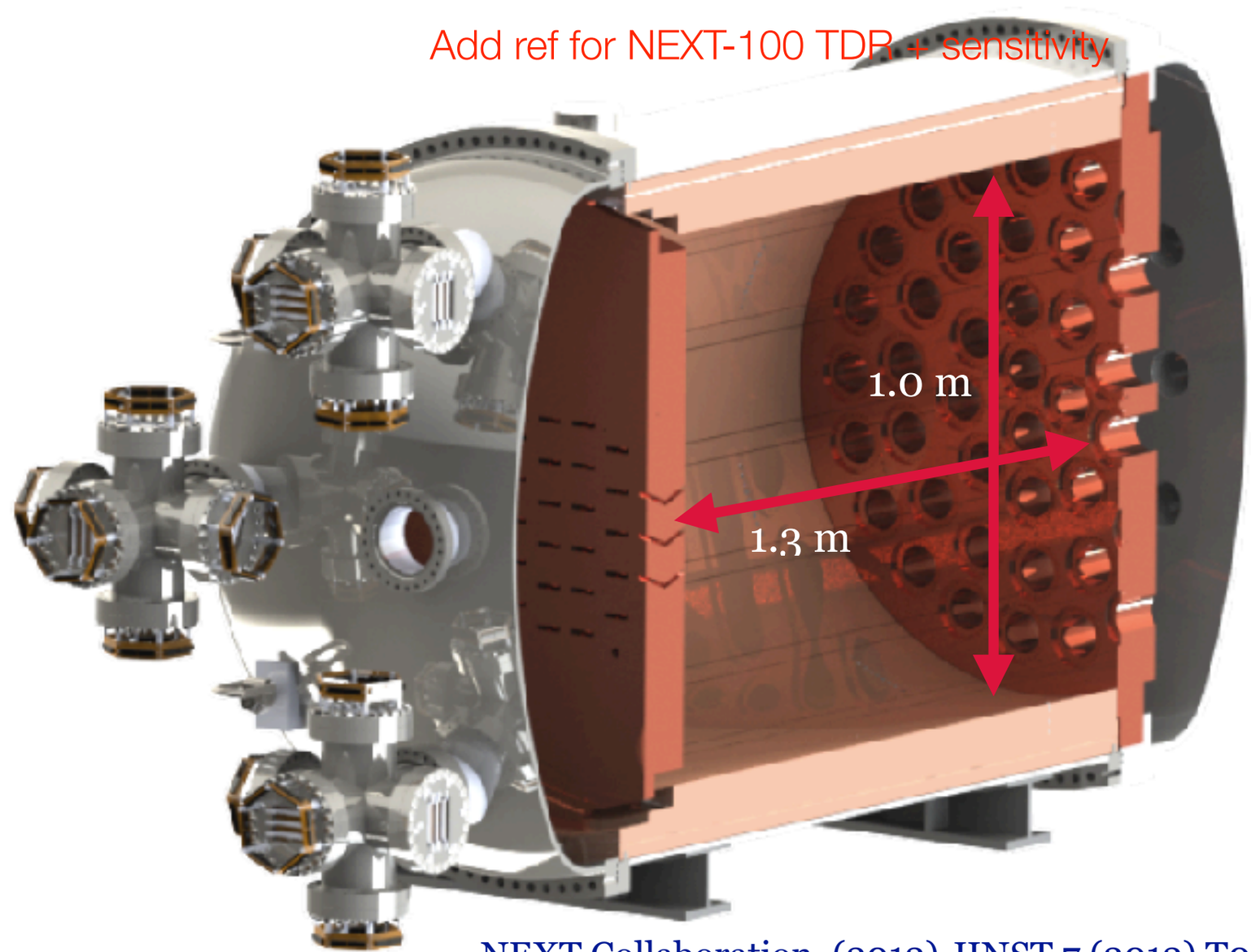
NEXT Collaboration, *JHEP* 10 (2019) 051
NEXT Collaboration, *JHEP* 01 (2016) 104

High-pressure Xe gas TPC (The NEXT program)

- Great energy resolution

- Imaging capabilities

Add ref for NEXT-100 TDR + sensitivity

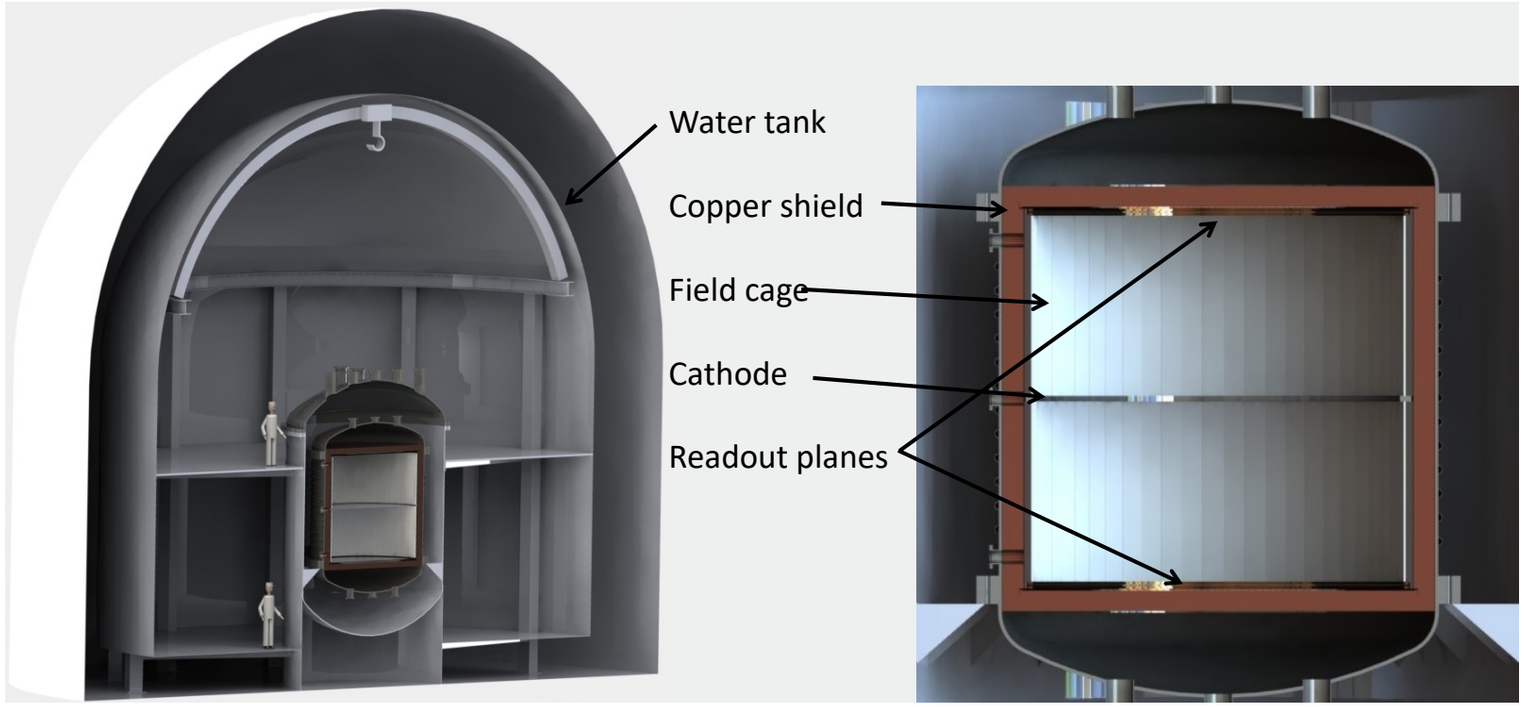


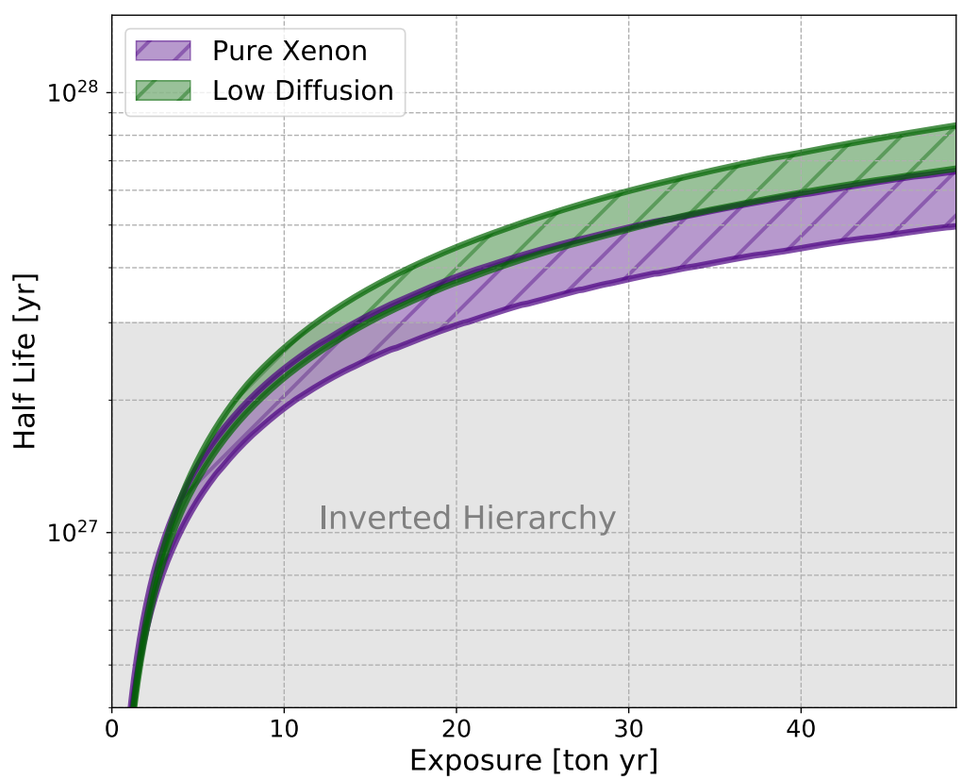
NEXT Collaboration, (2012) JINST 7 (2012) T06001
NEXT Collaboration, *JHEP* 05 (2016) 159

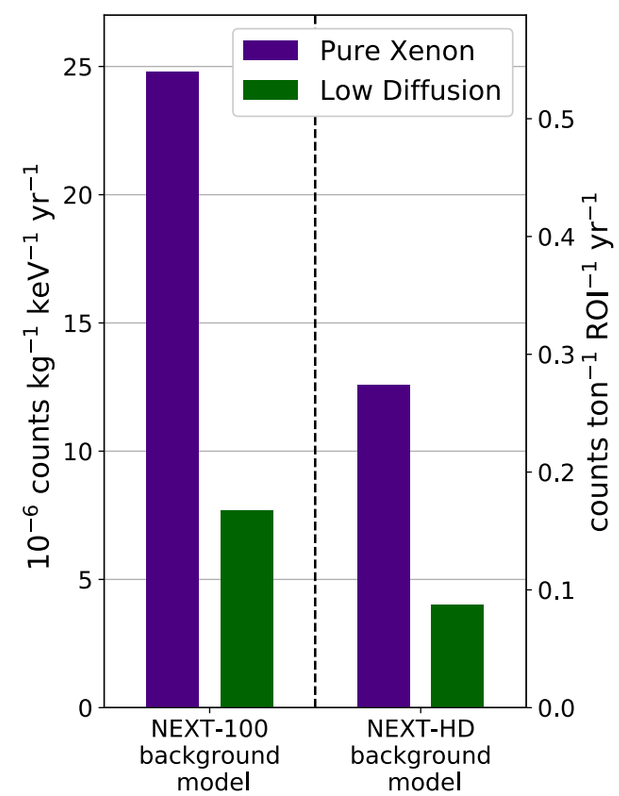
- Scalability → **NEXT-100 (currently under construction)**

NEXT at the ton scale

- Ton-scale module(s)
- Symmetric TPC
- e.g. Diameter 2.6m, drift 1.3m







NEXT Collaboration, (2020) submitted to *JHEP, arXiv: 2005.06467*

R&D to reach the ton scale and beyond

- Dedicated R&D effort to provide enhance detector capability at the ton-scale and beyond (with the ultimate goal to include Ba tagging)
- Free the cathode (No PMTs)
- Retain energy resolution
- Examples of efforts:
  - ✓ Energy-Tracking plane made of SiPMs
  - ✓ Optical TPC (see CRAB from Ben Jones' talk later in this session))
  - ✓ Double-cladding optical fibers barrel
  - ✓ Gas mixtures to reduce the diffusion
  - ✓ Cold TPC to reduce dark current from SiPMs
  - ✓ …

Plans for the contributed paper

- Perform the needed simulation to quantify the expected performances of each solution (already underway)
- Test assumptions with prototypes (already underway)
- Investigate other physics (BSM, solar nus,…) that can be done with large scale HPGTPCs (inputs welcome!)
- Address solutions that can allow for Ba tagging
- The paper would lay out the future NEXT program
- Goal is to demonstrate the potential of large-scale HPGTPCs