Results from the BNL 1T demonstrator



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June 3 2025



BNL 1T Design

- Acrylic tank
 - 1.3m tall
 - 1m diameter
- 58 PMTs
 - 30 2" diameter tubes on bottom
 - 28 3" diameter tubes on side
- Detector enclosed in dark hut





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 - 1m diameter
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 - 30 2" diameter tubes on bottom
 - 28 3" diameter tubes on side
- Detector enclosed in dark hut
- Scintillating paddles
 - 2 on top
 - 3 on bottom
 - Used to tag muons
 - 8x8 hodoscopes on top/bottom







BNL 1T Calibration

• Alpha Lightbulb

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- ²¹⁰Pb needle source inside plastic scintillator
- Triggered by small (0.5" PMT) next to scintillator
- Entire apparatus in acrylic tube
 - Lowered to center of detector





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IT base

BNL 1T Data Acquisition (DAQ)

- CAEN Digitizers
 - Convert analog voltages to digital signals
 - 64 500 MHz channels
 - 64 62.5 MHz channels







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 - Fan Ins/Outs
 - Signal Converters (NIM <-> TTL)
- HV
 - Supply all PMTs
 - Supply paddles and hodoscopes
 - 75 channels
 - Some CAEN, some LeCroy





Simulation

- Use RATPAC 2
 - Geant4-based physics process simulator
 - Photon propagation
 - "As Microphysical as Reasonably Achievable"
- Model detector geometry
 - Tanks
 - PMTs
 - Target material
 - Optical coupling
- Input detector parameters
 - PMT specs
 - Material properties
- Particle generators
 - Sources
 - Backgrounds







1T Results (Aug–Nov 2022)

- Light yield increase from water to 1% WbLS (DIN + PPO)
- Light yield stabilized in 20 minutes after injection

300

250

200

150

100

50

Median of Side Npe

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Pre-injection

light level









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WbLS stability

- 1% WbLS light yield is stable within a few percent over weeks
- A multi-month stability test is ongoing





1T recent results

- Current 1T run starting in April 2024
- Various water fills
 - Empty
 - 1⁄4 fill
 - 1⁄2 fill
 - Full

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- Increasing WbLS concentrations
 - 0.1% increments from 0.35% to 0.75%
 - Currently at 1%



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