

# Tagging Pb-214 Decay Events via Toy Monte Carlo Method

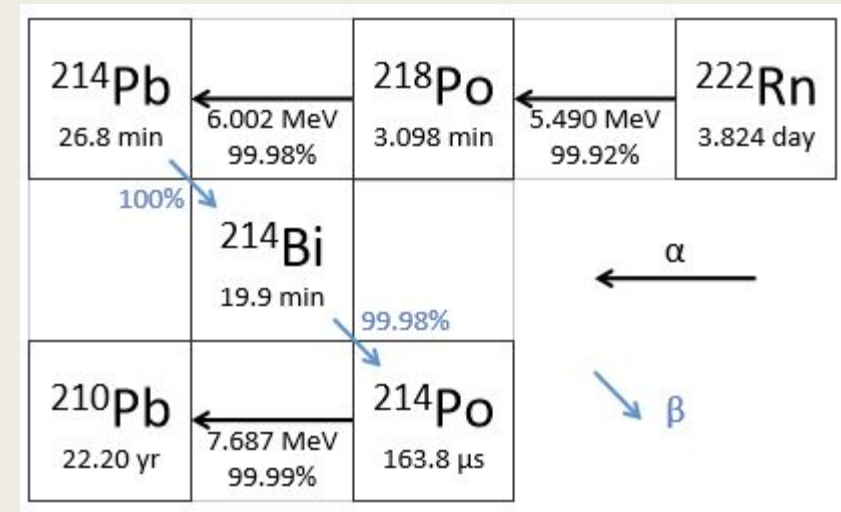
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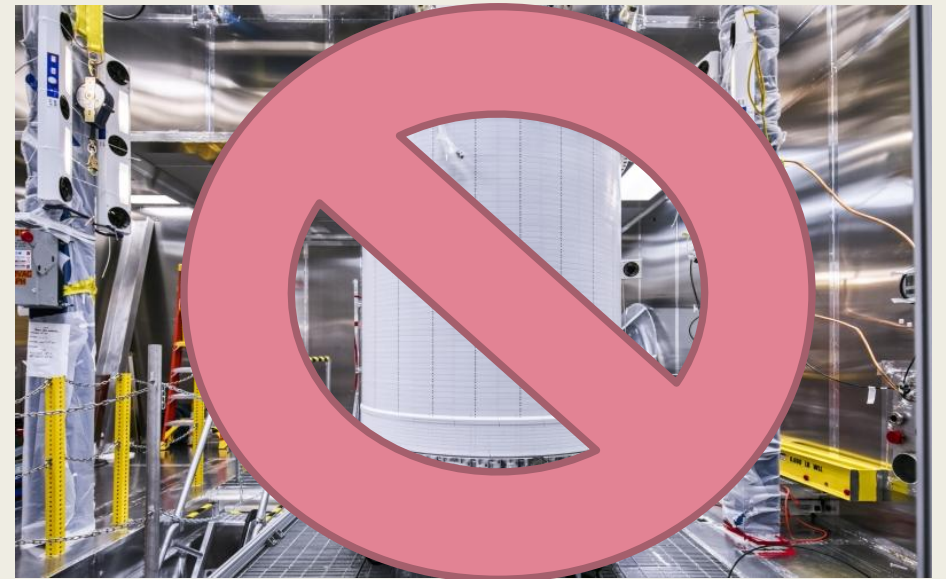
# Goal of Simulation

- Tag Pb-214 decay events
- “Naked”  $\beta$  decay can look like a WIMP
- Useful to prevent false positives

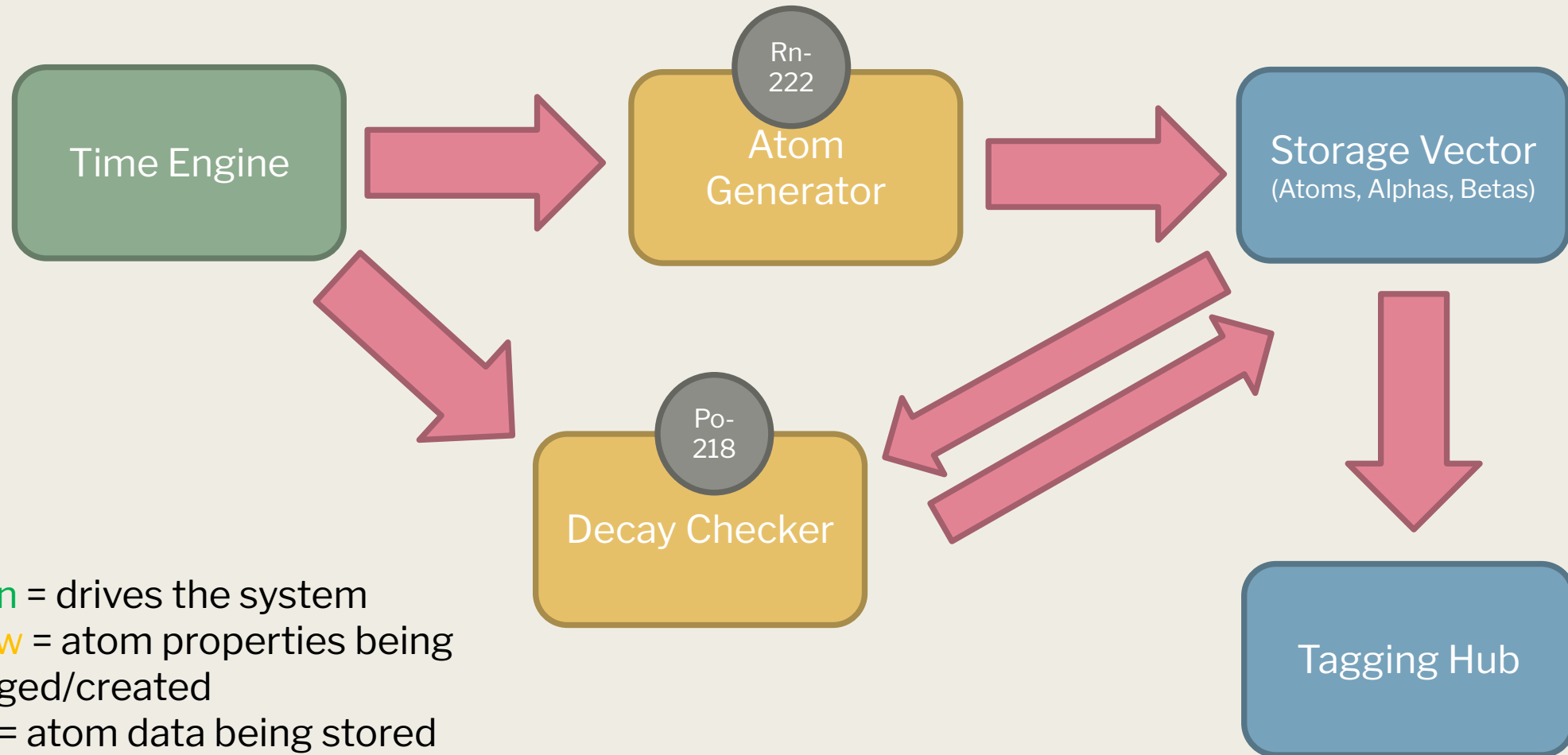


# Restrictions

- Certain natural phenomena are simplified
- Assumes that particle events can be perfectly recorded and reconstructed
- Atoms are stationary since velocity, charge, and flow rate are not used



# Simulation Flowchart



**Green** = drives the system  
**Yellow** = atom properties being changed/created  
**Blue** = atom data being stored

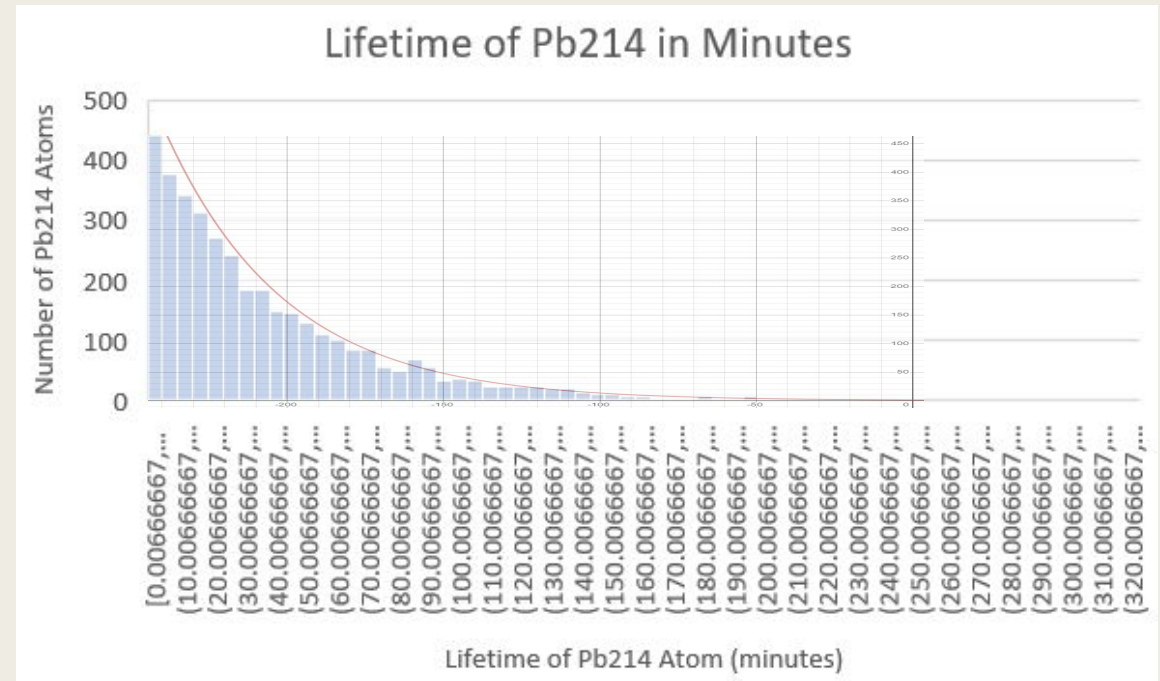
# Preliminary Results

- Currently tags Rn-222 decays and Po-218 decays
- Will tag all decay events except Pb-214
- Pb-214 events will “fill in the gaps”

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Rn-222 decay time: 10043.9
Rn-222 x position: 34.1845
Rn-222 y position: 457.371
Rn-222 z position: 952.017
List number: 851
Po-218 decay time: 10045.5
Po-218 x position: 34.1845
Po-218 y position: 457.371
Po-218 z position: 952.017
List number: 851
```

# Atomic Lifetimes in Simulation

- Decay rates align closely with calculated values
- $r = 1 - e^{-t/\tau}$   $\square$   $t = -\tau \cdot \ln(1 - r)$
- The  $\tau$  value is different depending on the atom, explains different lifetimes
- $\tau = \text{half-life} / \ln(2)$



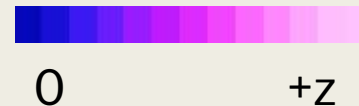
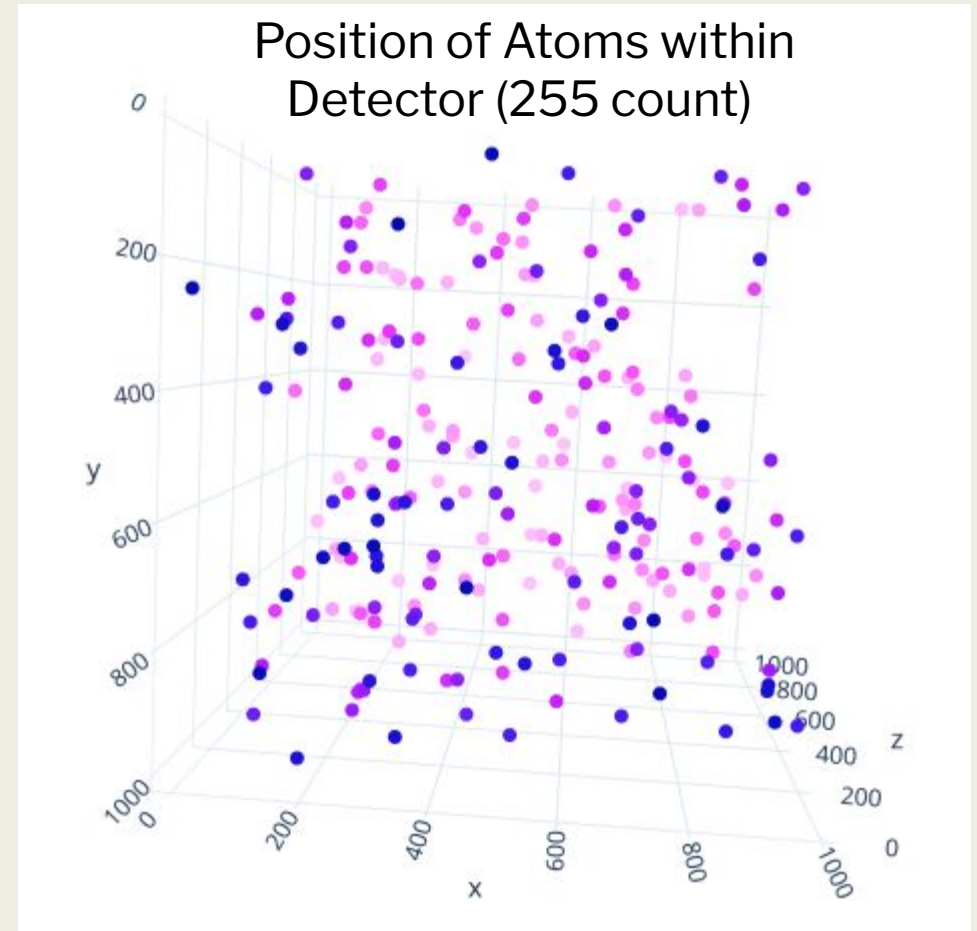
# Expected Results

- For now, atoms are expected to remain stationary
- Each progeny should report the same initial parent atom
- In the future, atoms' positions will change based on velocity, drift rate, charge



# Visualization Potential

- Tagged events and decay chain visualization
- Currently can visualize atom position
- Useful for troubleshooting, finding velocities, and more





# Questions?