A pre-supernova neutrino alert with SNO+

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SNEWS Meeting @ Neutrino 2020

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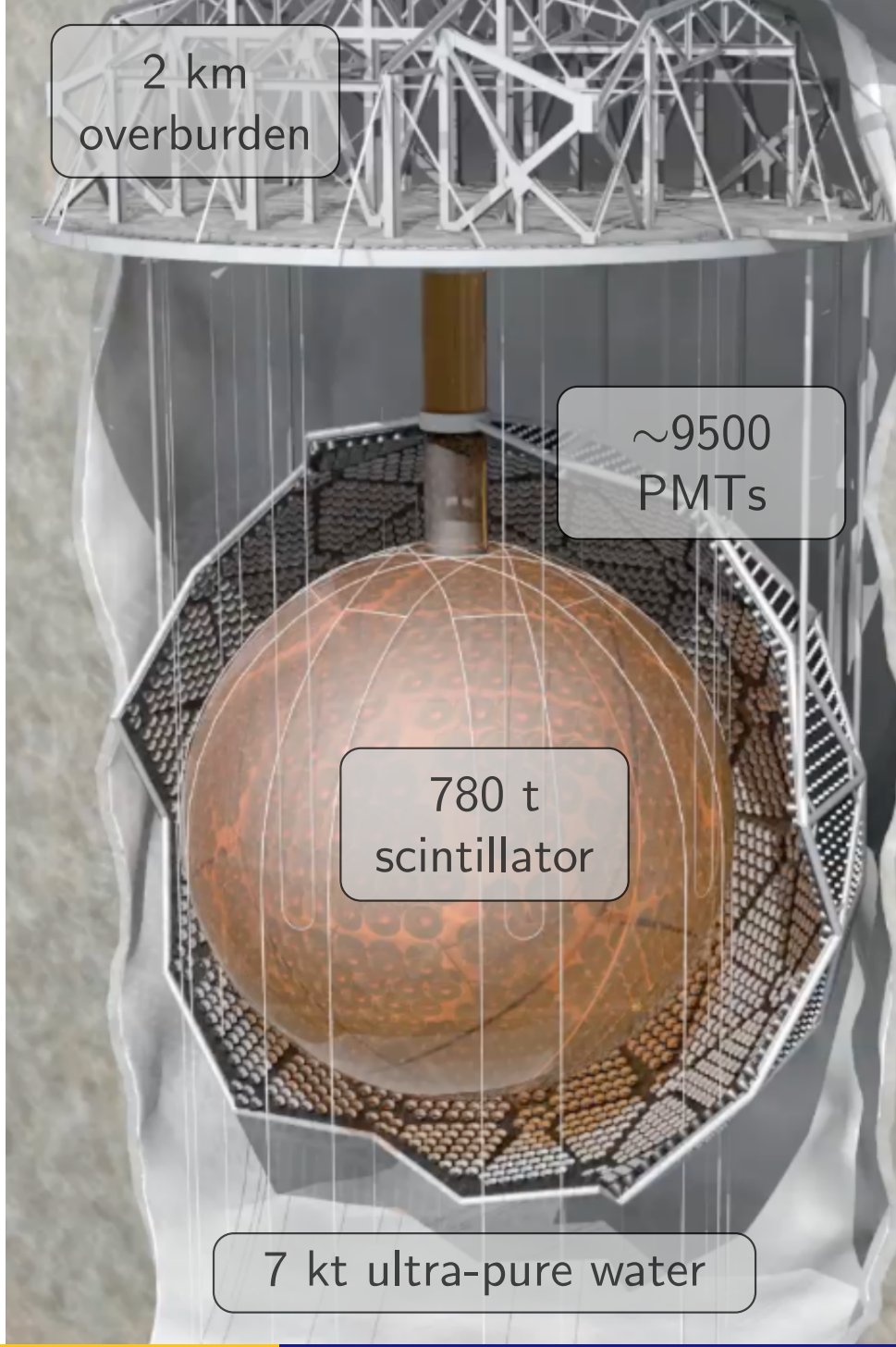
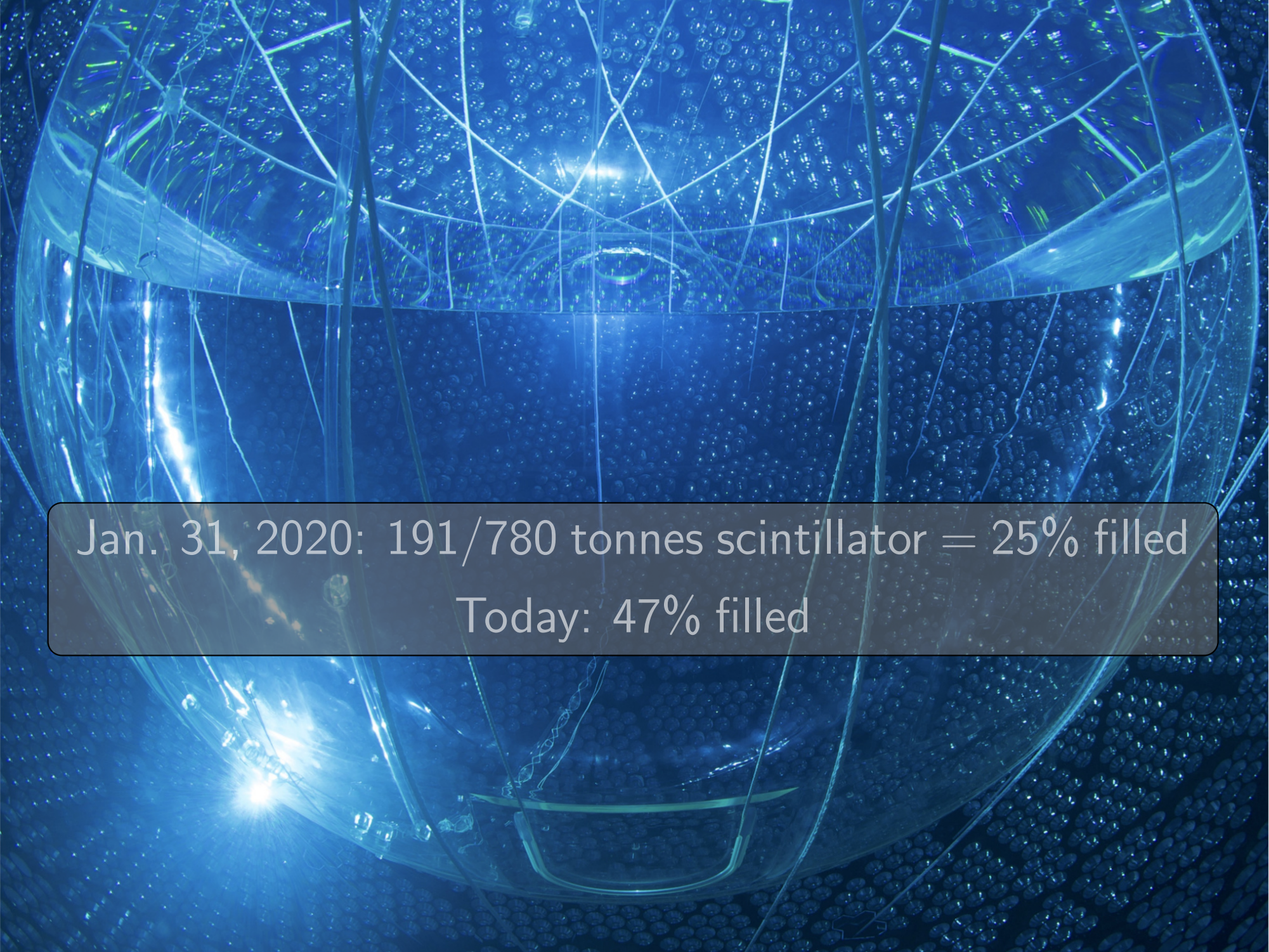
The SNO+ detector

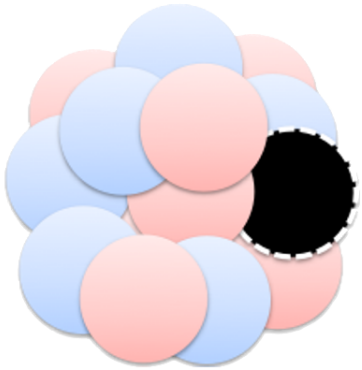
- Located at SNOLAB, Sudbury, Canada
- Detection medium:
  - 905 tonnes water
  - 780 tonnes liquid scintillator (LAB + 2 g/L PPO)
- Transition from water to scintillator paused due to pandemic (47% LS)
- 9500 PMTs, 54% photocoverage
- 2 km rock overburden (6 km water equiv.), 70 μ/day
- 7 kt water shielding (1.7 kt inner, 3.5 kt outer)

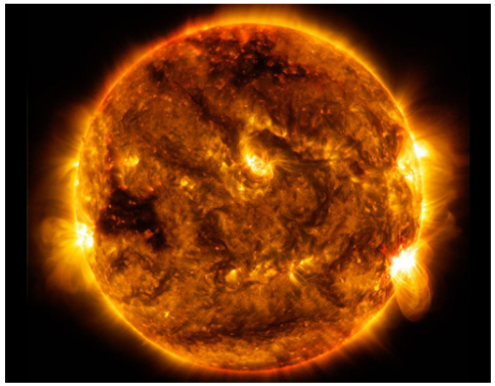


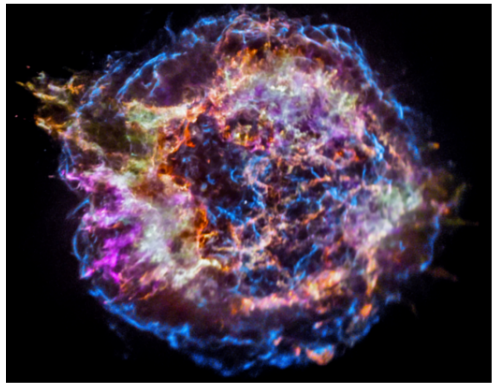

Jan. 31, 2020: 191/780 tonnes scintillator = 25% filled
Today: 47% filled

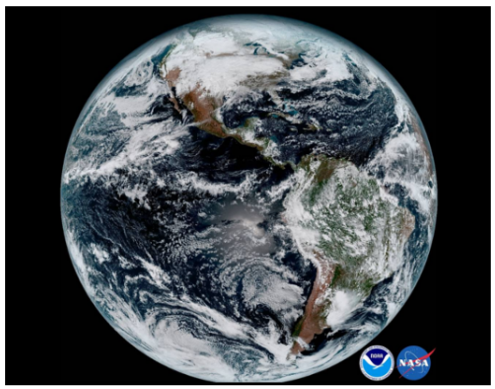
The SNO+ science program

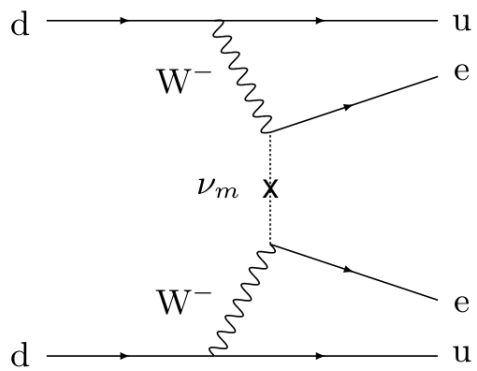
Water







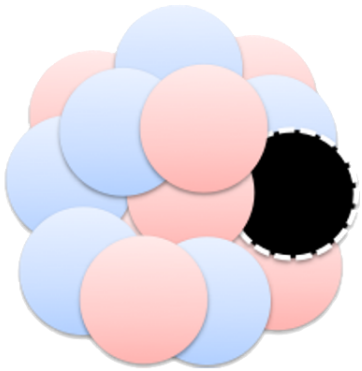


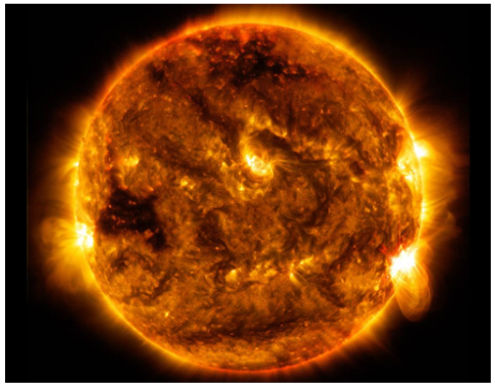


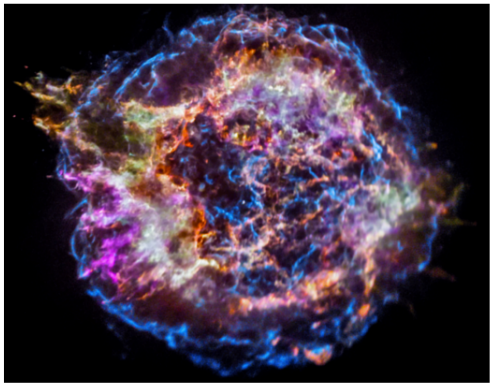
The SNO+ science program

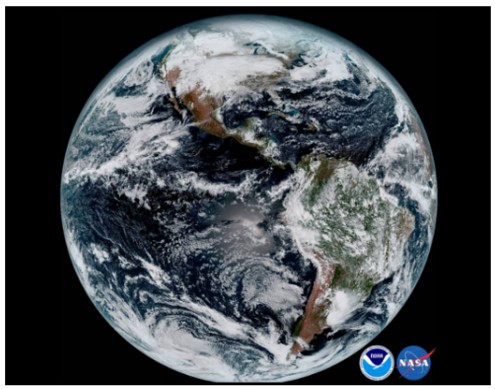
Water

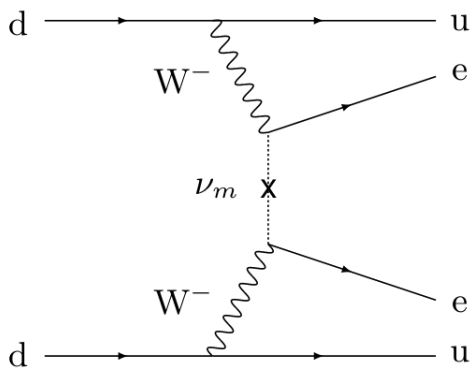
Scintillator











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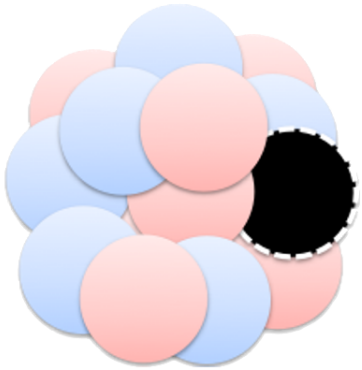
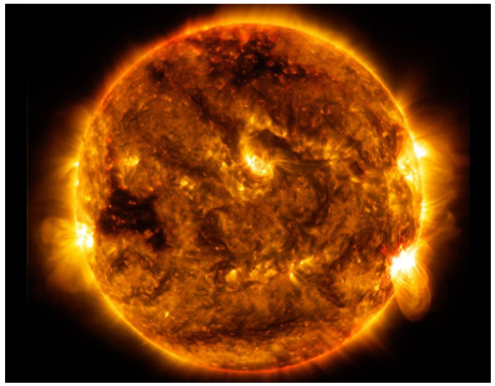
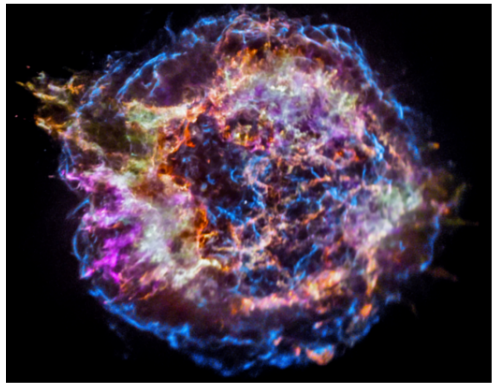
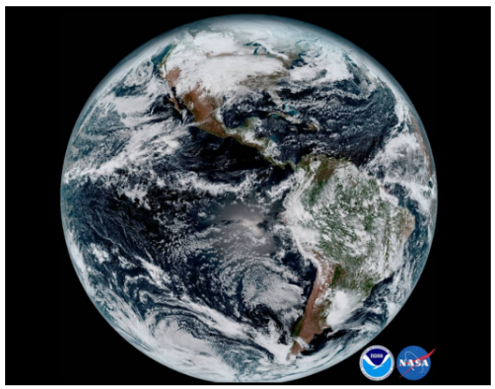
Water

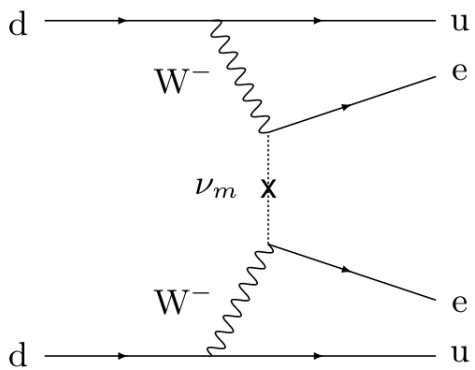
Scintillator











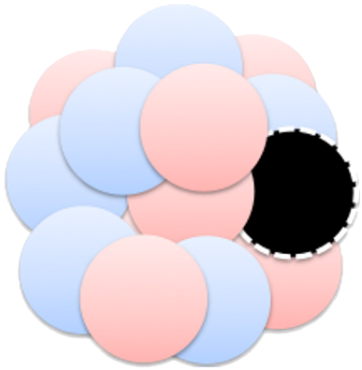
Te-loaded

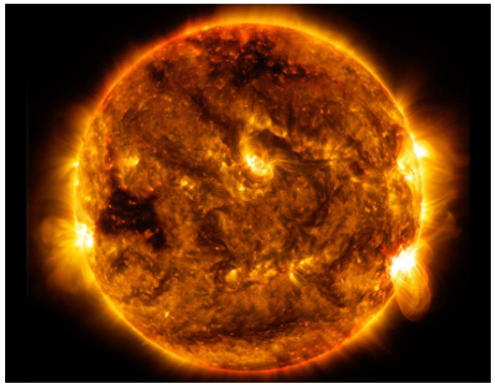
The SNO+ science program

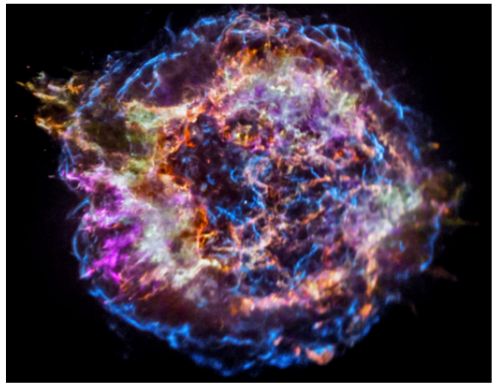
Water

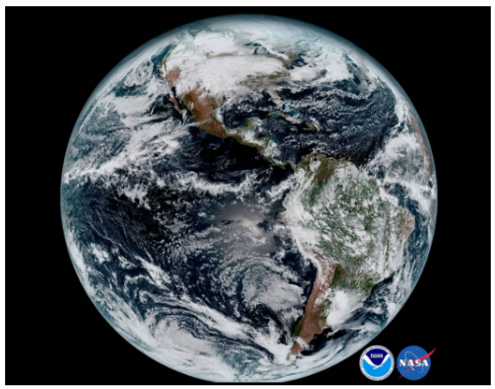
Scintillator

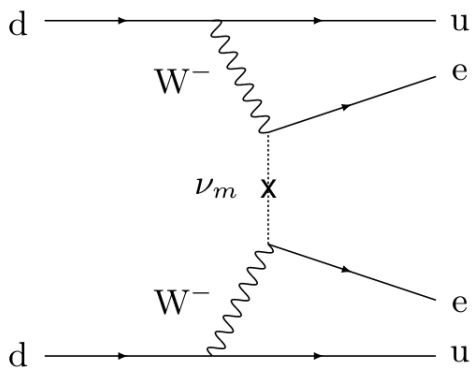
+ Pre-SN











Te-loaded

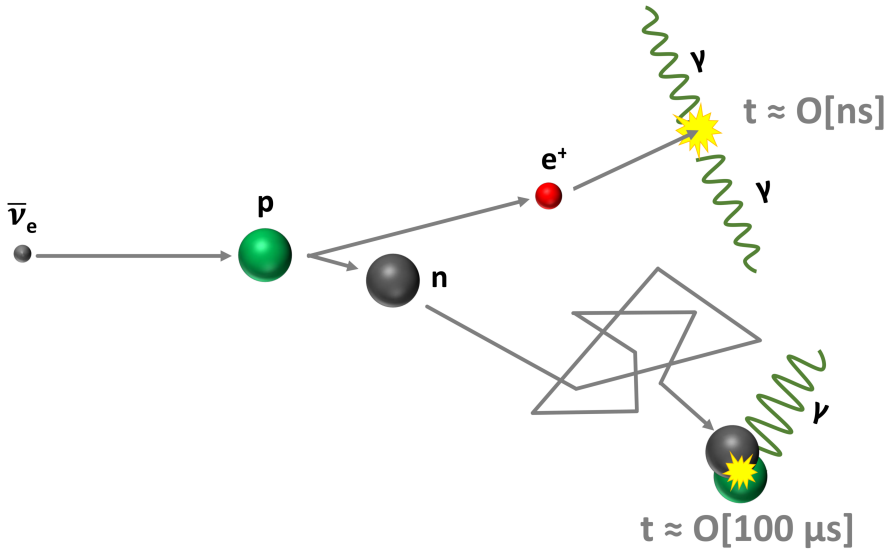
SNO+ participation in SNEWS

- SNO+ is currently developing the tools for a supernova alert - plan to join SNEWS this year
- SNO+ has also begun preparing the infrastructure necessary for integration with SNEWS2.0
- This includes a pre-supernova alert, which I am working on

A pre-SN alert will:

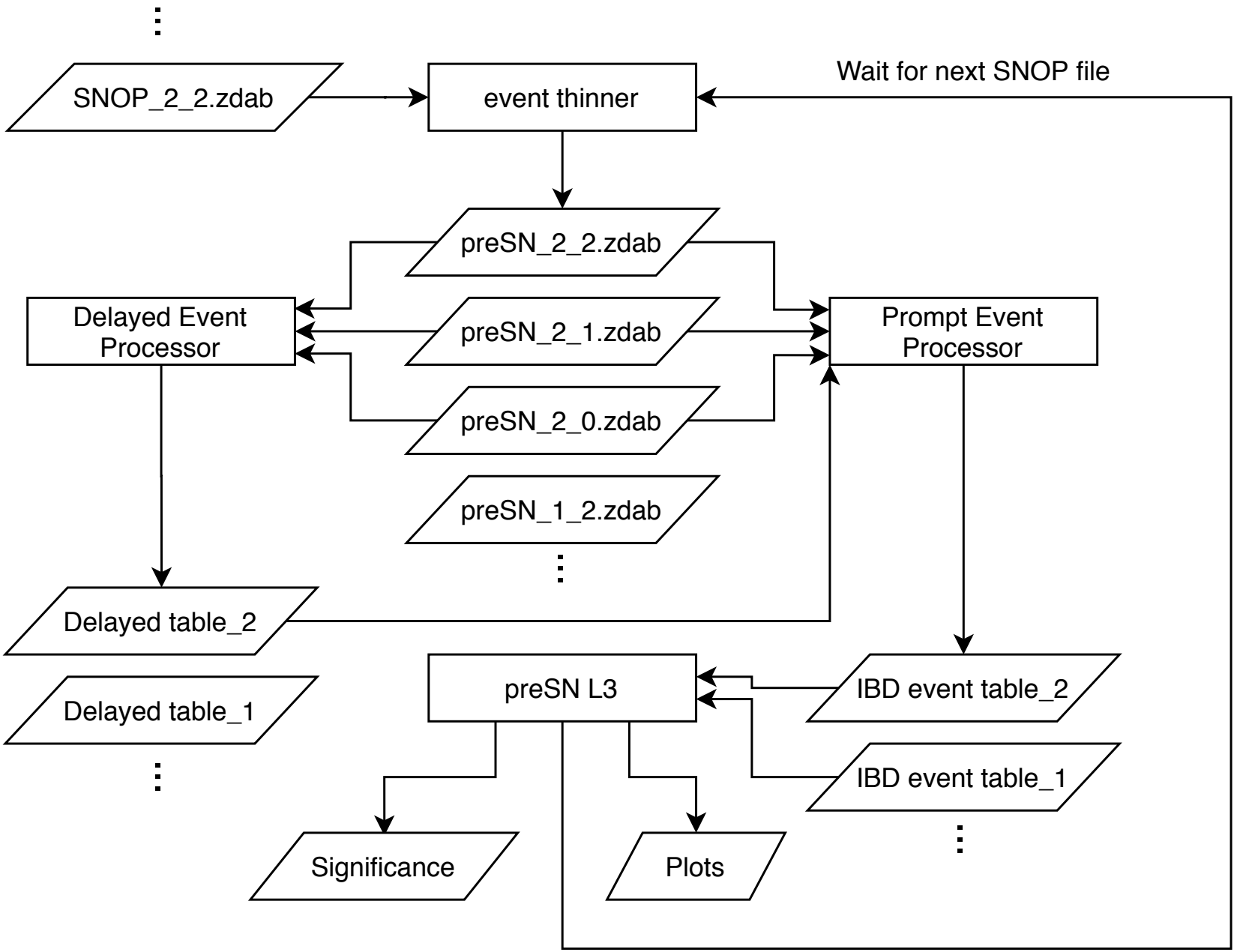
- Tell the SNO+ collaboration to avoid downtime of the detector
- Give SNO+ time to prepare for the supernova burst
- Be sent to SNEWS2.0 to alert the community

The SNO+ pre-SN monitor

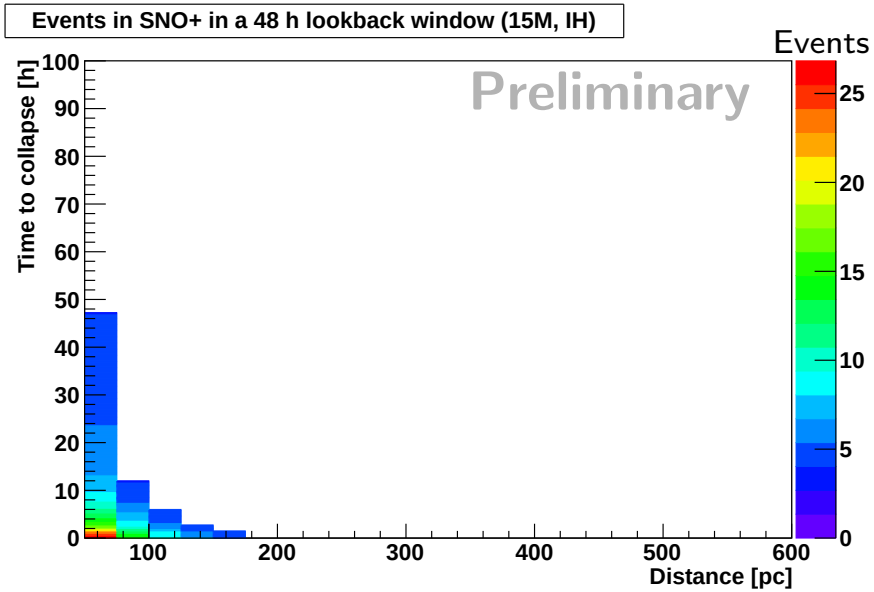


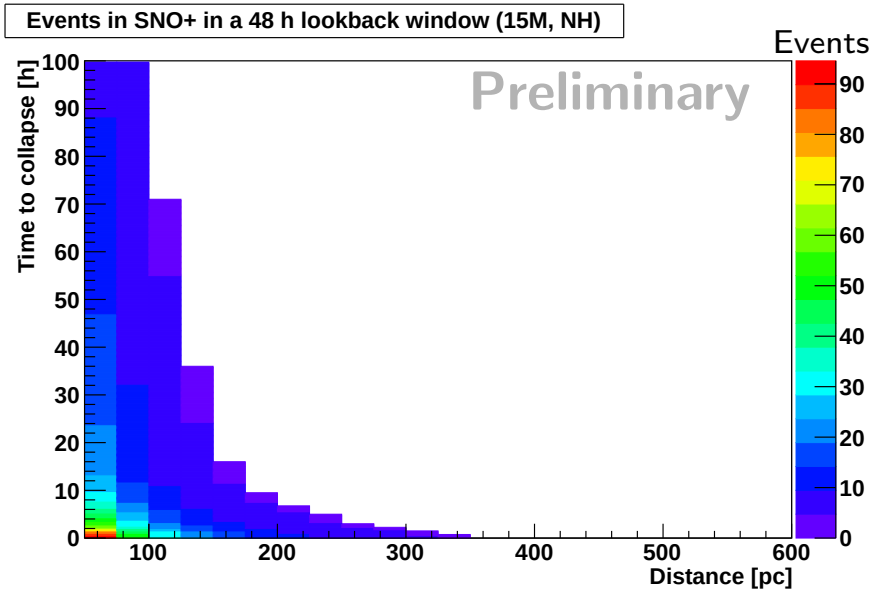
- Counting experiment: # of IBD interactions in a 48 hour window
- Generates significance+plots every time a new data file becomes available (approx. every 15-20 minutes) - this can change
- Skeleton code nearing completion, will undergo testing on SNO+ data and simulations to refine cut parameters, sensitivities

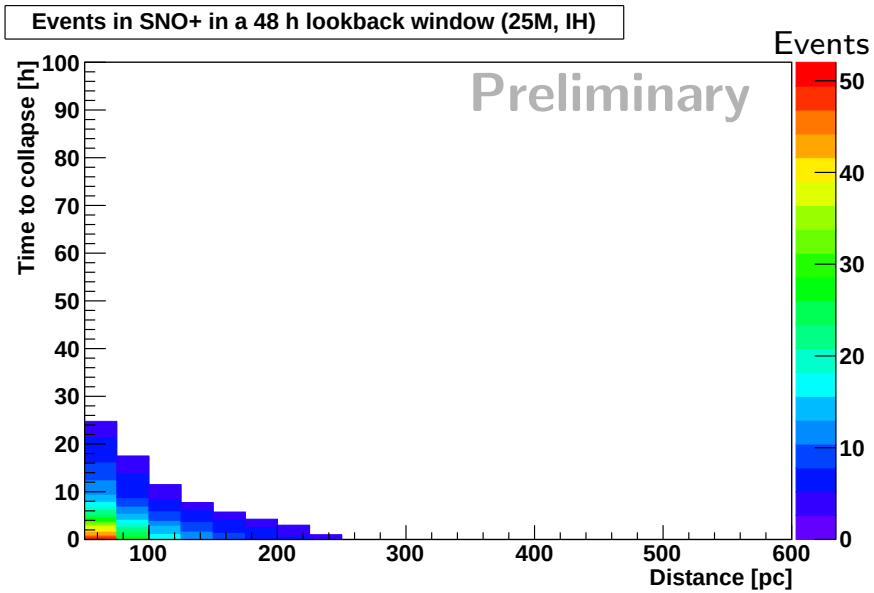
Pre-SN information flow

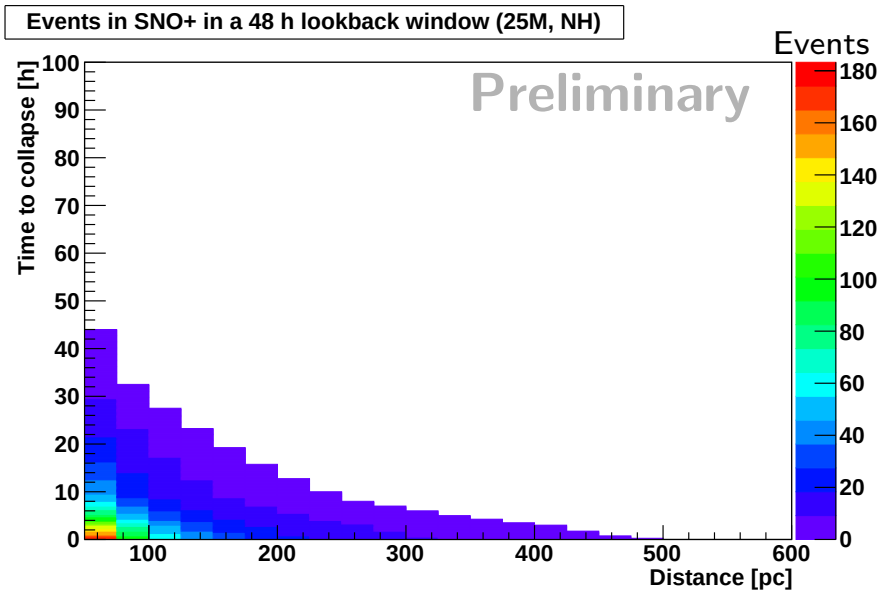


Pre-SN[1,2] sensitivity in SNO+ (events that pass 3σ)









[1] Odrzywolek, A., Heger, A. *ACTA Physica Polonica* B, 41, 1611 (2010)

[2] Odrzywolek, A., Misiaszek, M., Kutschera, M. *Astropart. Phys.* 21, 303 (2004)

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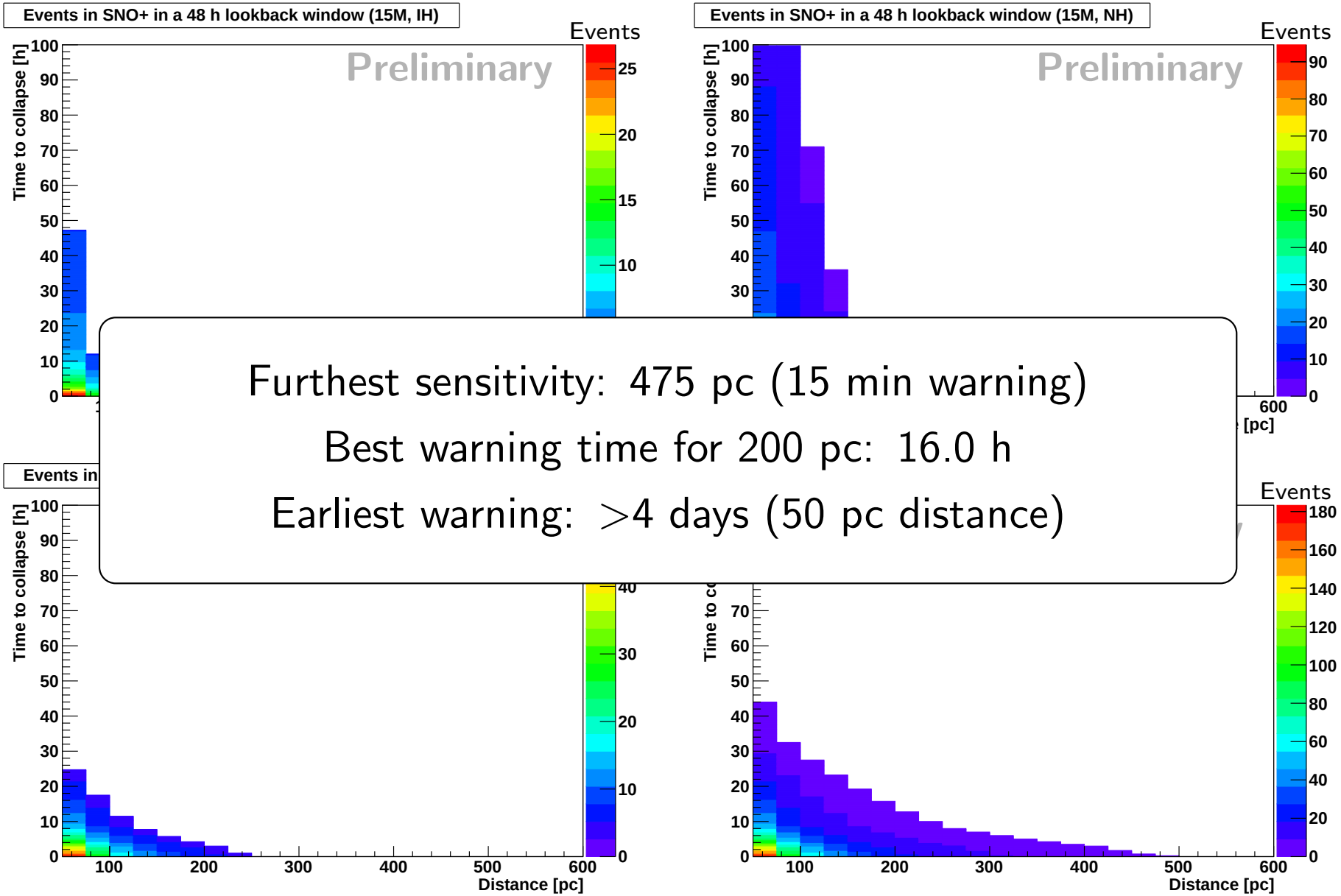

Furthest sensitivity: 475 pc (15 min warning)

Best warning time for 200 pc: 16.0 h

Earliest warning: >4 days (50 pc distance)

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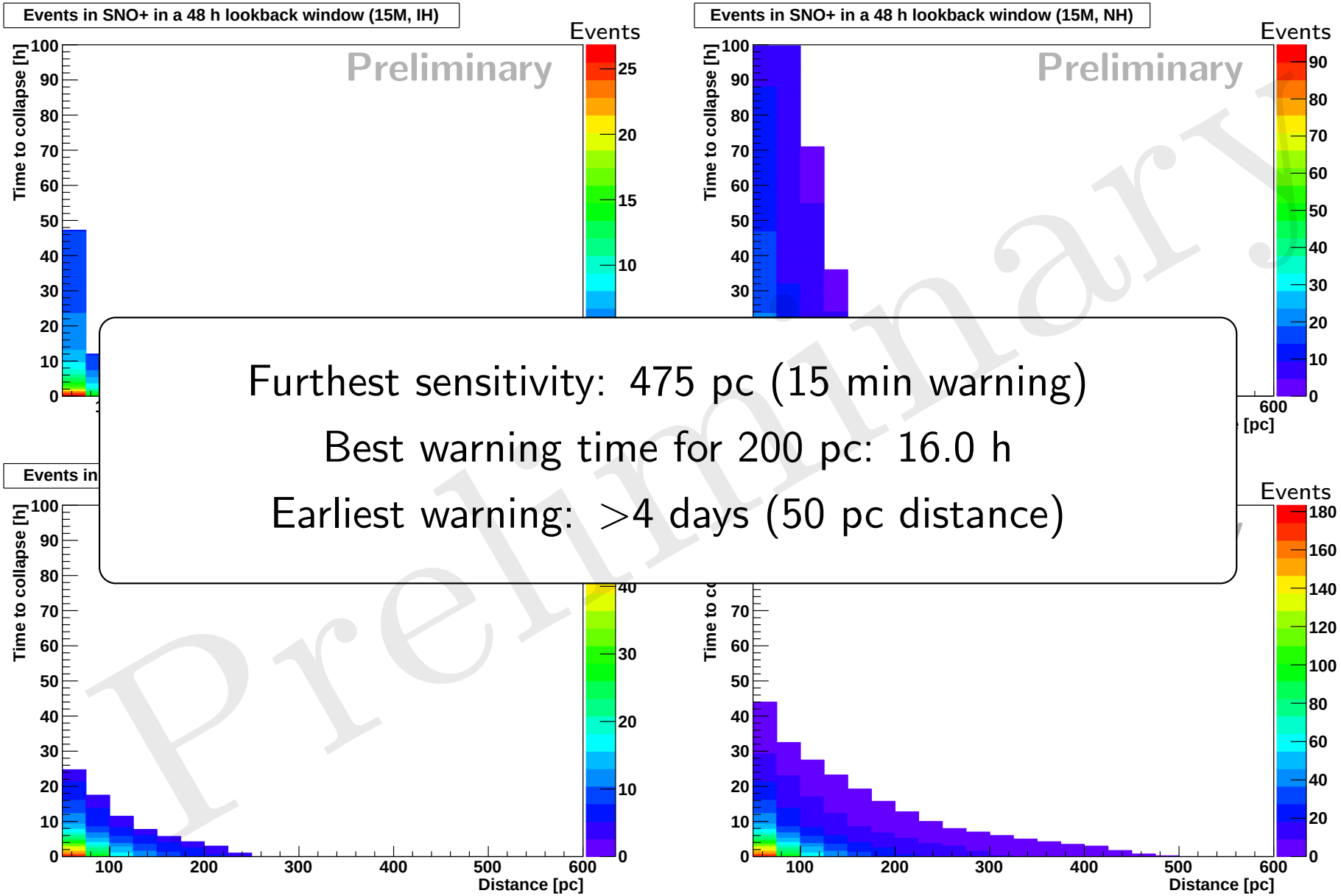

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What I'd like to know from the SNEWS2.0 community

- The SNO+ pre-supernova alert is still in its early stages, plenty of room for changes
- What format does SNEWS want?
- ...similar to KamLAND? Every $\sim$15 min. send a significance with a timestamp and a flag to indicate whether or not there is "unusual activity"
- Anything else?