New opportunities with IceCube-Gen2

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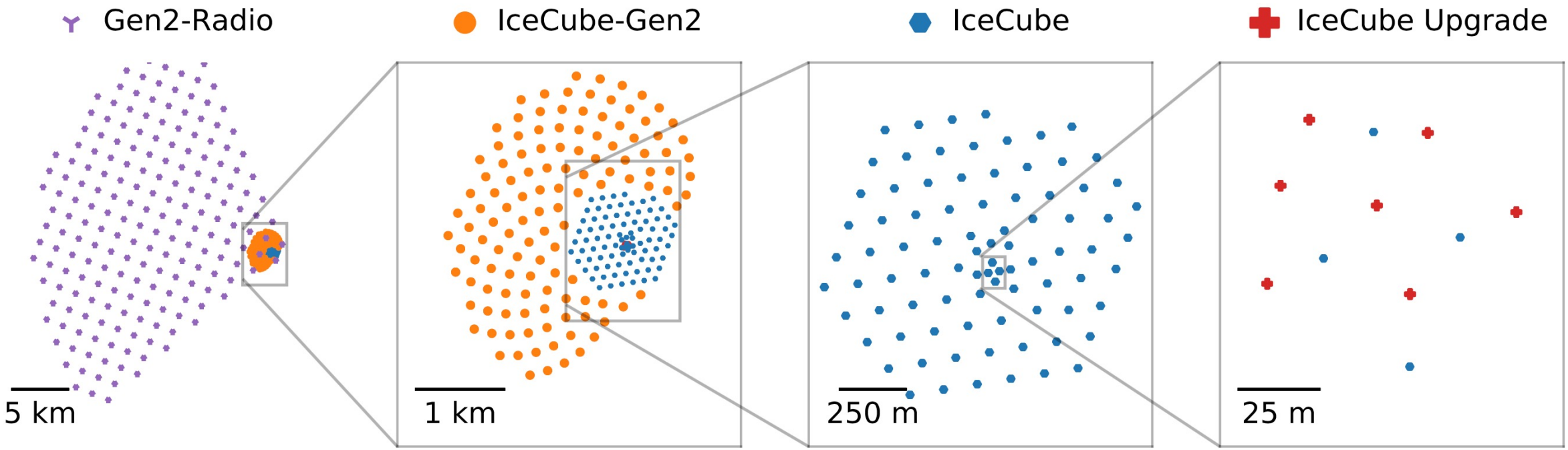
IceCube-Gen2:
expanded optical array and added radio array

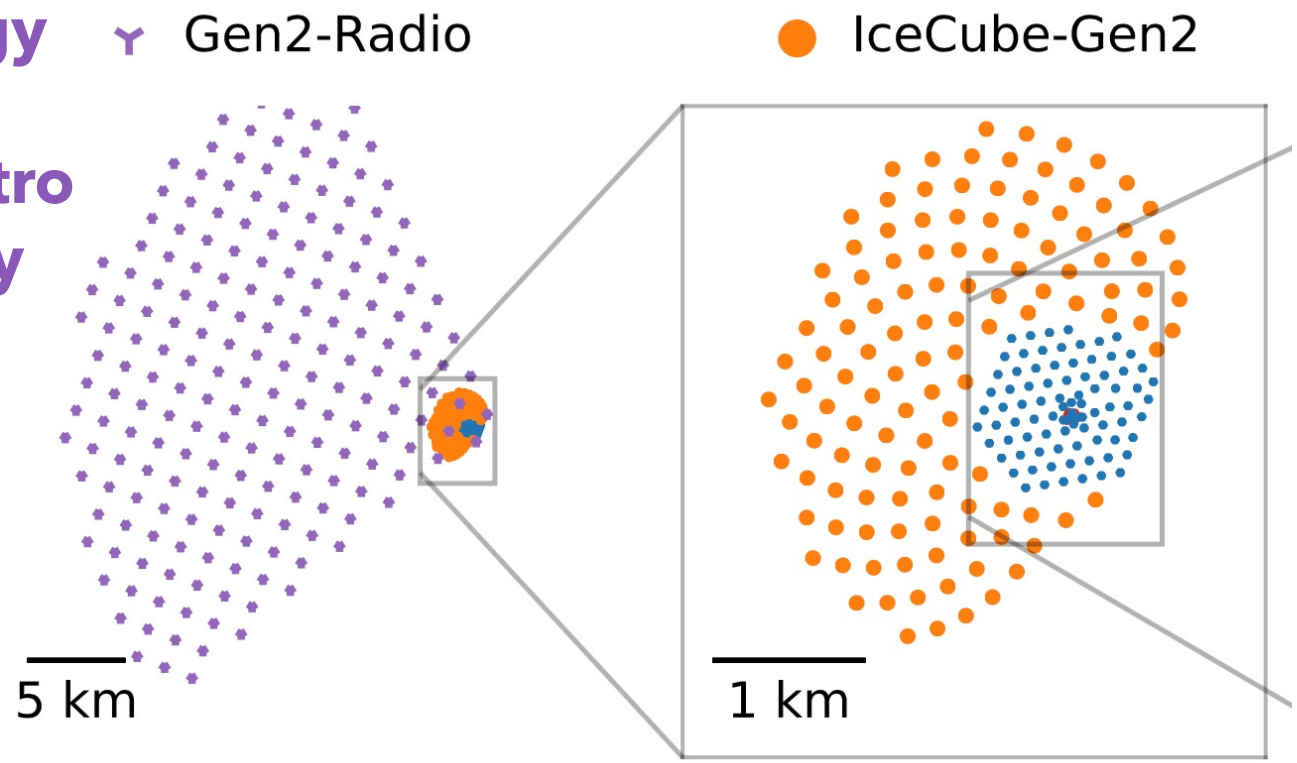


200
radio stations

9600
new optical modules

IceCube-Gen2

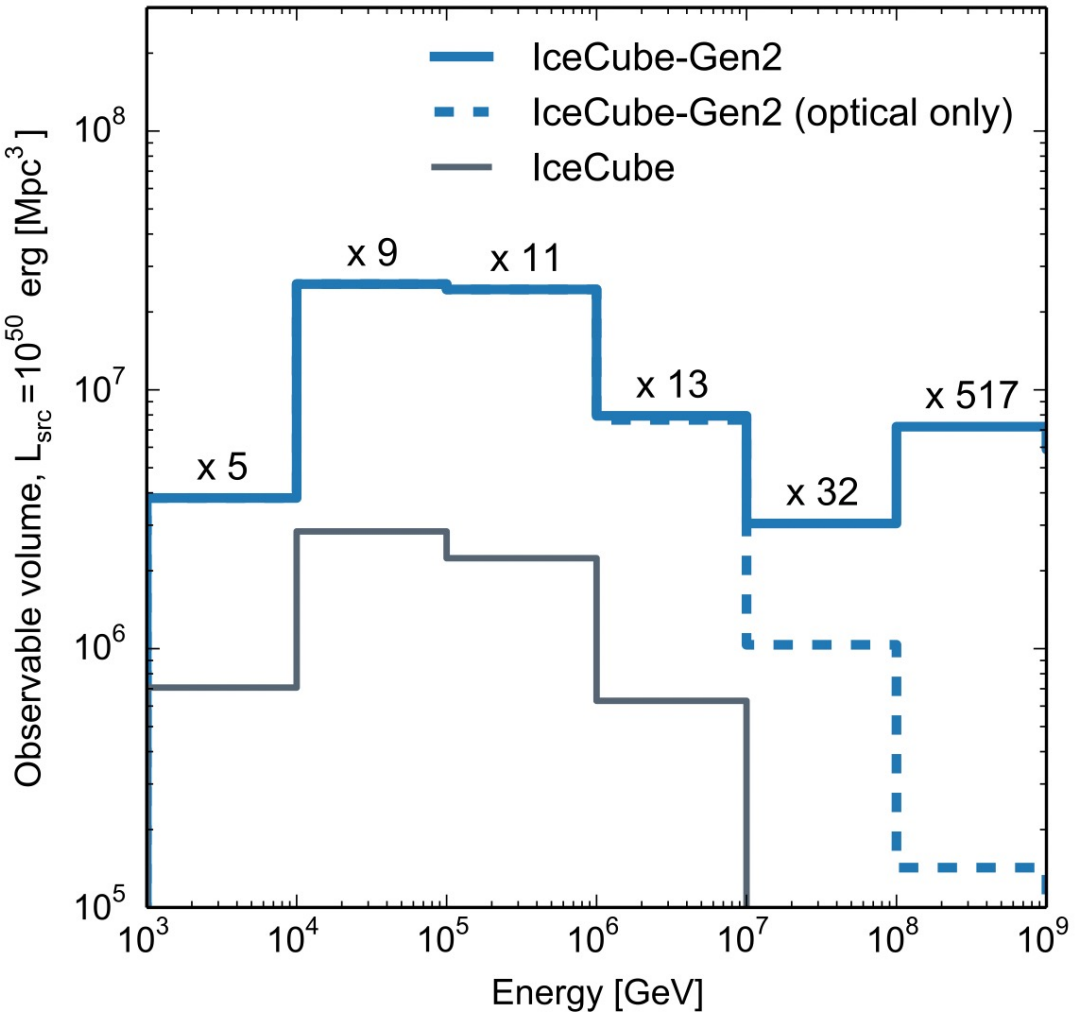
- **Extends the energy reach to EeV**
- **New classes of astro sources, especially those tied to UHE cosmic rays**
- **Discovery of GZK neutrinos**

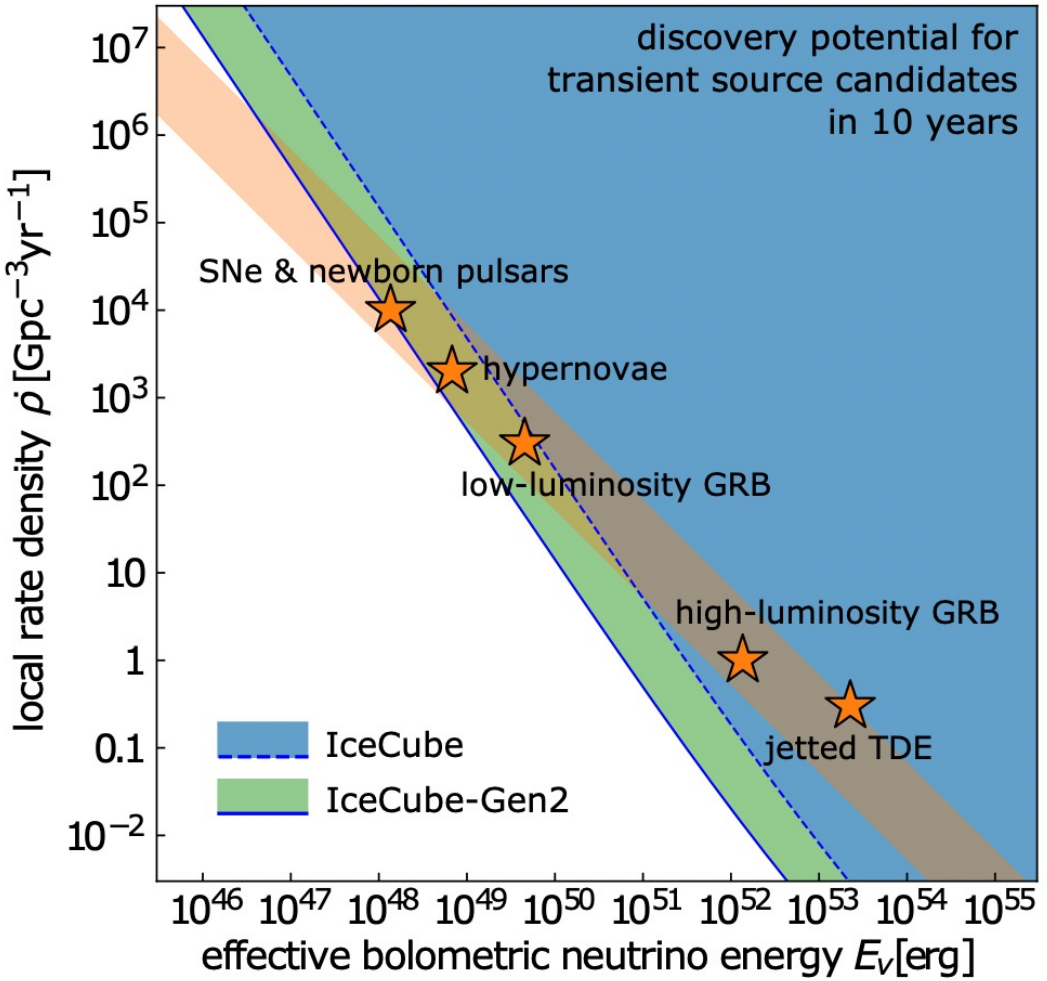


- **Discovery phase to firm detections of individual HE sources**
- **Allows us to see fainter source classes**
- **What environments are needed for HE neutrino production?**

- **Swedish participation in RNO-G experiment – radio in Greenland**

IceCube-Gen2: new horizons and new sources





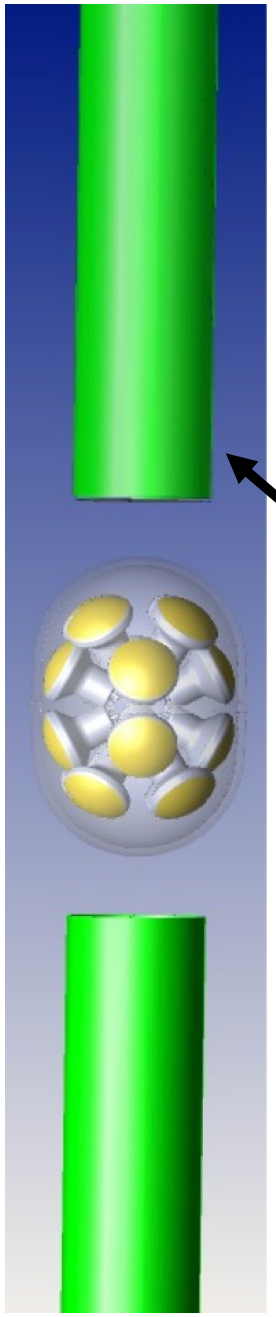
IceCube-Gen2 and Sweden

Vetenskapsrådet

- Awarded RFI grant for infrastructure 2022-2024
  - Development of novel optical modules
  - Development of wind power
  - Development of intellegent triggering for radio array
- Highest priority (A1) on the recently released 2022 “inventory of needs” roadmap

(See poster by Jakob Beise)

Development of new photon traps

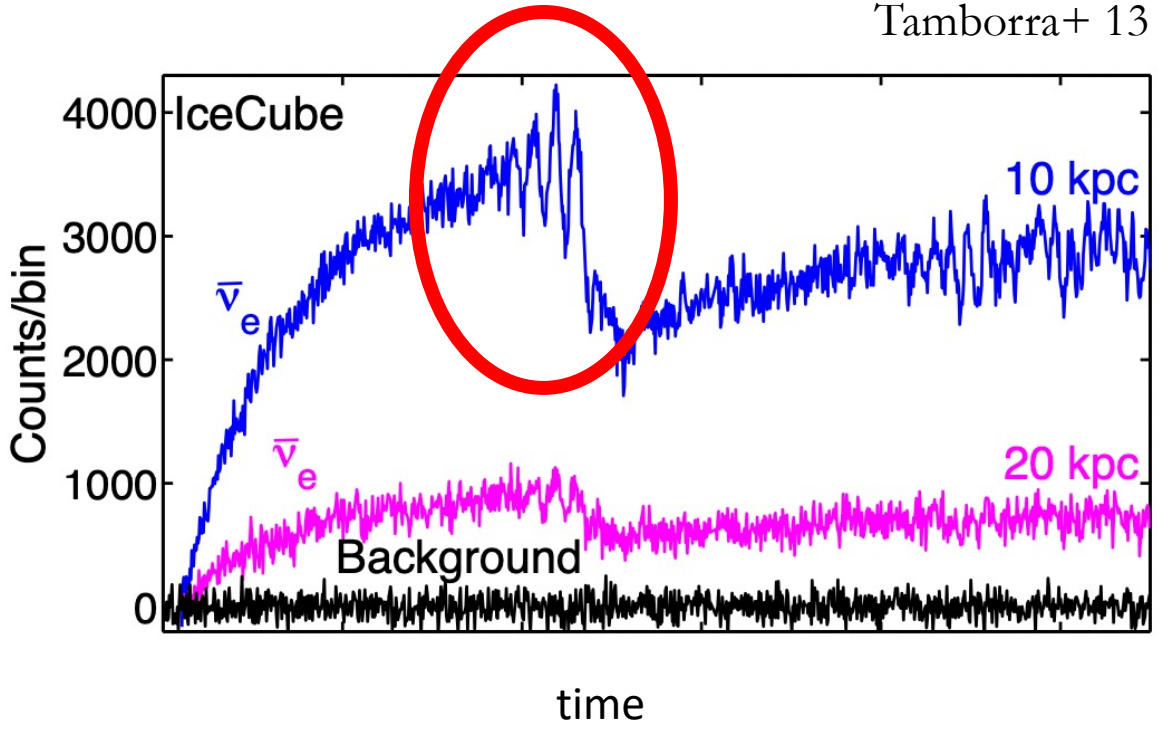


For a 2 m design, estimate about 2x more photons

Wavelength paint coats inside of quartz cylinders

Improved resolution for supernova neutrino light curve

Tamborra+ 13



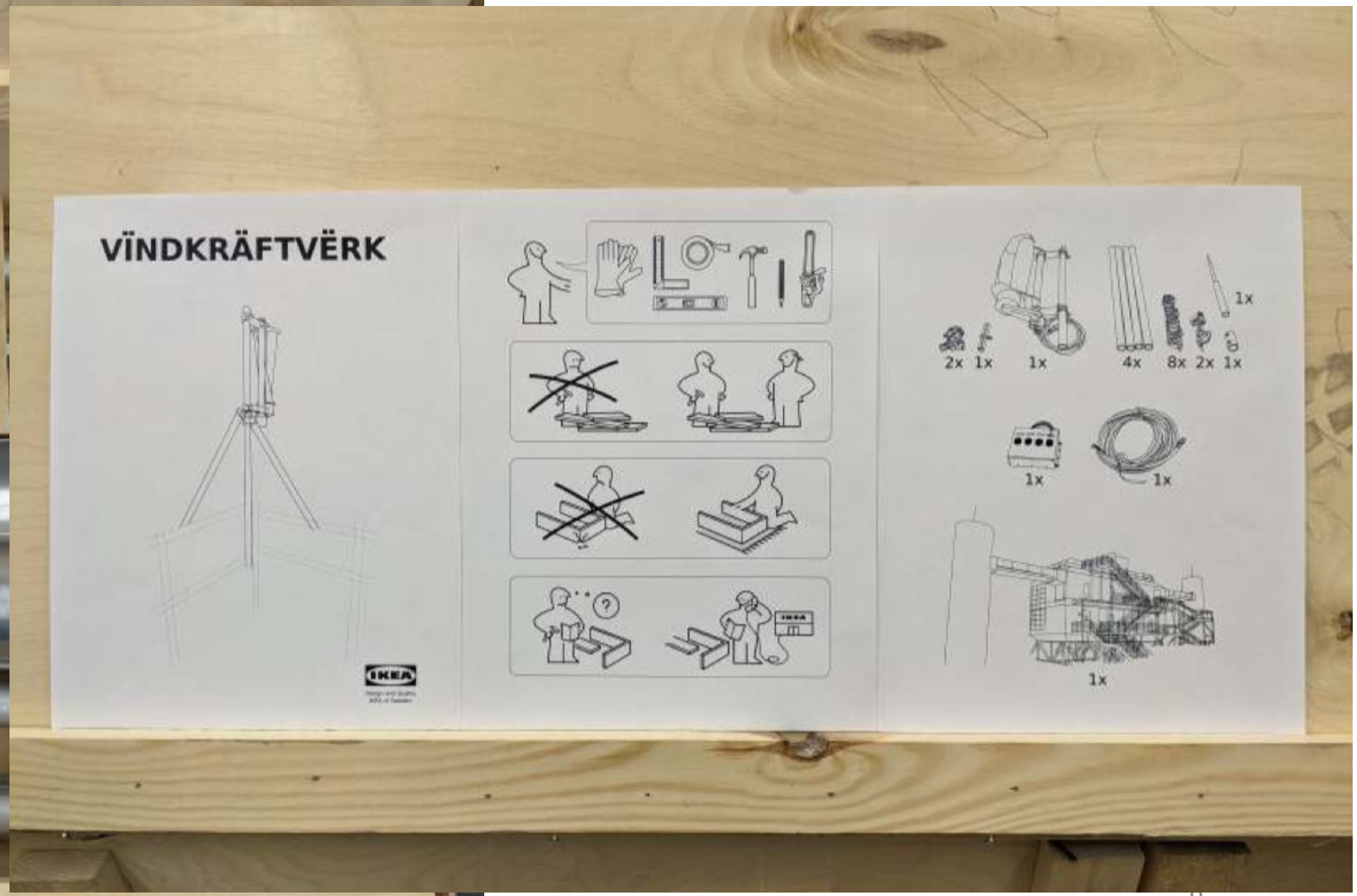
Wind power and low temperature batteries

Wind turbine developed at Uppsala –
3 stations sent to Greenland for RNO-G

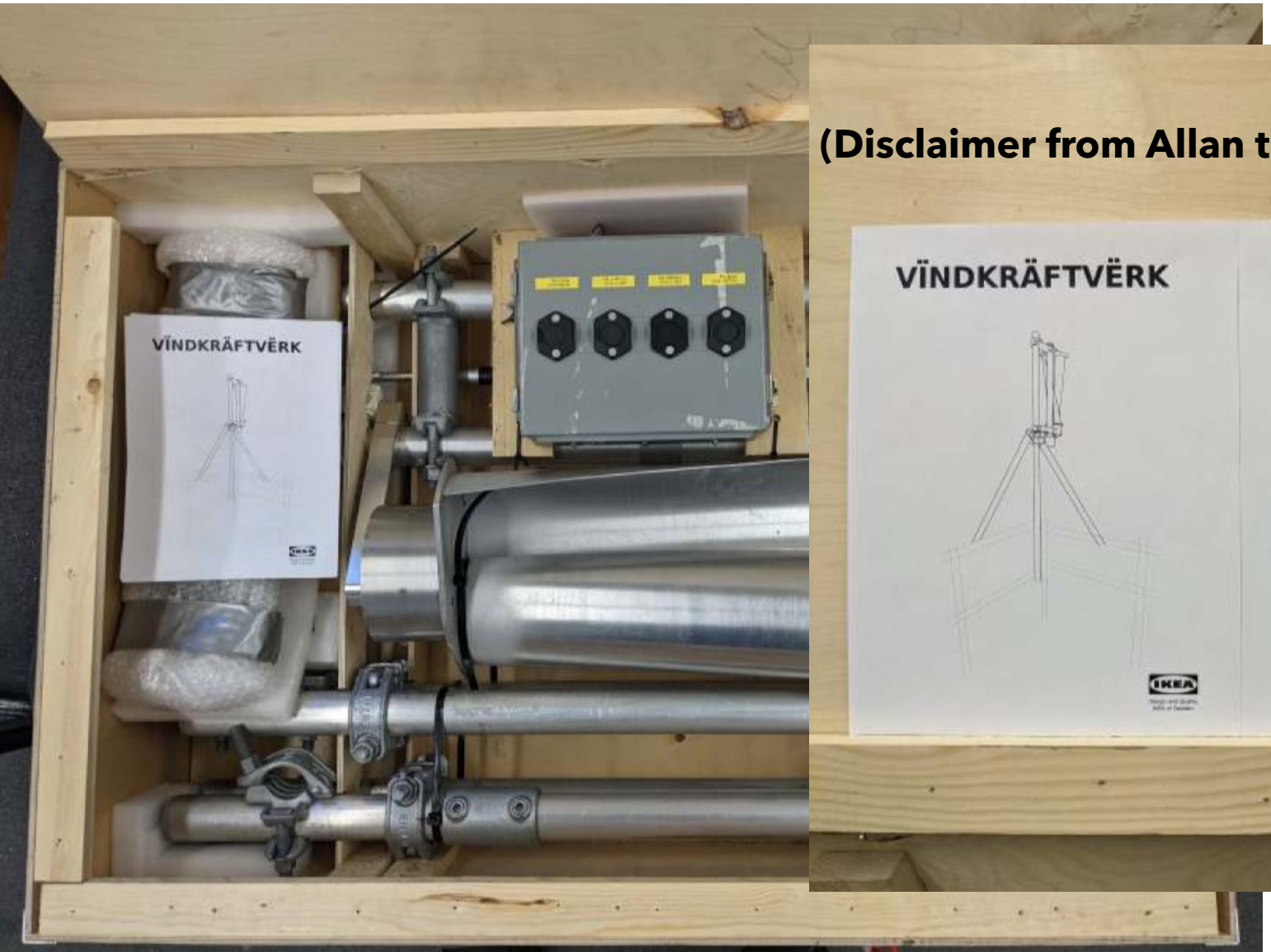
Special low temperature NiCd
batteries from SAFT Oskarshamn

Wind power at the Pole

Wind power at the Pole



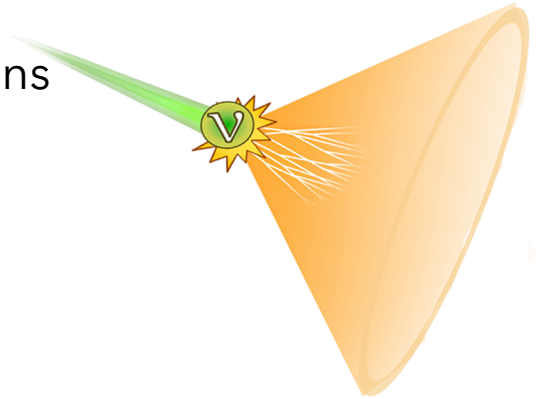
Wind power at the Pole

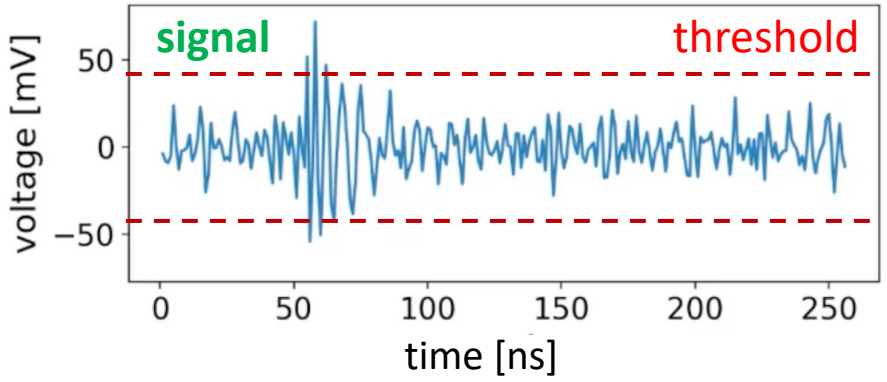


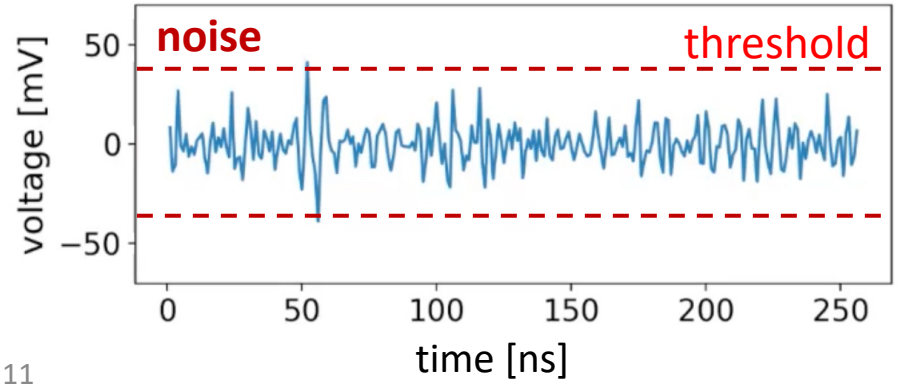
(Disclaimer from Allan that a non-Swede designed and wrote this)

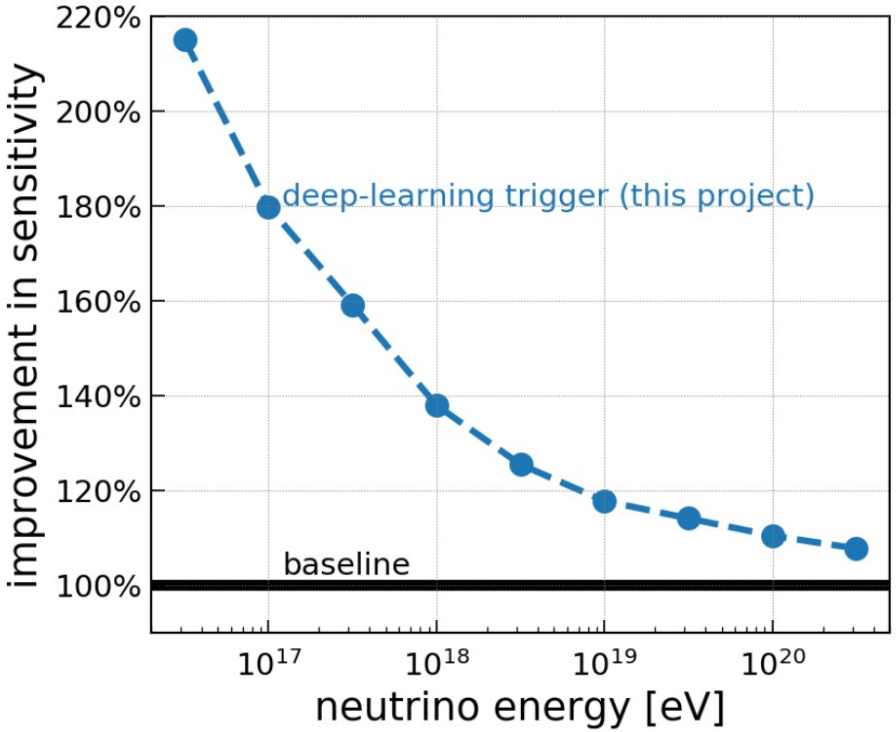
Sensitivity Improvement of Radio Detectors

- Detector is read out if signal is above threshold
- Trigger rate limited by triggers on thermal noise fluctuations
  - for 10Hz readout rate -> several TB of data/day
- Real-time rejection of thermal noise
  → lower threshold
  → larger sensitivity



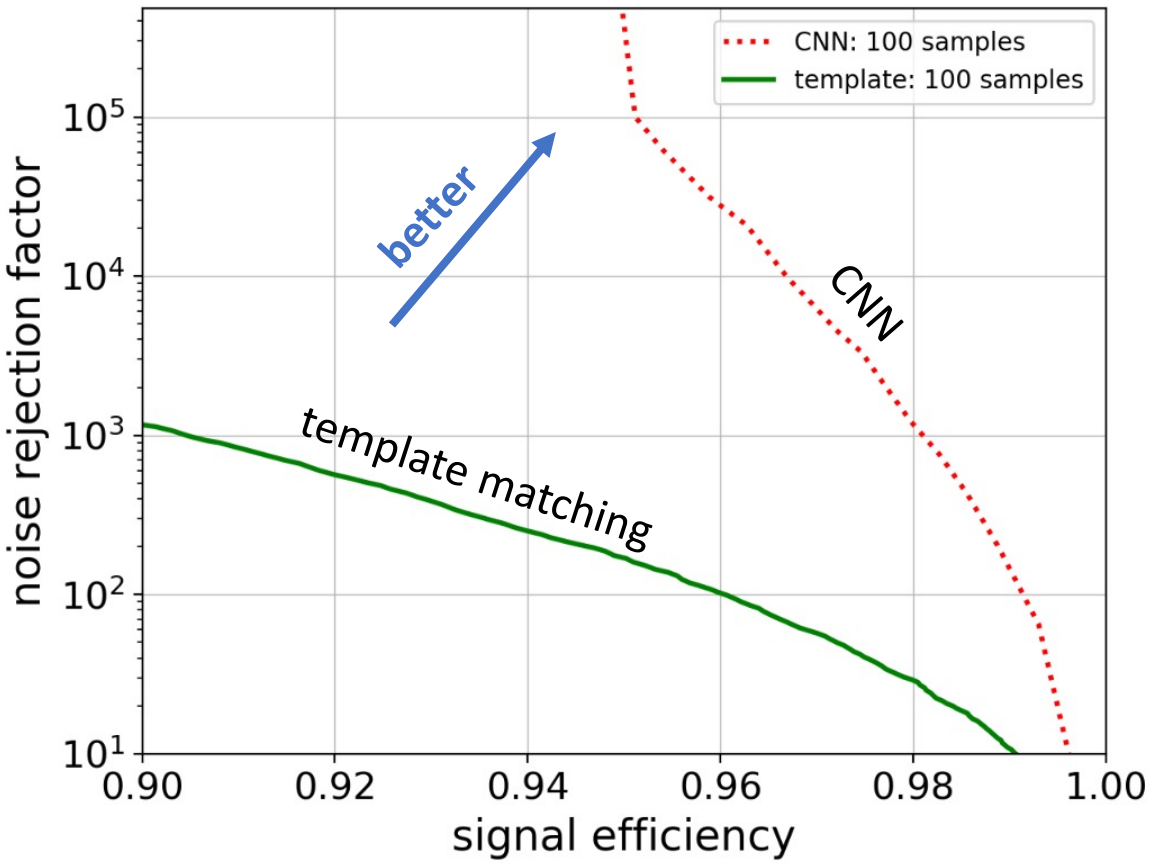






Deep Learning Trigger

- Requirement: Fast enough for real time processing on low-power hardware
- With small neural network:
  - 5 orders of magnitude noise rejection at 95% signal efficiency
- Significant improvement over template matching
- Verified in lab measurements



Now: Development for RNO-G (Greenland) and Gen2 (South Pole)

New opportunities with IceCube-Gen2

- IceCube-Gen2 consists of an expanded optical array + radio
- Sweden is involved mainly in new photosensor designs, wind power (and low temperature batteries), and the development of radio triggering
- A factor of ten more astrophysical neutrinos with improved directional reconstruction = sources that are five times fainter compared and fewer false coincidences with potential sources.
- New window with ultra high energies: pushing the energy frontier and connecting with new source classes

New horizons for supernova detection