

Measurement of cosmic-ray air-shower radio emission with an IceCube Surface Array station



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IceCube

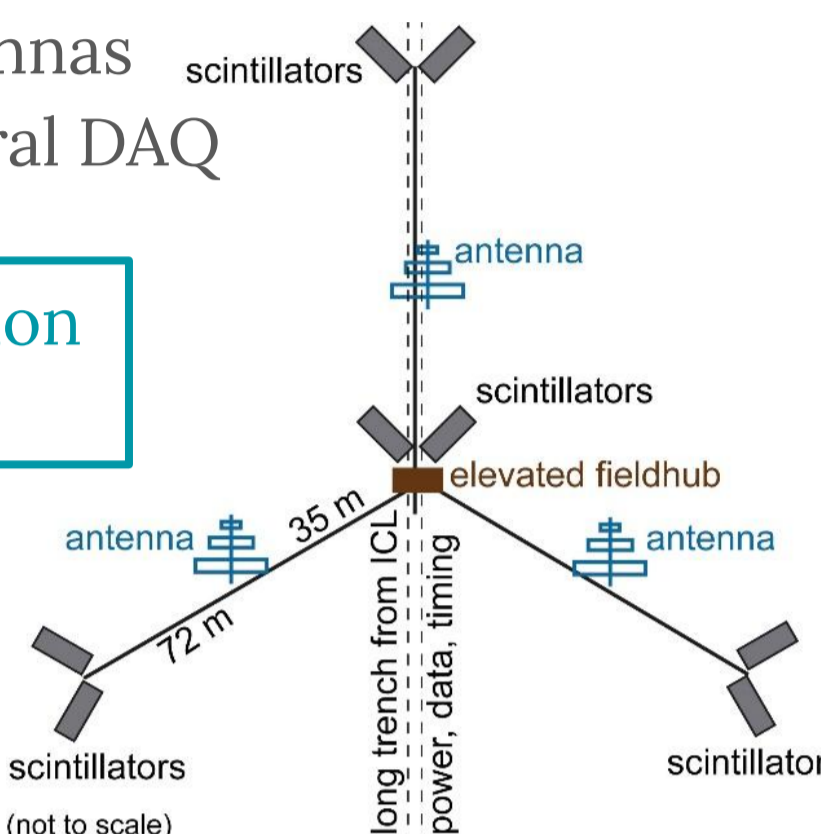
- Located at the South Pole
- In-ice neutrino detector consisting of > 5000 digital optical modules
- IceTop array on the surface consists of 162 ice-Cherenkov tanks
→ Cosmic ray physics & veto



Surfac Array Enhancement

- Decrease energy threshold
- Reduce systematics due to snow
- 32 stations each with:
 - 8x Scintillators
 - 3x Antennas
 - 1x Central DAQ

So far 1 station deployed

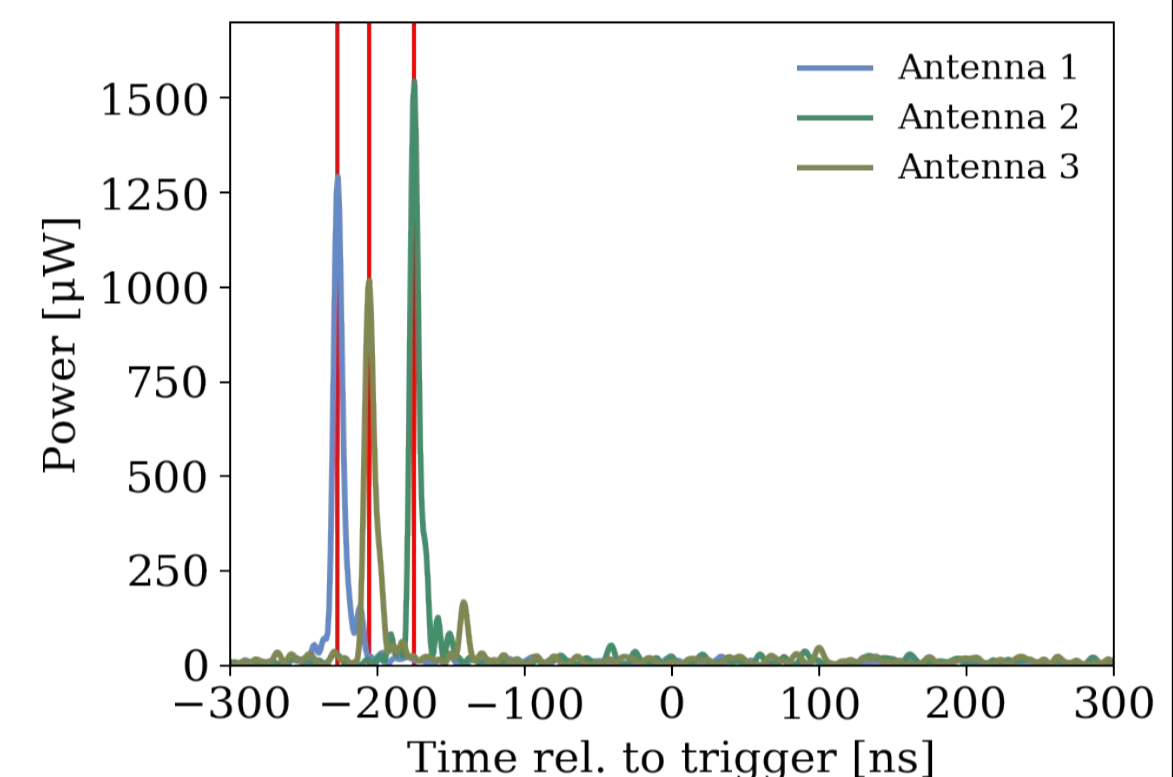
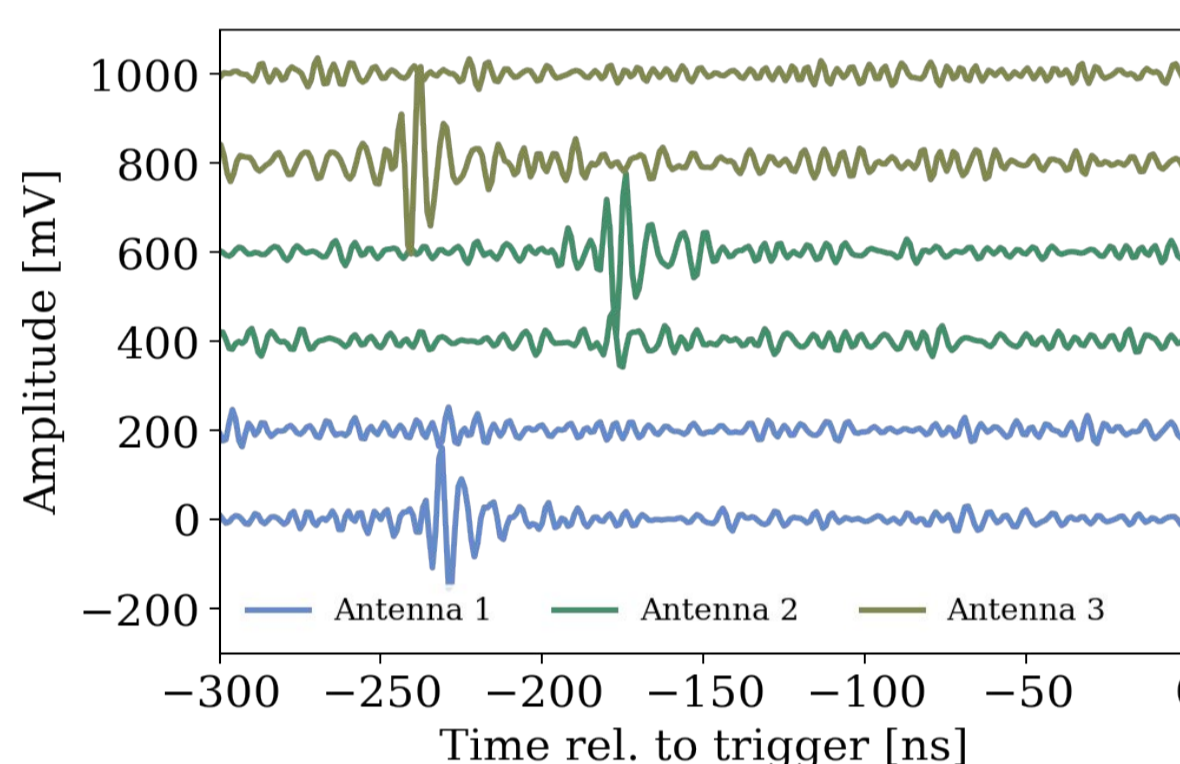
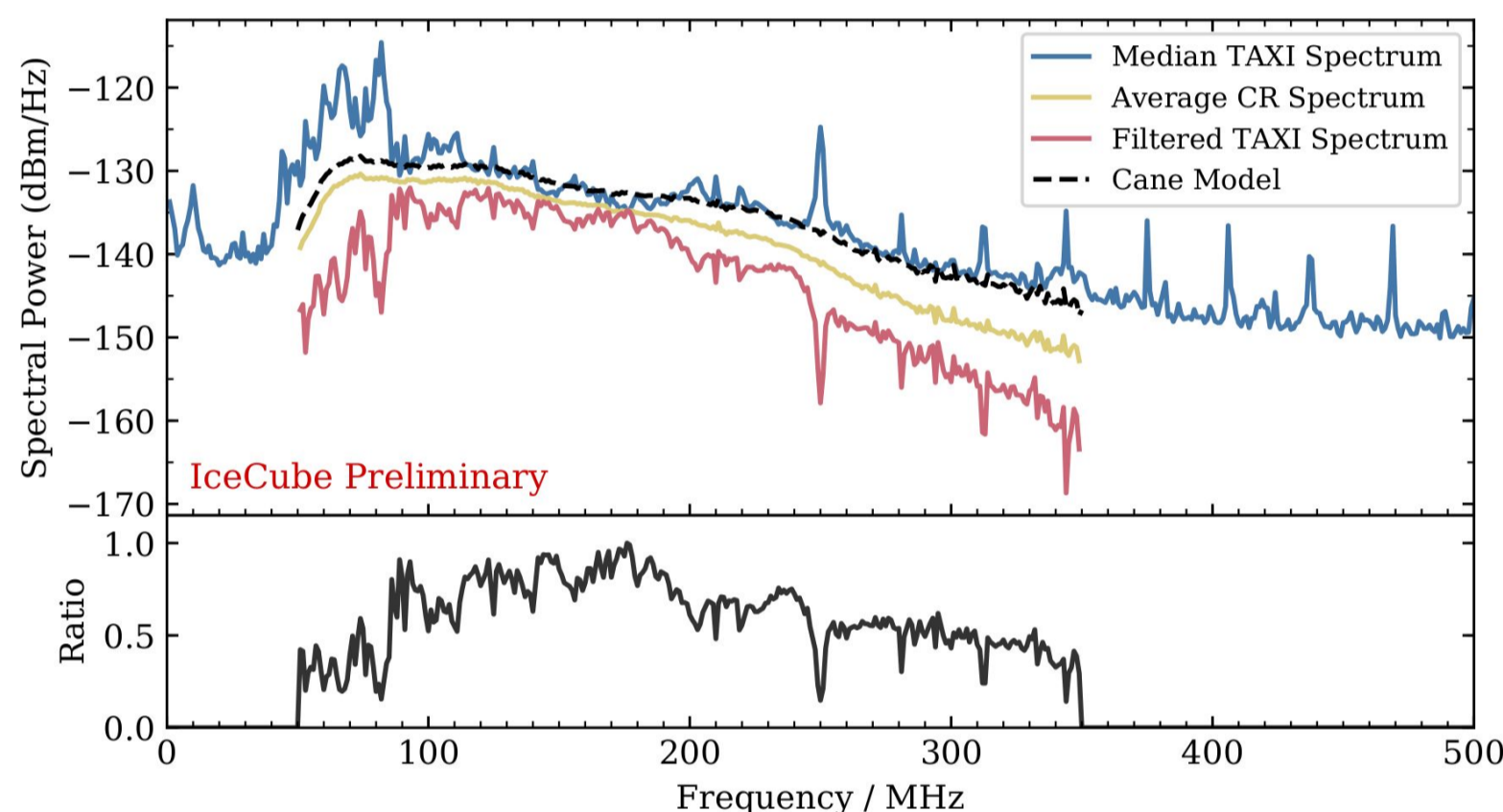


Air showers & radio

- Separation of charges in cosmic-ray air-showers
→ Radio emission
- Great E_{EM} and X_{max} resolution compared to traditional methods
- Especially effective for inclined showers

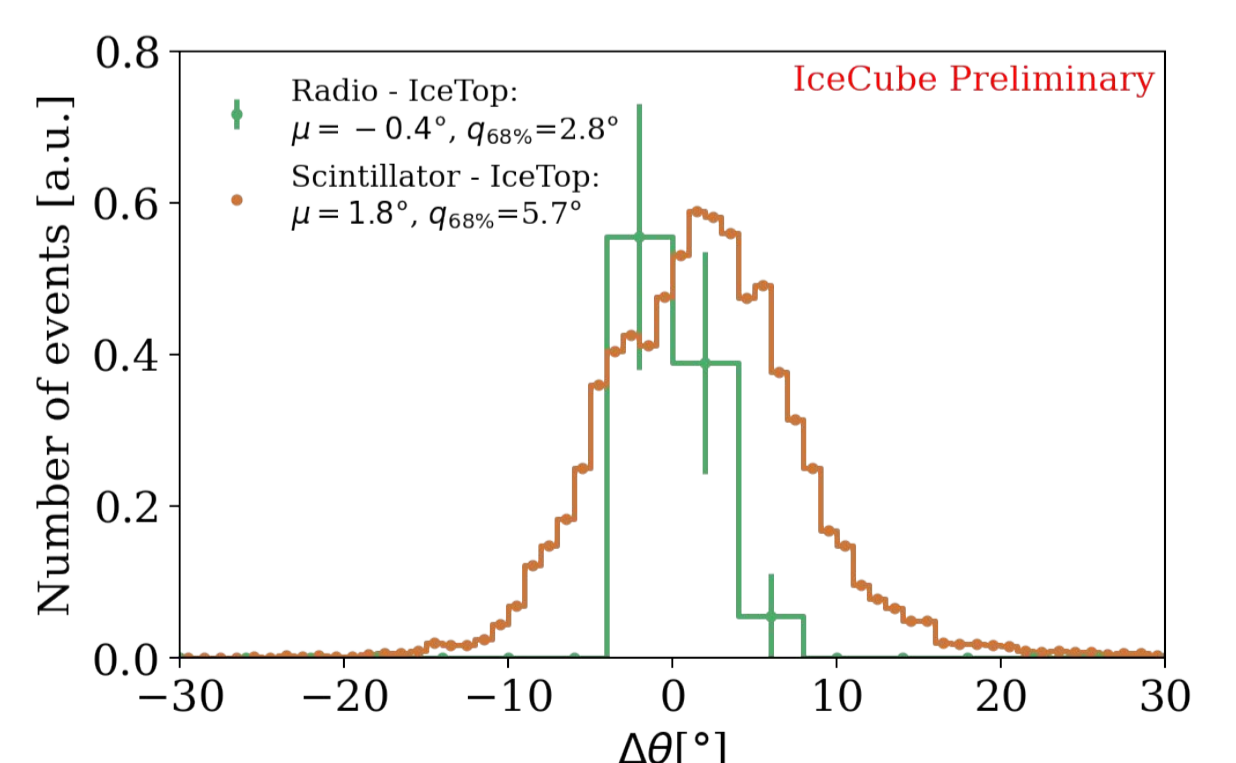
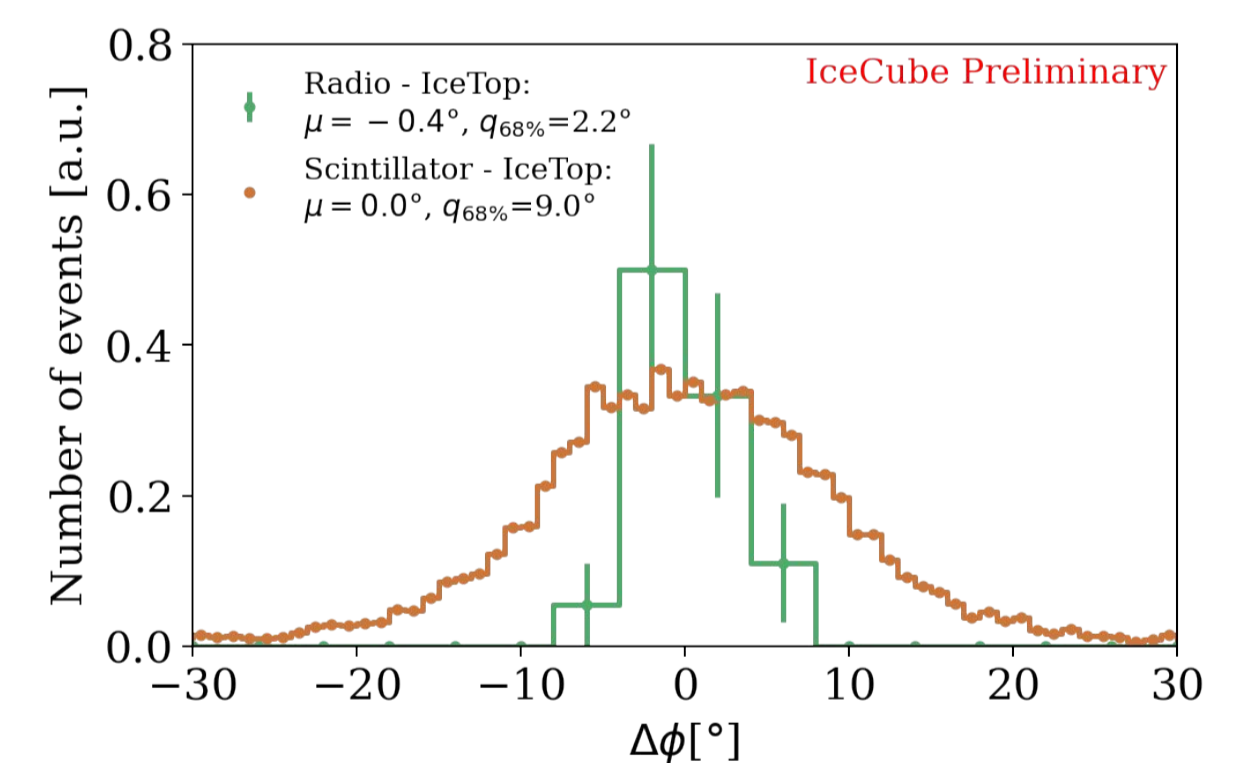
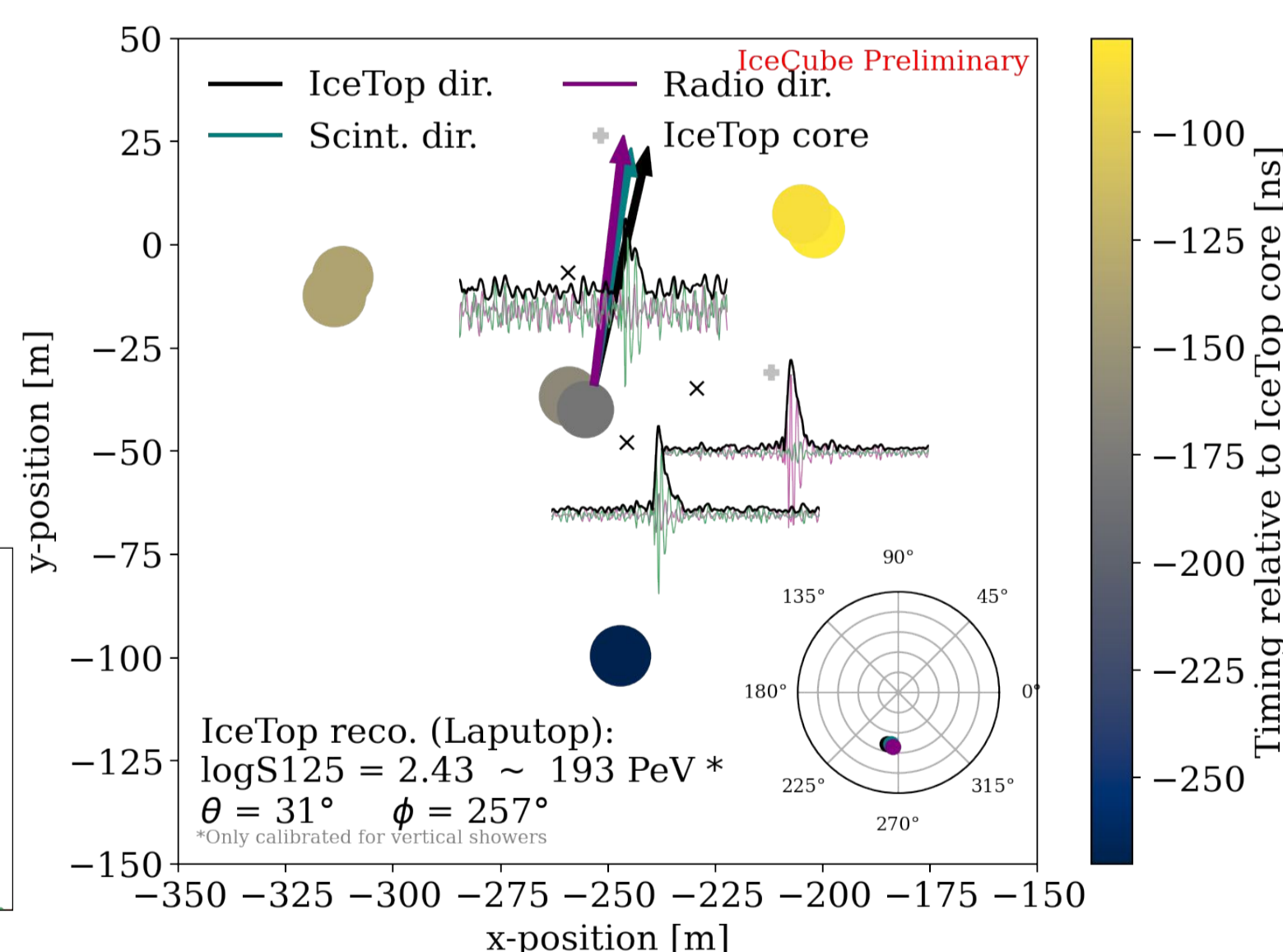
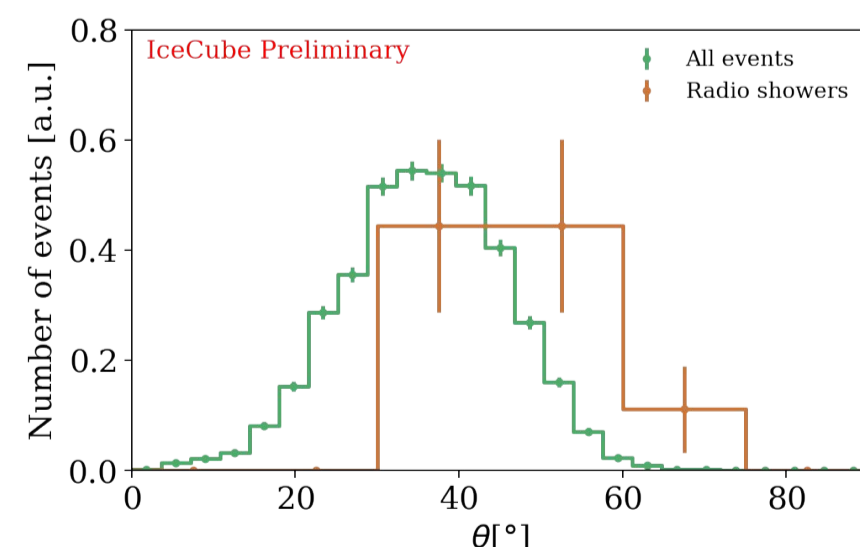
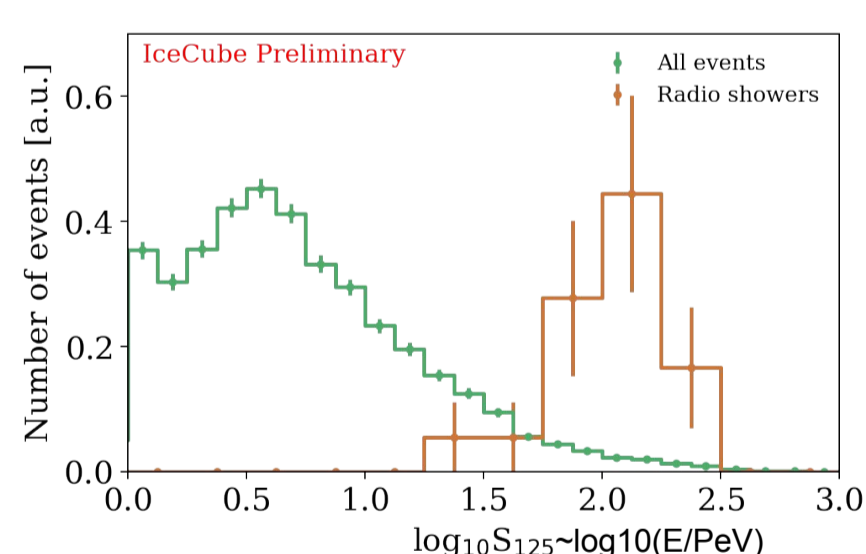


Air shower reconstruction



Results

- ~1 reconstructable radio shower / day of lifetime
- Reconstructed shower directions match with IceTop
- Event distribution looks as expected



Further reading

IceCube Collaboration.
ICRC 2021. PoS 2021:
 • Vol 225
 • Vol 314
 • Vol 317

arXiv:2205.02258

Conclusion

- 1 Surface Array station deployed so far
- Data can be used to develop data processing and analysis techniques applicable to the full array
- Reconstructed air showers look as expected → detector works
- Additional stations to be deployed in the coming years

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This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 802729).

