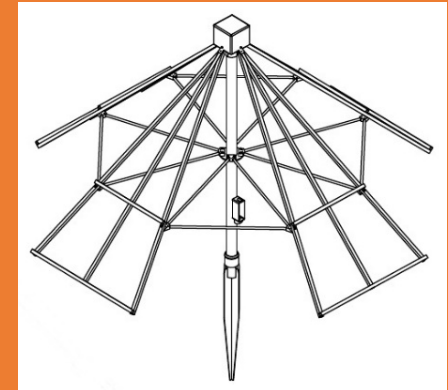


# LWA ANTENNAS AROUND THE WORLD

Whitham D. Reeve  
Anchorage, Alaska USA



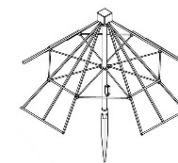


# LOCATIONS AROUND THE WORLD

LWA antennas **NOT** used in Long Wavelength Arrays

Relatively small installations

1 to 10 antennas per location



# LOCATIONS AROUND THE WORLD

Country	Location	Organization	Program
Canada	Saskatchewan	University of Calgary	Sky Survey
Canada	Axel Heiberg Island, 77° N	McGill University	Sky Survey
Denmark	Brorfelde	Private	e-Callisto
Finland	Kirkkonummi, Kylmäla	Metsahovi Radio Observatory	e-Callisto
Greenland	Kangerlussuaq	Technical University of Denmark	e-Callisto
Mexico	Puebla	HAWC Gamma-Ray Observatory	Lightning
South Africa	Marion Island, 46° S	University of KwaZulu-Natal	Sky Survey
Spain	Peralejos de las Truchas	Peralejos de las Truchas Astron	e-Callisto
Switzerland	Bleien	Bleien Radio Observatory	e-Callisto
Switzerland	Muhen	Swiss-Muhen	e-Callisto
Switzerland	Heiterswil	Private	e-Callisto
USA	Arecibo, Puerto Rico	Arecibo Observatory	e-Callisto
USA	Cohoe, Alaska	Cohoe Radio Observatory, private	e-Callisto
USA	Roswell, New Mexico	Private	e-Callisto



# LOCATIONS AROUND THE WORLD

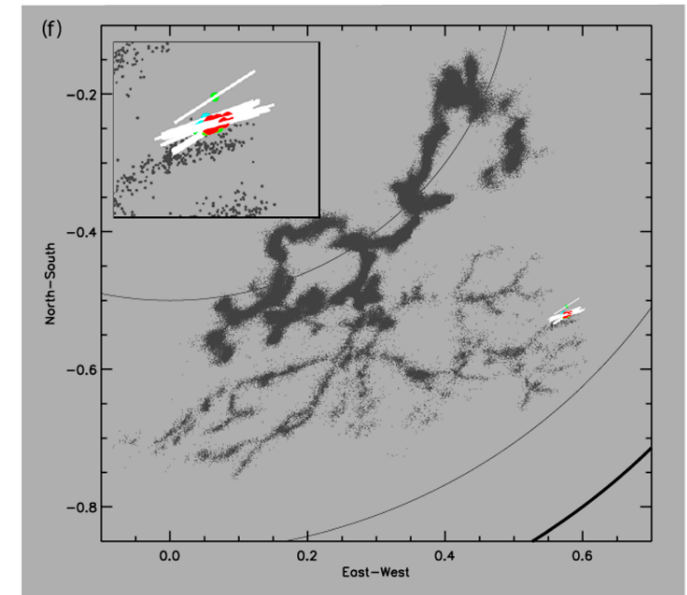
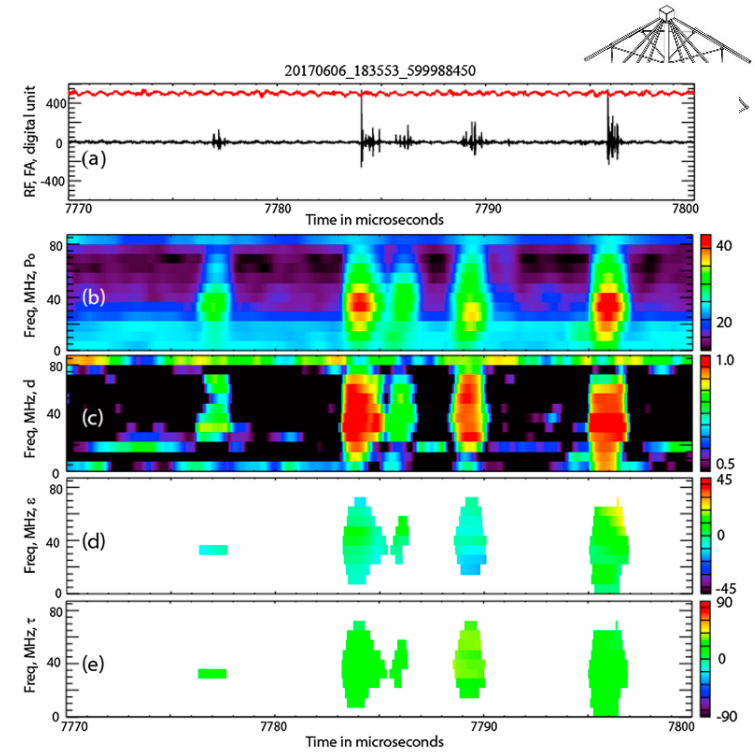


# PUEBLA MEXICO



## Lightning Research

Source: [Shao]





# BLEIEN RADIO OBSERVATORY ~ SWITZERLAND



Source: [Monstein]

# SWISS-MUHEN ~ SWITZERLAND



e-CALLISTO

Source: [Monstein]

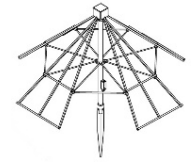
# HEITERSWIL ~ SWITZERLAND

## e-CALLISTO

Source: [Monstein]





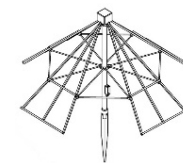


# HEITERSWIL ~ 2018 DAMAGE

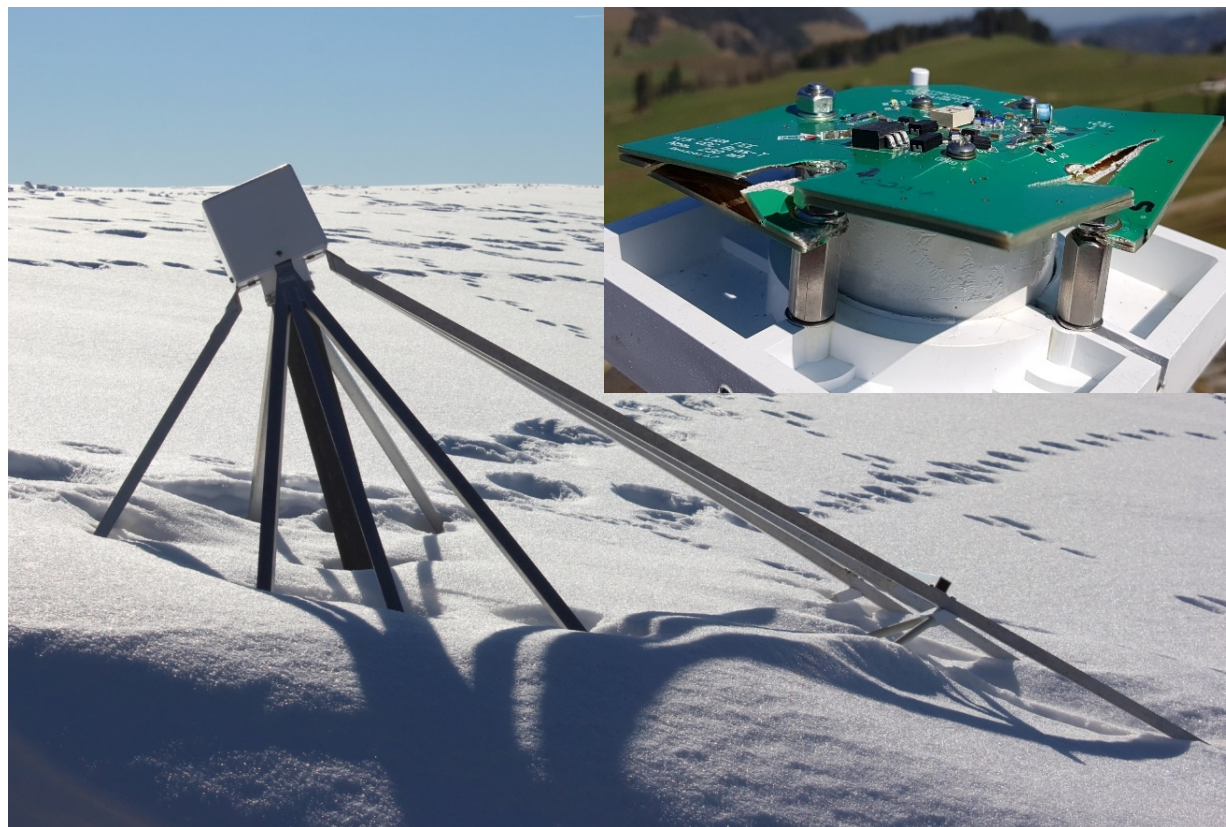


Source: [Bircher, 2018]

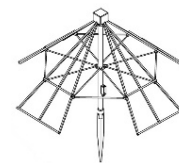




# HEITERSWIL ~ 2019 DAMAGE



Source: [Bircher, 2019]



# BRORFELDE ~ DENMARK

Source: [Monstein]

## e-CALLISTO



# METSÄHOVI RADIO OBSERVATORY ~ FINLAND



e-CALLISTO

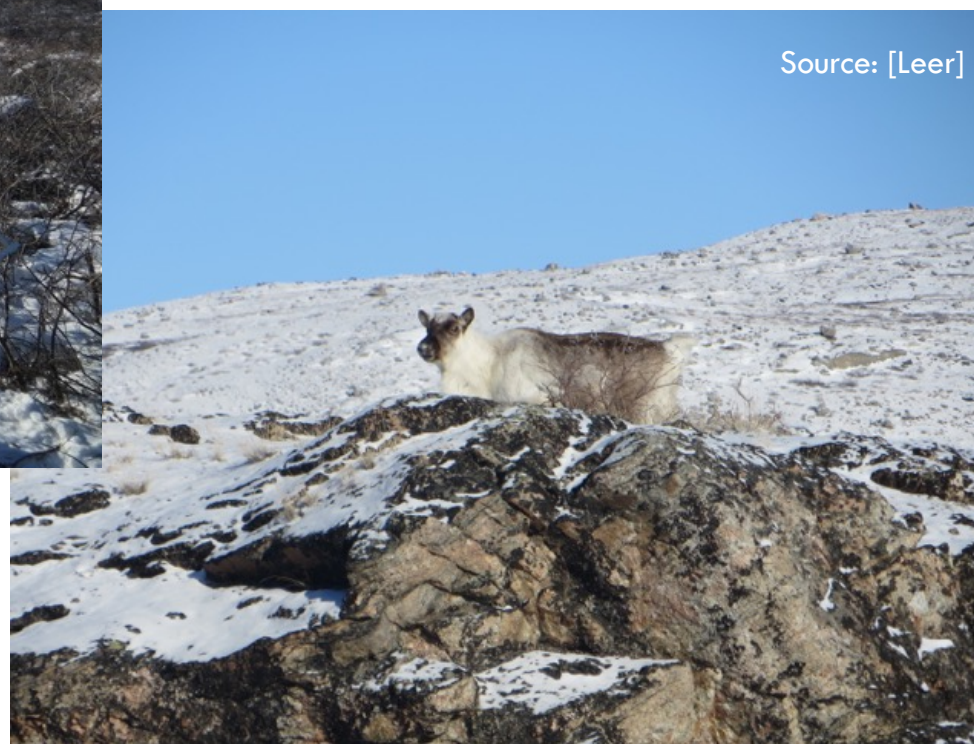
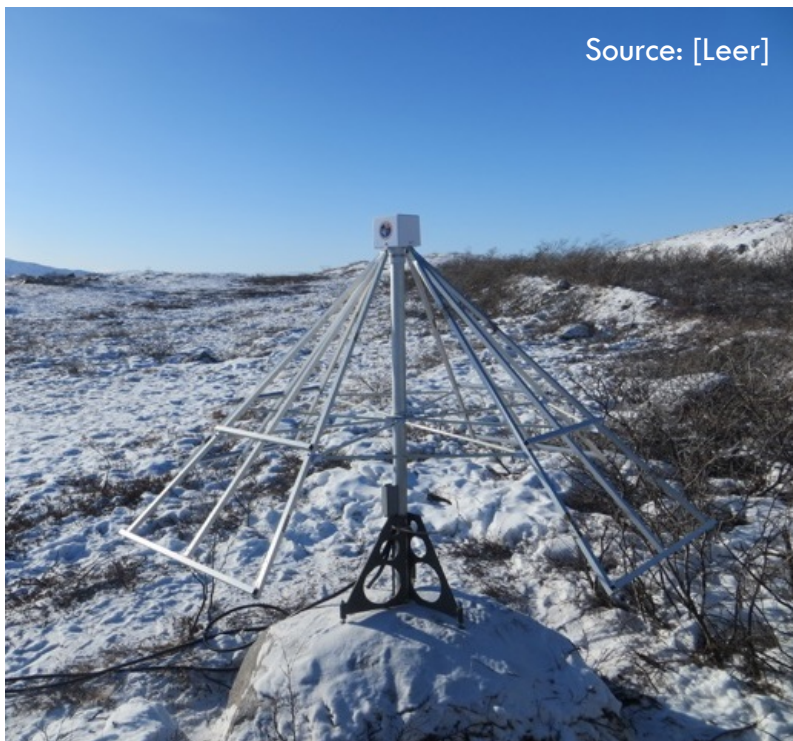
Source: [Tornikoski]





# KELLYVILLE ~ GREENLAND

## e-CALLISTO



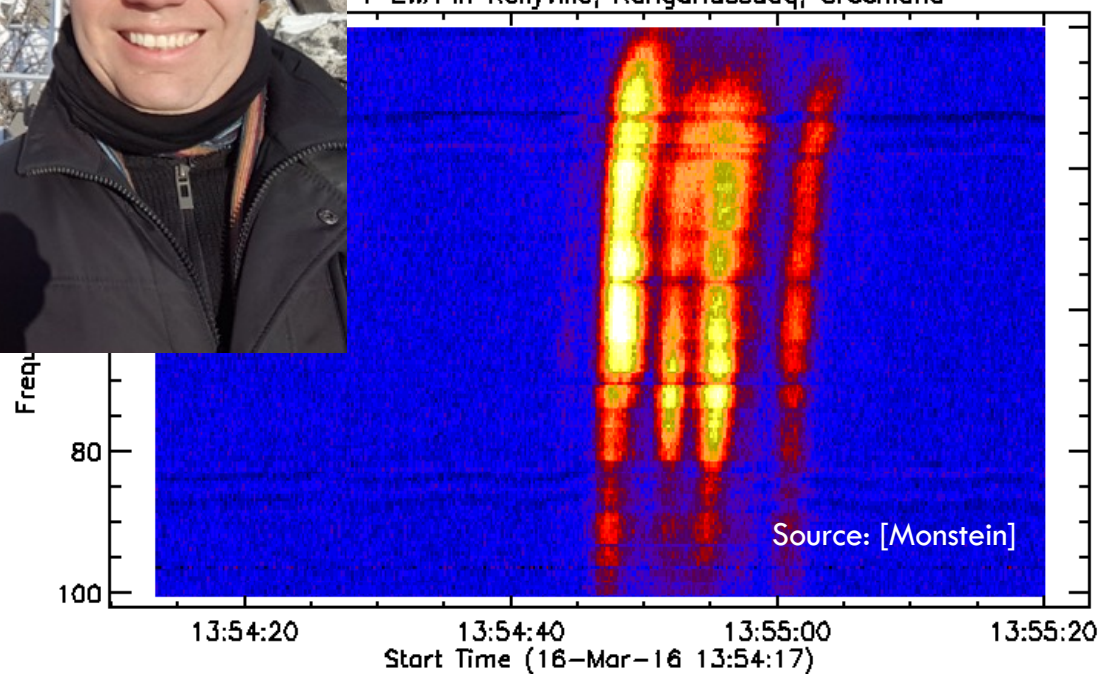


# KELLYVILLE ~ GREENLAND



## e-CALLISTO

+ LWA in Kellyville, Kangerlussuaq, Greenland

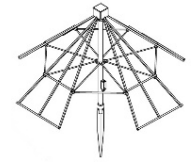




# PERALEJOS DE LAS TRUCHAS ASTRONOMICAL OBSERVATORY ~ SPAIN

e-CALLISTO





# PERALEJOS DE LAS TRUCHAS ASTRONOMICAL OBSERVATORY ~ SPAIN





# UNIVERSITY OF CALGARY ~ ALBERTA CANADA

10 LWA Antennas at each of 11 locations

Location	Province
Pinawa	Manitoba
Gillam	Manitoba
Meanook	Alberta
Meadow Lake	Saskatchewan
Buffalo Narrows	Saskatchewan
Russell	Manitoba
Flin Flon	Manitoba
Fort Smith	Manitoba
Rabbit Lake	Saskatchewan
Island Lake	Manitoba
Lucky Lake	Saskatchewan



# COHOE RADIO OBSERVATORY ~ ALASKA USA

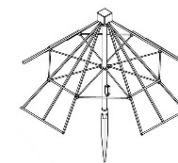


Rampaging Moose Problem

Solar Radio 5 ~ 85 MHz ~ e-CALLISTO



Source: [Reeve]



# COHOE RADIO OBSERVATORY

~ ALASKA USA Rampaging Moose Problem

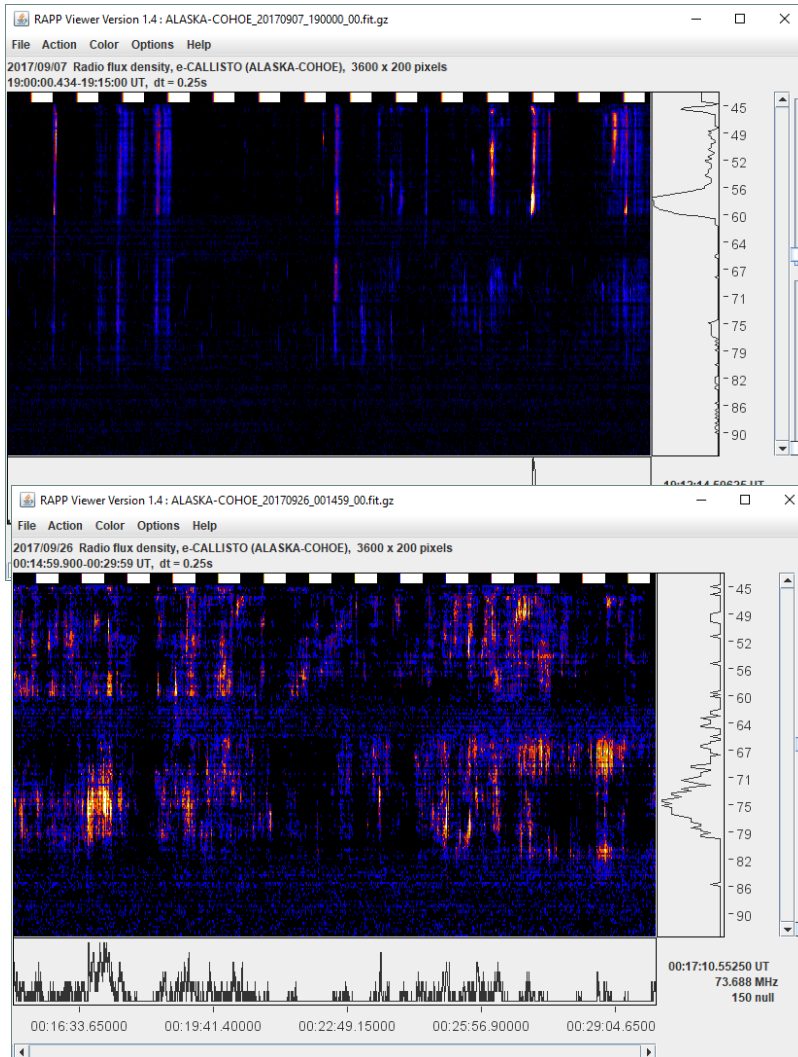


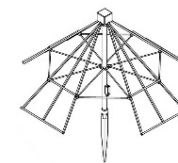
Source: [Reeve]

# COHOE RADIO OBSERVATORY ~ ALASKA USA



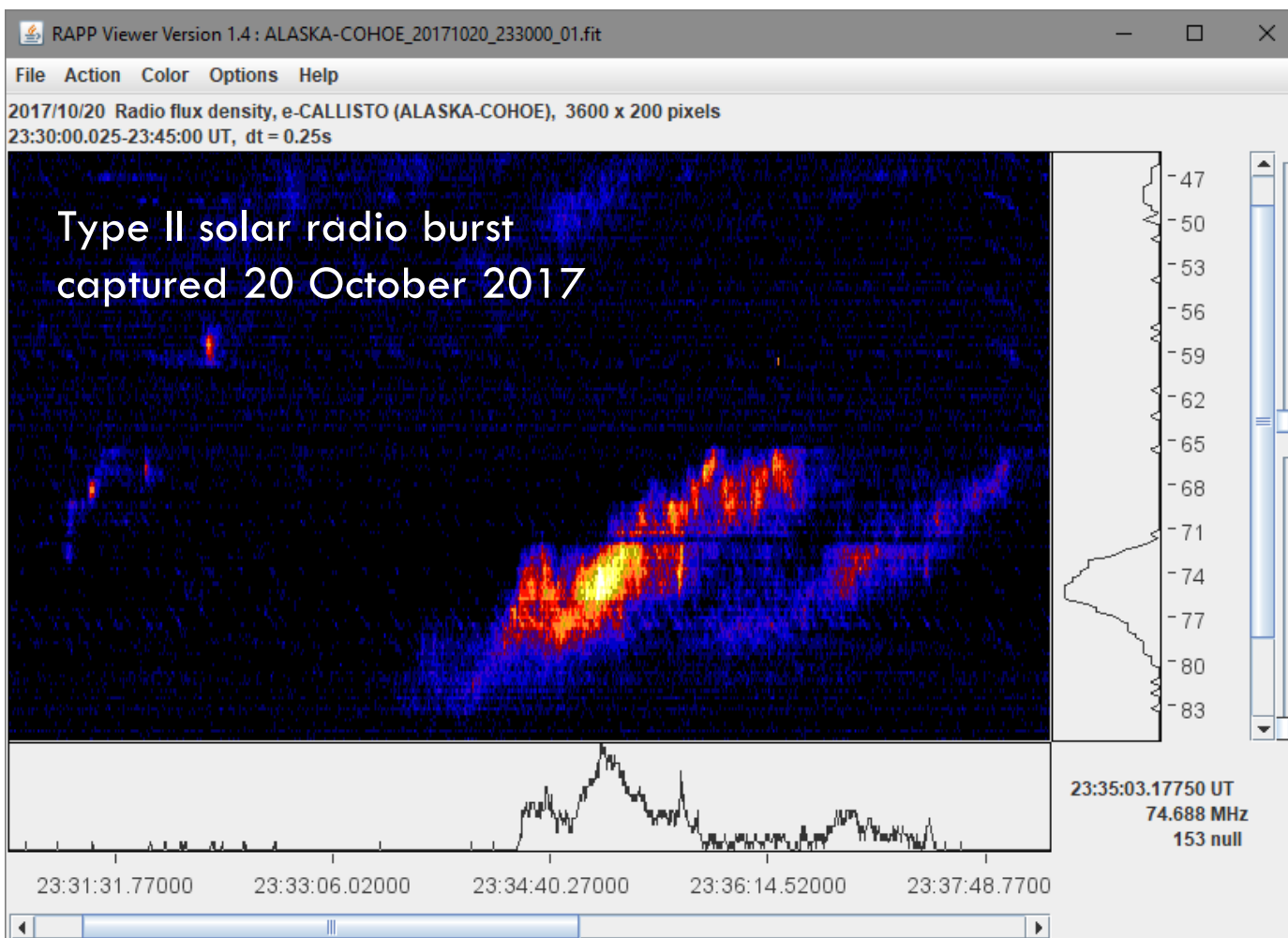
Source: [Reeve]

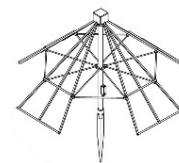




# COHOE RADIO OBSERVATORY ~ ALASKA USA

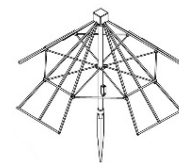
Source: [Reeve]





# STAN NELSON ~ NEW MEXICO USA





# ARECIBO ~ PUERTO RICO USA





# MARION ISLAND ~ SOUTH AFRICA

Radio sky 5 ~ 100 MHz

Low RFI

Future Dark Ages probing

10 LWA antennas planned



Source: [Chiang]





# MARION ISLAND ~ SOUTH AFRICA

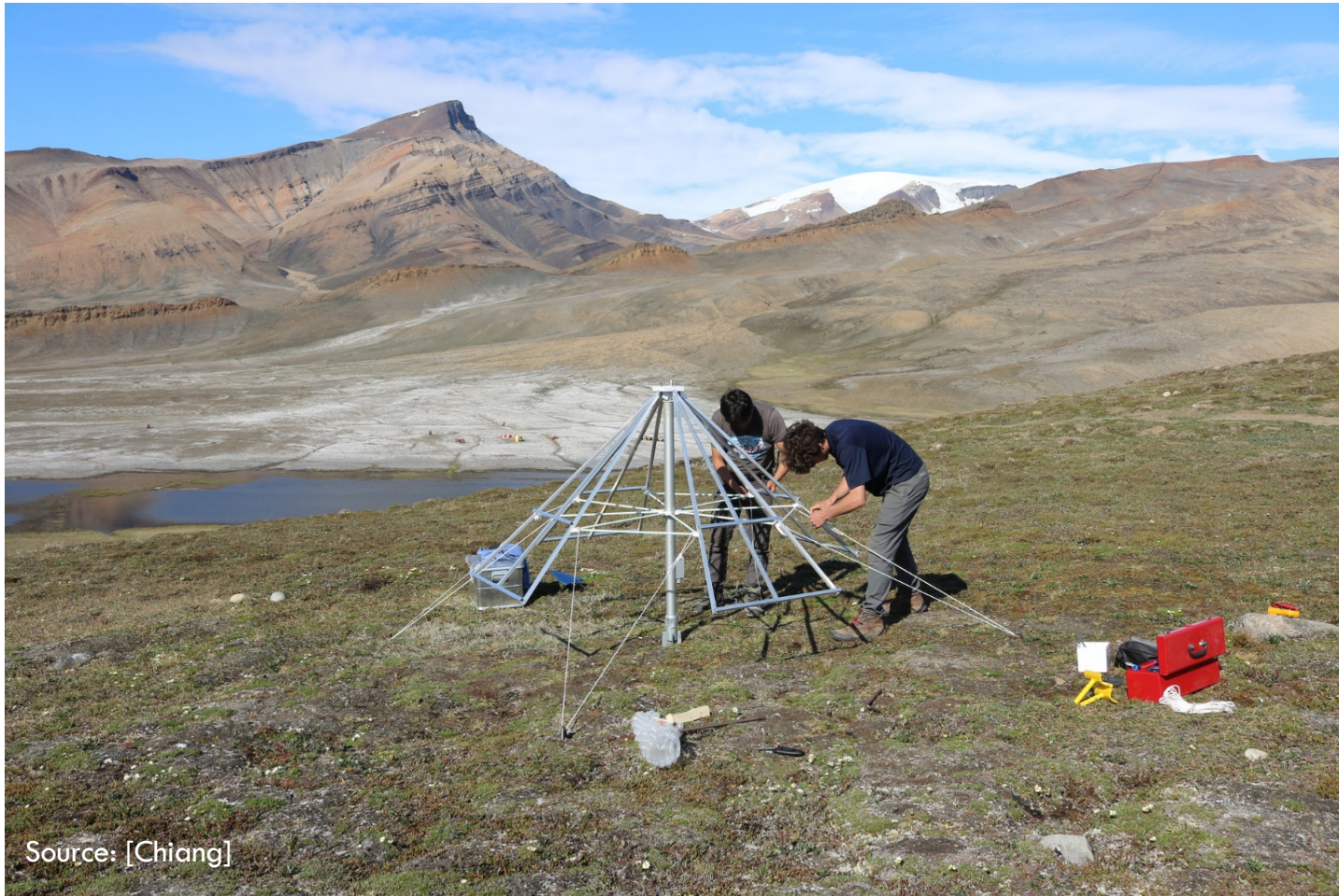
First autonomous installation

- Photovoltaic with Battery
- Readout electronics record baseband

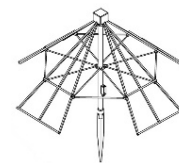


Source: [Chiang]

# AXEL HEIBERG ISLAND NUNAVUT ~ CANADA

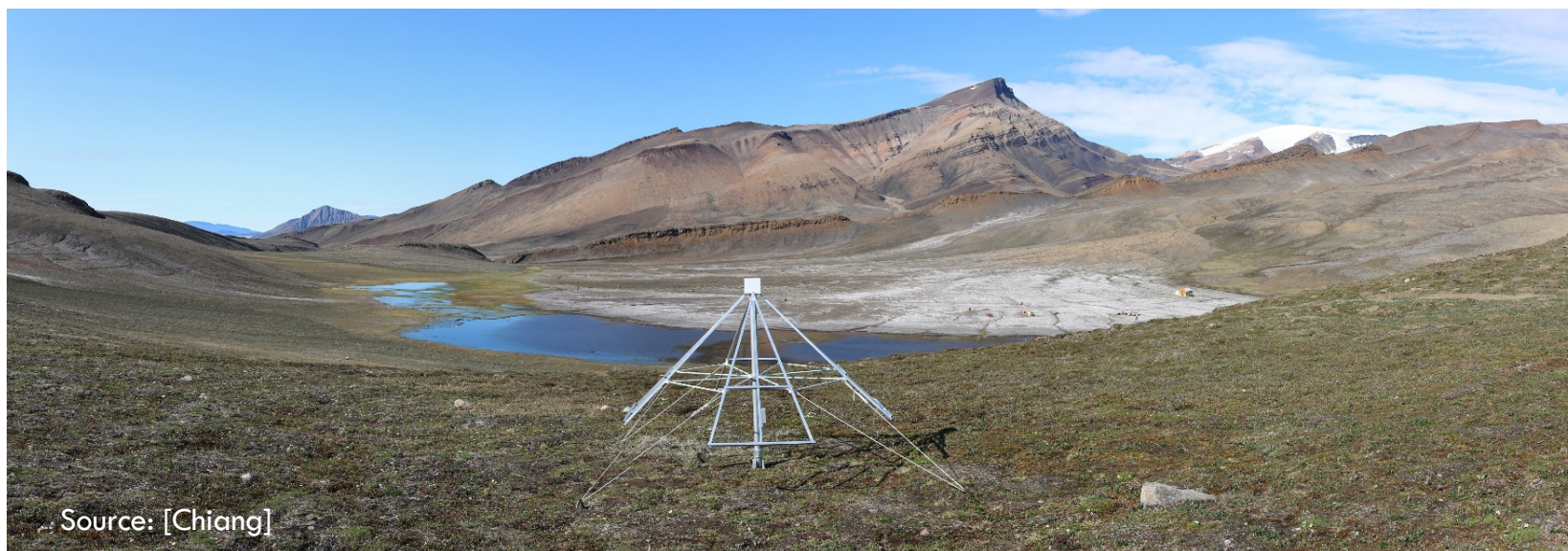


Source: [Chiang]



# AXEL HEIBERG ISLAND NUNAVUT ~ CANADA

Essentially an RFI survey

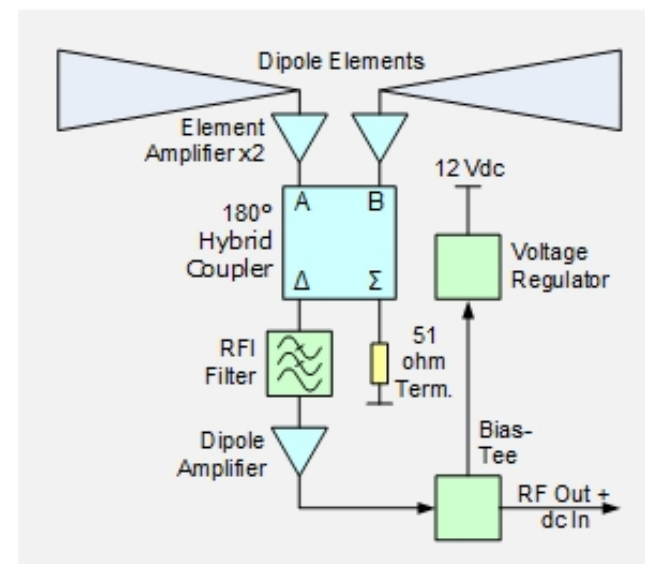
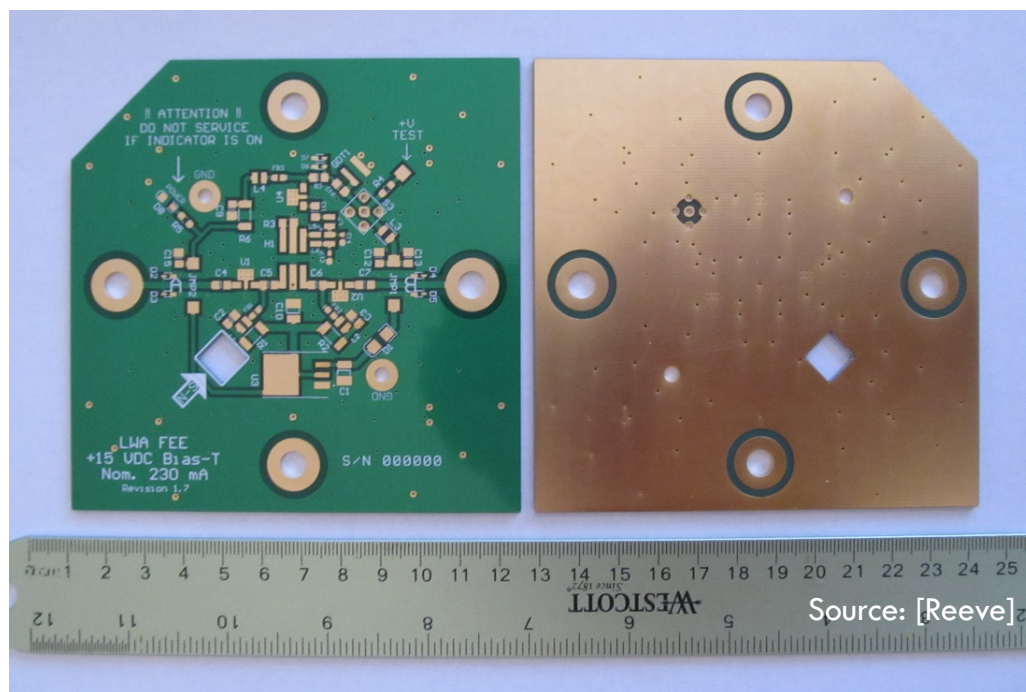


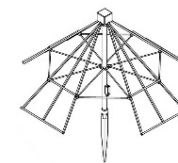


# FRONT-END ELECTRONICS ~ FEE

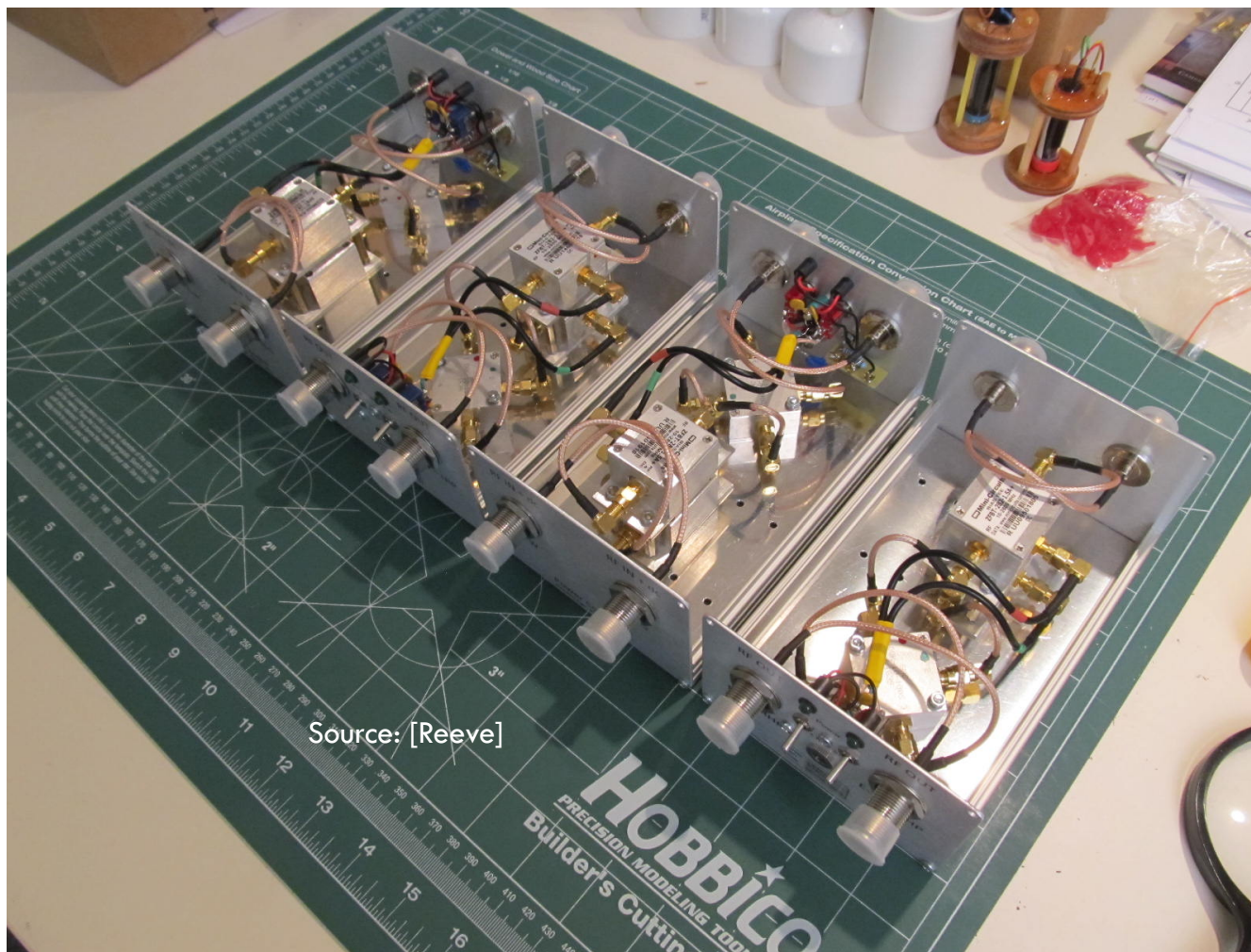
Popular in custom-designed antennas

Single and cross-polarized

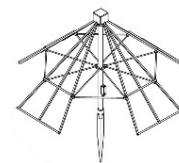




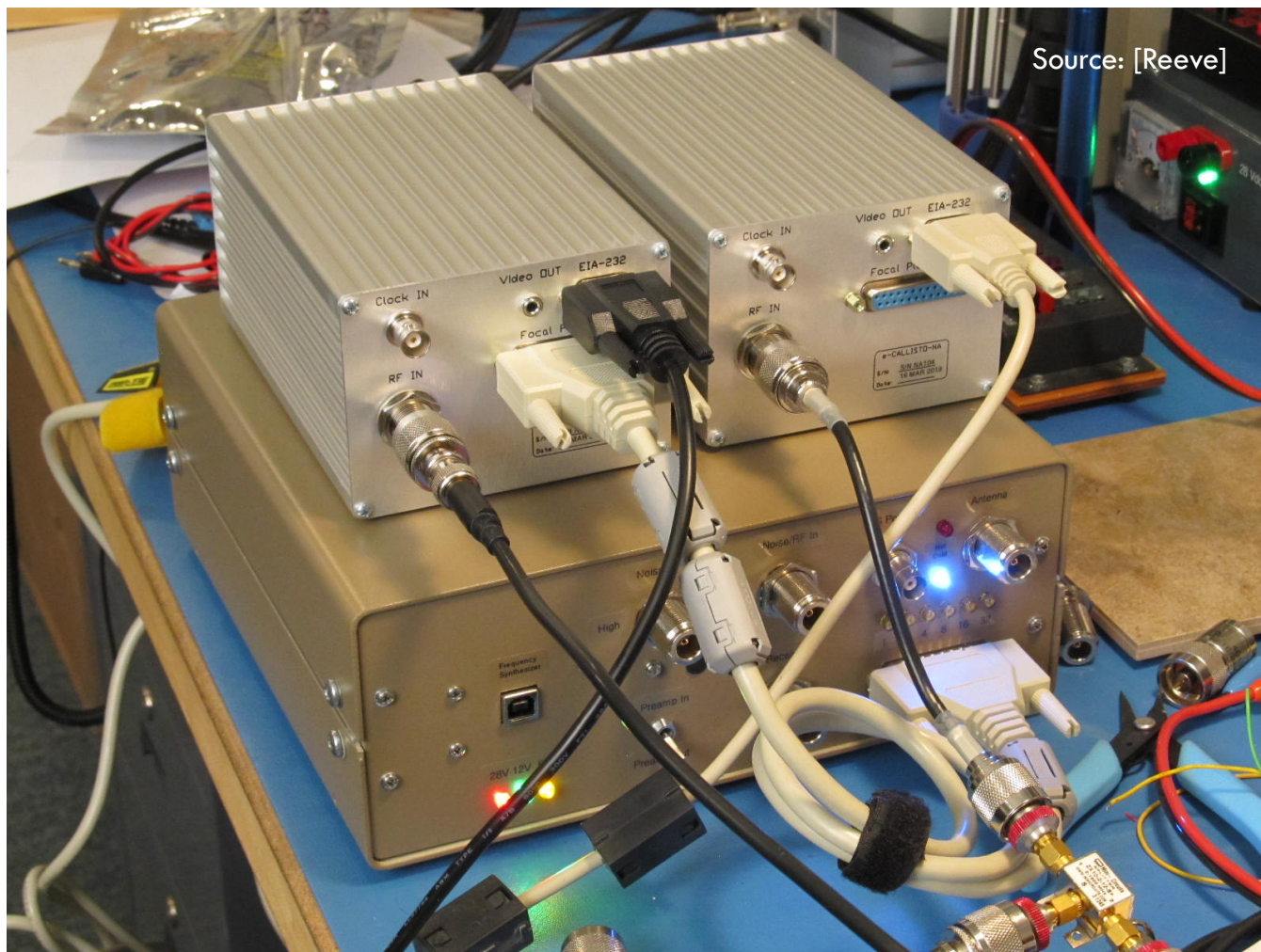
# LWA POWER COUPLER $\sim$ LWAPC (-Q)



Source: [Reeve]



# CALLISTO UNDER TEST



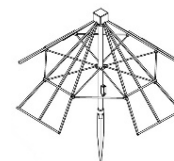


# SUMMARY

The LWA antenna is versatile and can take it, anywhere in the world

“The antenna structure is made of aluminum frames and so does not need a heavy foundation. The lightweight structure is simply attached to wedges hammered into the ground, and this is enough to withstand the most severe local weather; the first winter season 2017–2018 allowed testing the system in cold temperatures (down to  $-25^{\circ}\text{C}$ ), high wind speeds, and heavy snowfall.” +

+ Kallunki J, Tornikoski M, Oinaskallio E, et al. Solar observing system for radio frequencies 5–120 MHz. *Astron. Nachr.* 2018;339:656–660.  
<https://doi.org/10.1002/asna.201913545>



# IMAGE CREDITS

[Bircher] Bircher, C., personal communication, 2018, used with permission

[Bircher] Bircher, C., personal communication, 2019, used with permission

[Chiang] Chiang, C., personal communications, 2019, used with permission

[Leer] Leer, K., personal communication, 2016, used with permission

[Monstein] Monstein, C., personal communication, 2015, used with permission

[Nelson] Nelson, S., personal communication, 2014, used with permission

[Reeve] Reeve, W., personal archive, 2018

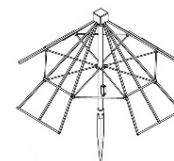
[Russu] Russu, B. A., personal communication, 2016, used with permission

[Shao] Shao, X.-M., Ho, C., Caffrey, M., Graham, P., Haynes, B., Bowers, G., et al (2018). Broadband RF interferometric mapping and polarization (BIMAP) observations of lightning discharges: Revealing new physics insights into breakdown processes. *Journal of Geophysical Research: Atmospheres*, 123. <https://doi.org/10.1029/2018JD029096>

[Tornikoski] Tornikoski, M., Metsähovi Radio Observatory, through personal communication by J. Kallunki, 2019, used with permission

[Vollmerhaus] Vollmerhaus, L., personal communication, 2019, used with permission





# PRESENTER



Whitham Reeve is (mostly) retired. He obtained B.S. and M.S. degrees in Electrical Engineering at University of Alaska Fairbanks, USA. He worked as a professional engineer and engineering firm owner/operator in the airline and telecommunications industries for more than 40 years and now manufactures electronic equipment used in radio astronomy. He has lived in Anchorage, Alaska his entire life.

Email contact: [whitreeve@gmail.com](mailto:whitreeve@gmail.com)

