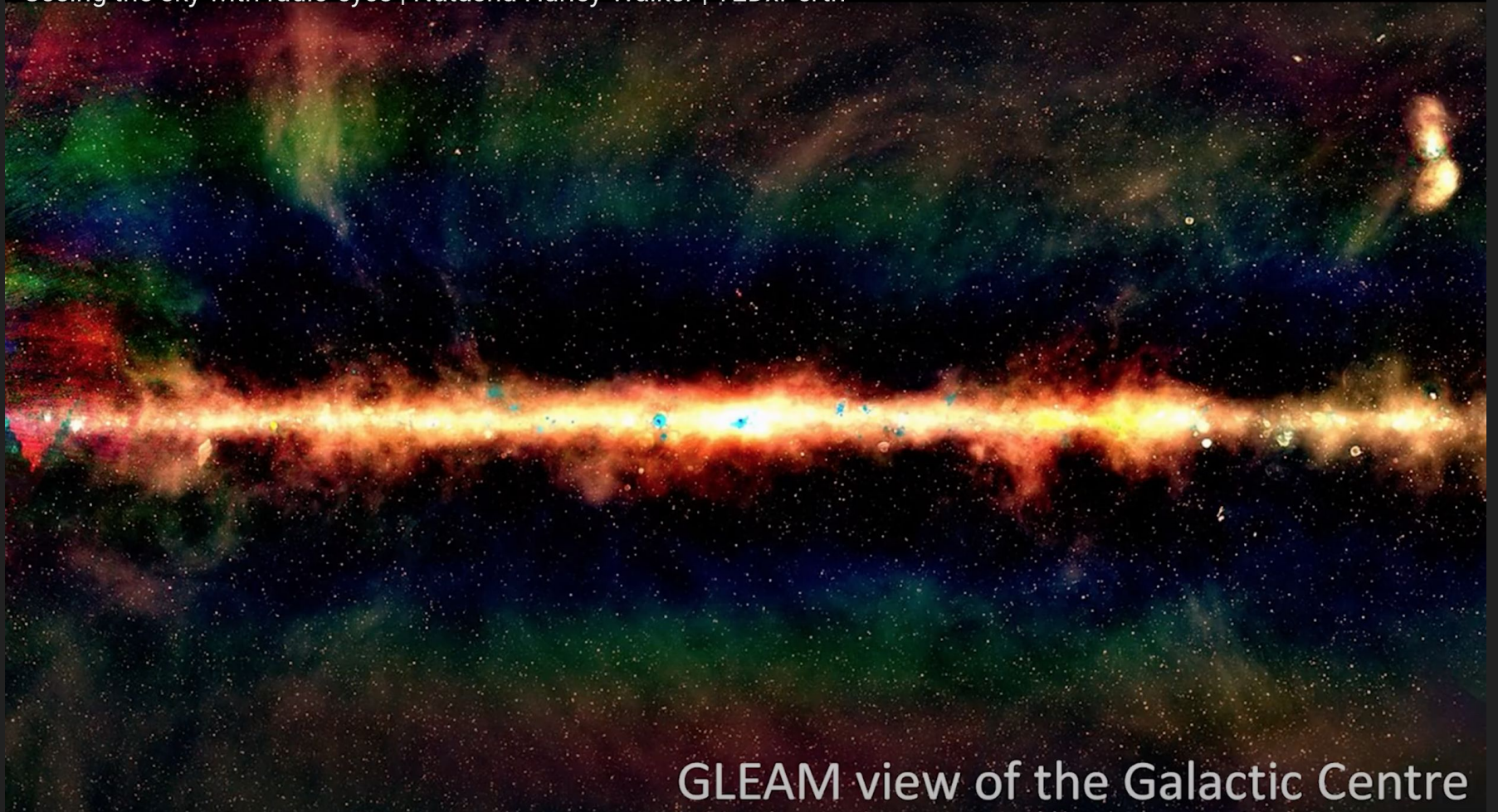


Seeing Signals

Real-time Visualization of a Delay-and-Sum Beamformer
github.com/citizenrich/seeingsignals

Richard Stanley, K3PLR
@datarichness



GLEAM view of the Galactic Centre

Motivation

(Re)invention of a radio camera

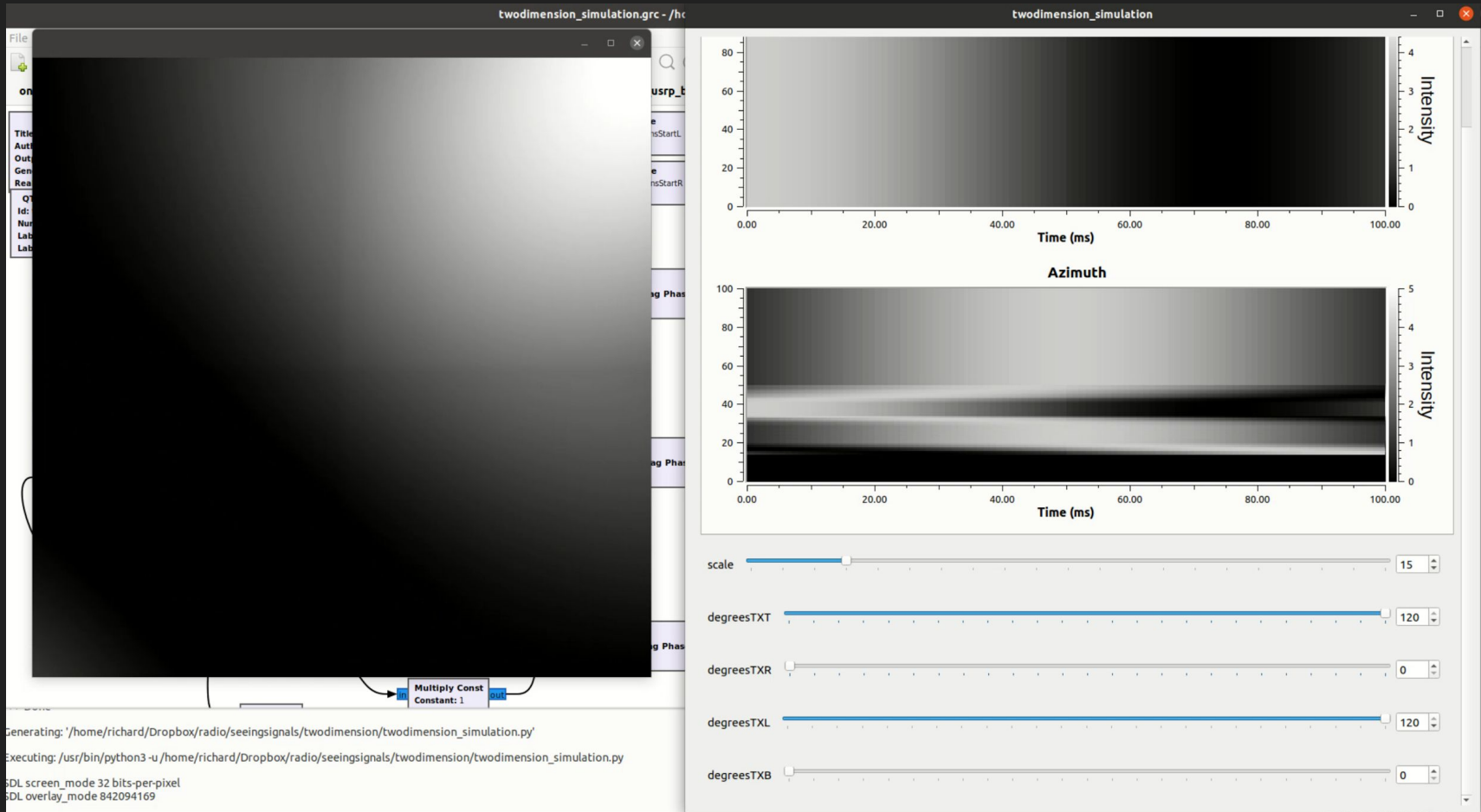
→ Real-time heatmaps of magnitude and DOA

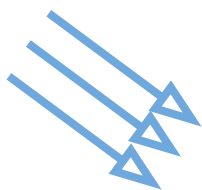
Bare minimum requirements are:

- GNU Radio (in-tree modules)
- Directional antennas
- 2 Rx (1 dimension) and 4 Rx (2 dimensions)

This is a work-in-progress!

2D simulation (4 elements)





Rx Left



Rx Right

Repeat samples

Phase Lags Left

-3	-2	-1	0	0	0	0
----	----	----	---	---	---	---

0	0	0	0	-1	-2	-3
---	---	---	---	----	----	----

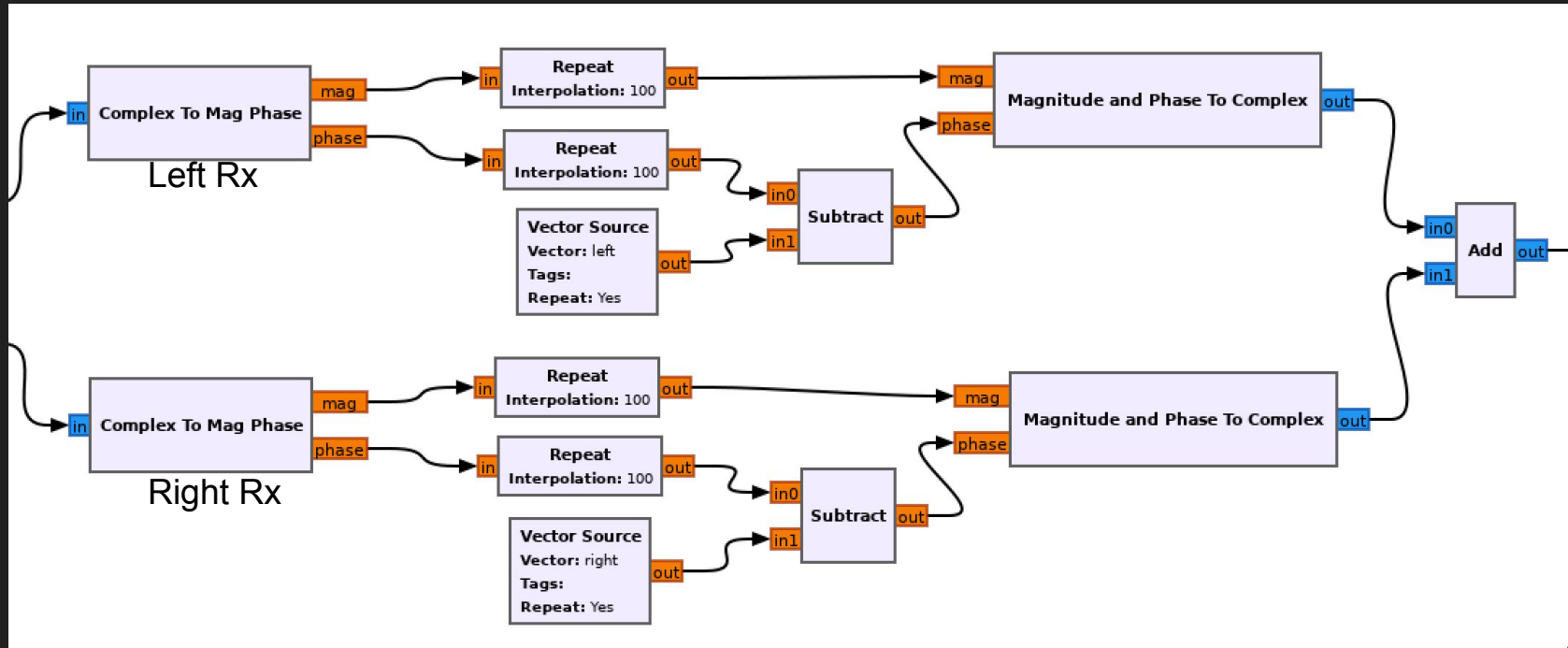
Add Signals

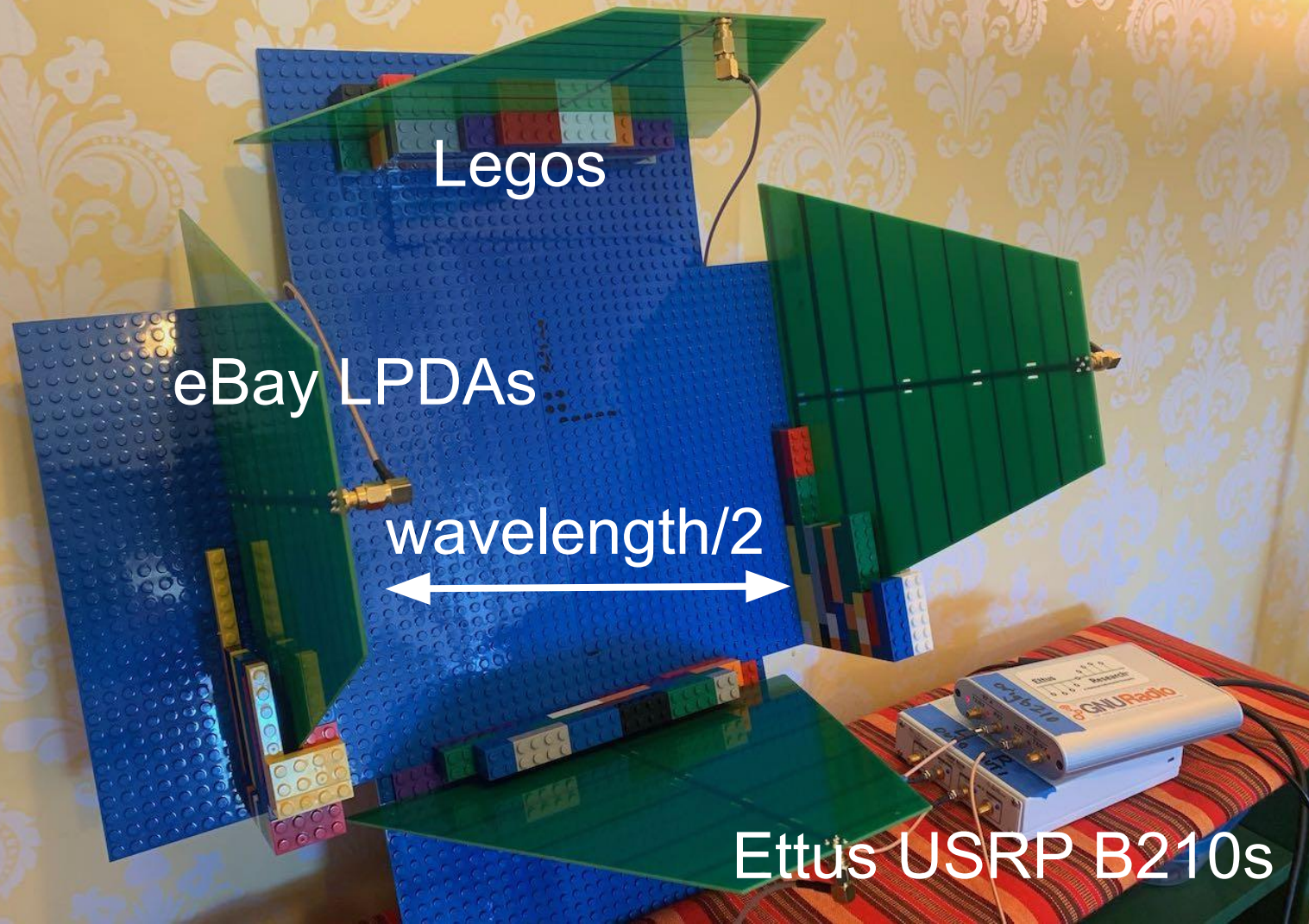
+	+	+	+	+	+	+
---	---	---	---	---	---	---

Magnitudes²



1D Delay-and-Sum Beamforming





Legos

eBay LPDAs

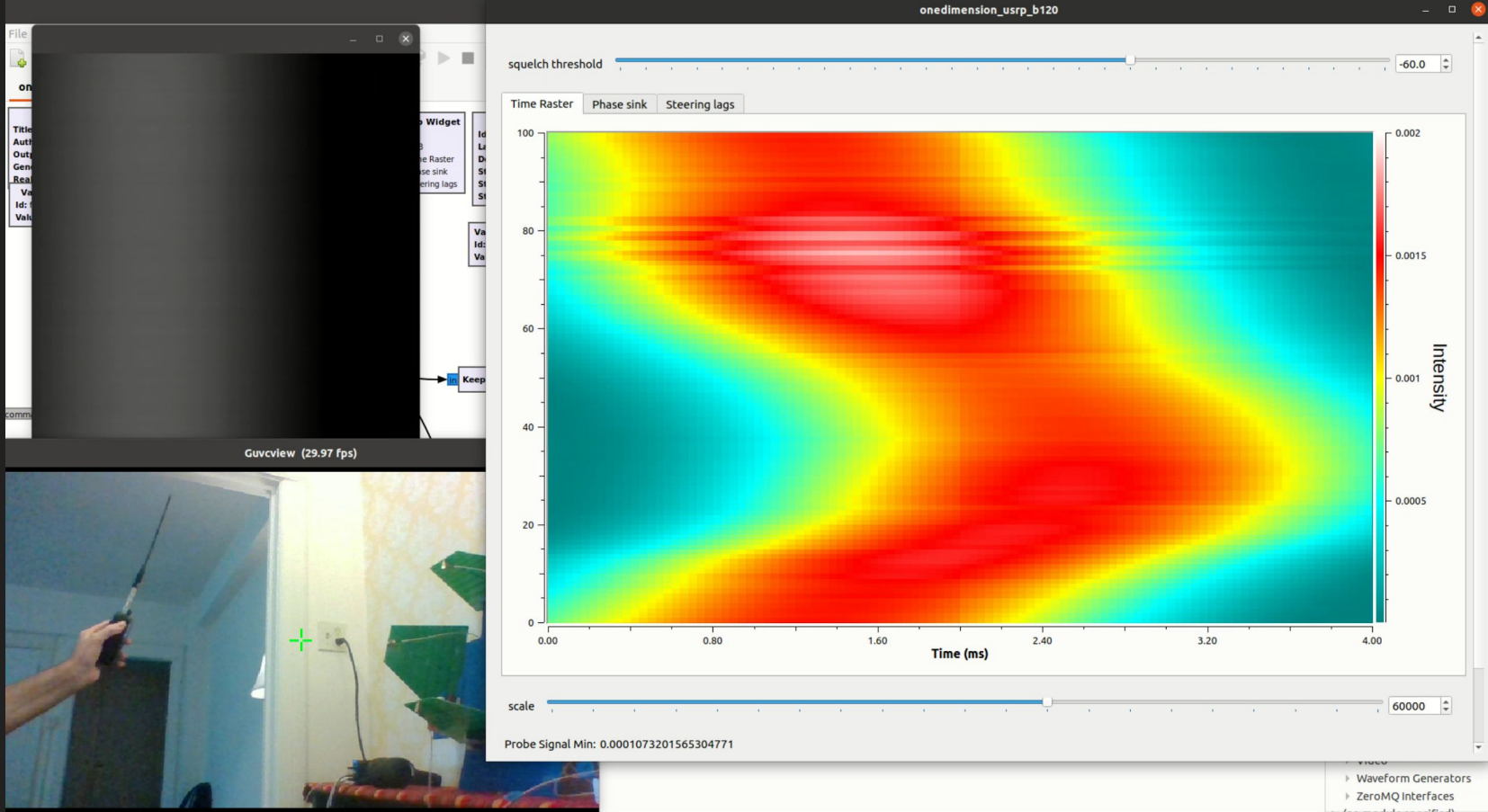
wavelength/2

Ettus USRP B210s



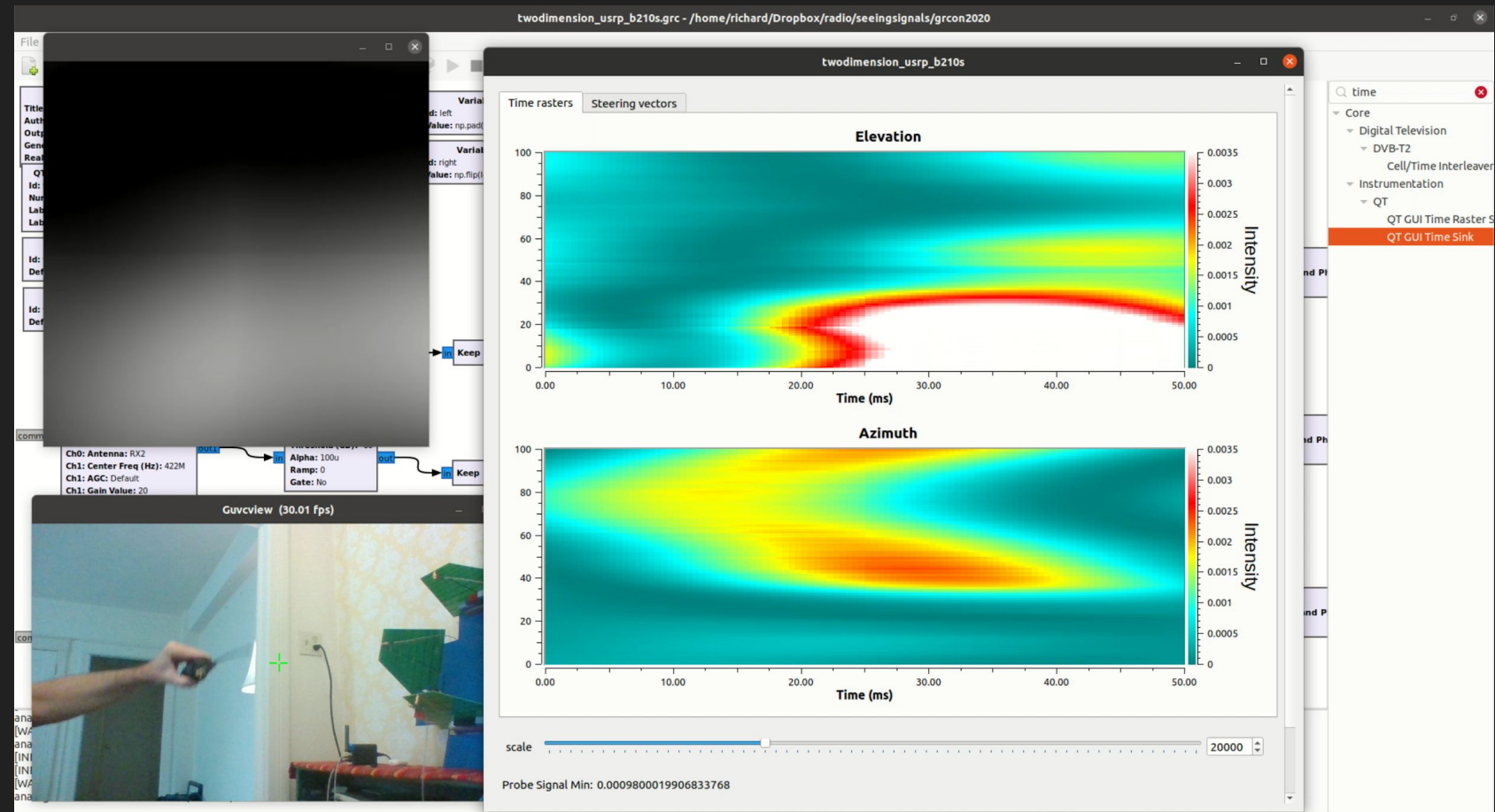
Ham HT w/
attenuation

1D demo (2 elements)



Work-in-Progress...

2D demo (4 elements)



For more GNU Radio and Beamforming...

Jon Kraft of Analog Devices - Workshop on Thursday:

[Phased Array Beamforming: Understanding and Prototyping](#)

[GNU Radio 3.9 has fun phase stuff, thanks to Mike P. \(ghostop14\)](#)

Also, GRCon 2017 in San Diego was pretty awesome on phased arrays:

- Finding an Active Shooter Using GNU Radio - **Ben McCall**
- GPS Beamforming with Low-Cost RTL-SDRs - **Wil Myrick**
- gr-doa: GNU Radio Direction Finding - **Travis Collins**
- Real-Time Direction Finding Using Two Antennas on an Android Phone - **Sam Whiting**

> Sorry, but this is a lightning talk, I have to leave stuff out. There's a huge amount of military, industrial, and scientific leadership on this topic.,

github.com/citizenrich/seeingsignals

Thanks!