Large Aperture Experiment to Detect the Dark Ages (LEDA)

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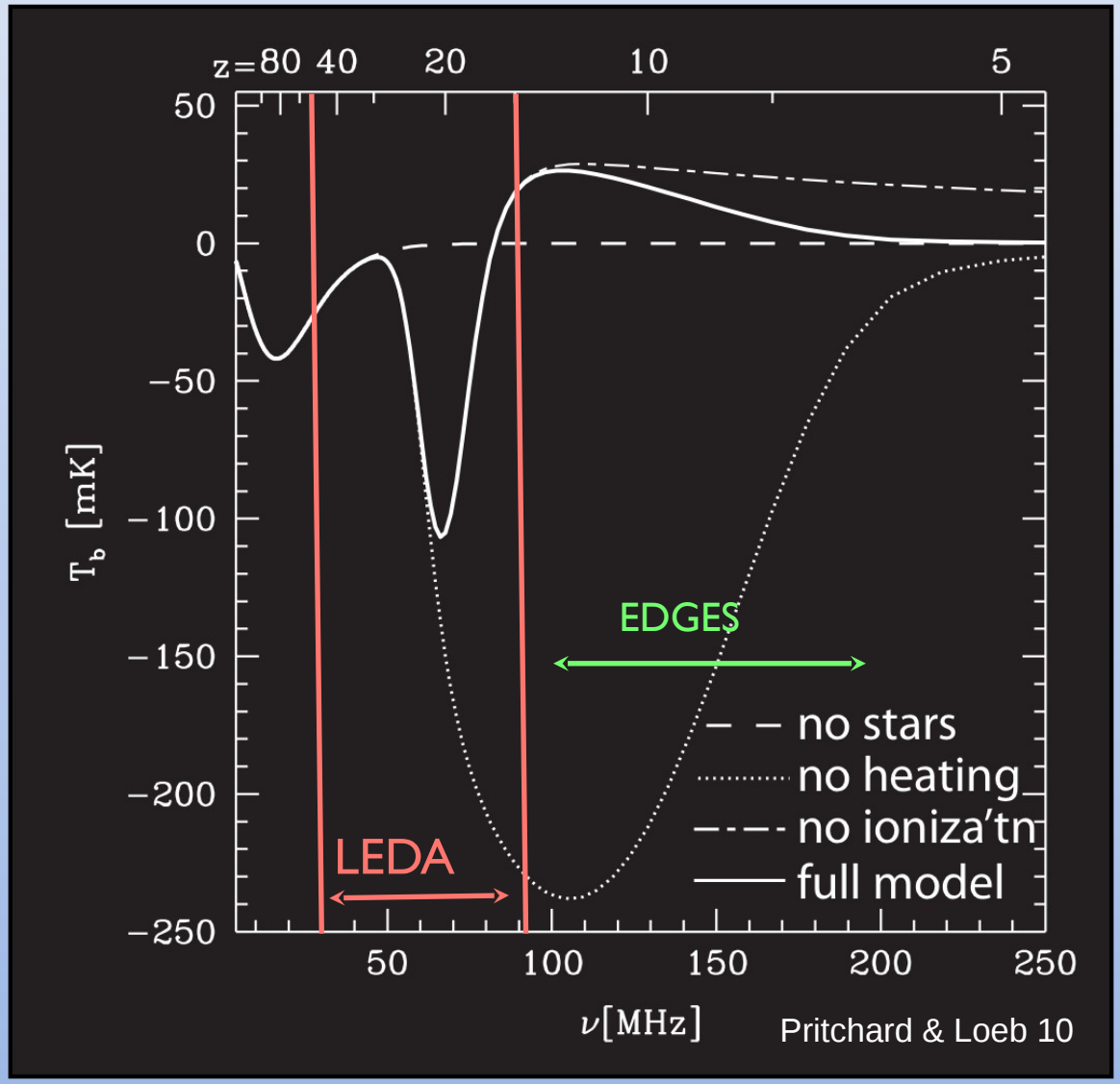
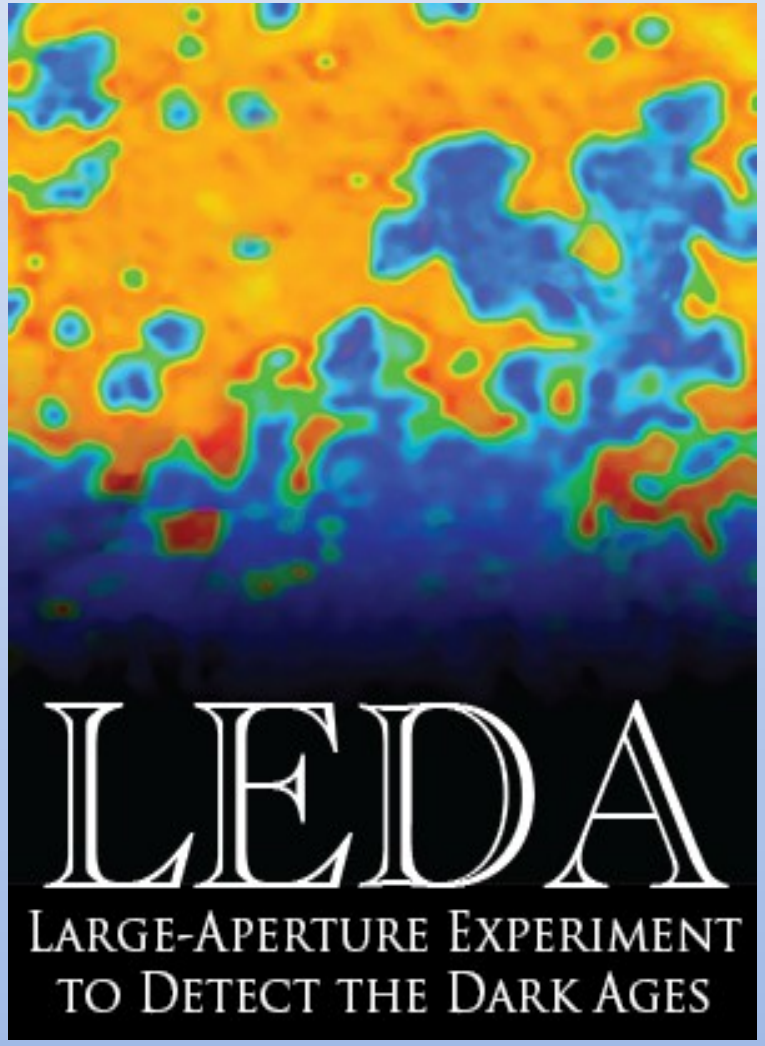
CfA

What are we looking for?



LEDA Summary

- Demonstrate a large-N correlator
  - A scalable design
- Suppression of systematics in total-power measurement
  - Array-based calibration, ionosphere, gain patters, etc
  - All-sky pulsar calibration of gain patterns
- Discovery of the HI absorption feature to infer the initial conditions of reionization
- Requires:
  - Implementing a full correlation backend for the LWA
  - Generalized package for warped snapshot cal/im
  - Discover HI absorption feature

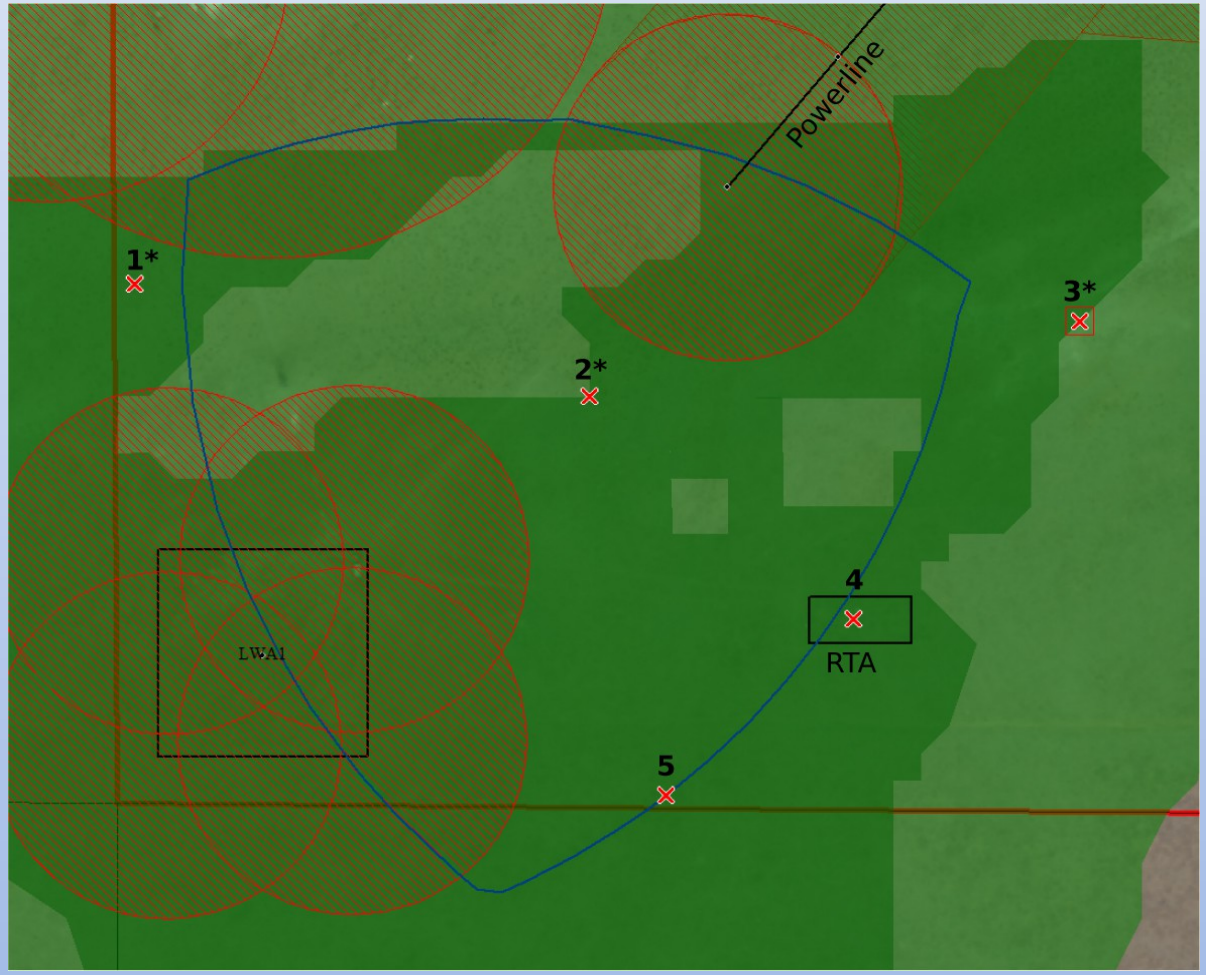


Outriggers

Outriggers

Snapshot array and total power dipoles

Outriggers

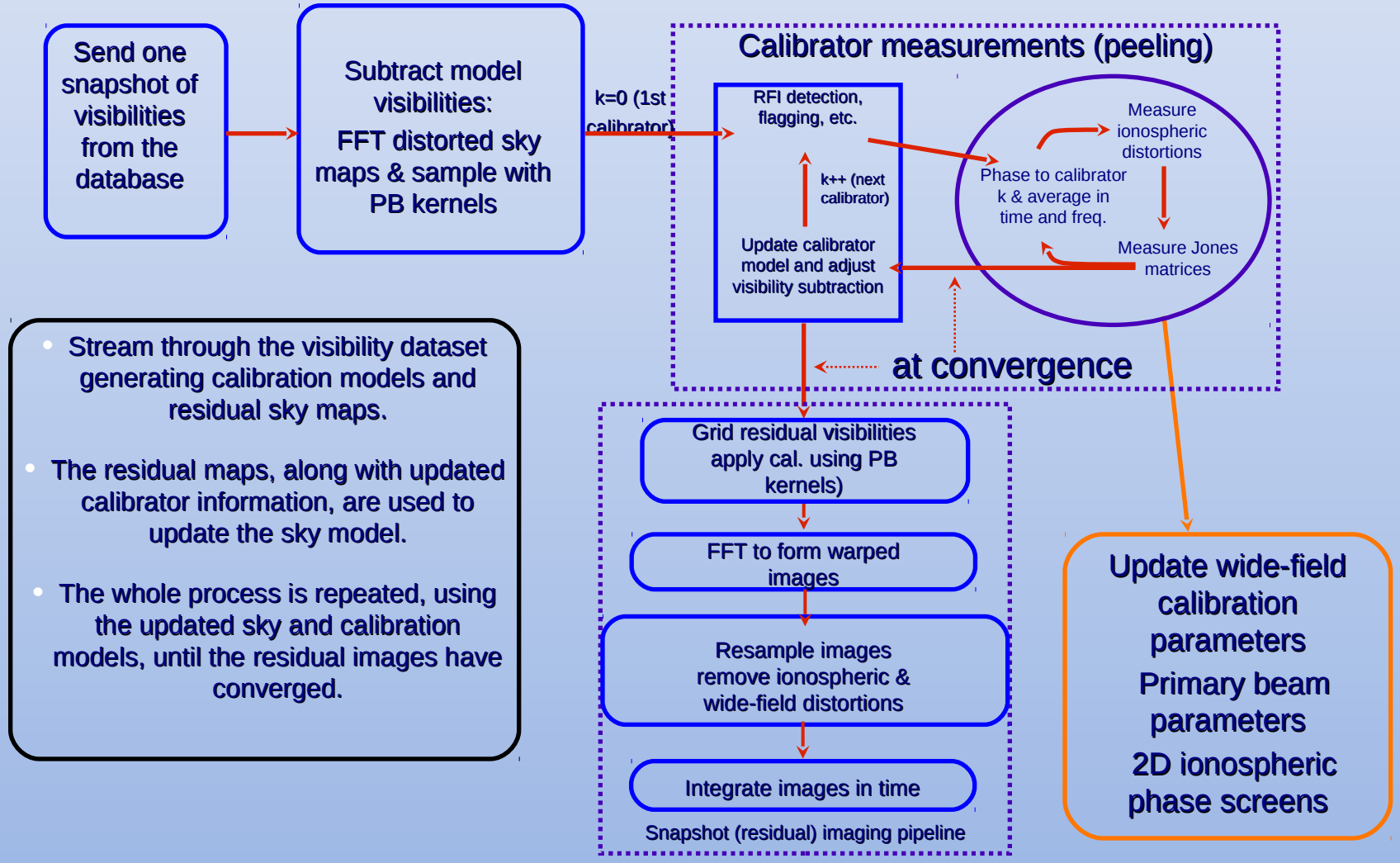


Calibration and Imaging

Warped Snapshot

CUDA Wide-field Array Processing

(cuWARP: after Mitchell et al. ′08; Ord et al. ′10)



- Stream through the visibility dataset generating calibration models and residual sky maps.
- The residual maps, along with updated calibrator information, are used to update the sky model.
- The whole process is repeated, using the updated sky and calibration models, until the residual images have converged.

Polarized Point Source/ISM

$\Delta\theta \sim 15'$

FOV = 2400 $^{\circ 2}$

190 MHz / 31 MHz

$\Delta RM = 1$ rad m^{-2}

$-50 < RM < 50$ rad m^{-2}

(Bernardi , LG, et al. 12)

Pulsar Calibration

LOFAR LBA Data:

- 30-90 MHz

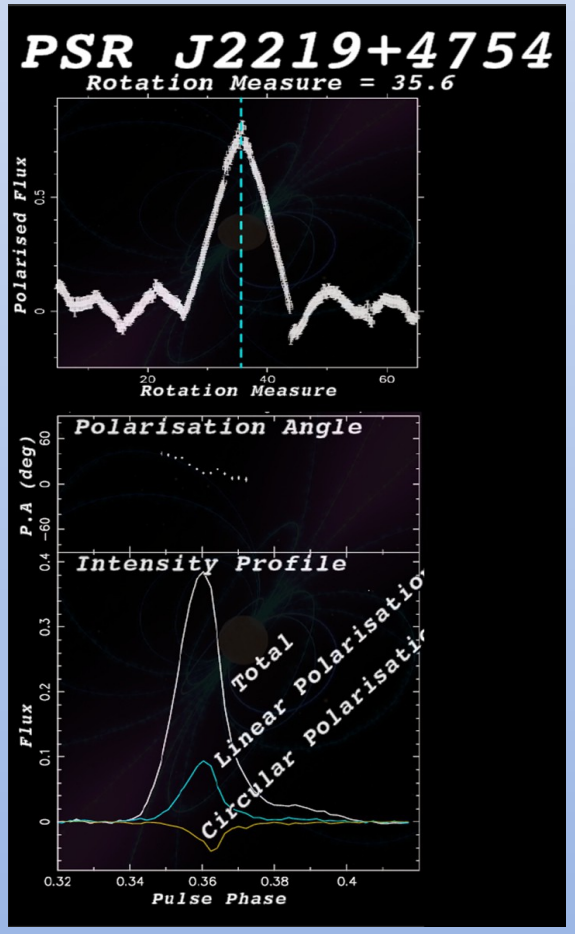
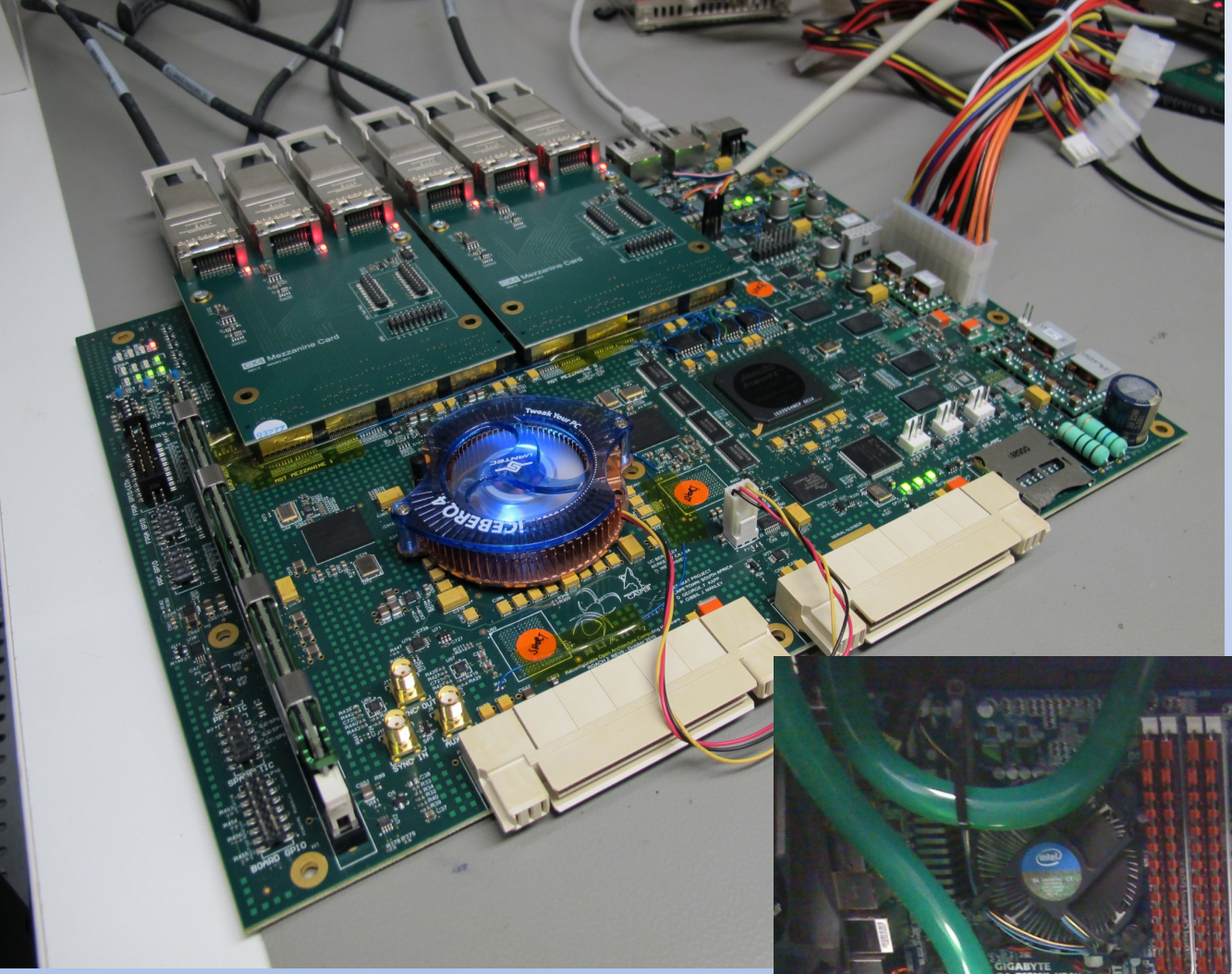
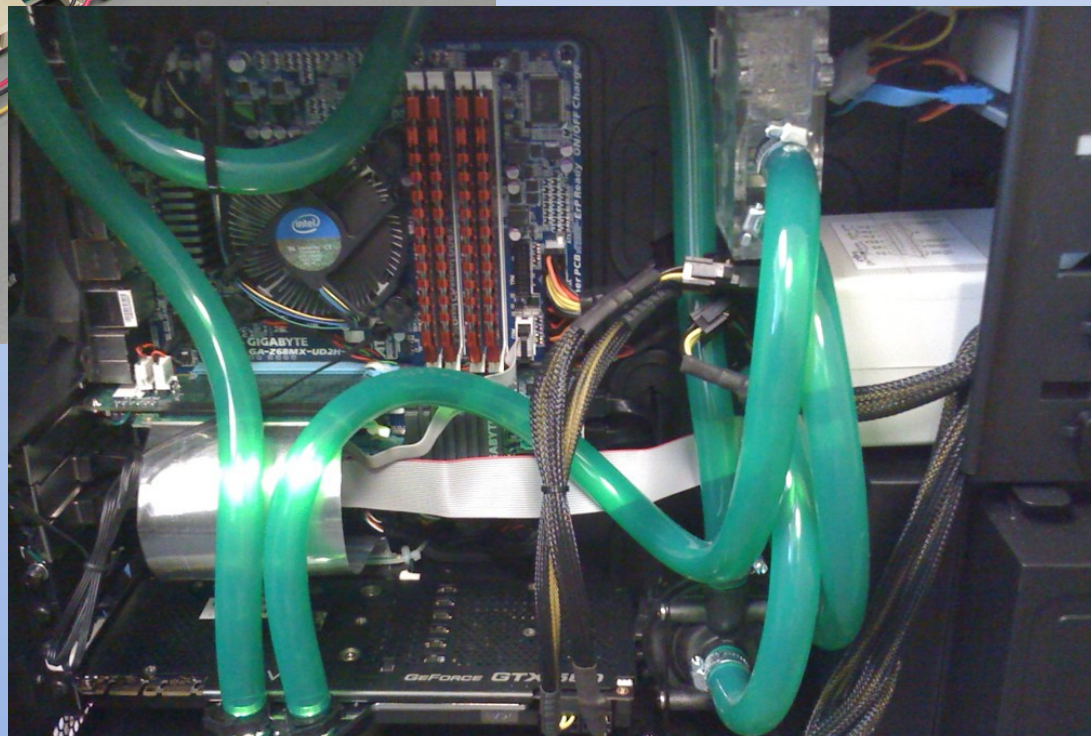


Table 1: A subset of the pulsar population, previously observed at this wavelength range, with sufficient signal to noise to aid mapping of the primary beam.

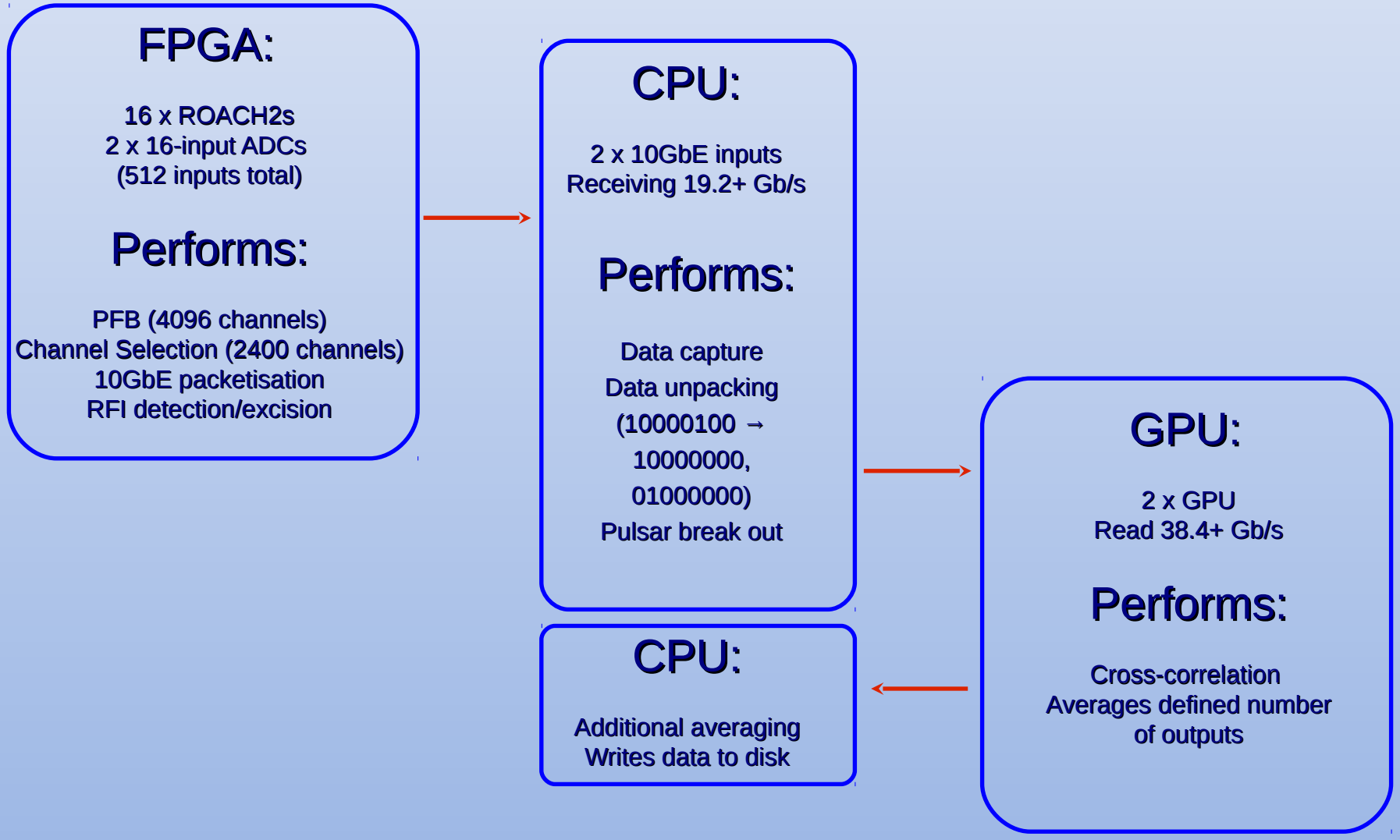
Pulsar	Period (ms)	DM pccm^{-3}	Width t_i (ms)	t_{sc}^1 (ms)	δ_t (s)	t_{DM}^2 (ms)	δ_f^3 (kHz)	flux[4] (Jy)	SNR[5] (peak)
B2303+30	1575.89	49.54	34.10	50.2	0.00	20.07	0.00	0.10	20
B1929+10	226.518	3.180	14.00	0.05	64.2	1.288	1.87	0.22	37
B2016+28	557.953	14.17	22.20	0.91	8.89	5.742	1.60	0.20	41
B0320+39	3032.07	26.01	74.70	5.33	0.00	10.54	0.00	0.16	43
B0818-13	1238.13	40.94	35.60	24.8	9.14	16.59	0.01	0.27	58
B1237+25	1382.45	9.240	60.60	0.32	22.0	3.744	8.60	0.44	89
B1642-03	387.690	35.73	8.000	15.3	3.09	14.48	1.20	0.72	118
B1749-28	562.558	50.37	15.00	53.5	25.6	20.41	0.01	0.96	119
B1133+16	1187.91	4.860	41.80	0.09	4.59	1.969	8.19	0.77	175
B1508+55	739.682	19.61	26.30	2.25	11.4	7.947	0.16	0.84	183
B0329+54	714.520	26.83	31.40	5.89	32.0	10.87	0.07	0.97	186
B2217+47	538.469	43.52	13.10	31.0	20.1	17.63	0.04	1.45	221
B0823+26	530.661	19.45	12.40	2.20	4.23	7.882	1.40	1.07	262
B0950+08	253.065	2.960	20.60	0.04	0.00	1.199	0.00	1.82	265
B0834+06	1273.77	12.89	33.90	0.71	10.1	5.223	2.50	1.58	412
B1919+21	1337.30	12.46	40.80	0.65	5.30	5.049	6.50	2.10	512

Correlator

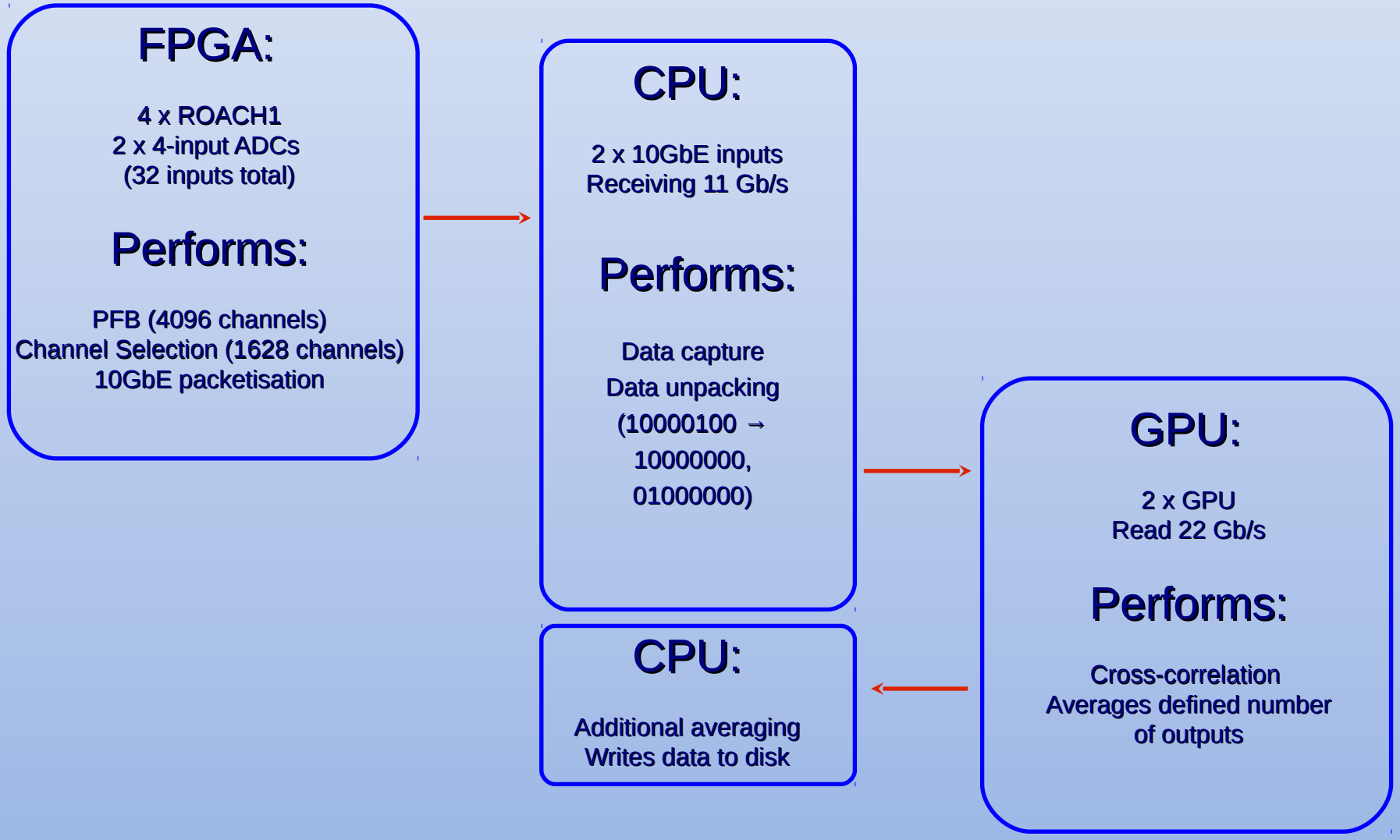

Mezzanine Card
Mezzanine Card
ICEBERG 4


GIGABYTE

Correlator - Final



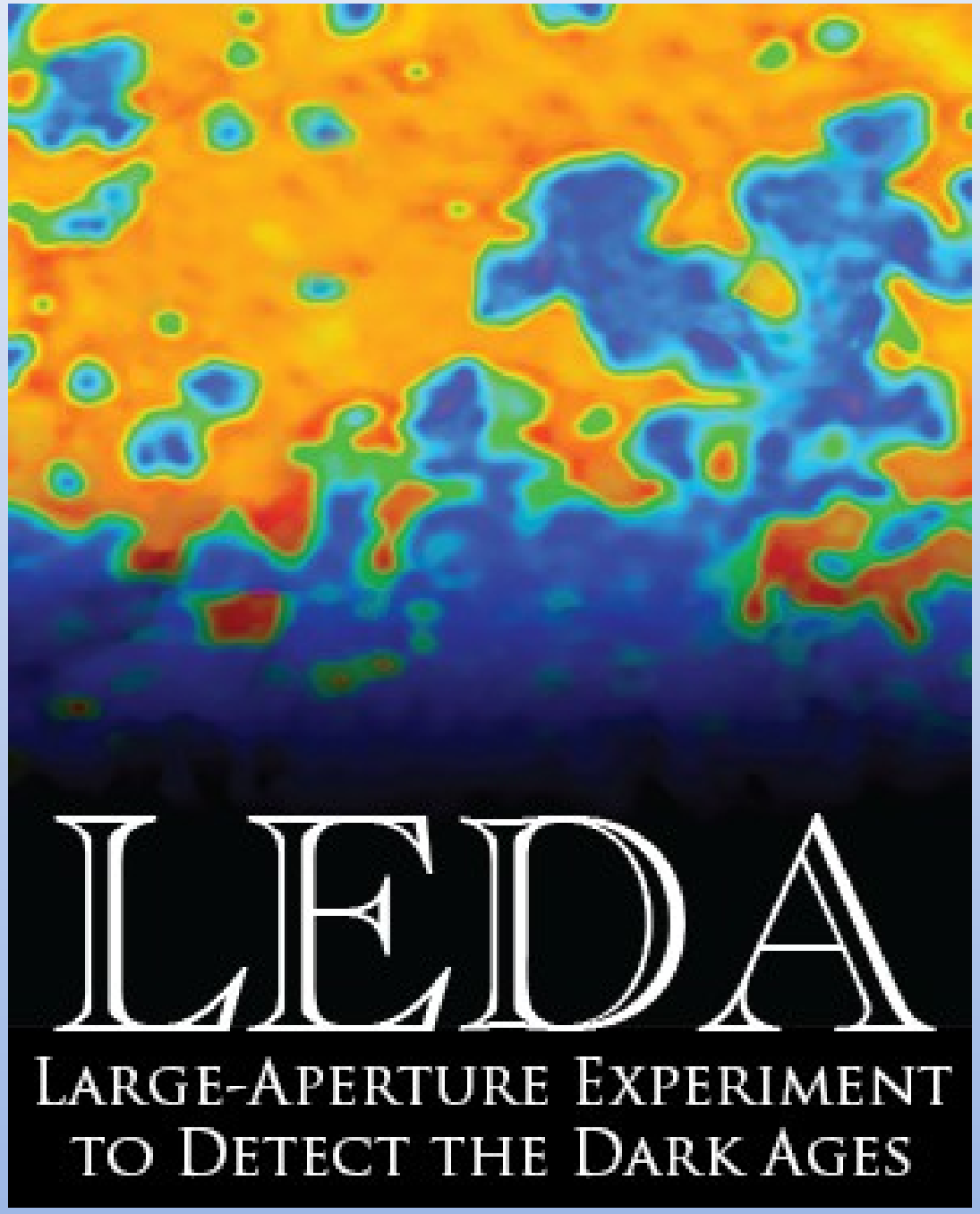
Correlator - Current



Correlator

- Current status:
  - Two 32-input complete correlator designs have undergone bench testing:
    - 4096 selectable channel F-engine → PSRDADA → Harvard X-engine
    - 2048 channel F-engine → #PIPE → Harvard X-engine
  - LEDA-64 correlator on ROACH2 under development.

https://github.com/GPU-correlators/xGPU



Deployment Schedule:

- RFI testing LEDA-32 prototype (next week)
- Deployment LEDA-32 Mid-August
- Deployment LEDA-64 2012
- Deployment LEDA-512 2013

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