# Canadian PAF Update

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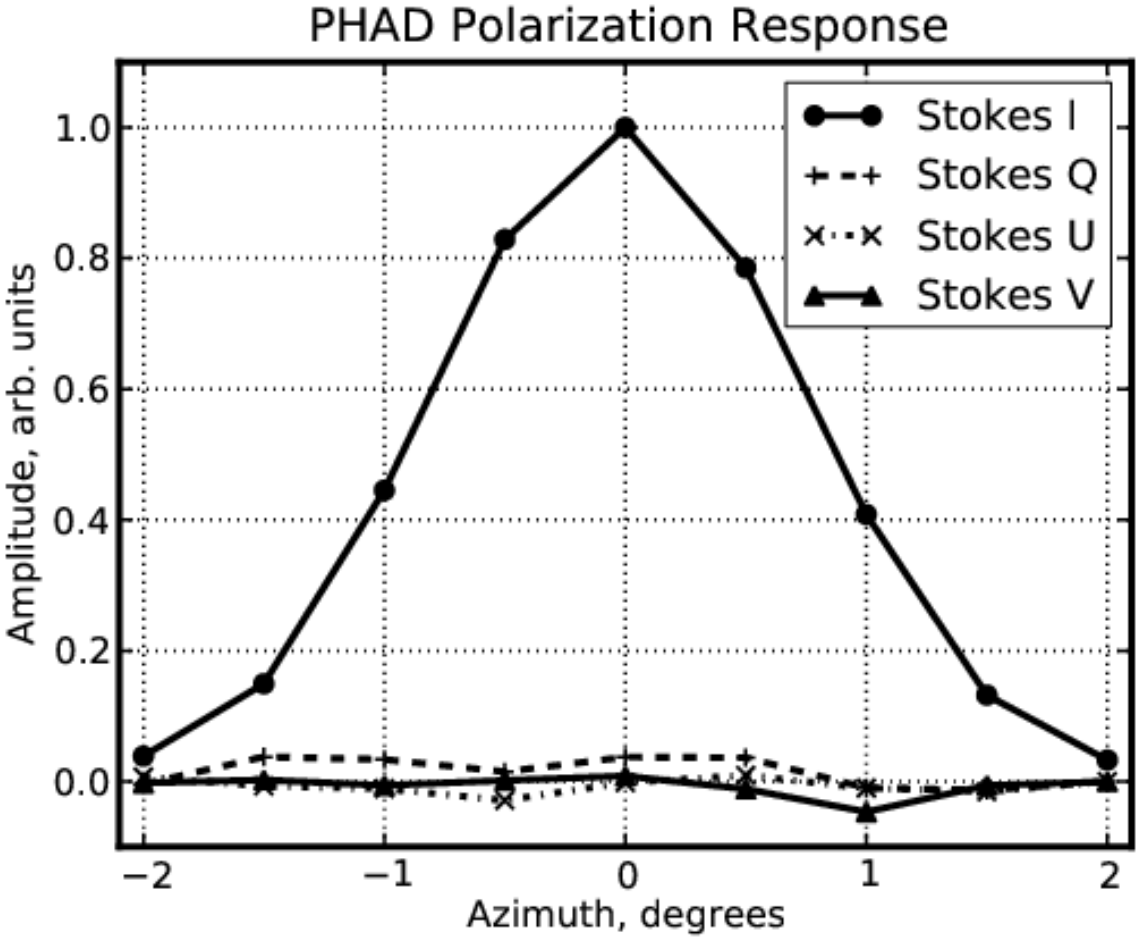
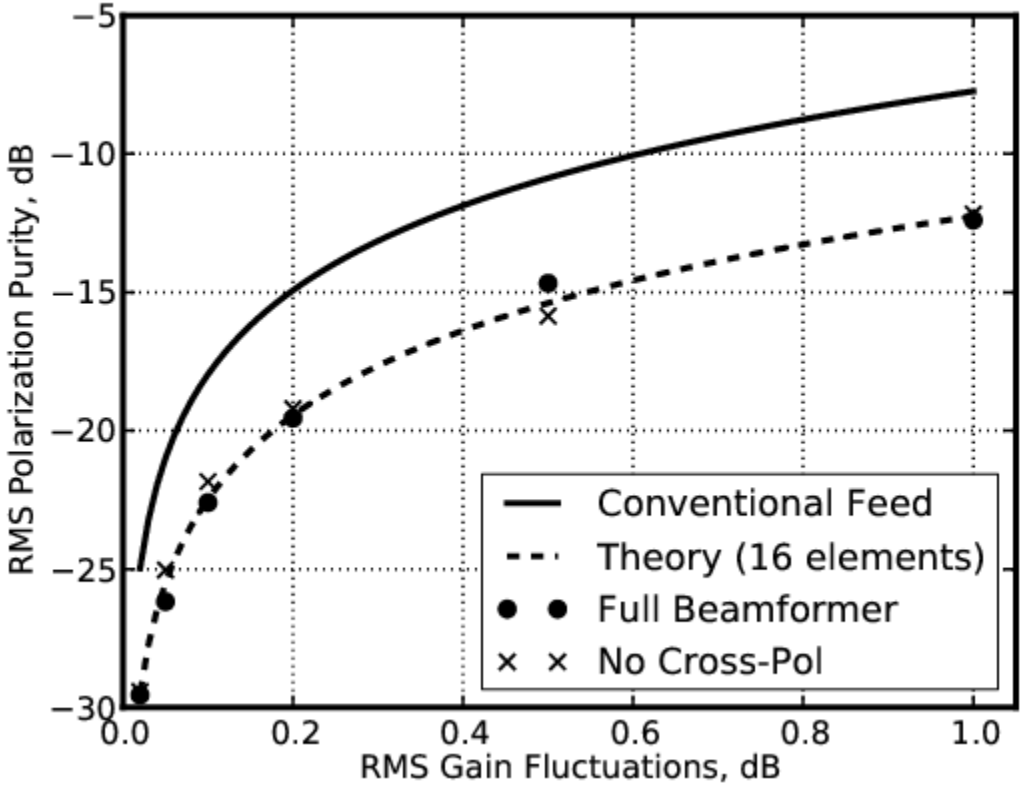
# PHAD

- Array on telescope for 1.5 years
- Dual-pol array (42 active elements in each polarization)
  - First dual-pol PAF results
- Calibration for polarimetry
  - unpolarized source
  - Conjugate Field Matching method
  - beamformer weights from *two* dominate eigenvectors
  - yields two beams that are orthogonal in polarization
  - requires additional observation of polarized sources to establish position angle of coordinate system

# PHAD


PHAD Polarization Response
Stokes I
Stokes Q
Stokes U
Stokes V
Amplitude, arb. units
1.0
0.8
0.6
0.4
0.2
0.0
−2
−1
0
1
2
Azimuth, degrees

# PHAD




-40 dB (pol) $\Rightarrow 2 \times 10^{-4} = 1 \times 10^{-3}$ dB ($\Delta G$)

# Advanced Focal Array Demonstrator (AFAD)

- Goals
  - Engineering demonstrator $\Rightarrow$ scientific demonstrator
  - Provide PAF for DVA
- Implementation
  - Low-loss Vivaldi
  - CMOS LNA
  - No-conversion receiver
  - 8b@3GHz ADC $\longrightarrow$ DSP $\longrightarrow$ fibre
  - Real-time FPGA-based beamformer (0.5 GHz BW)
  - Robust calibration

# Shaped Optics & PAFs

Are shaped optics compatible with PAFs?

- Use Cornell shaped optics design ("42")
- Explore prime-focus caustic region with GRASP9
  - 1m $\times$ 1m measurement plane, transverse fields only
  - integrate total intercepted power
  - vary focal position of measurement plane along beam
  - vary far-field beam direction
  - compare with true parabola with same focal length, $f/D$, offset angle, etc.

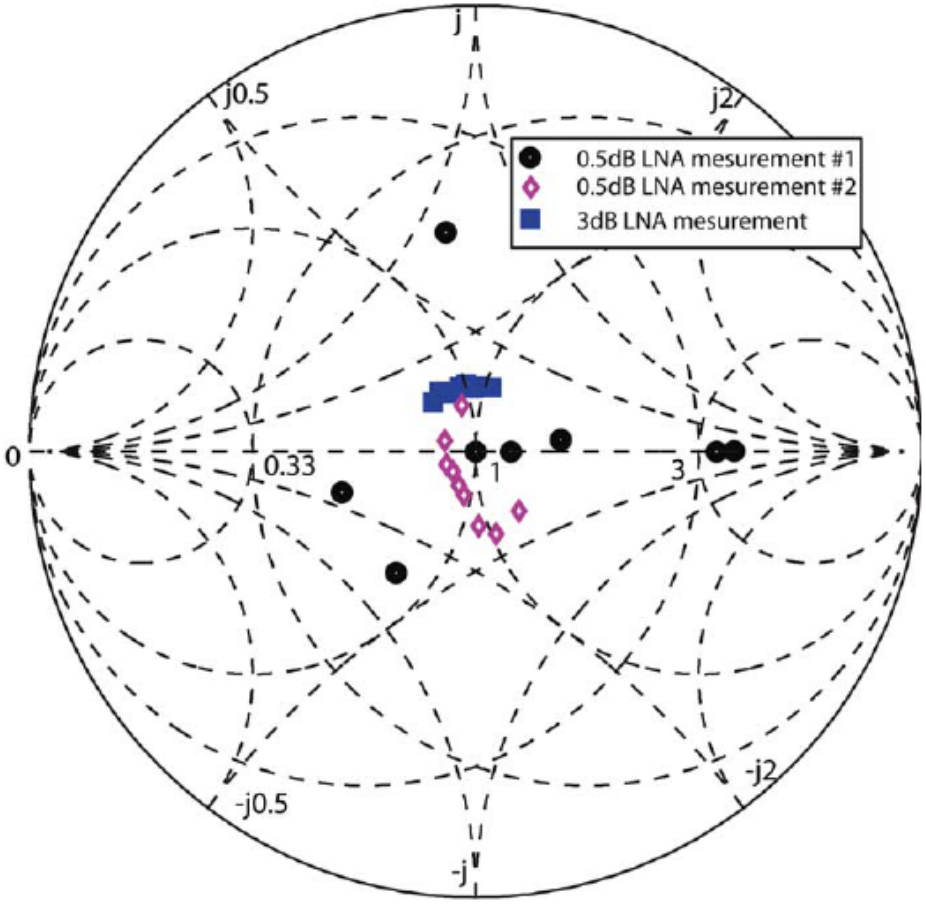
# Shaped Optics & PAFs (II)

- Findings
  - location of best focus is not obvious from ray plots
  - off-boresight focal spots are ugly
  - can recover 95% of power for $2^\circ \times 2^\circ$ field by increasing array by 10% in each direction (+20% total area)
  - investigation of secondary focus to come next
- Concerns
  - not known how to physically combine PAFs with WBSPFs
  - current optical designs do not leave much room for PAFs
  - is maximizing $A_{eff}/T_{sys}$ the best optimization goal for shaping algorithm?

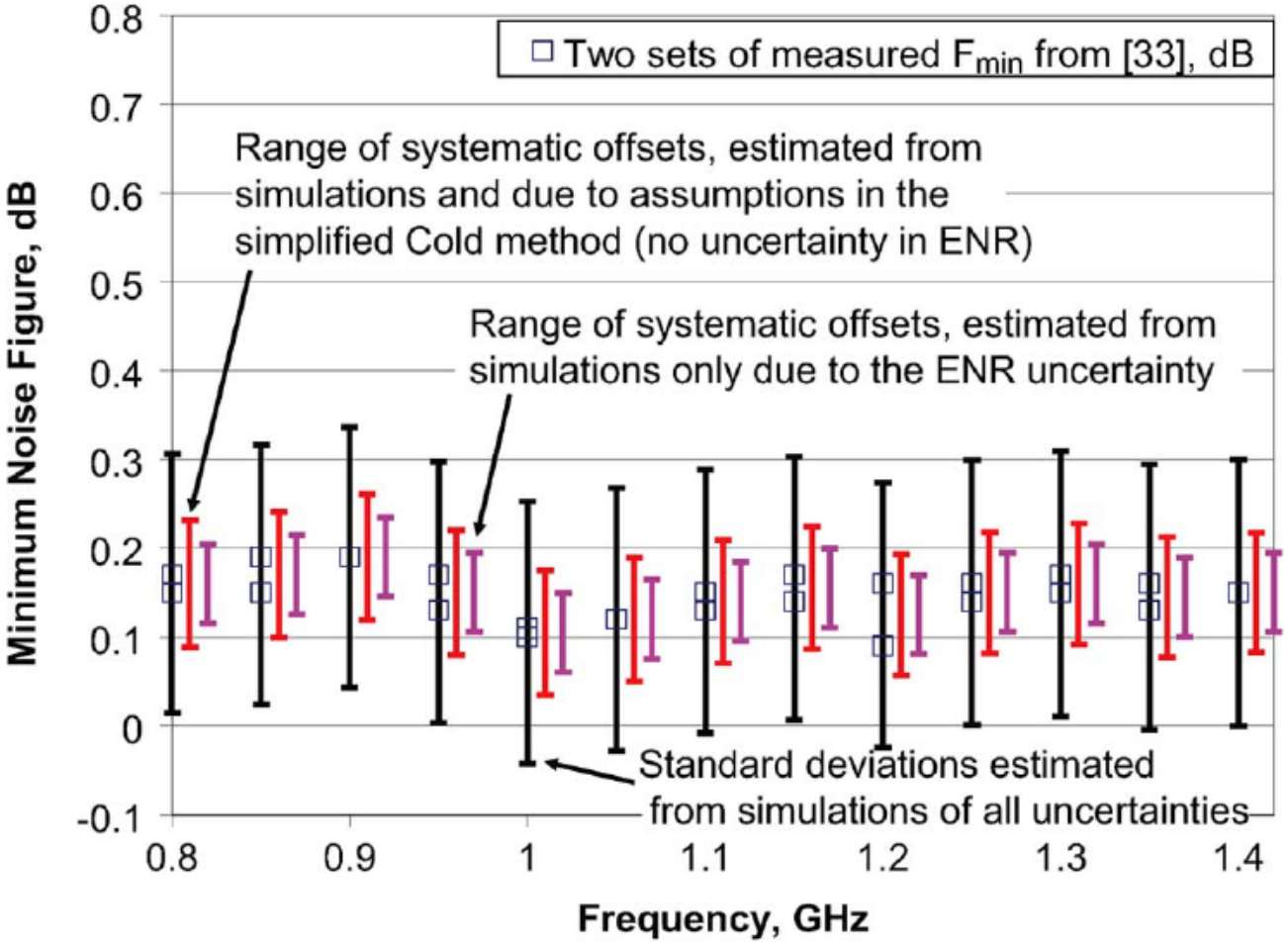
# LNA (University of Calgary)

- Extensive work on measurement facility
  - PNA-X
  - Focus tuner
  - Maury tuner
  - Maury hot/cold load
  - developed in-house software
- Error analysis
  - Belostotski & Haslett "Evaluation of Tuner-Based Noise-Parameter Extraction Methods for Very Low Noise Amplifiers", *IEEE Trans. MTT*, Jan. 2010, pp. 236–250

# LNA (II)


j
j0.5
j2
0
0.33
1
3
-j0.5
-j2
-j
0.5dB LNA mesurement #1
0.5dB LNA mesurement #2
3dB LNA mesurement

# LNA (III)


Two sets of measured $F_{min}$ from [33], dB
Range of systematic offsets, estimated from simulations and due to assumptions in the simplified Cold method (no uncertainty in ENR)
Range of systematic offsets, estimated from simulations only due to the ENR uncertainty
Standard deviations estimated from simulations of all uncertainties
Minimum Noise Figure, dB
Frequency, GHz
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0.8
0.9
1
1.1
1.2
1.3
1.4

# LNA Future Work

- Develop LNA to interface directly to feedpoint of AFAD Vivaldi element
- 65 nm (TSMC) design in works
- Some concern about fab access