Coherent Receivers: System Considerations

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Coherent Receivers

- Ability to make multiple signal copies without additional noise penalty...
  - Allow system architectures with null science data channel
    - Baseline/Offset potentially small and stable...
  - Simultaneous measurement of desired basis set by receiver topology
    (e.g., Q/U/I, Q/V/I, other...)
  - Rapid phase modulation used to stabilize receiver and measurement basis. Excellent systematic control. Due to high coupling efficiency addition of beam waveguide polarization modulators (e.g., HWP, VPM, other...) un-needed/undesired...
  - Relatively modest cooling and bias stability requirements. System noise properties degrade gracefully with detector ambient temperature...

- Complexity – reduced I&T risk – high reliability
  - Limited number of elements before setting noise
  - Many elements can be testing at room temperature...
Future Technology Needs

- **Approaching QL Device Noise**
  - 1/f-noise more pronounced as device noise approaches QL
  - charting the unknown, however, might anticipate higher phase switching rates to stabilize radiometer...

- **Optimal Element Design**
  - Phase switch, transitions, other...
  - Q/U polarimeter desire circular polarization from antenna – need high performance antenna polarization diplexers with greater bandwidth... – presently elements ~20% fractional bandwidth need to be pushed to full waveguide band...
Waveguide Hybrid Septum Polarizer

\[ \text{RHCP} = \left( \text{TE}_{10}^{\oplus} + i \text{TE}_{01}^{\oplus} \right)/\sqrt{2} \]
\[ \text{LHCP} = \left( \text{TE}_{10}^{\ominus} - i \text{TE}_{01}^{\ominus} \right)/\sqrt{2} \]

\[ d\phi = \sum_{i=0}^{N} (\beta_o - \beta_i) l_i + d\phi_i \approx \frac{\pi}{2} \]


Centimeter wave solutions have from radioastronomy have been demonstrated…