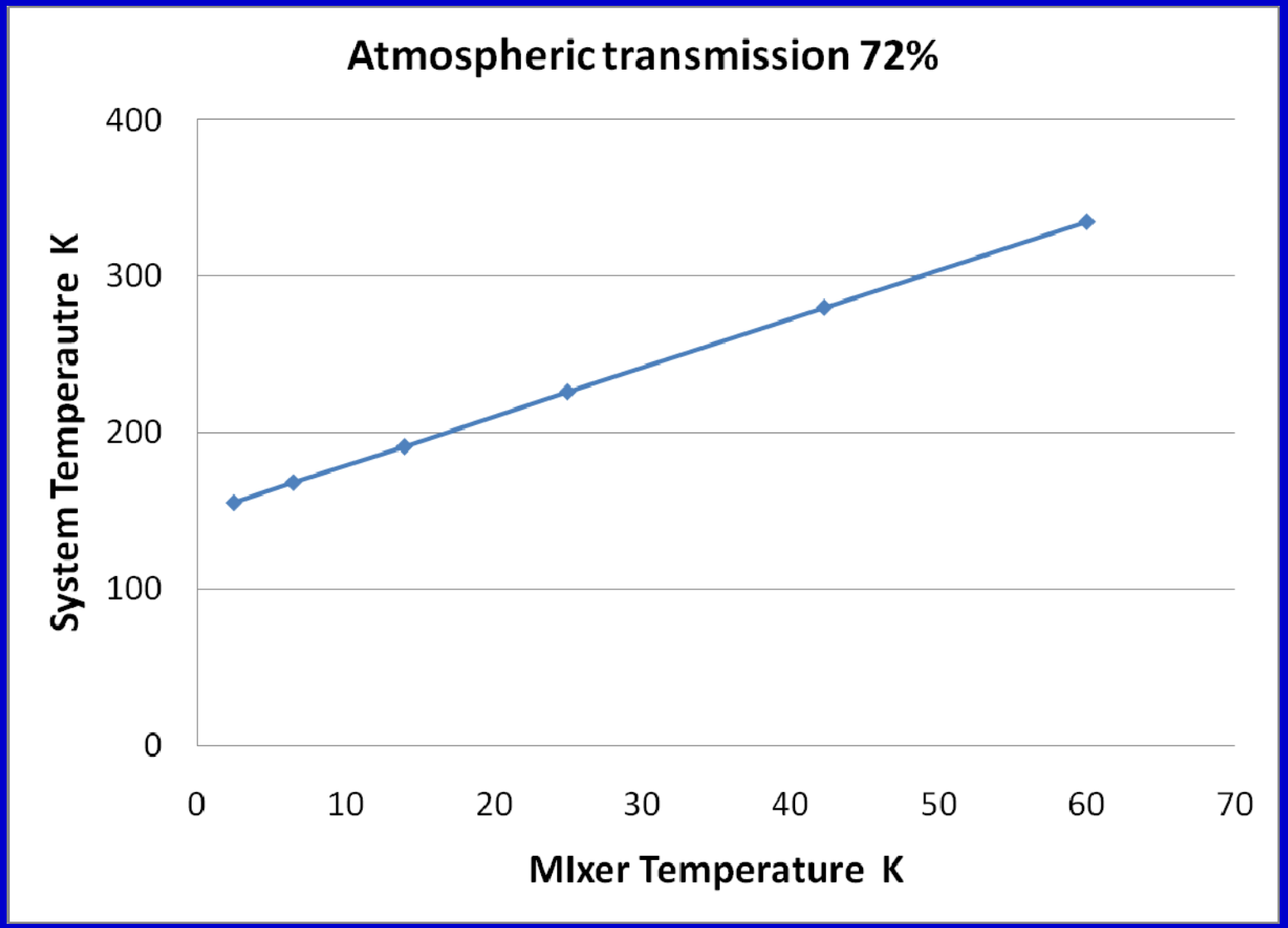
Development Plan

- Now starting to consider what should be planned after the baseline ALMA is built.
- First step is to identify science drivers – but not here!
- Some obvious things to start with:
  - Fill in missing receiver bands
  - More sophisticated polarization measurement devices
  - Phase-up the array for VLBI
  - More computer power (and software?)
- Others cost money but are straight-forward:
  - Higher resolution – more distant pads (extending site tricky?)
  - Faster mapping – more antennas

More difficult areas

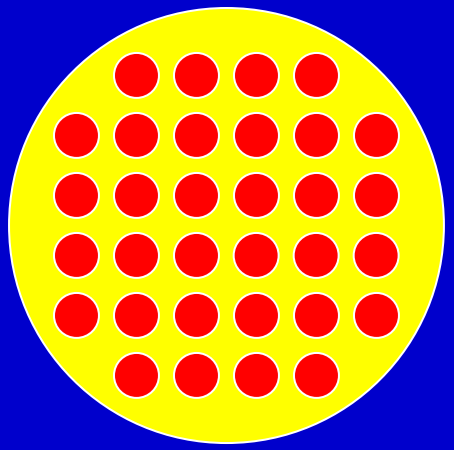
- Higher Frequencies?
  - Dishes could probably do 1.5 THz but to get high efficiency would need to put motors on panels and derive corrections
    (Panels are ~ 8 microns, dishes overall ~ 20 microns)
  - Receivers presumably OK in 5-10 years ?
- Substantially quieter receivers?
  - Getting hard: we are approaching the background limit
- More bandwidth?
  - Possible in principle but big investment to get say factor of 2
  - Only gains factor 2 in speed or root(2) in sensitivity
- More spectral resolution?
  - Yes, e.g. big FX correlator based on FPGA's

Diminishing Returns on improved mixer performance



Array Receivers

- So long as the requirement is to map objects that are much bigger than the primary beam, this is how we win.
- Must at least match current sensitivity: then gain in speed goes directly with number of detectors.
- Need substantial step to justify new infrastructure – electronics, backend, correlator – e.g. 32 beams.
- Physical size not too huge:
  - For spacing 1.6 x FWHM would need about 120mm diameter window at 345 GHz (f/8)
  - Unit size 12mm square
  - Probably some compromises – use lenses instead of mirrors in front of horns?



Plenty of Challenges Here !

- Assume HEMPT's are not going to compete above 200GHz, so SIS. Need integration of at least complete dual-pol sideband-separating receivers on chip.
- LO distribution – photonic direct to device on chip? (Superconducting photo-mixers?) How to kill noise?
- I.F. amplifier's – really low power, small.
- Then we need to digitize and transport that data at about 5Tb/s. Still might (just) get this on one fibre!
- Correlator is probably not even as large as the present one! (For a two-year Moore's law doubling time we need ~10 years but present design is getting of for 10 years old anyway.) Power density might be an issue?