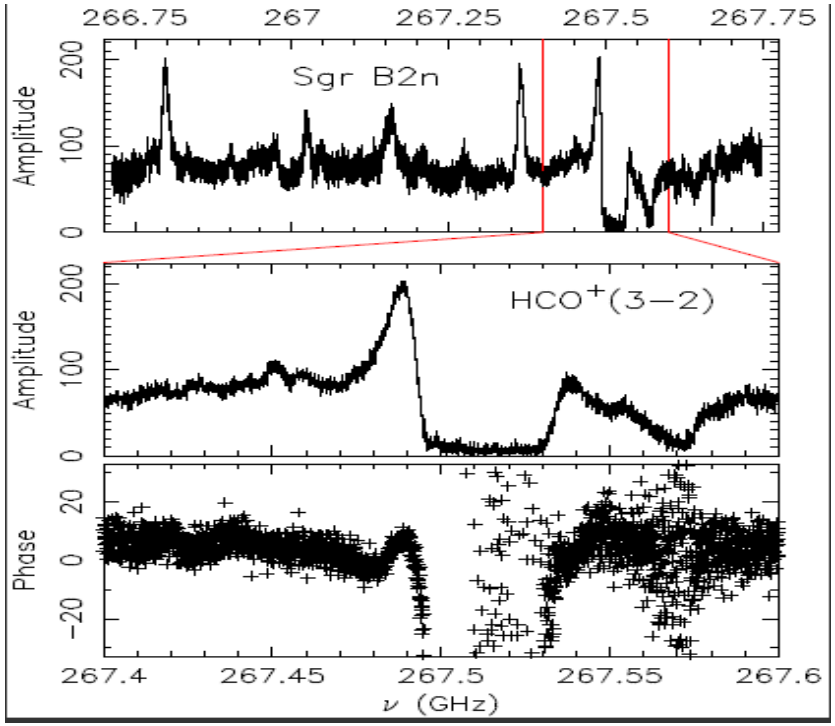
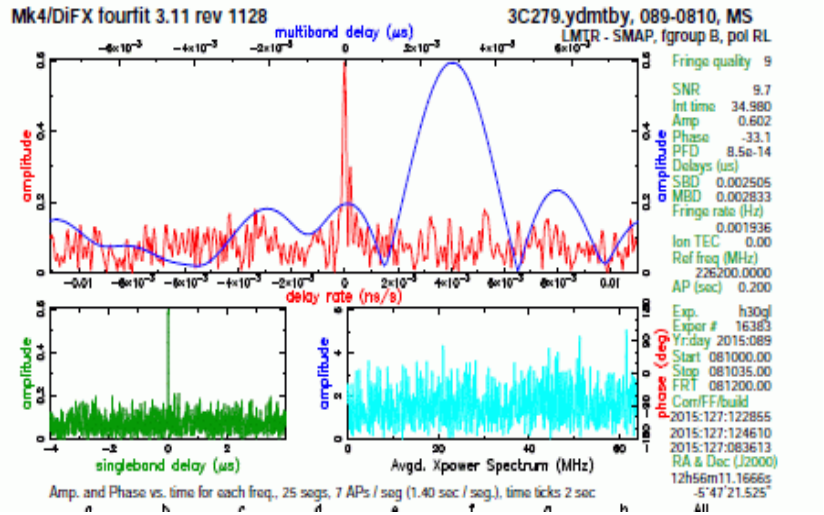
Correlator and IF Plans

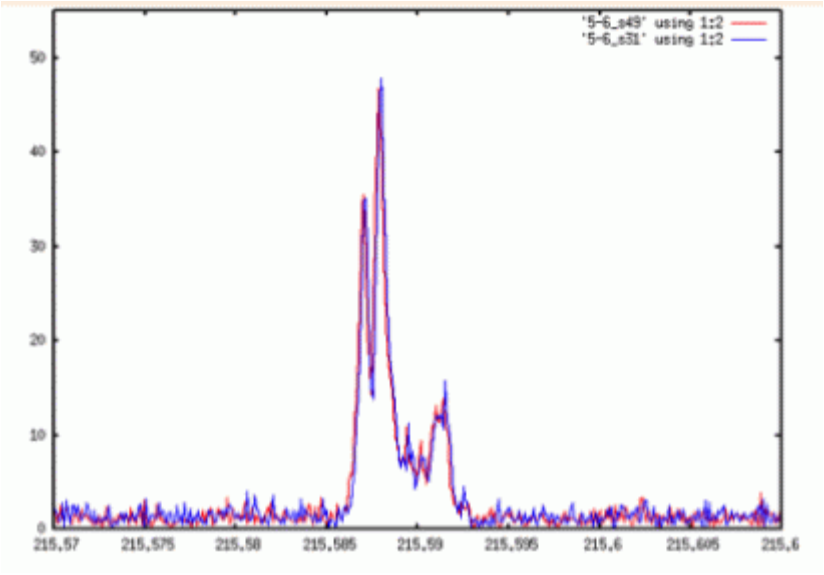
SMA Governing Board Meeting 12/3/15

Bob Wilson

The First Quadrant of SWARM is Working Very Well







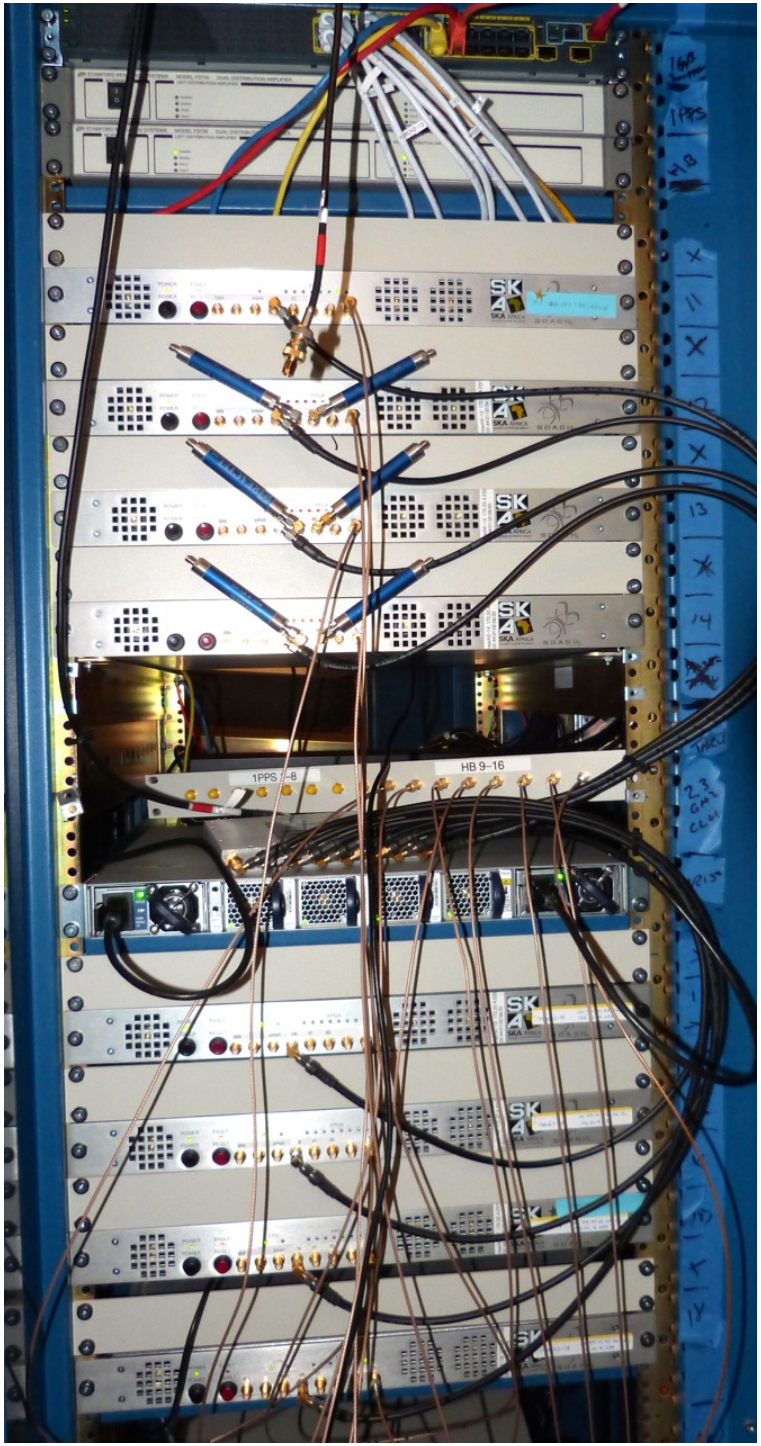
SWARM has

- Higher uniform spectral resolution
- VLBI phased array processor built in
- ~10% better SNR
- 10x smaller and less power

The Coming Year

- The 1st quadrant of SWARM is now running reliably and not burdening the operators
- The 2nd quadrant has taken longer to bring up than expected due to 10G network problems and our being short handed in HI.
- The team is in Hawaii to get the problems worked out now.
- Most of the IF modifications needed for polarization options for quadrants 1 & 2, have been made.
- Replacement Roaches which should allow full speed operation of these two quadrants are on order for delivery by the end of the year.
- Jonathan expects to have full speed operation of quadrants 1 & 2 in the first quarter of 2016.
- If that happens, Ray has committed to buying additional parts for the remaining two quadrants, ~$500k for digital equipment in 3QFY16.
- The ASIAA BDC will need to be expanded for full 4 quadrant operation (~$80k)
- Part of the ASIC correlator will have to be removed to make space for quads 3 & 4
- Jonathan expects to have full speed 4 quadrant operation by the end of calendar 2016 covering a usable IF band of 4-12 GHz dual polarization or dual receivers.

Quadrant 2 of SWARM



The Next Stage

- Edward proposes to extend the upper end of the IF band to 18 GHz by ~2019.
- The easiest and most expedient way to process that additional bandwidth would probably be with three additional 'quadrants' of SWARM and the associated block down converters.
- I don't think that that would be the best path:
  - –As receivers are improved, the top of the IF band will probably increase to 22 GHz and above and we will need more correlator capacity.
  - –The additional extension would involve more block down converters than I want to contemplate.
  - –Edward now thinks that a dichroic plate could allow operation with two polarizations in two bands simultaneously. To take full advantage of this, we would need twice as much correlator capacity.
  - –If we stop keeping up with technology we will not be in a position to improve the SMA or contribute to other instruments such as ALMA (Jonathan has such a proposal in now).
  - –ASIAA is developing a 10 Gs/s ADC for Roach2
  - –We have 20 Gs/s A/D converter which is almost working with a Xilinx demo board
  - –SKARAB (aka. Roach3) is becoming a commercial product (we have a brochure and price list).
- We should keep our options open, but don't have to decide for a year or more

IF Processing and Transmission

- The present IF system will soon be adequate for the IF band covering 4-12 GHz for 2 receivers
- Various amplifiers and other components will have to be replaced to increase the bandwidth.
- More importantly, we will need new FO transmitters and receivers to allow transmission of 4-18 GHz
- At present each IF is transmitted to the control room at 1310 nm and the same fiber caries reference signals to that receiver at 1550 nm.
- We could buy FO transmitters and receivers covering 4-22 GHz at 1310 on both fibers for about $250K, but that is the limit of that technology at present.
- If we reverse the wavelength usage, we could have a “dense” or “coarse” WDM system with multiple wavelengths carrying multiple IF signals on the same fiber using “inexpensive” commercial components.
- For one channel the component cost would be about the same in this case, but we would have to reconnect quite a few optical fibers (this time with connectors rather than splices).
- If in the future, if Edward makes sideband separating receivers we would need to digitize at the antenna and the same WDM system would allow a high bit rate with commodity components in parallel with the analog transmission.