LWA Outreach South of the Border

Stan Kurtz
Centro de Radioastronomía y Astrofísica
UNAM, Campus Morelia

The Large Millimeter Telescope

Currently at 30 meter
(could go to 50-m)

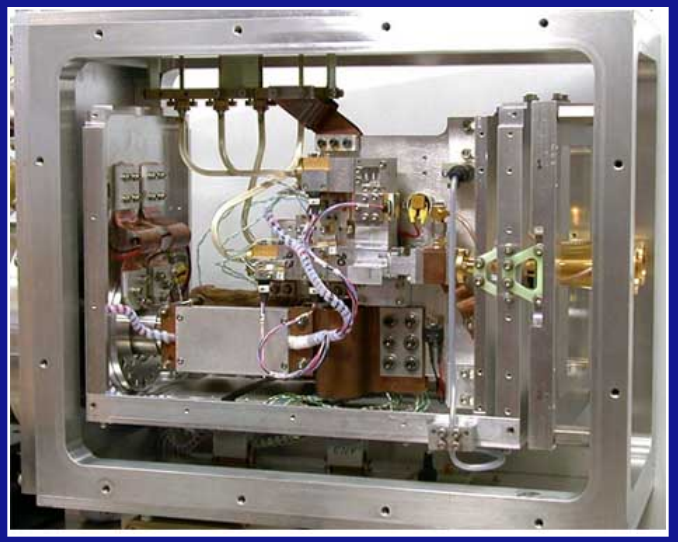
4600 meter elevation
1 - 3 mm observing

Excellent potential as a
mm-VLBI station

2nd Inauguration on
May 17th
Observing by Fall 2011?

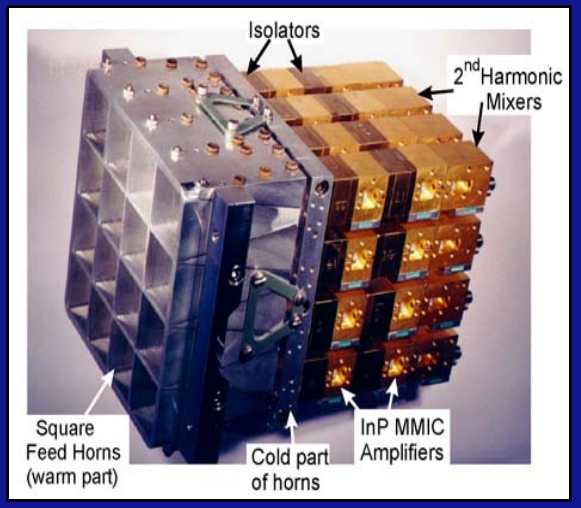
LMT Instrumentation

- Ultra-wideband receiver covering 75 – 111 GHz in a single tuning
- 4 pixels, dual polarization
- Analog auto-correlator with 31 MHz resolution or 100 km/s over full 36 GHz
- Searches for CO in high redshift (z > 3) galaxies with exceptional baseline stability



Redshift Search Receiver

- 32 pixels in a dual polarization 4x4 array
- 85 – 116 GHz
- Noise temperature of 50 – 80 K
- Ideal for mapping molecular clouds and star formation regions



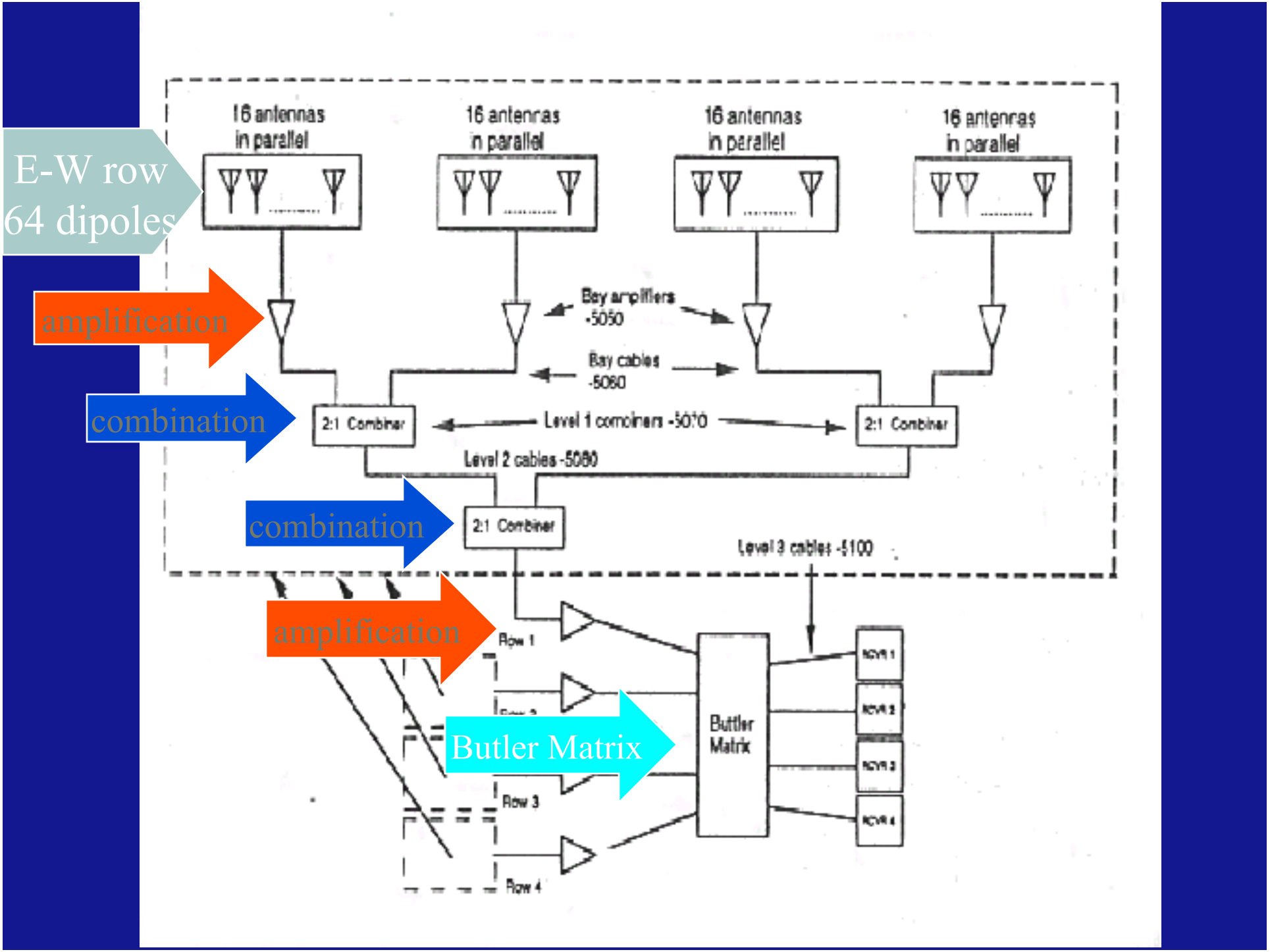
SEQUOA Focal Plane Array

Also available is the AzTEC 144 pixel bolometer array, operating at 2.1 and 1.1 mm
Successfully commissioned on the JCMT in 2005

MEXART: 140 MHz Dipole Array

- IPS solar wind studies by UNAM Geophysicists
- Design and development in the USA and India
- Analog Butler Matrix

Operation Frequency	139.65 MHz
Basic Antenna Element	Full wavelength dipole
Number of Elements	4096
Element Arrangement	64 E-W lines of 64 dipoles each
Bandwidth	1 MHz
Angular Resolution	1^{o} x 1^{o}

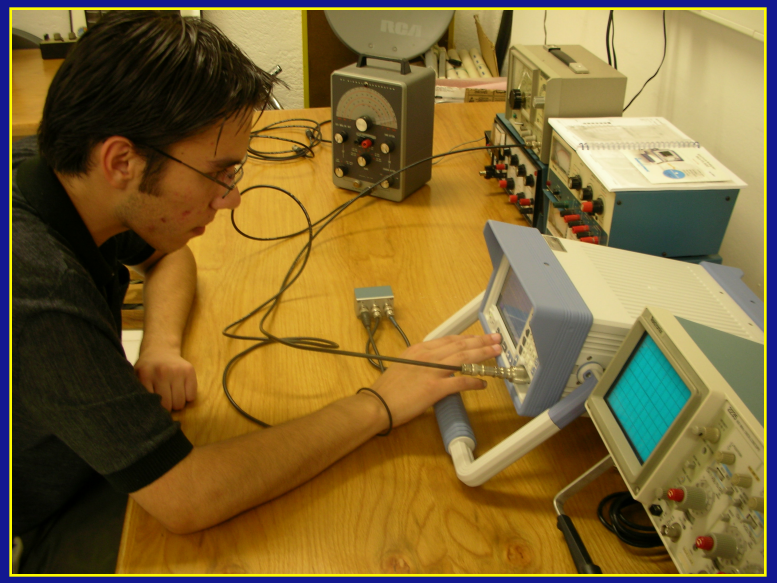

E-W row
64 dipoles
amplification
combination
combination
amplification
Butler Matrix
16 antennas in parallel
16 antennas in parallel
16 antennas in parallel
16 antennas in parallel
Bay amplifiers -5050
Bay cables -5060
2:1 Combiner
Level 1 combiners -5070
2:1 Combiner
Level 2 cables -5080
2:1 Combiner
Level 3 cables -5100
Row 1
Row 3
Row 4
Butler Matrix

EVLA + VLBA

Mexico contributes 1.76 M$
NRAO outfits 2 antennas
Ensures Mexican access to ALMA

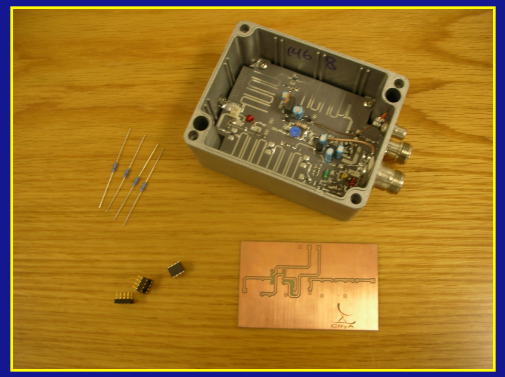
Mexico contributes 0.4 M$
to buy disk drives and
playback units

CRyA Radio Observatory



Bare-bones RF laboratory

Two Haystack SRT systems
C, Ku-band projects underway
Interferometer projects underway
at 20 MHz and 1400 MHz



Mostly undergraduate level,
But with potential for
masters/PhD projects

Lots of outreach to schools

Radio Jove: A project for high schools & colleges

Project initiated by NASA

Observations of solar and jovian storms

High school level

Introduction to:
Electronics
Antennas & Radio
Data analysis
RFI
& many more…

What's a Radio Jove System?

15m λ/2 dipole(s)

20.1 MHz DC Rx

PC

Optional filter
& Noise diode

Final Data via Sky Pipe

Mexico City High Schools using Radio Jove

- First system installed in 2005
- 10 high schools currently participating
- Plans to extend to technology institutes
- Multiple projects, not just Radio Jove

How does the LWA fit in?

1. Mexico has radio instrumentation needs that it currently can't meet (mostly for lack of knowledge and experience)
2. Corollary: we need to train ourselves to do radio instrumentation
3. CRyA radio lab needs challenging projects for students
4. High schools need to keep pushing the envelope
5. Worthwhile goal is to involve technology institutes
6. Mexican participation in LWA (with $) is feasible

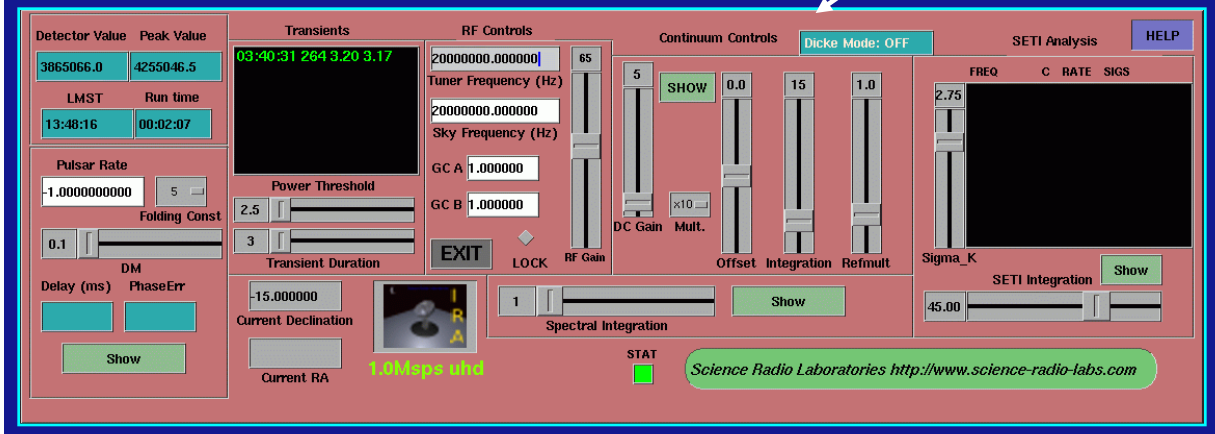
How LWA fits in

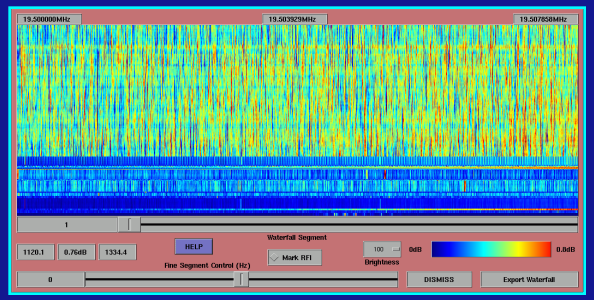
Step 1: Broadband Solar Telescopes

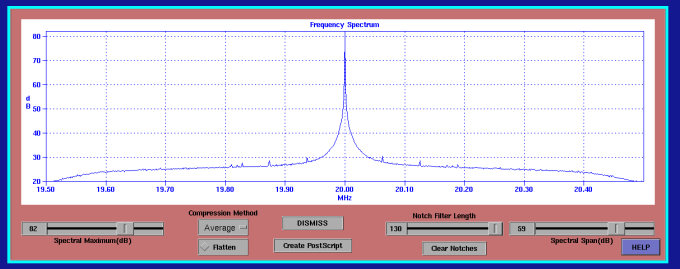
12 antennas

USRP 1

4 channel input
(2 I/Q pairs)
64 Ms/s sampling
12 bit resolution
DC to 2400 MHz
Altera FPGA

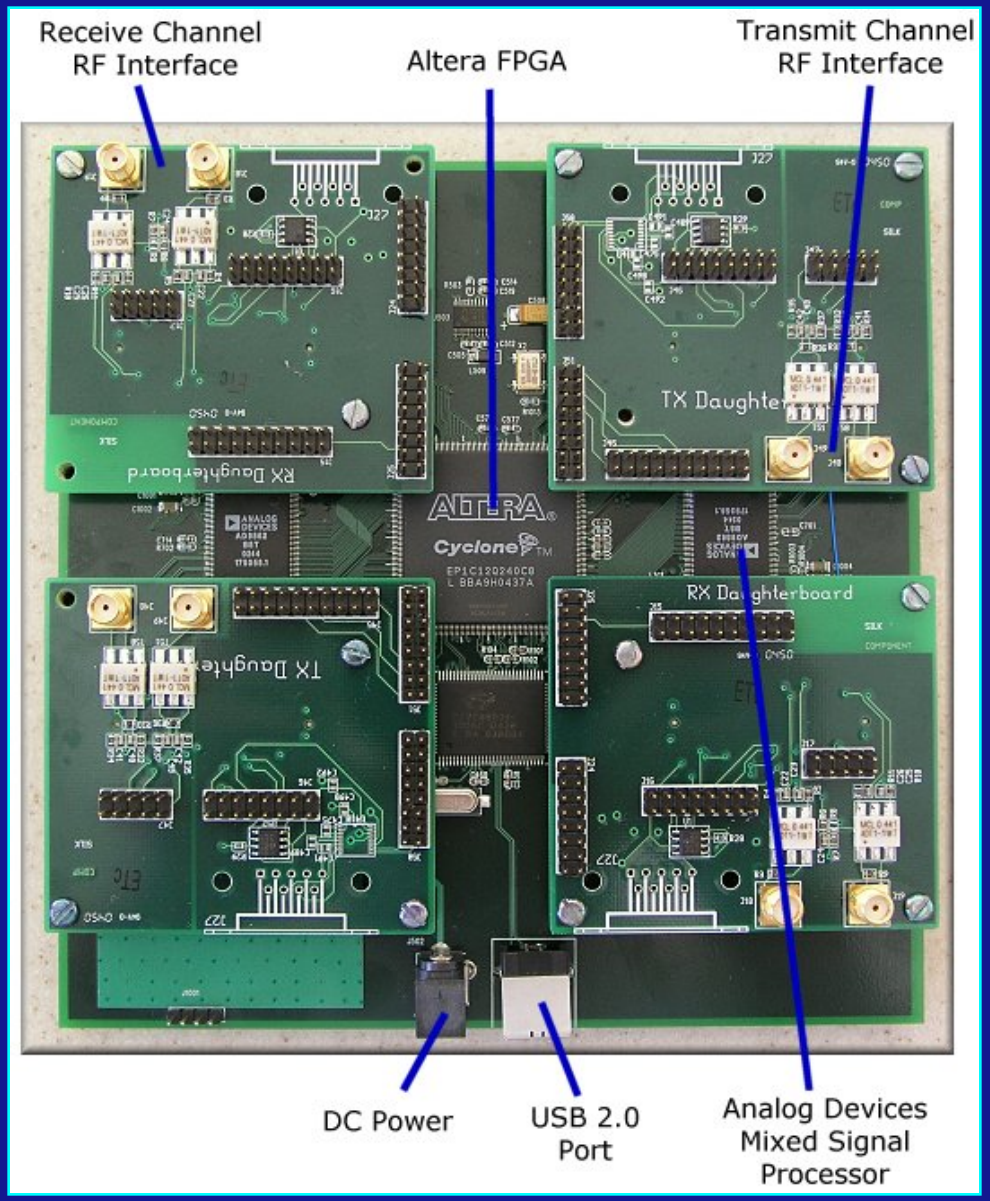






GnuRadio Software Defined Radio

Ettus Research & National Instruments



Available Rx modules

DC - 30 MHz ✓
50 - 860 MHz ✓
800 - 2400 MHz

USRP1 capable of 16 MHz bandwidth

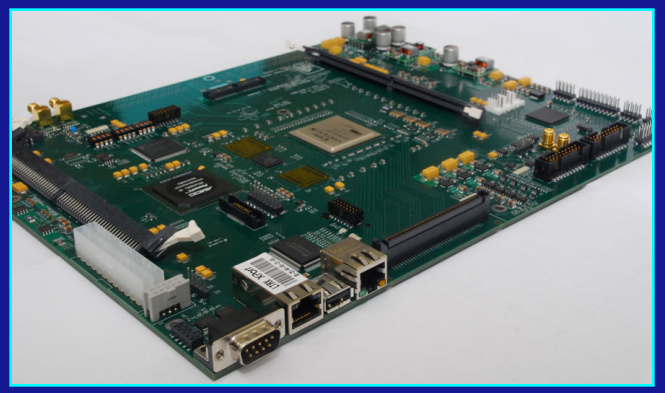
Our bandwidth set by PC (6 core 3.3 GHz CPU)
We expect 4 MHz with swept operation

Small cluster would be ideal

Step 2: More ambitious projects

more LWA antennas

+



ROACH or RHINO board

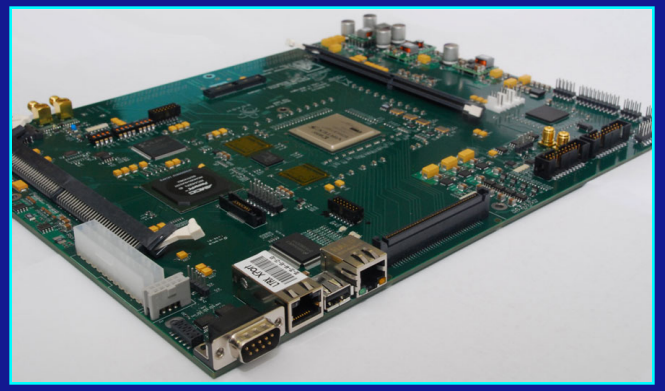
=

Correlator for interferometry
Digital Beamformer
Gain valuable experience and involve Tecnology Institutes

Step 3: Even *more* ambitious projects

LOTS more LWA antennas

+



Multiple ROACH and/or RHINO boards

=

LWA South station in northern Mexico?
Fabrication of antennas & front ends in Mexico?
Digital beamformer for MEXART?
Digital spectrometer for LMT?

Interference Study at 139.65 MHz +- 1 MHz