

50 MHz and Up

2021 TuneUp Results

K6ML, Test Tech

420' Test Range (128 m)

Sandy Wool area of Ed Levin Park, 8/1/21

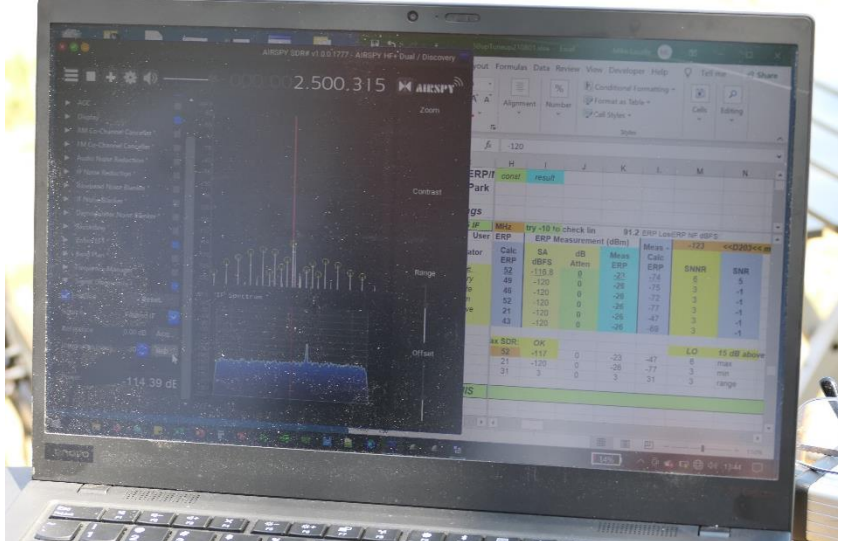


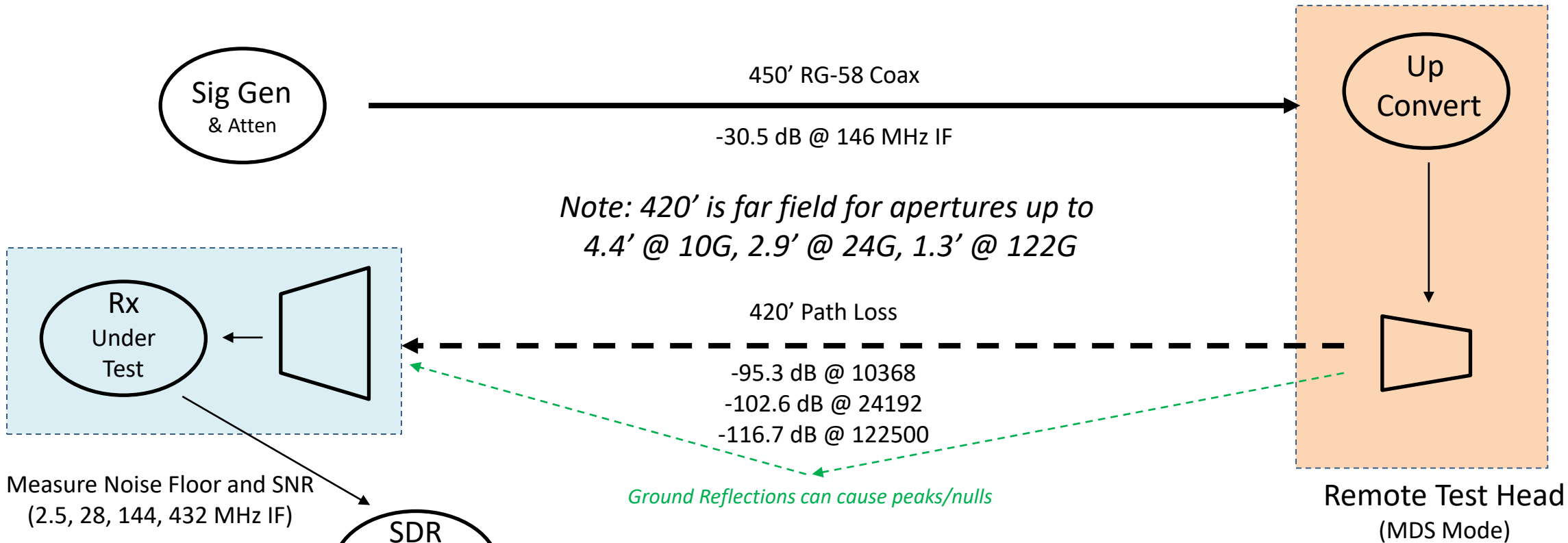
Geese Range Techs

Remote Test Head

10, 24 and 122 GHz Transceivers
450' RG-58 back to test line (144/2.5M IF)

Test Line: 18 Members' Rigs and Control Station





Minimum Detectable Signal (MDS) Rx Test

MDS Range Loss = coax + test head + path

Rx Sig @ Ant = (Sig Gen – atten) – MDS range loss (*calc vs actual; gnd refl errs*)

Measure IF SNNR & convert to IF SNR (2500 Hz BW)

MDS (500 Hz) = Rx Sig – IF SNR – 7 (dBm) *Total Antenna + RX performance*

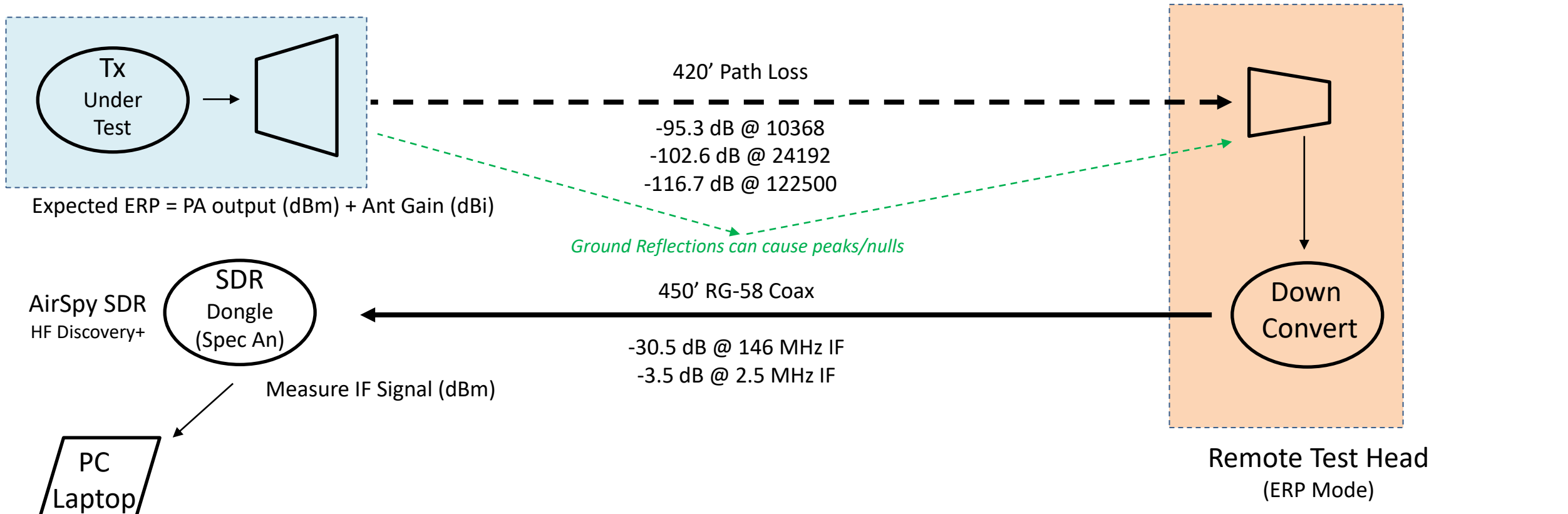
MDS & NF errors: pointing, near field, focus, feed, surface, line/conn/switch losses, LNA NF

NF ≈ MDS + calc'd Rx Ant gain + 147 (dB) *feedline + switch + conns + LNA*

Example @ 10 GHz: -20 dBm sig, 125 dB MDS loss gives -145 @ Rx ant

measure 28 dB SNR gives MDS500 = -145-28-7 = -180 dBm

'remove' Rx ant 35 dBi gives NF ~ -180+147+35 = 2 dB



Effective Radiated Power (ERP) Tx Test
 ERP Range Loss = path + test head + coax
 Measure IF signal level
 Measured ERP = IF signal + ERP Range Loss *measures Tx power & antenna performance*

ERP errors: *line/conn/switch losses, low PA output, focus, feed, surface, pointing, near field*
Note that *line/conn/switch losses, focus, feed, surface, pointing, near field* are common to MDS test
Note that range calibration, ground reflections, ear field and pointing errors are misleading errors (not in your rig)

*Comparing Expected and Measured ERP is our 'sanity check' to catch range errors
 Likewise, most folks expect their NF to be 1 or 2 dB; that's our MDS 'sanity check'*

MDS Results 124.6 dB MDS Loss SDR noise floor -96 @ 432, -110 @ 145; orange: hot Rx?, yellow: low Rx conv gain?

IF	Operator	Call	Dish Size (in)	Calc Ant Gain	calc dBm at rig ant	IF noise floor 2500	IF S+N/N dB 2500	IF SNR dB 2500	MDS 500 at rx ant	Rx NF (incl losses)
144	Brian	K6OJM	23.6	33.2	-144.6	-84.4	28.0	28.0	-180	0.6
144	Pete	K6TJ	48	39.4	-144.6	-100.5	27.5	27.5	-179	7.3
144	Brian	WA6QDP	18.1	30.9	-144.6	-76.4	25.9	25.9	-177	0.4
432	Jim	N9JIM	18.1	30.9	-144.6	-85.3	25.1	25.1	-177	1.2
28	Bill	N6OLD	30	35.3	-144.6	-70.6	21.5	21.5	-173	9.2
144	Mike	K6ML	23.6	33.2	-144.6	-96.4	19.4	19.4	-171	9.3
144	Paul	AA6PZ	36	36.9	-144.6	-108.9	14.4	14.2	-166	18.1
144	David	KI6CLA	12" panel	25.0	-144.6	-97.4	5.2	3.6	-155	16.8
432	Dan	AC6KG	18.1	30.9	-134.6	-95.5	6.9	5.9	-147	30.4
28	Dan	AC6KG	18.1	30.9	-134.6	-110.6	6.5	5.4	-147	30.9

ERP Results

124.6 dB ERP Loss

Operator	Call	PA Out dBm	Dish Size (in)	Calc Ant Gain	Expected ERP	SA dBFS	dB Atten	Meas ERP	Meas - Expected
Pete	K6TJ	40.0	48	39.4	79	-34.2	10	78	-1
Brian	WA6QDP	42.0	18.1	30.9	73	-37.7	10	74	1
Jim	N9JIM	41.8	18.1	30.9	73	-37.8	10	74	2
Bill	N6OLD	40.0	30	35.3	75	-42.7	10	69	-6
Brian	K6OJM	34.0	23.6	33.2	67	-43.6	10	68	1
Mike	K6ML	40.8	23.6	33.2	74	-49.15	10	63	-11
Dan	AC6KG	25.0	18.1	30.9	56	-58.9	10	53	-3
David	KI6CLA	33.0	12" panel	25.0	58	-71.8	10	40	-18

10 GHz Results

K6OJM: Tx/Rx excellent

K6TJ: expected Tx, missing ~6 dB Rx

WA6QDP: Tx/Rx excellent

N9JIM: Tx/Rx excellent

N6OLD: missing ~6dB common (antenna? pointing? losses?) and maybe another dB or two on Rx

K6ML: missing ~10 dB common (antenna? pointing? losses?)

AA6PZ: only Rx tested, missing ~17 dB (antenna? pointing? losses? Rx?)

KI6CLA: missing ~15 dB common (antenna? pointing? losses?)

AC6KG: ~30 dB Rx shortfall; Tx audio problems (note: Rx IF out did not raise SDR noise floor... low gain?)

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Sanity Checks
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MDS Results 142.1 dB MDS Loss SDR noise floor -130 @ 2.5, -110 @ 145; orange: hot Rx?, yellow: low Rx conv gain?

IF	Op	Call	Dish Size (in)	Calc Ant Gain	calc dBm at rig ant	IF noise floor 2500	IF S+N/N dB 2500	IF SNR dB 2500	MDS 500 at rx ant	Rx NF (incl losses)
144	Jim	N9JIM	18.1	38.2	-132.1	-80.7	12.5	12.2	-151	33.9
144	Mike	K6ML 10/24	23.6	40.5	-132.1	-80.2	11.7	11.4	-151	37.0
144	Pete	K6TJ	48	46.7	-132.1	-103.4	10.1	9.7	-149	44.9
144	Brian	WA6QDP	18.1	38.2	-132.1	-92.2	6.0	4.7	-144	41.4
2.5	Mike	K6ML 24/122	23.6	40.5	-132.1	-67.2	0.7	-7.6	-132	56.0

24 GHz Results

Range (probably test head) has about 35-45 dB extra loss; must use relative comparisons
Range too short for 4' dish

N9JIM: Tx/Rx appear to be doing well

K6ML 10/24: doesn't seem to be getting 100% of antenna potential (compare his 24" with Jim's 18" results; otherwise similar rigs) (antenna? pointing?)

K6TJ: Seems to be missing ~10 dB on Rx when compared to Jim & Mike (also note low conversion gain) (also, not far field)

WA6QDP: missing a few dB on Rx & Tx (antenna? pointing? losses?)

K6ML 24/122 (radar chip rig): Rx missing ~15 dB

ERP Results 124.1 dB ERP Loss

Op	Call	PA Out dBm	Dish Size (in)	Calc Ant Gain	Expected ERP	SA dBFS	dB Atten	Meas ERP	Meas - Expectd
Pete	K6TJ	30.0	48	46.7	77	-69.4	0	32	-44
Mike	K6ML 10/24	35.4	23.6	40.5	76	-69.7	0	32	-44
Jim	N9JIM	34.8	18.1	38.2	73	-71.7	0	30	-43
Brian	WA6QDP	28.8	18.1	38.2	67	-80.3	0	21	-46
Mike	K6ML 24/122	5.0	23.6	40.5	46	-87.7	0	14	-32

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Sanity Checks
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RED dish sizes are too large for (accurate) far field measurement

MDS Results 107.7 dB MDS Loss SDR noise floor -130 @ 2.5, -110 @ 145; orange: hot Rx?, yellow: low Rx conv gain?

122 GHz Results

IF	Op	Call	Dish Size (in)	Calc Ant Gain	calc dBm at rig ant	IF noise floor 2500	IF S+N/N dB 2500	IF SNR dB 2500	MDS 500 at rx ant	Rx NF (incl losses)
144	Jim	N9JIM	23.6	54.6	-112.7	-88.4	45.0	45.0	-165	36.9
2.5	Mike	K6ML 24/122	23.6	54.6	-112.7	-103.3	41.0	41.0	-161	40.9
144	Steve	N6KLD	horn	24.0	-112.7	-85.1	23.0	23.0	-143	28.3
144	Pete	K6TJ	12	48.8	-112.7	-86.7	19.1	19.0	-139	57.0

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Sanity Checks
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Range losses higher than expected;
Must use relative comparisons;
Range too short for > 1' dishes.

ERP range sensitivity very poor...
could not copy lower ERP rigs
K6TJ no copy (maybe his ant?)
N6KLD in the weeds (-5 SNR)

N9JIM edged out **K6ML** on Tx & Rx
... opposite of prev test

N6KLD's tiny horn does better than expected (vs 2 ft dishes)
... same as previous test

ERP Results 91.2 dB ERP Loss

Op	Call	PA Out dBm	Dish Size (in)	Calc Ant Gain	Expected ERP	SA dBFS	dB Atten	Meas ERP	Meas - Expectd
Pete	K6TJ	-3.0	12	48.8	46	<< NF	0	n/a	n/a
Jim	N9JIM	-3.0	23.6	54.6	52	-113.2	0	-19	-71
Mike	K6ML 24/122	-3.0	23.6	54.6	52	-116.8	0	-23	-74
Steve	N6KLD	-3.0	horn	24.0	21	-121.5	0	-27	-48

RED dish sizes are too large for (accurate) far field measurement

Differences from the 10 & 24 up/down conv test head:
The 122 test head uses a radar chip as a fixed power local MDS test source (no Tx IF) and also as the ERP test down converter (has gain instead of loss).

Thoughts for Future TuneUps

- The new IF SNR method for MDS test worked well
 - Replaces the time consuming & subjective “I can/can’t hear” measurement
 - Folks need to be ready with an IF output connection (BNC preferred)
 - at a supported IF frequency (2-31, 60-260, 40-1000 MHz)
- Test source power can be fixed instead of variable
- Build a new multiband/extensible test system before next year
 - Locked synth Local Oscillators (stop chasing signals up & down the band)
 - Current 24 & 122 GHz test head conversion losses/antennas just don’t cut it
 - Remote control (mode, band, gain/power) and downconverter IF over coax
 - Streamline testing process; save walking 900’ once or twice per test
 - Some gain/power control in the remote head
 - Relatively fixed power sources can be in remote head
 - Design for expected range distance and DUT dynamic range on each band
- *As always, careful and stable pointing (El/Az) and correct antenna height will yield best results*
- Work on some better, quicker ways to calibrate the range
- It would help to isolate DUT faults if we had PA power and LNA NF unit tests as well
 - But maybe a bit difficult in the field and better done as a workshop