Update to iMGOABA Aeff Recal.

Whee Yeon Cheong

Errors found since

- Wrong polynomial function for gain curve
- Wrong gain curve coefficients for KYS 43 GHz post 2017-05-19.

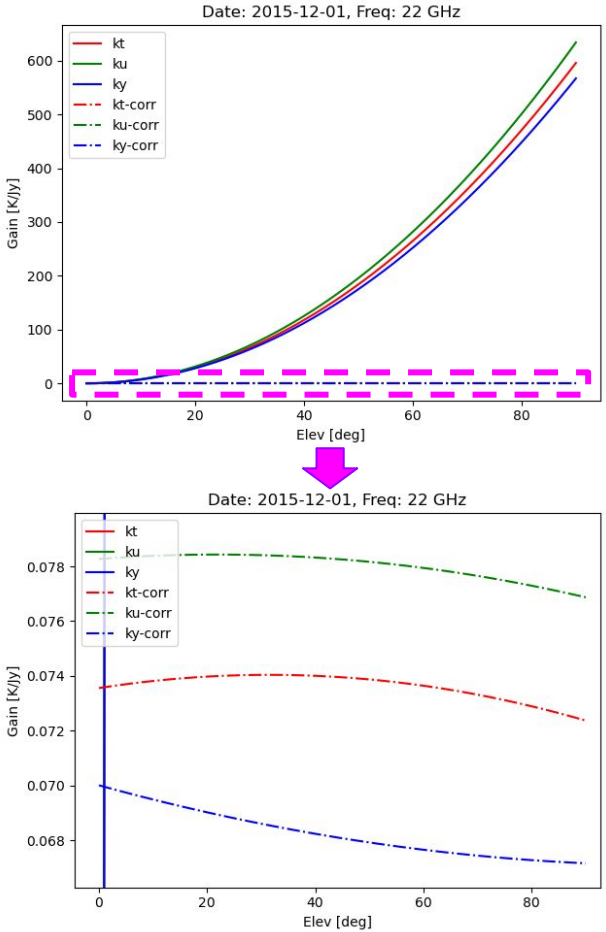
1) Wrong polynomial function for GC

: With the way the coefficients were stored, the previous definition of the gain curve function was wrong (brought to my attention by Myoung-Seok Nam)

antab_gc3 = (0.06716256, 1.04235321,-0.00080929, 0.00000376)

```
def gain_curve_poly(ele,gc_param_dat):
    # ele : elevation in degrees.
    dpfu,a0,a1,a2 = gc_param_dat
    return  dpfu*(a0*ele**2 + a1*ele + a2)

def gain_curve_poly_correct(ele,gc_param_dat):
    # ele : elevation in degrees.
    dpfu,a0,a1,a2 = gc_param_dat
    return  dpfu*(a2*ele**2 + a1*ele + a0)
```



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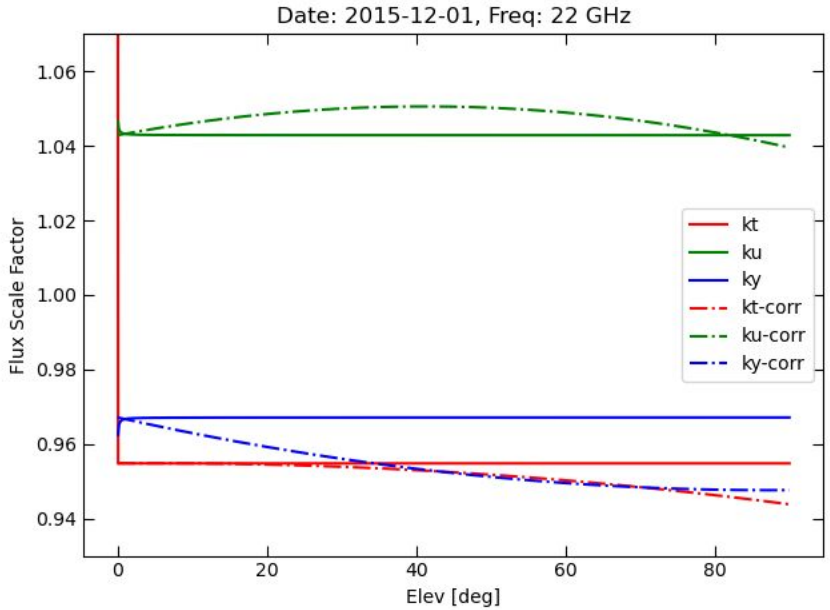
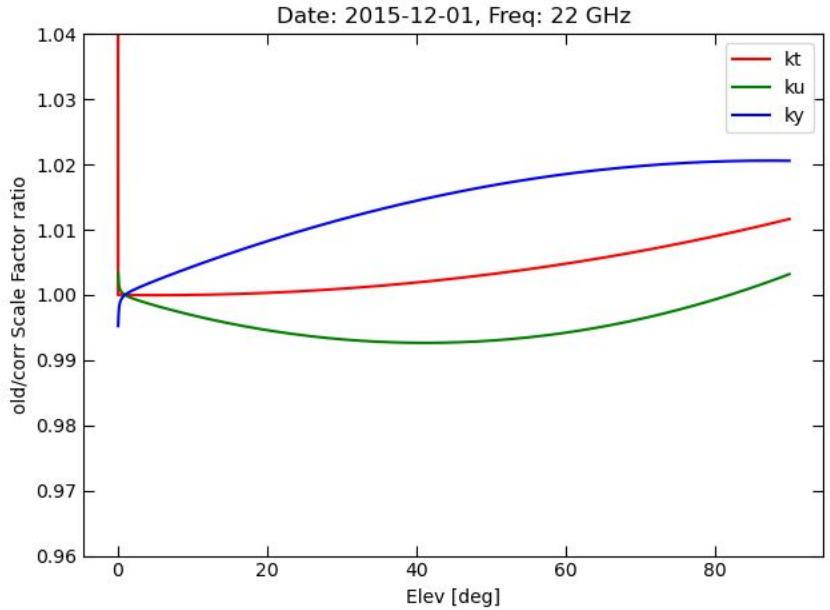
: On the bright side

1) we are dealing with gain ratios

2) the gain curve of the KVN is quite flat at 22 and 43 GHz.





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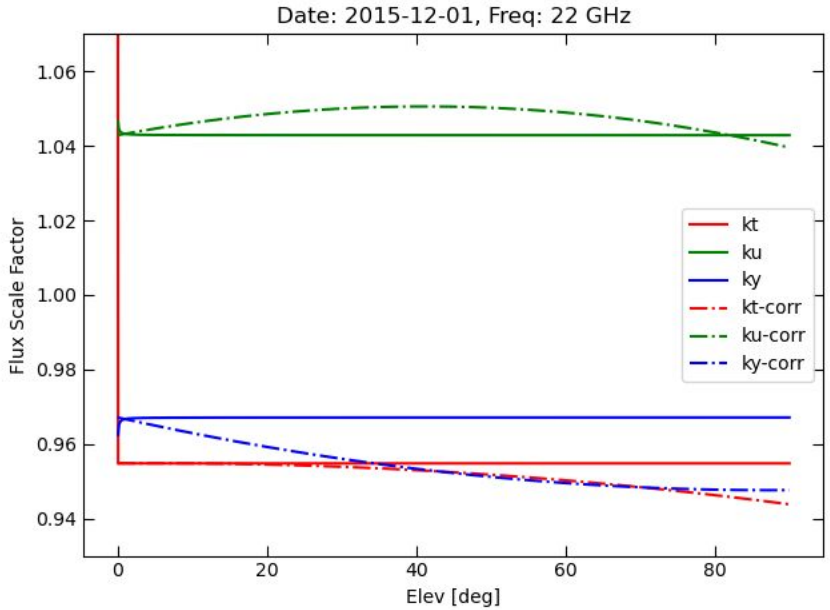

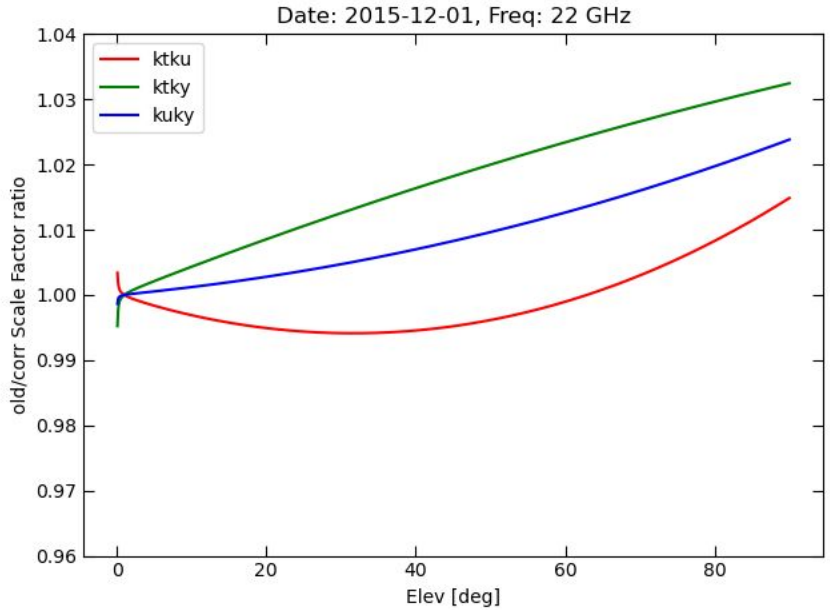

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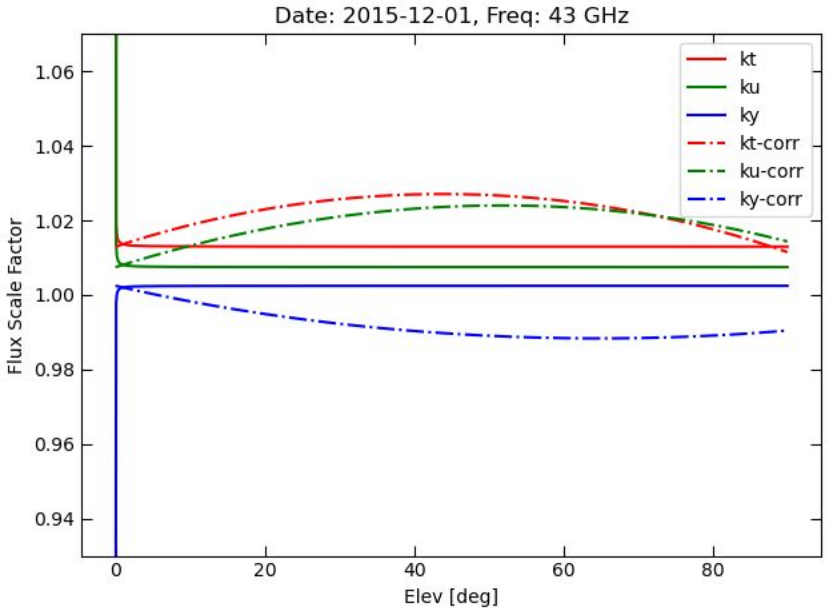

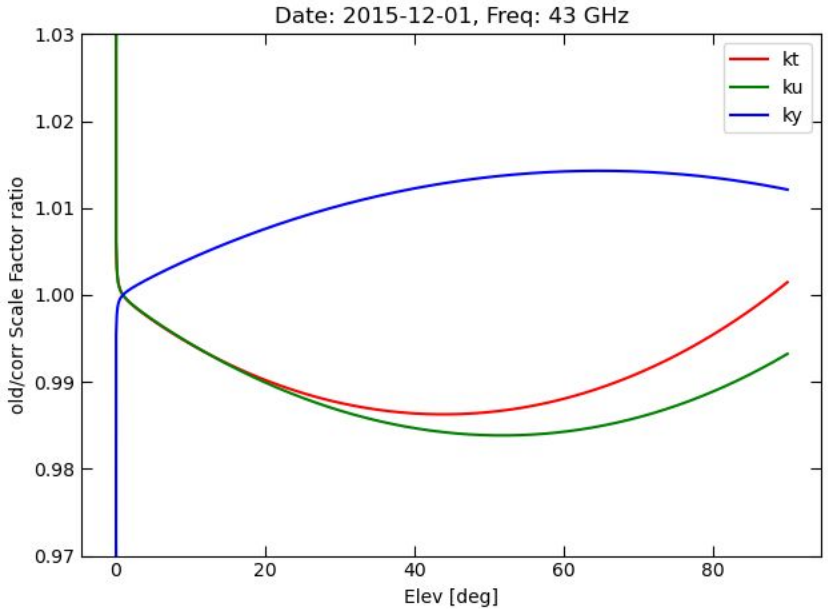

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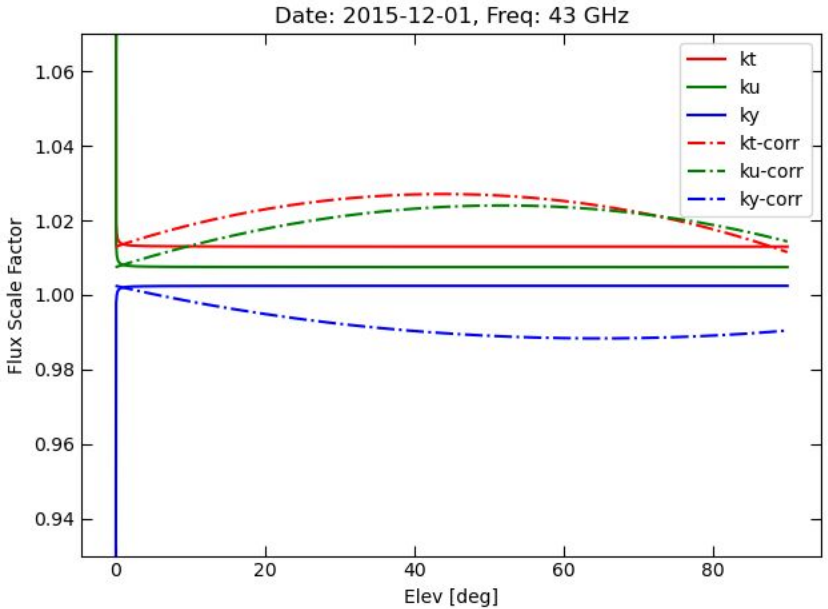
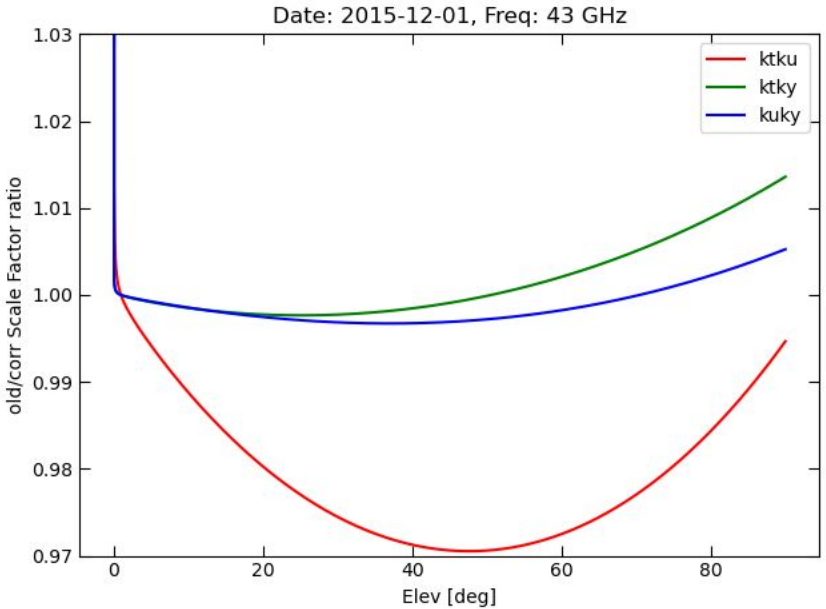


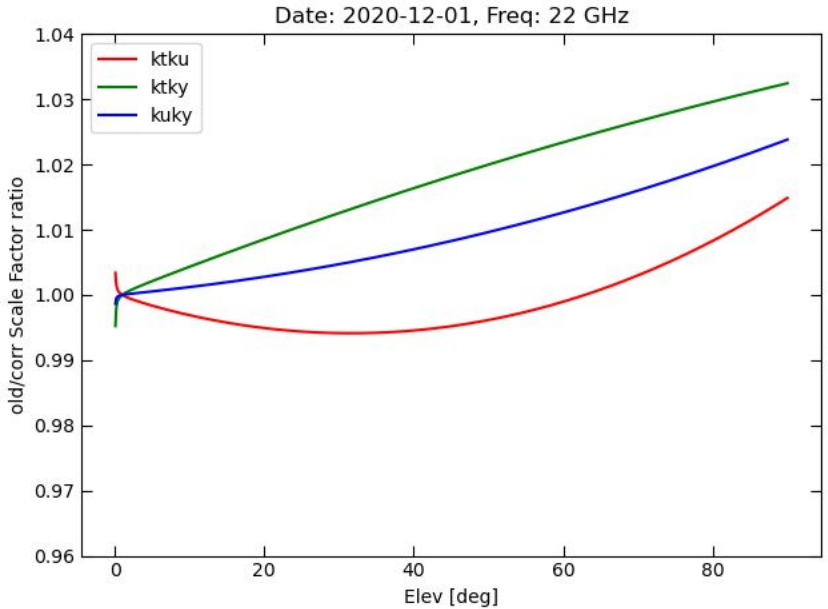


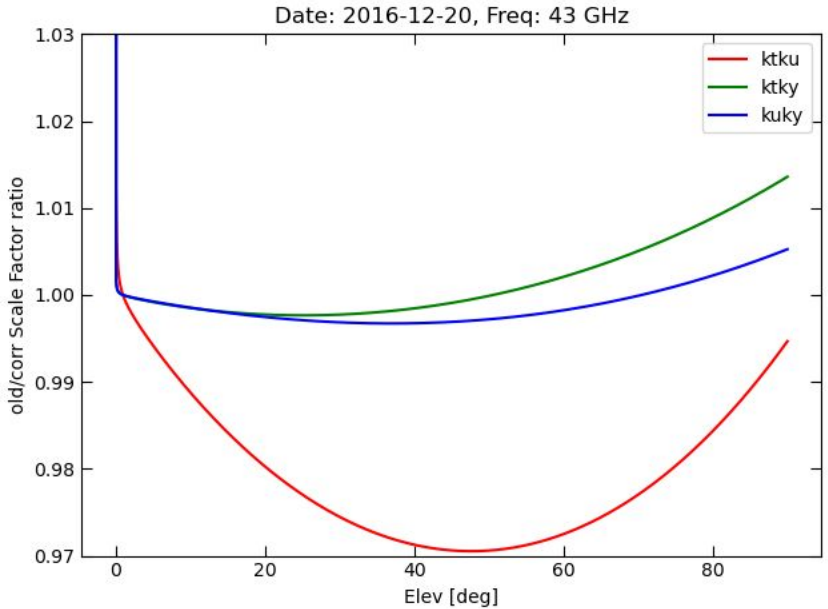
1) Wrong polynomial function for GC

: Gain curve polynomials coefficients remained fixed, only Aeff values were updated

→ up to 3% offsets due to the wrong polynomial function within the script.

→ Effect should be minimal for data prior to 2017-05-19.





2) Wrong gain curve coefficients for KYS 43 GHz

: When deriving new Aeff values, had fixed the polynomial coefficients to the most recent "well-measured" GC values.

model = a0*(in_x/100-a1)**2 + a2

Gain Curve Parameters											ANTAB ELEV Convention			
Name	Start	End	Data_Count	A0	A1	A2	ResFracMn	ResFracSdv	MaxElev	Aeff(max)	GC_A0	GC_A1	GC_A2	
GC4-2	03/08/15	03/08/15	185	-1.72E-01	4.75E-01	6.41E-01	8.57E-05	00641413409	4.75E+01	6.41E-01	9.39E-01	2.55E-03	-2.68E-05	
GC4-3	04/11/15	04/11/15	122	-1.37E-01	4.85E-01	6.39E-01	8.09E-06	00333850721	4.85E+01	6.39E-01	9.49E-01	2.08E-03	-2.15E-05	
GC5-1	~	01/22/16	4	-1.31E-01	4.85E-01	6.11E-01	-1.20E-06	00203491739	4.85E+01	6.11E-01	9.49E-01	2.08E-03	-2.15E-05	# Using GC f
GC6-1	02/04/16	02/09/16	9	-1.23E-01	4.85E-01	5.71E-01	-2.51E-05	00556035153	4.85E+01	5.71E-01	9.49E-01	2.08E-03	-2.15E-05	# Using GC f
GC7-1	10/04/16	05/14/17	124	-1.07E-01	4.85E-01	4.99E-01	1.46E-04	0465958531	4.85E+01	4.99E-01	9.49E-01	2.08E-03	-2.15E-05	# Using GC f
GC8-1	05/19/17	03/23/21	235	-1.37E-01	4.85E-01	6.37E-01	-4.27E-05	0521773824	4.85E+01	6.37E-01	9.49E-01	2.08E-03	-2.15E-05	# Using GC f

: However, the actual code had wrong "A0", "A1" values for KYS at 43 GHz, for data 2017-05-19 and later.

```
##########################################################################
if Time(obs_date) < Time('2016-02-09'): #<--date may be off
    wycjupgc3 = (0.07689246, 0.94946968, 0.00208465,-0.00002150)# KYS
elif Time(obs_date) < Time('2016-08-31'):
    wycjupgc3 = (0.07185862, 0.94946968, 0.00208465,-0.00002150)# KYS
elif Time(obs_date) < Time('2017-05-19'): #<--date may be off by couple of days
    wycjupgc3 = (0.06279863, 0.94946968, 0.00208465,-0.00002150)# KYS
else:
    wycjupgc3 = (0.08013851, 0.99688671, 0.00014536,-0.00002150)# KYS
```

2) Wrong gain curve coefficients for KYS 43 GHz

: In fact, the problematic values of “A0” and “A1” are identical to those for KYS at 22 GHz, while the value of “A2” is correct. → Suspecting human error while copying code.

```
    antab_gc2 = (0.07625360, 1.01825705, 0.00019177,-0.00000438)# KUS-ANTAB (2016 ver)
antab_gc1 = (0.07237465, 1.01635444, 0.00042356,-0.00000673)# KTN-ANTAB
##########################################################################
wycjupgc3 = (0.07508119, 0.99688671, 0.00014536,-0.00000171)# KYS
if Time(obs_date) < Time('2020-08-31'):
    wycjupgc1 = (0.08155963, 0.98931915, 0.00038022,-0.00000338)# KTN
else:
    wycjupgc1 = (0.07694384, 0.98931915, 0.00038022,-0.00000338)# KTN
if Time(obs_date) < Time('2018-08-31'):
    wycjupgc2 = (0.07196967, 1.00000000,-0.00052698, 0.00000442)# KUS
else:
    wycjupgc2 = (0.08249817, 1.00000000,-0.00052698, 0.00000442)# KUS
##########################################################################
e:
##########################################################################
antab_gc3 = (0.07263276, 1.01009575, 0.00128409,-0.00001551)# KYS-ANTAB
if Time(obs_date) < Time('2016-03-15'):
    antab_gc2 = (0.07240779, 1.06107499, 0.00050293,-0.00001313)# KUS-ANTAB (2013 ver)
else:
    antab_gc2 = (0.07299647, 1.06107499, 0.00050293,-0.00001313)# KUS-ANTAB (2016 ver)
antab_gc1 = (0.07374193, 1.00319584, 0.00234228,-0.00002642)# KTN-ANTAB
##########################################################################
if Time(obs_date) < Time('2016-02-09'): #<--date may be off
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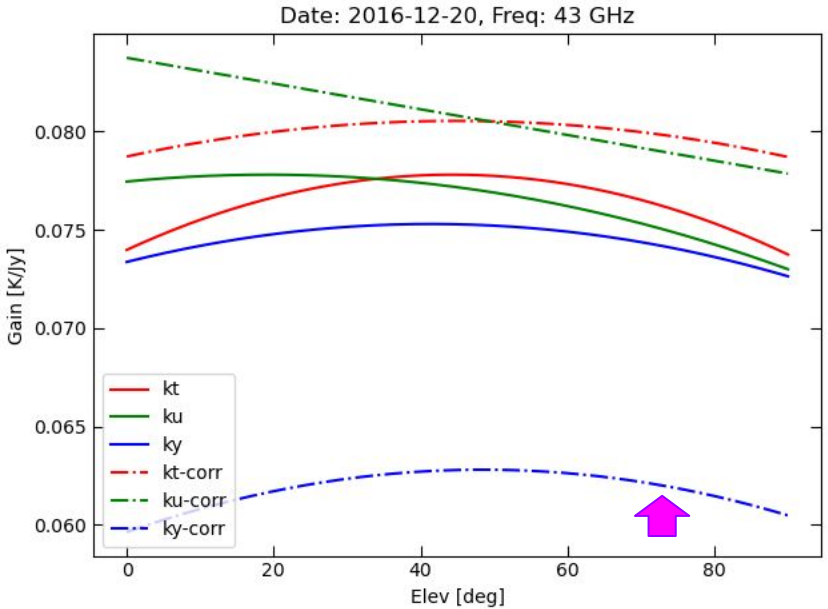
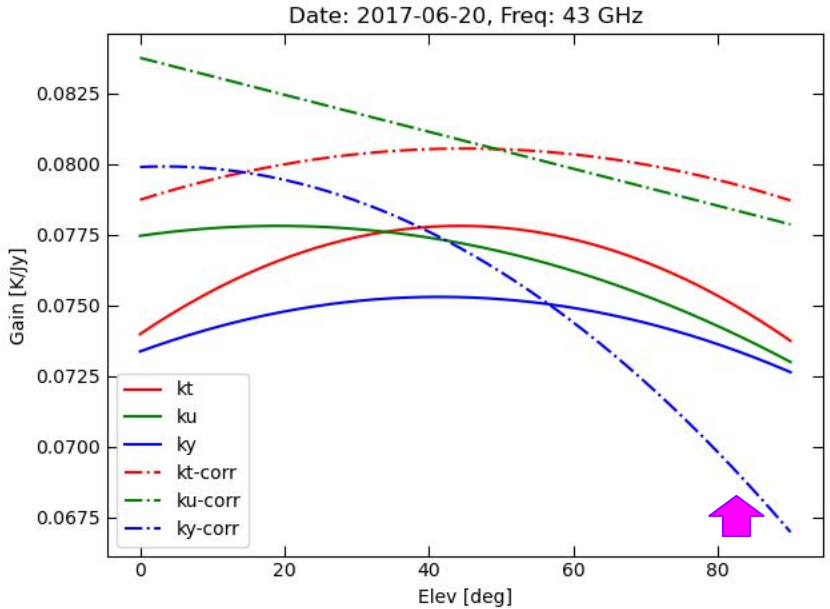
2) Wrong gain curve coefficients for KYS 43 GHz

: Gain curve shape (as implemented in the rescale script) was wrong.

: This led to significant offsets, in particular for high elevations.





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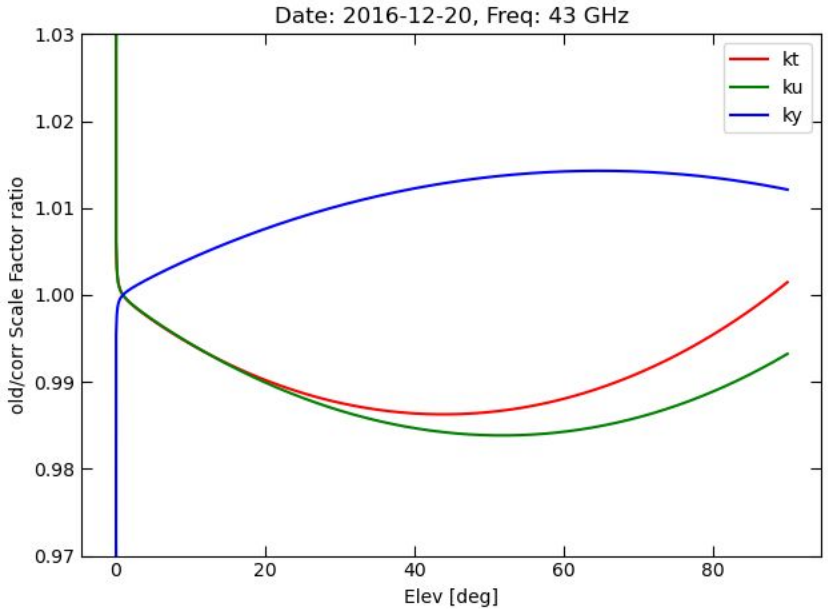

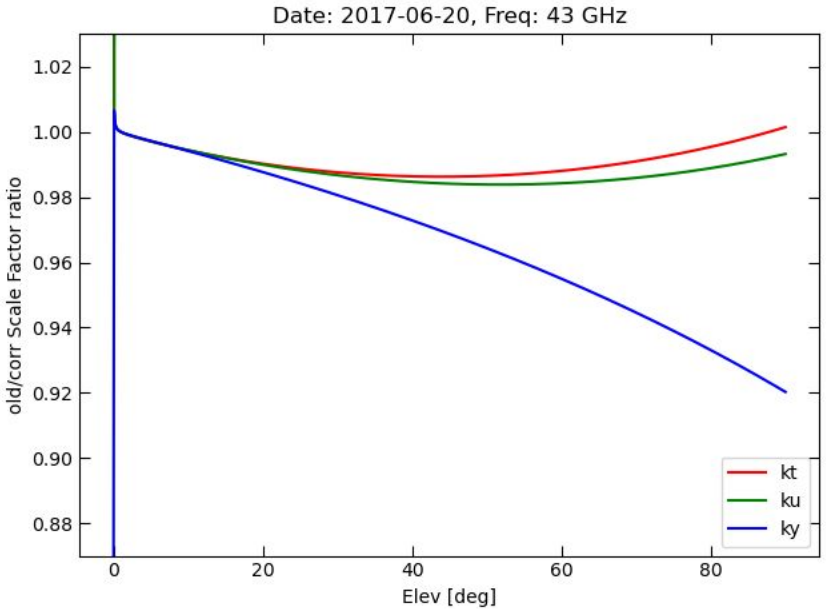

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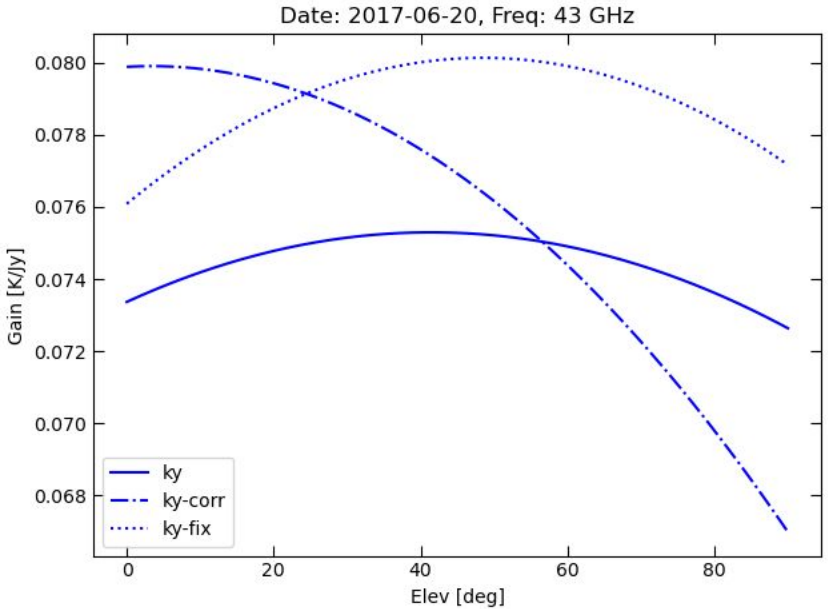

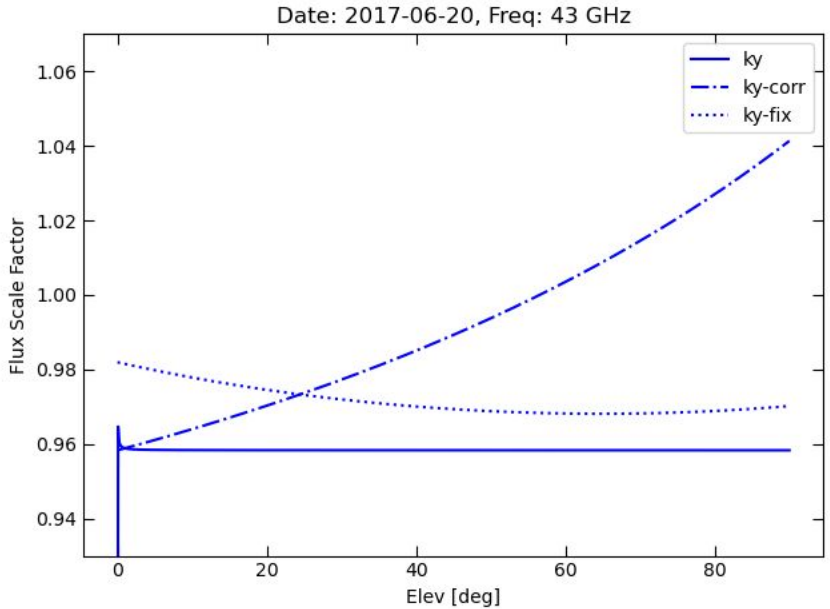

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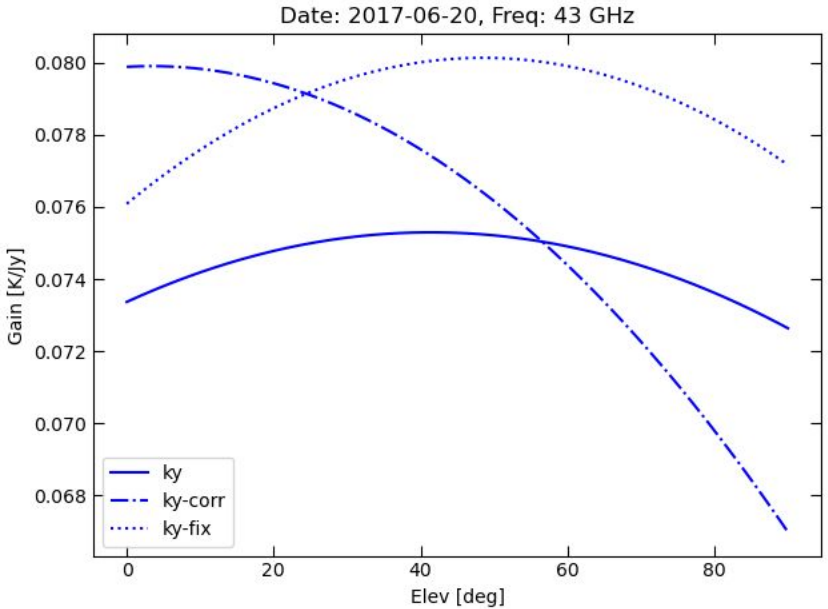
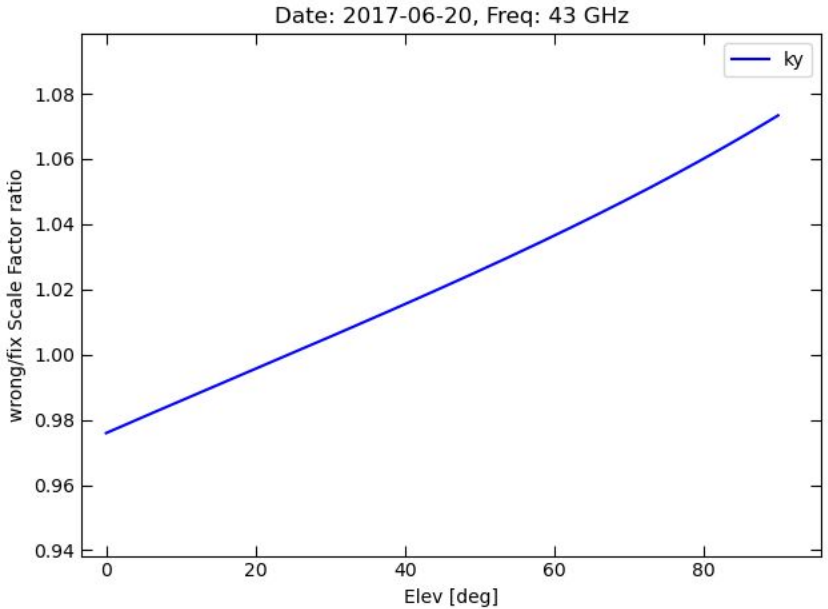
(within 5% of correct values for elevations <70 deg. Up to 8% at zenith)





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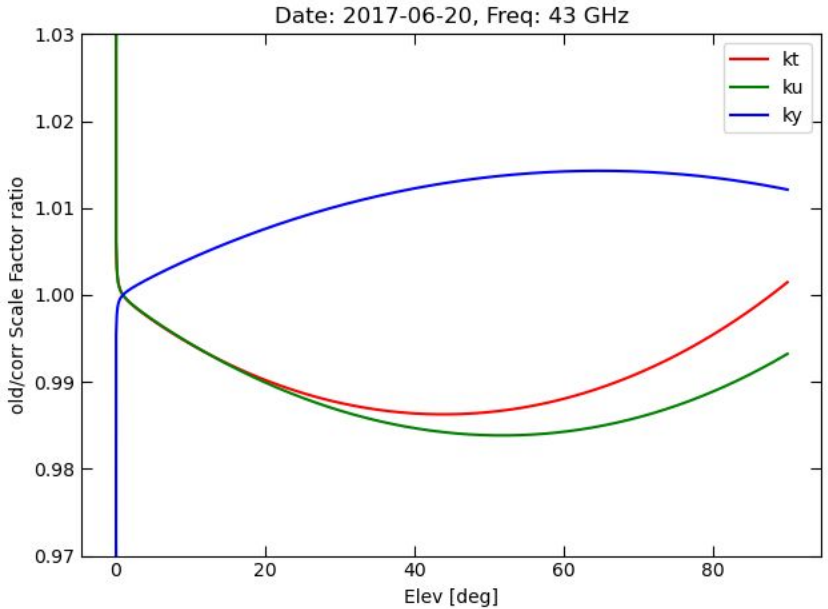
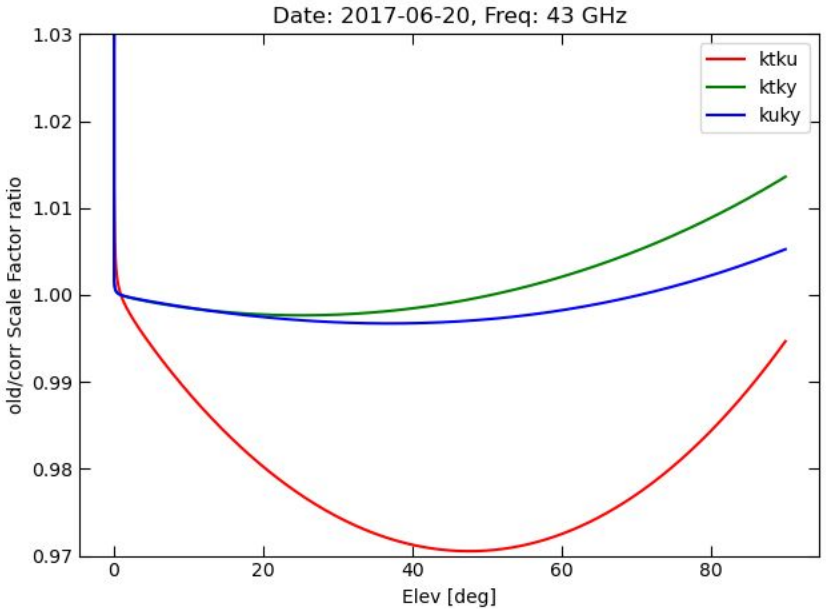
: With proper coefficients, the effect of issue1 is once again, minimal.





Changes

- Included new function “gain_curve_poly_correct”. Code will now call this function when calculating the gain curve
- Updated “wycjupgc3” for 43 GHz, 2017-05-19 ~
- Updated KVN 43 GHz GC in KVN_Gains.key file

Summary

- Two errors identified in original version of the iMOGABA KQ Aeff correction script
- 22 GHz data, and KUS,KTN 43 GHz data will be affected by less than, or up to 3%.
- Correction for KYS at 43 GHz may have been offset by up to 8%.
- These errors have been fixed.