Expected Performance of KVN Telescope at 230GHz

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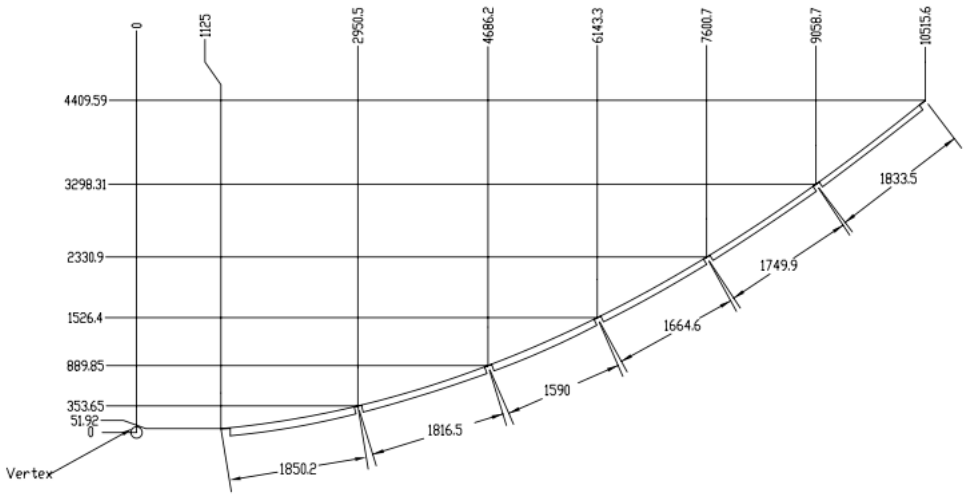
EKVN Plan Meeting on 2017 Sep 5

Antenna Optics

- D = 21m
- Shaped Cassegrain



- Main reflector
  - 200 panels (6 rings)
  - Four adjusters in each panel
  - Panel Align with photogrametry

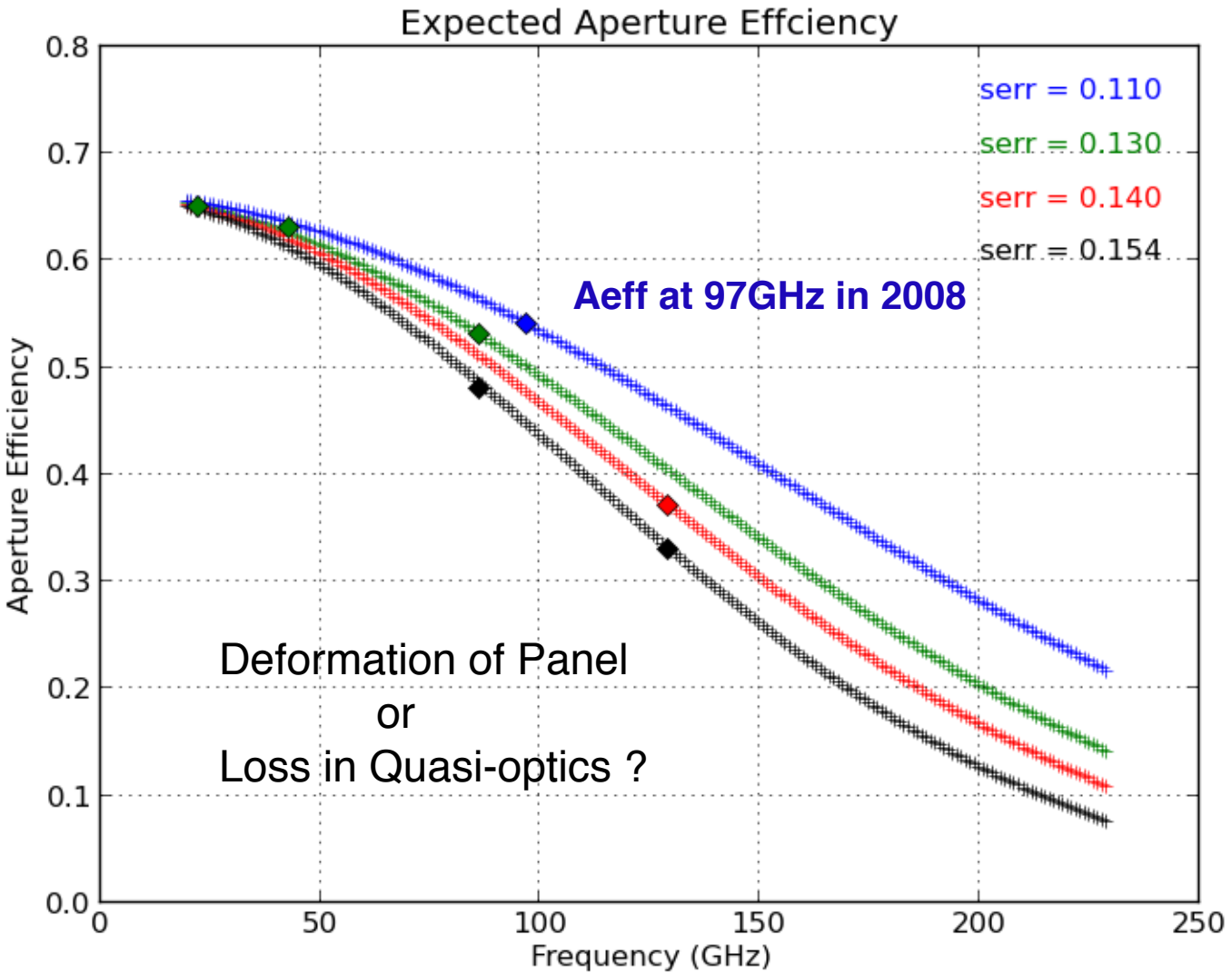
- Sub-reflector
  - X,Y,Z,Tip,Tilt control to compensate gravitational deformation

Aperture Efficiencies in 2014-15

Freq [GHz]	Aperture Efficiency [%]
22	65
43	63
86	53
129	40

* Measured Aeff of Yonsei at 97GHz was 54% in 2008.
* A 100GHz test Rx was installed at Cassegrain focus without multi-frequency quasi-optics.

KVN Aperture Efficiency



Surface Accuracy

	Normal Accuracy (μm) - Antedo TM-137	Night + Mild Wind Accuracy (μm)
Main Reflector	80	70
Alignment	65	65 (50)
Sub Reflector	53	53
Wind + Thermal + Gravity	50	30
Total RSS	126	112 (105)
Aeff_129 (%)	41	45 (47)
Aeff_230 (%)	15	20 (23)

Accuracy = 100μm —> Aeff_230 = 26% , Aeff_0 = 65% assumed

Possible Additional Loss

- Sub-reflector position
  - optimized with 86GHz
  - gain stability of 129GHz is not good for accurate measurement
- Quasi-Optics
  - beam alignment loss
  - different Z – focus with frequency

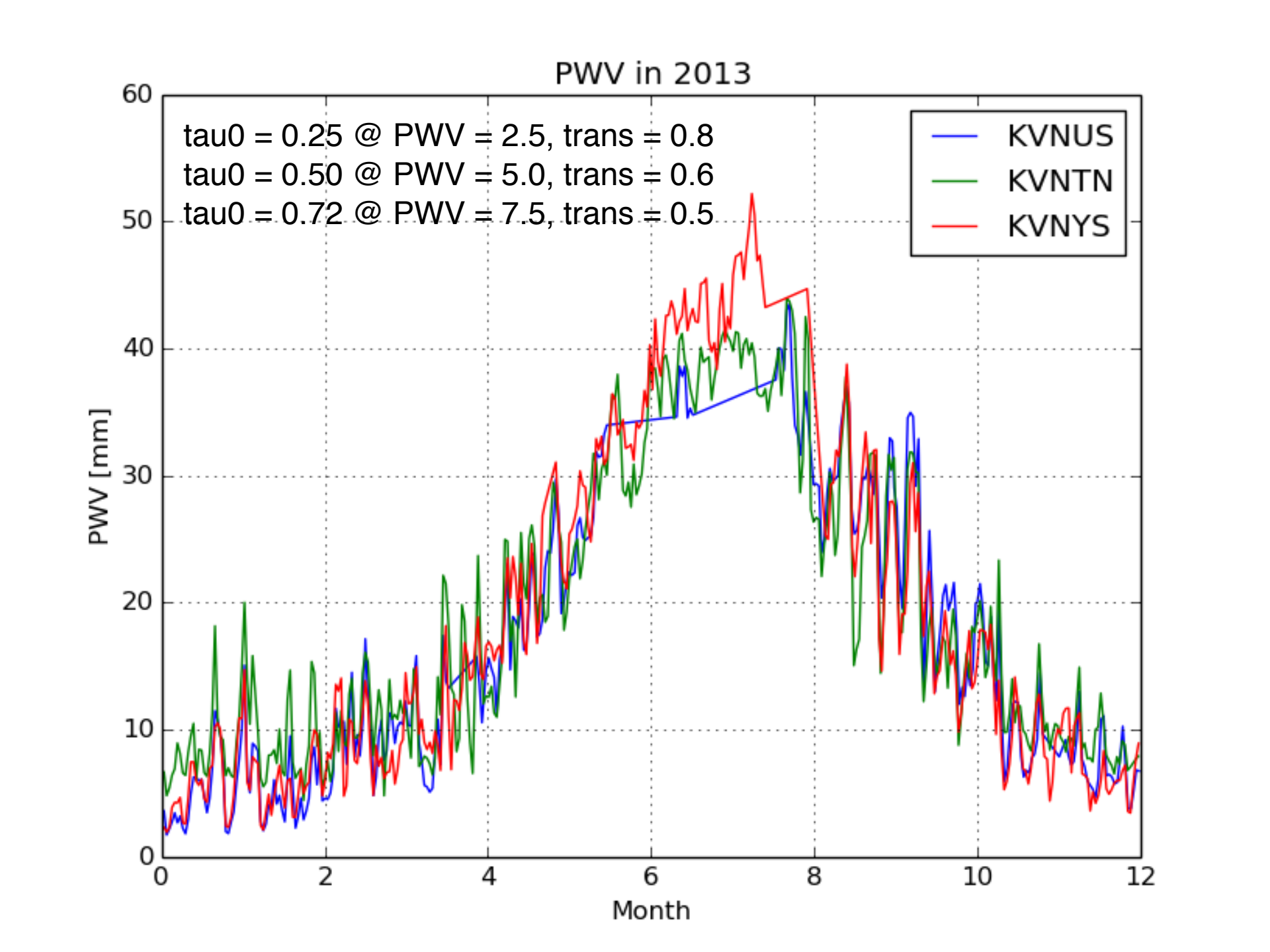
Surface Accuracy

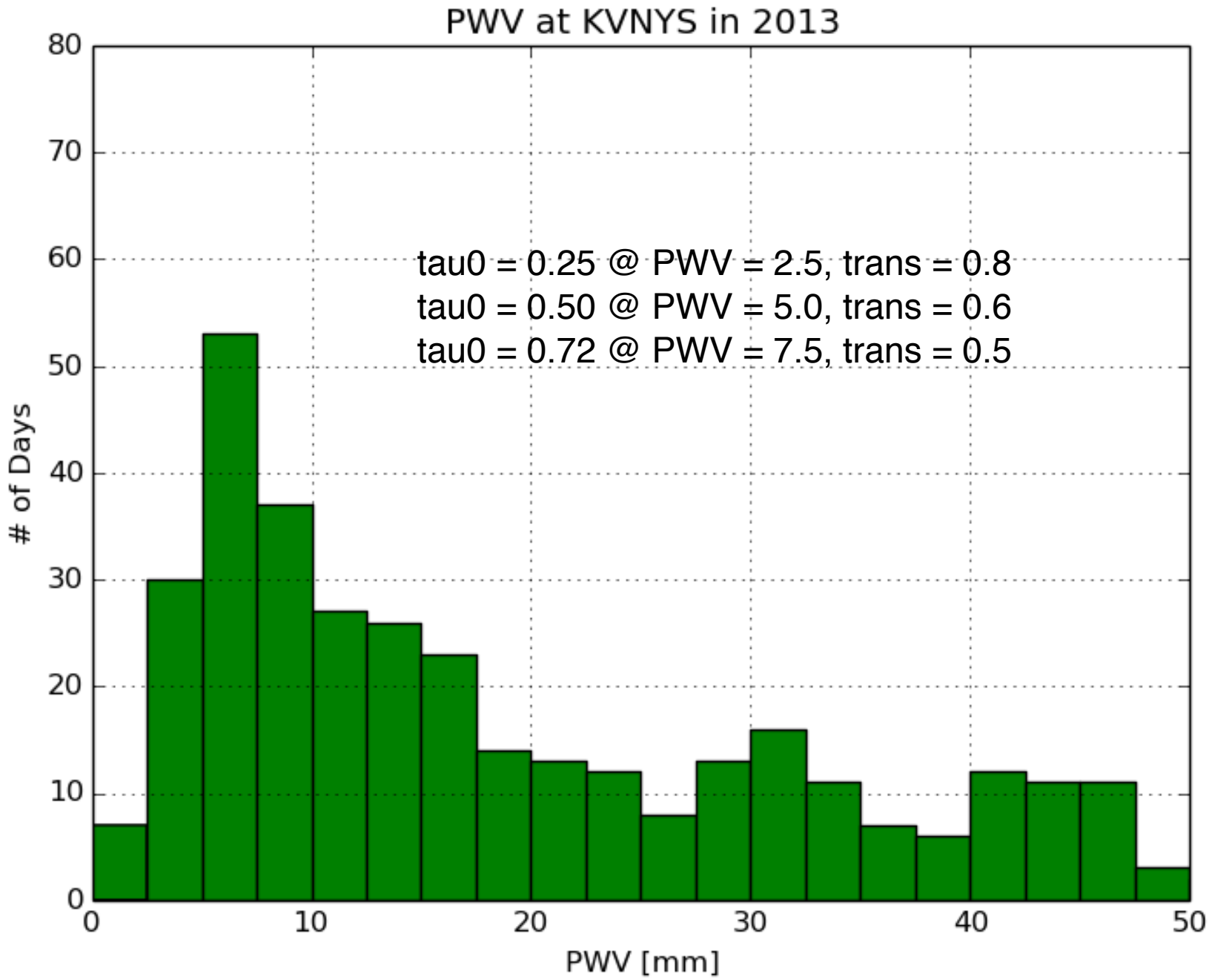
	Normal Accuracy (μm) - Antedo TM-137	Night + Mild Wind Accuracy (μm)
Main Reflector	80	70
Alignment	65	65 (50) -> 40
Sub Reflector	53	53 -> 30
Wind + Thermal + Gravity	50	30
Total RSS	126	112 (105) -> 90
Aeff_129 (%)	41	45 (47) -> 51
Aeff_230 (%)	15	20 (23) -> 30

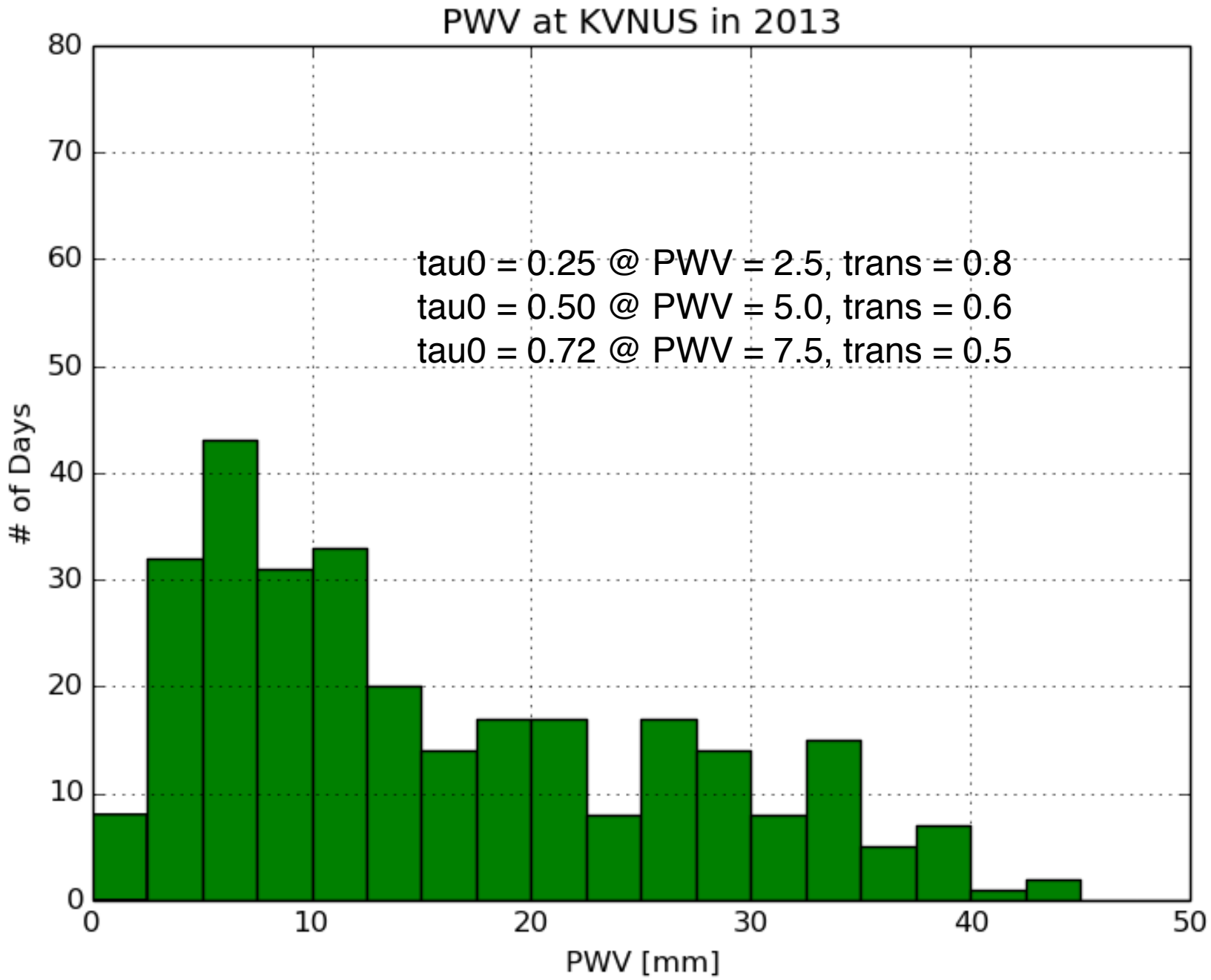
Aeff_0 = 65% assumed

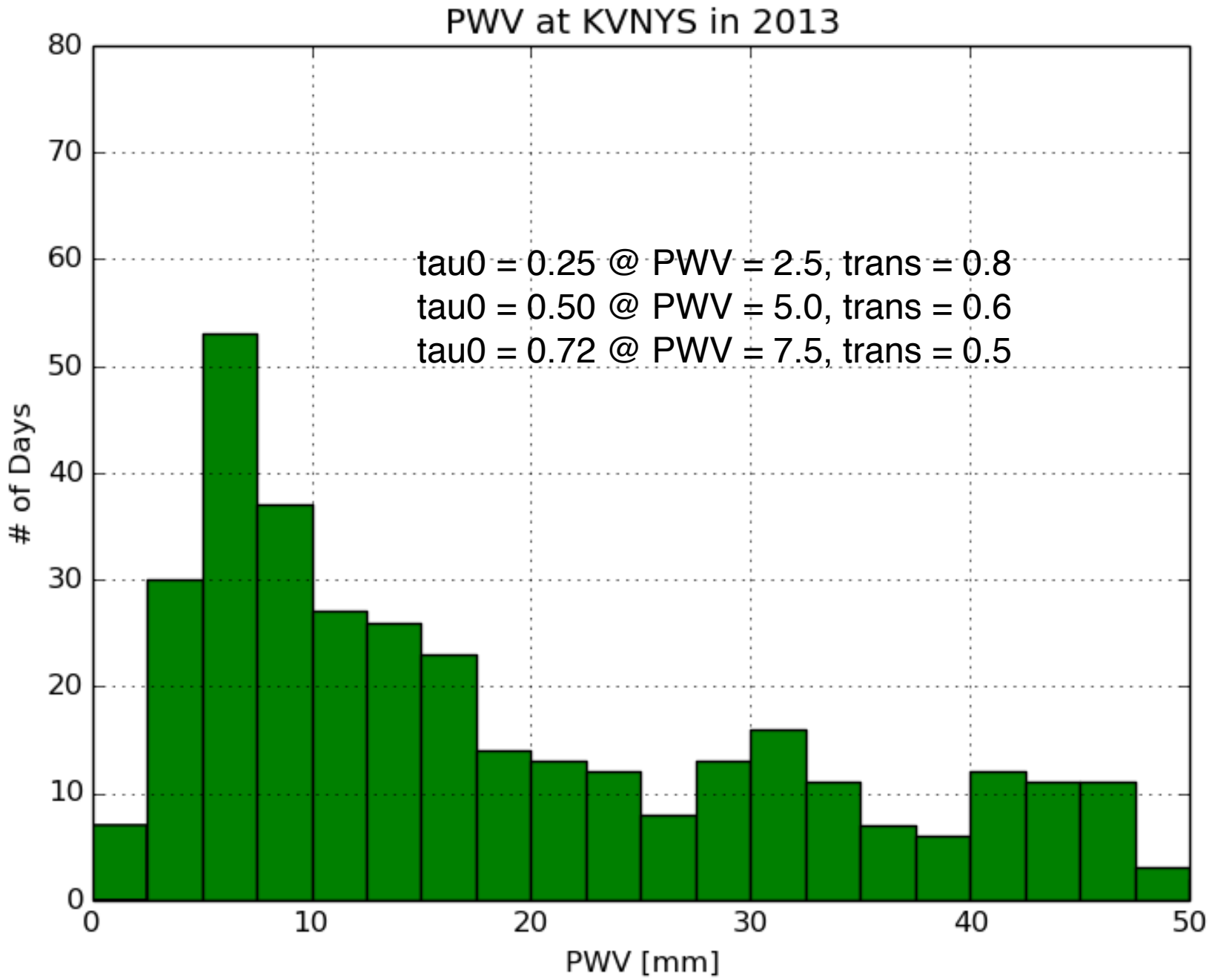
Weather

- Weather data from KVNFS
  - weather sensors on the top of observing building
  - Temperature could be overestimated (?)
- SRAO
  - tau0 ~ 0.16 (trans ~ 0.86) in cold winter
  - tau0 ~ 0.60 (trans ~ 0.55) in April


PWV in 2013
tau0 = 0.25 @ PWV = 2.5, trans = 0.8
tau0 = 0.50 @ PWV = 5.0, trans = 0.6
tau0 = 0.72 @ PWV = 7.5, trans = 0.5
KVNUS
KVNTN
KVNYS
PWV [mm]
Month
0
10
20
30
40
50
60
0
2
4
6
8
10
12


PWV at KVNYS in 2013
tau0 = 0.25 @ PWV = 2.5, trans = 0.8
tau0 = 0.50 @ PWV = 5.0, trans = 0.6
tau0 = 0.72 @ PWV = 7.5, trans = 0.5
# of Days
PWV [mm]
0
10
20
30
40
50
60
70
80


PWV at KVNUS in 2013
tau0 = 0.25 @ PWV = 2.5, trans = 0.8
tau0 = 0.50 @ PWV = 5.0, trans = 0.6
tau0 = 0.72 @ PWV = 7.5, trans = 0.5
# of Days
PWV [mm]
0
10
20
30
40
50
60
70
80


PWV at KVNYS in 2013
tau0 = 0.25 @ PWV = 2.5, trans = 0.8
tau0 = 0.50 @ PWV = 5.0, trans = 0.6
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# of Days
PWV [mm]
0
10
20
30
40
50
60
70
80

PWV

PWV (mm)	tau0	trans-parency	Tsys* (K) (Trx = 50/100K)	SEFD (KJy) (Aeff ~ 30%)
2.5	0.25	0.8	160 / 230	4.2 / 6.1
5.0	**0.50**	**0.6**	**280 / 370**	**7.4 / 9.8**
7.5	0.72	0.5	420 / 520	11.1 / 13.8

tau @ 171GHz ~ tau @ 230GHz

SFED of other Telescopes

Table 2: write caption here

Stations	Location	Diameter [m]	SEFD [Jy]	Status
ALMA 37	Chile	37 × 12	100	2017 -
APEX	Chile	12	3600	operational
GLT	Greenland	12	3000	2018 (planned)
IRAM 30m	Spain	30	1400	operational
JCMT	Hawaii	15	4700	operational
LMT	Mexico	32	1400	operational
NOEMA1	France	15	5200	operational
SMA	Hawaii	8 × 6	4000	operational
SMT	Arizona	10	11000	operational
SPART	Japan	10	10000	2018? (planned)
SPT	South Pole	10	9000	operational
SRAO	Korea	6	40000	2018? (planned)

write footnote here.

from white paper on EA mm/submm VLBI

Servo System

- HPBW (230GHz) ~ 12”
- Pointing Accuracy
  - (Blind) Accuracy ~ 5” rms
    - significant increase in daytime due to thermal effect
  - Corrected Pointing Accuracy < 3” (16% loss)
  - Self Pointing < 2” (8% loss)
- Tracking Accuracy < 1” rms
  - 2” p-p (need to check again)

Summary

- Surface Accuracy for 230GHz
  - not good
  - need to improve down to 90μm for Aeff = 30% (Panel Adjustment, Sub-Ref, etc)
- Weather Condition for 230GHz
  - good from Dec to Feb
  - marginal in March and April
- SEFD_230GHz ~ 10000Jy (Trx = 100K, Aeff = 30%)
- Pointing & Tracking
  - < 10% error of amplitude