























$$\tilde{V}_{ijk} = g_i(t) g_j^*(t) b_{ijk}(t) V_{ij}(v_k(t), v_k(t)) + \text{noise term}$$

















10

11

12 13 14 15







$$T_a^* = \frac{(1 + g_{im})}{\eta_f} e^{\tau_{atm}} T_a$$









$$I_b = \frac{c^2}{2kT^2} I_\nu$$



$$T_a^* = \frac{\eta_0 A}{2k} S_v = \frac{1}{J} S_v$$

↓

—
—

24
—
no A

Indice + Indice + Indice + Indice









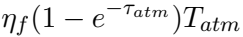














1-17-2020





$$T_{sys} = \frac{1 + g_{irm}}{\eta_f} e^{\tau_{atm}} T_{noise}$$













$$\sigma = \frac{1}{\eta_g \eta_p} \frac{\sqrt{2k}}{\eta_a A} \frac{T_{sys}}{\sqrt{\delta v \delta t}}$$

$$\sigma = \frac{1}{\eta_g \eta_p} \frac{2k}{\eta_a A} \frac{T_{sys}}{\sqrt{n(n-1)} \delta v \delta t}$$



100



1

0

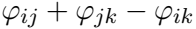
—

2

$$W_{ij} = \frac{1}{\sigma_{ij}^2}$$

$V_j = \omega_j$



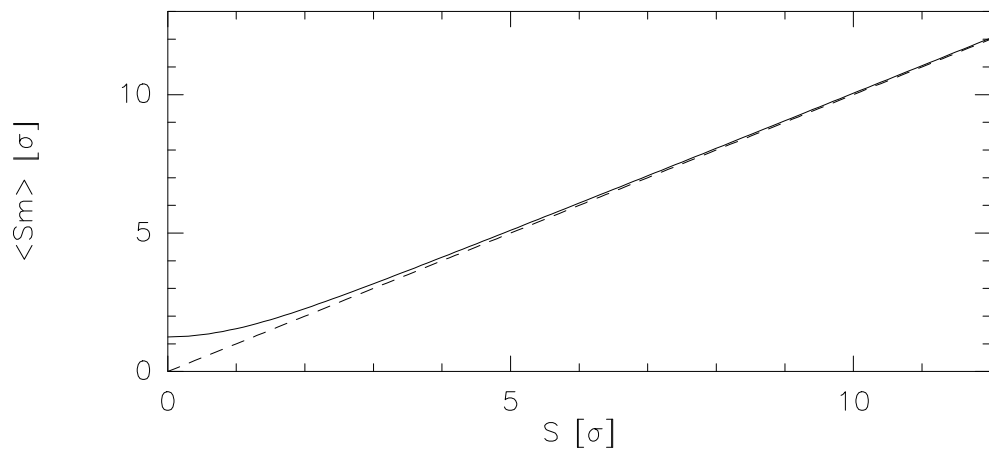
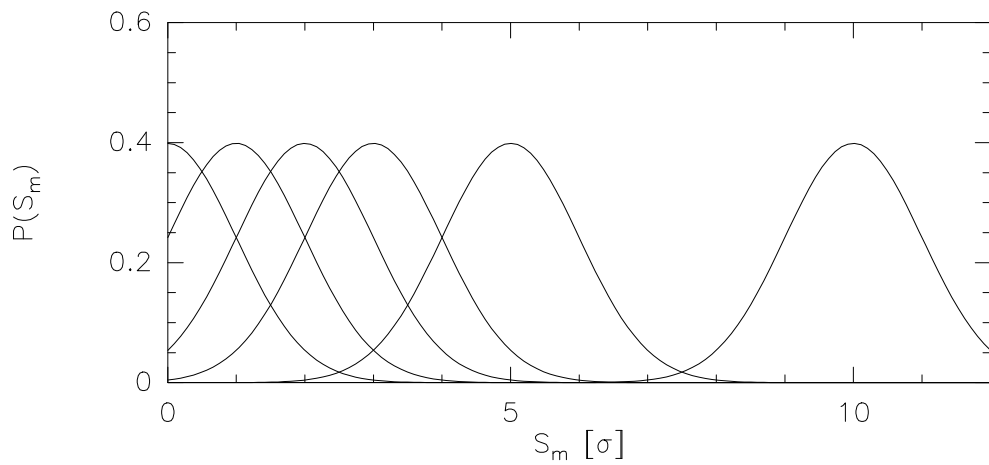
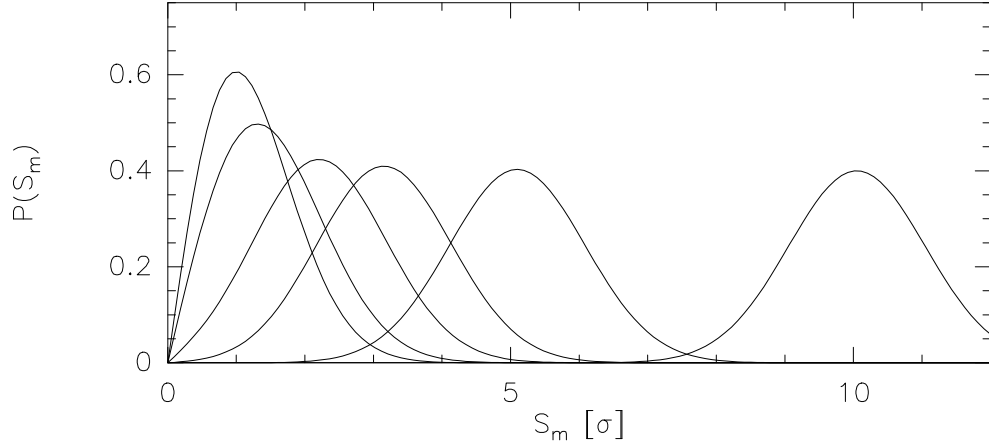


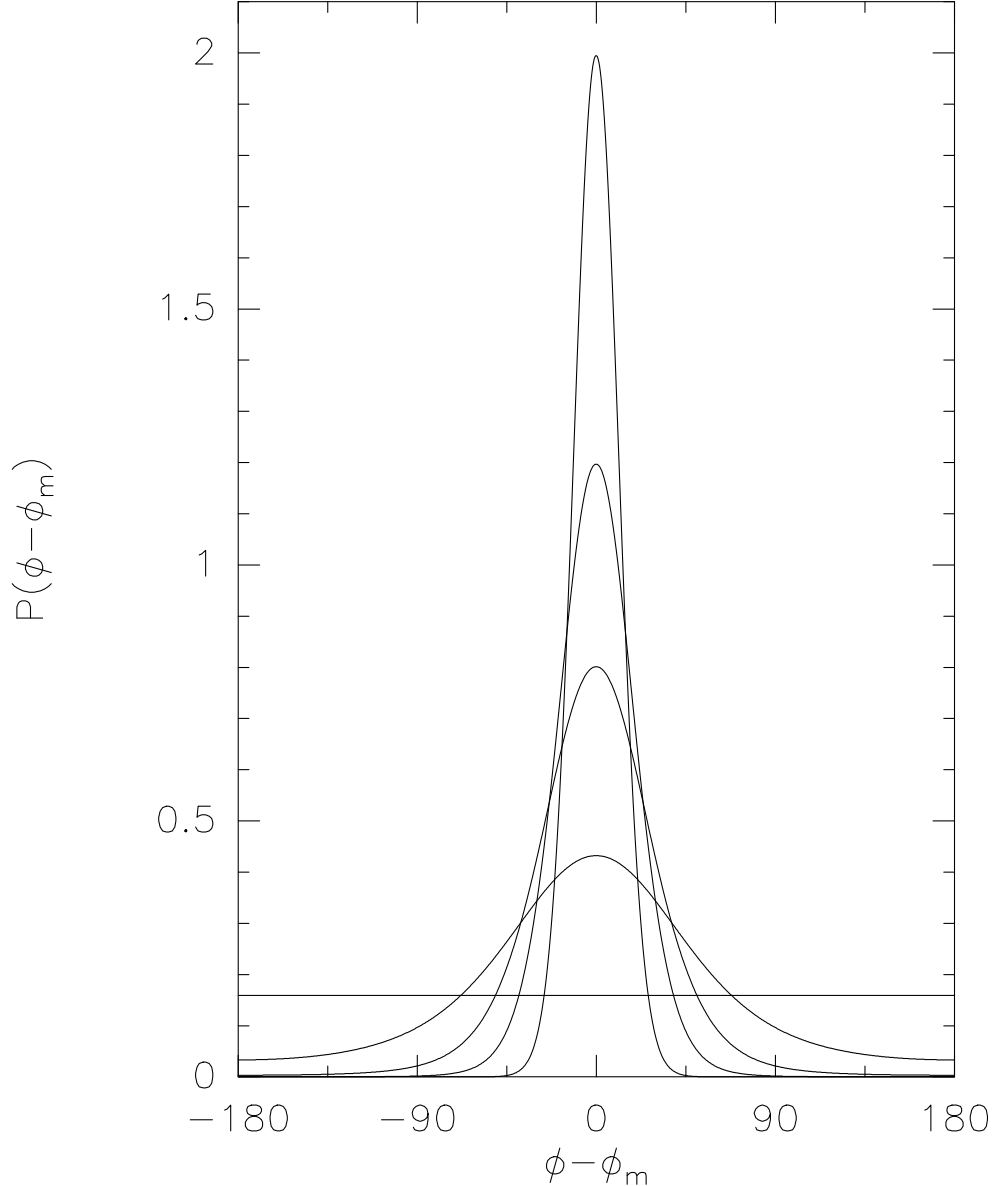
$$\begin{array}{cc} \sim & \sim \\ a_{ij} & a_{kl} \end{array}$$

$$\begin{array}{cc} \sim & \sim \\ a_{ik} & a_{jl} \end{array}$$

Qzj Qkl

Qzk Qji

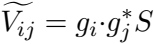


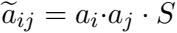




9020

Geometrische Optik

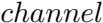






(spelled in, spelled in)

(c) 1997, 2000, 2003, 2006, 2009, 2012, 2015, 2018, 2021, 2024



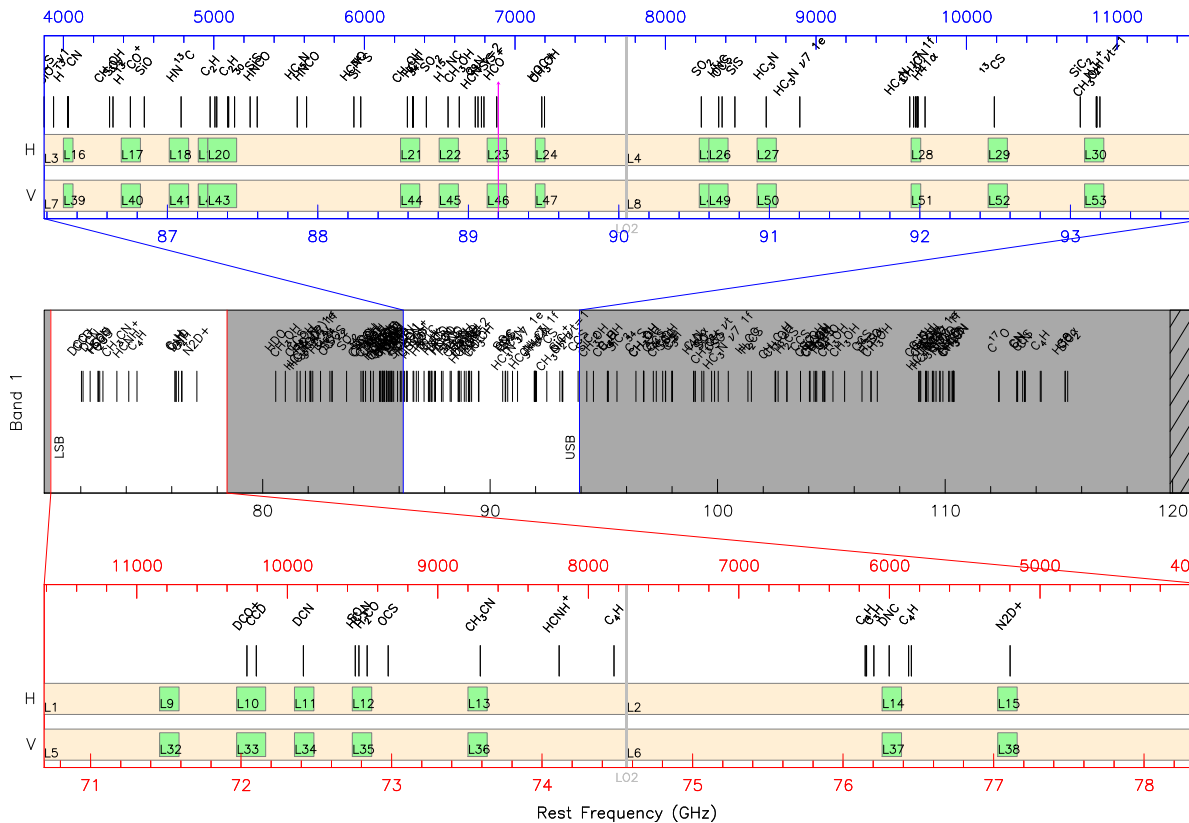


3C8

LO: 82.299 GHz

Intermediate Frequency IF1 (MHz)

3C8



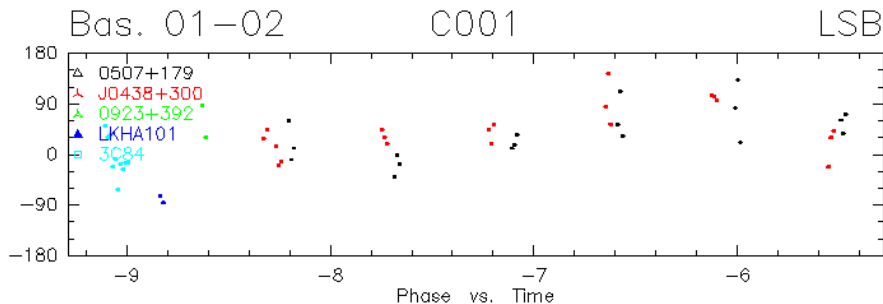
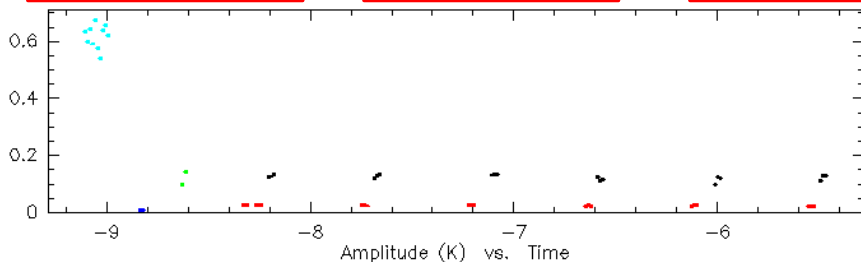
4

RF: Uncal.
Am: Abs.
Ph: Abs.

CLIC - 06-NOV-2019 13:30:29 - pietu@pietu.iram.fr ED3W12N11W20E16E68W09 7ant-Special
017IC001 isotopologue 89.200GHz B1 Q0() Q0()
(17 6322 P CORR)-(373 6602 P CORR) 19-APR-2018 14:53-18:31

Scan Avg.
HORIZONTAL pol.

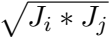
1 Bas. 01-02 2 C001 3 LSB





100%

15









Erw

—

Ordn



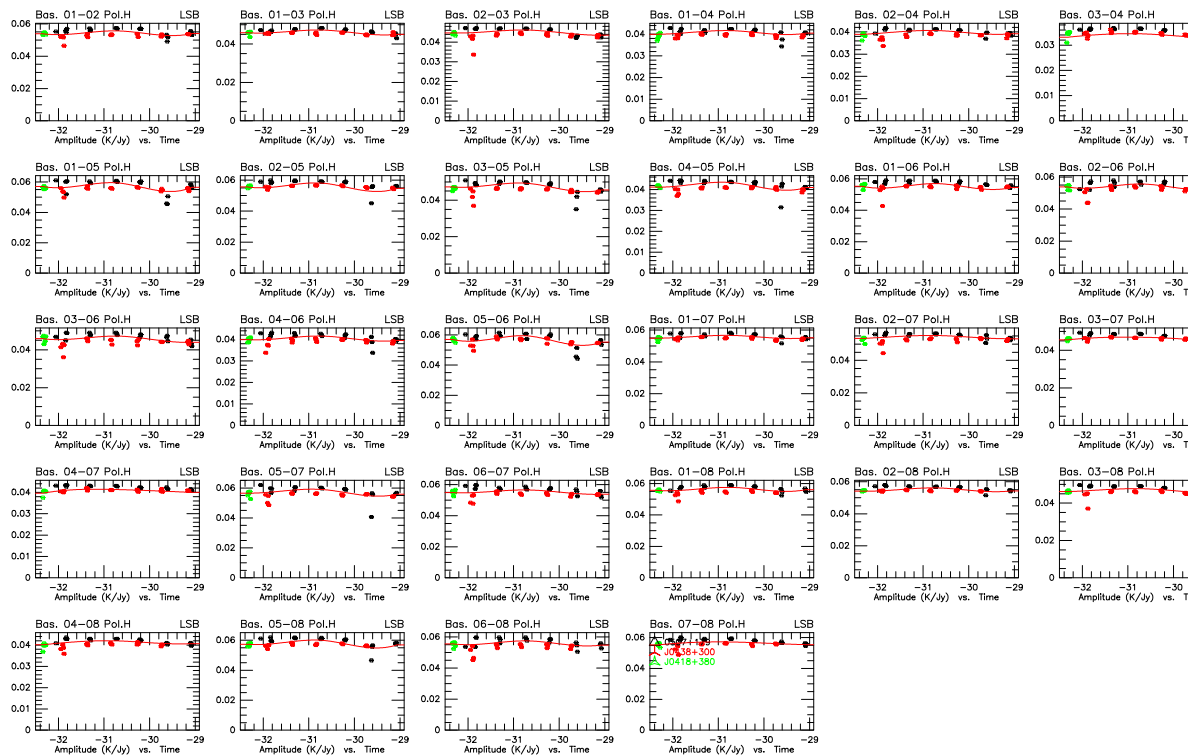




RF: Uncal.
Am: Scaled
Ph: Abs.

CLIC - 07-NOV-2017 14:06:59 - pietu@pietu.iram.fr
D17IC001 isotopologue 89.200GHz B1 Q0() Q0()
(21 4716 P CORR)-(352 4985 P CORR) 18-APR-2018 15:39-18:55

Scan
HORIZONTAL



RF: Uncal.

CLIC - 07-NOV-2017 14:02:27 - pietu@pietu.iam.fr

E03W12N11N29W20E16N20W09 9C-E10

Scan

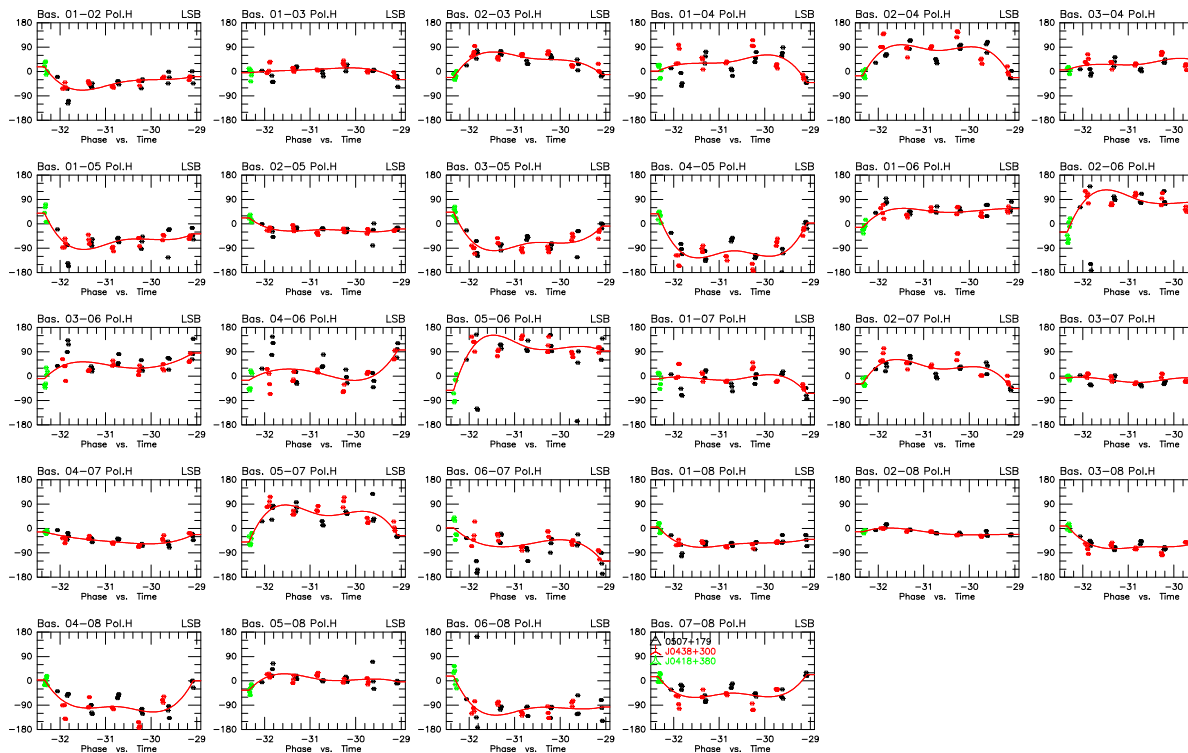
Am: Abs.

D17IC001 isotopologue 89.200GHz B1 Q0() Q0()

HORIZONTAL

Ph: Abs.

(21 4716 P CORR)-(352 4985 P CORR) 18-APR-2018 15:39-18:55



$$A_j = a_j(1 + b \cos(2x) + c \sin(2x))$$



1999

P

=

$$\frac{\sqrt{v_0^2 + v^2}}{I}$$



2020-2021









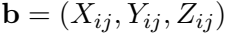


$$(T_{hot} + T_{rec}) \times \frac{P_{sky}}{P_{hot}} - T_{rec} = \eta_f \times Airmass \times T_{zenith} + (1 - \eta_f) \times T_{ground}$$

τ_g

$=$

$\frac{b.s}{c}$



$B = (b_{ij})_{i,j=1}^n$



2020-2021

2π

λ

b.s

$$\frac{2\pi}{\lambda_k} (X_{ij} \cos h \cos \delta - Y_{ij} \sin h \cos \delta + Z_{ij} \sin \delta)$$

GOVERNMENT

2024



30-sep-2019-holo-r1

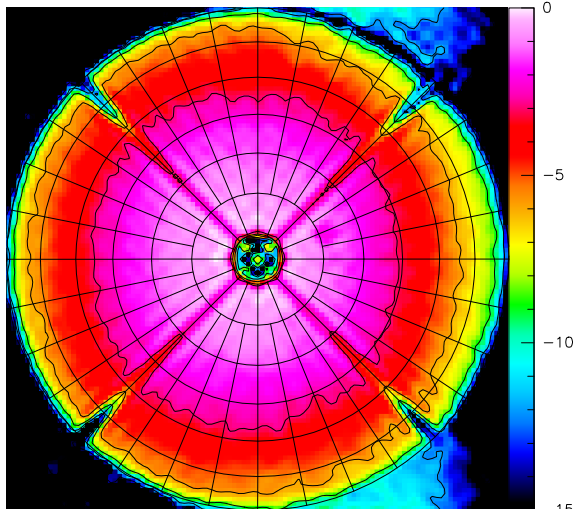
RF: Fr.(B) CLIC - 19-NOV-2019 10:01:36 - pietu@pietu.iram.fr - Ant 10 - N05N13W12W09E10E04W05N02N09
 Am: Rel.(B) 3C454.3 9D scans 6011 to 6085 30-SEP-2019 23:23UT El: 56.00
 Ph: Rel.(B)

rms Pha.

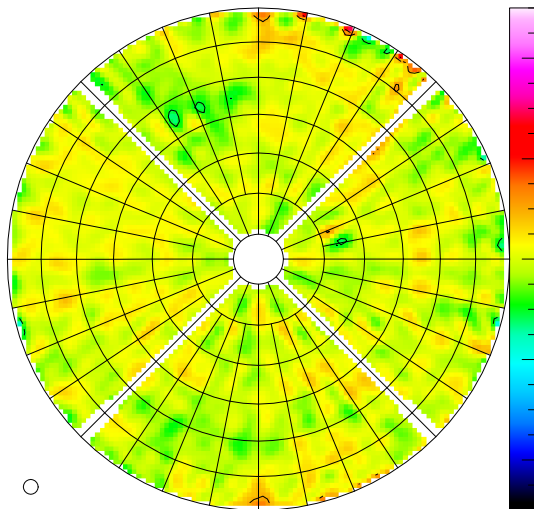
01-09 4.82
 02-09 3.75
 03-09 14.35
 04-09 13.36
 05-09 10.87
 06-09 10.26
 07-09 11.02
 08-09 8.17

Edge taper = 19.05x 16.49 dB - offset X= -0.39 Y= -0.13 m
 Focus offsets (X,Y,Z) = -0.71 -1.40 0.12 mm; Astigmatism = 20.4 μm (52.0deg.)
 Phase rms (unweighted)= 0.101 (weighted)= 0.097 radians
 Surface rms (unweighted)= 33.63 - (weighted)= 31.09 μm
 η_A (82.000 GHz) = 0.737; η_A (230.0 GHz) = 0.692; η_A (345.0 GHz) = 0.632
 S/T(82.000 GHz)= 21.179 Jy/K; S/T(230GHz)= 22.573 Jy/K; S/T(345 GHz)= 24.720 Jy/K
 $\eta_I=0.744$ $-\eta_S=0.862$ $-\eta_P$ (82.000 GHz)=0.991 $-\eta_P$ (230 GHz)=0.930 $-\eta_P$ (345 GHz)=0.849
 Rms/ring: 27.6 29.3 26.5 33.4 31.0 37.8

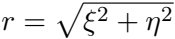
Amplitude (back view)
 -15.000 to 0.000 by 3.000



Normal errors (back view)
 -500.000 to 500.000 by 100.000









0123456789





www.venkateswara.org









$$\delta z \left(1 - \frac{1 - \frac{r^2}{4f^2}}{\sqrt{\frac{r^2}{f^2} + \left(1 - \frac{r^2}{4f^2}\right)^2}} \right)$$



$$\delta x \frac{\xi}{f} \left(1 - \frac{1}{\sqrt{\frac{r^2}{f^2} + \left(1 - \frac{r^2}{4f^2} \right)^2}} \right)$$



$$\delta y \frac{\eta}{f} \left(1 - \frac{1}{\sqrt{\frac{r^2}{f^2} + \left(1 - \frac{r^2}{4f^2} \right)^2}} \right)$$



$$a + \frac{\xi^2 - \eta^2}{2f^2}$$



$$a_x \frac{257}{2f^2}$$





















$$\psi_a = \frac{\arctan(a_x, a_y)}{2}$$







$$|\int_A A(\xi, \eta) \exp(i\phi(\xi, \eta)) d\xi d\eta|^2$$

$$\pi r^2 \int_A A(\xi, \eta)^2 d\xi d\eta$$



$$|\int_A A(\xi, \eta) d\xi d\eta|^2$$

$$\pi r^2 \int_A A(\xi, \eta)^2 d\xi d\eta$$

$$J = \frac{2k}{\eta_A \pi r^2}$$

$$\delta p = \delta \phi \times \frac{\lambda}{4\pi} \times \sqrt{1 + \frac{r^2}{4f^2}}$$







bs



$$\frac{1}{c}(X_{ij}\cos h\cos\delta-Y_{ij}\sin h\cos\delta+Z_{ij}\sin\delta)$$

Free
Free



Free
AI





$$F_{topo} = F_{rest} \left(1 + \delta - \epsilon \right)$$

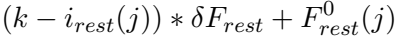


$$F_{IF} = \pm \left(F_{rest} \left(1 + \delta - \frac{v}{c} \right) - F_{D1} \right)$$

$$F_{IO1} = F_{rest} \left(1 + \delta - \frac{v}{c} \right) \mp F_{IF}^{rest}$$



1992-93





$$dI_{pop} = dI_{rest} + d - v$$









FO

reel















Av



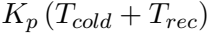
Kp Av





10

0010





$\ln \left(\frac{1}{1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} - \frac{1}{32} + \frac{1}{64} - \frac{1}{128} + \frac{1}{256} - \frac{1}{512} + \frac{1}{1024} - \frac{1}{2048} + \frac{1}{4096} - \frac{1}{8192} + \frac{1}{16384} - \frac{1}{32768} + \frac{1}{65536} - \frac{1}{131072} + \frac{1}{262144} - \frac{1}{524288} + \frac{1}{1048576} - \frac{1}{2097152} + \frac{1}{4194304} - \frac{1}{8388608} + \frac{1}{16777216} - \frac{1}{33554432} + \frac{1}{67108864} - \frac{1}{134217728} + \frac{1}{268435456} - \frac{1}{536870912} + \frac{1}{1073741824} - \frac{1}{2147483648} + \frac{1}{4294967296} - \frac{1}{8589934592} + \frac{1}{17179869184} - \frac{1}{34359738368} + \frac{1}{68719476736} - \frac{1}{137438953472} + \frac{1}{274877906944} - \frac{1}{549755813888} + \frac{1}{1099511627776} - \frac{1}{2199023255552} + \frac{1}{4398046511104} - \frac{1}{8796093022208} + \frac{1}{17592186044416} - \frac{1}{35184372088832} + \frac{1}{70368744177664} - \frac{1}{140737488355328} + \frac{1}{281474976710656} - \frac{1}{562949953421312} + \frac{1}{1125899906842624} - \frac{1}{2251799813685248} + \frac{1}{4503599627370496} - \frac{1}{9007199254740992} + \frac{1}{18014398509481984} - \frac{1}{36028797018963968} + \frac{1}{72057594037927936} - \frac{1}{144115188075855872} + \frac{1}{288230376151711744} - \frac{1}{576460752303423488} + \frac{1}{1152921504606846976} - \frac{1}{2305843009213693952} + \frac{1}{4611686018427387904} - \frac{1}{9223372036854775808} + \frac{1}{18446744073709551616} - \frac{1}{36893488147419103232} + \frac{1}{73786976294838206464} - \frac{1}{147573952589676412928} + \frac{1}{295147905179352825856} - \frac{1}{590295810358705651712} + \frac{1}{1180591620717411303424} - \frac{1}{2361183241434822606848} + \frac{1}{4722366482869645213696} - \frac{1}{9444732965739290427392} + \frac{1}{18889465931478580854784} - \frac{1}{37778931862957161709568} + \frac{1}{75557863725914323419136} - \frac{1}{151115727451828646838272} + \frac{1}{302231454903657293676544} - \frac{1}{604462909807314587353088} + \frac{1}{1208925819614629174706176} - \frac{1}{2417851639229258349412352} + \frac{1}{4835703278458516698824704} - \frac{1}{9671406556917033397649408} + \frac{1}{19342813113834066795298816} - \frac{1}{38685626227668133590597632} + \frac{1}{77371252455336267181195264} - \frac{1}{154742504910672534362390528} + \frac{1}{309485009821345068724781056} - \frac{1}{618970019642690137449562112} + \frac{1}{1237940039285380274899124224} - \frac{1}{2475880078570760549798248448} + \frac{1}{4951760157141521099596496896} - \frac{1}{9903520314283042199192993792} + \frac{1}{19807040628566084398385987584} - \frac{1}{39614081257132168796771975168} + \frac{1}{79228162514264337593543950336} - \frac{1}{158456325028528675187087900672} + \frac{1}{316912650057057350374175801344} - \frac{1}{633825300114114700748351602688} + \frac{1}{1267650600228229401496703205376} - \frac{1}{2535301200456458802993406410752} + \frac{1}{5070602400912917605986812821504} - \frac{1}{10141204801825835211973625643008} + \frac{1}{20282409603651670423947251286016} - \frac{1}{40564819207303340847894502572032} + \frac{1}{81129638414606681695789005144064} - \frac{1}{162259276829213363391578010288128} + \frac{1}{324518553658426726783156020576256} - \frac{1}{649037107316853453566312041152512} + \frac{1}{1298074214633706907132624082305024} - \frac{1}{2596148429267413814265248164610048} + \frac{1}{5192296858534827628530496329220096} - \frac{1}{10384593717069655257060992658440192} + \frac{1}{20769187434139310514121985316880384} - \frac{1}{41538374868278621028243970633760768} + \frac{1}{83076749736557242056487941267521536} - \frac{1}{166153499473114484112975882535043072} + \frac{1}{332306998946228968225951765070086144} - \frac{1}{664613997892457936451903530140172288} + \frac{1}{1329227995784915872903807060280344576} - \frac{1}{2658455991569831745807614120560689152} + \frac{1}{5316911983139663491615228241121378304} - \frac{1}{10633823966279326983230456482242756608} + \frac{1}{21267647932558653966460912964485513216} - \frac{1}{42535295865117307932921825928971026432} + \frac{1}{85070591730234615865843651857942052864} - \frac{1}{170141183460469231731687303715884105728} + \frac{1}{340282366920938463463374607431768211456} - \frac{1}{680564733841876926926749214863536422912} + \frac{1}{1361129467683753853853498429727072845824} - \frac{1}{2722258935367507707706996859454145691648} + \frac{1}{5444517870735015415413993718908291383296} - \frac{1}{10889035741470030830827987437816582766592} + \frac{1}{21778071482940061661655974875633165533184} - \frac{1}{43556142965880123323311949751266331066368} + \frac{1}{87112285931760246646623899502532662132736} - \frac{1}{174224571863520493293247799005065324265472} + \frac{1}{348449143727040986586495598010130648530944} - \frac{1}{696898287454081973172991196020261297061888} + \frac{1}{1393796574908163946345982392040522594123776} - \frac{1}{2787593149816327892691964784081045188247552} + \frac{1}{5575186299632655785383929568162090376495104} - \frac{1}{11150372599265311570767859136324180752990208} + \frac{1}{22300745198530623141535718272648361505980416} - \frac{1}{44601490397061246283071436545296723011960832} + \frac{1}{89202980794122492566142873090593446023921664} - \frac{1}{178405961588244985132285746181186892047843328} + \frac{1}{356811923176489970264571492362373784095686656} - \frac{1}{713623846352979940529142984724747568191373312} + \frac{1}{1427247692705959881058285969449495136382746624} - \frac{1}{2854495385411919762116571938898990272765493248} + \frac{1}{5708990770823839524233143877797980545530986496} - \frac{1}{11417981541647679048466287755595961091061972992} + \frac{1}{22835963083295358096932575511191922182123945984} - \frac{1}{45671926166590716193865151022383844364247891968} + \frac{1}{91343852333181432387730302044767688728495783936} - \frac{1}{182687704666362864775460604089535377456991567872} + \frac{1}{365375409332725729550921208179070754913983135744} - \frac{1}{730750818665451459101842416358141509827966271488} + \frac{1}{1461501637330902918203684832716283019655932542976} - \frac{1}{2923003274661805836407369665432566039311865085952} + \frac{1}{5846006549323611672814739330865132078623730171904} - \frac{1}{11692013098647223345629478661730264157247460343808} + \frac{1}{23384026197294446691258957323460528314494920687616} - \frac{1}{46768052394588893382517914646921056628989841375232} + \frac{1}{93536104789177786765035829293842113257979682750464} - \frac{1}{187072209578355573530071658587684226515959365500928} + \frac{1}{374144419156711147060143317175368453031918731001856} - \frac{1}{748288838313422294120286634350736906063837462003712} + \frac{1}{1496577676626844588240573268701473812127674924007424} - \frac{1}{2993155353253689176481146537402947624255349848014848} + \frac{1}{5986310706507378352962293074805895248510699696029696} - \frac{1}{11972621413014756705924586149611790497021399392059392} + \frac{1}{23945242826029513411849172299223580994042798784118784} - \frac{1}{47890485652059026823698344598447161988085597568237568} + \frac{1}{95780971304118053647396689196894323976171195136475136} - \frac{1}{191561942608236107294793378393788647952342390272950272} + \frac{1}{383123885216472214589586756787577295904684780545900544} - \frac{1}{766247770432944429179173513575154591809369561091801088} + \frac{1}{1532495540865888858358347027150309183618739122183602176} - \frac{1}{3064991081731777716716694054300618367237478244367204352} + \frac{1}{6129982163463555433433388108601236734474956488734408704} - \frac{1}{12259964326927110866866776217202473468949912977468817408} + \frac{1}{24519928653854221733733552434404946937899825954937634816} - \frac{1}{49039857307708443467467104868809893875799651909875269632} + \frac{1}{98079714615416886934934209737619787751599303819750539264} - \frac{1}{196159429230833773869868419475239575503198607639501078528} + \frac{1}{392318858461667547739736838950479151006397215279002157056} - \frac{1}{784637716923335095479473677900958302012794430558004314112} + \frac{1}{1569275433846670190958947355801916604025588861116008628224} - \frac{1}{3138550867693340381917894711603833208051177722232017256448} + \frac{1}{6277101735386680763835789423207666416102355444464034512896} - \frac{1}{12554203470773361527671578846415332832204710888928069025792} + \frac{1}{25108406941546723055343157692830665664409421777856138051584} - \frac{1}{50216813883093446110686315385661331328818843555712276103168} + \frac{1}{100433627766186892221372630771322662657637687111424552206336} - \frac{1}{200867255532373784442745261542645325315275374222849104412672} + \frac{1}{401734511064747568885490523085290650630550748445698208825344} - \frac{1}{803469022129495137770981046170581301261101496891396417650688} + \frac{1}{1606938044258990275541962092341162602522202993782792835301376} - \frac{1}{3213876088517980551083924184682325205044405987565585670602752} + \frac{1}{6427752177035961102167848369364650410088811975131171341205504} - \frac{1}{12855504354071922204335696738729300820177623950262342682411008} + \frac{1}{25711008708143844408671393477458601640355247900524685364822016} - \frac{1}{51422017416287688817342786954917203280710495801049370729644032} + \frac{1}{102844034832575377634685573909834406561420991602098741459288064} - \frac{1}{205688069665150755269371147819668813122841983204197482918576128} + \frac{1}{411376139330301510538742295639337626245683966408394965837152256} - \frac{1}{822752278660603021077484591278675252491367932816789931674304512} + \frac{1}{1645504557321206042154969182557350504982735865633579863348609024} - \frac{1}{3291009114642412084309938365114701009965471731267159726697218048} + \frac{1}{6582018229284824168619876730229402019930943462534319453394436096} - \frac{1}{13164036458569648337239753460458804039861886925068638906788872192} + \frac{1}{26328072917139296674479506920917608079723773850137277813577744384} - \frac{1}{52656145834278593348959013841835216159447547700274555627155488768} + \frac{1}{105312291668557186697918027683670432318895095400549111254310977536} - \frac{1}{210624583337114373395836055367340864637790190801098222508621955072} + \frac{1}{421249166674228746791672110734681729275580381602196445017243910144} - \frac{1}{842498333348457493583344221469363458551160763204392890034487820288} + \frac{1}{1684996666696914987166688442938726917102321526408785780068975640576} - \frac{1}{3369993333393829974333376885877453834204643052817571560137951281152} + \frac{1}{6739986666787659948666753771754907668409286105635143120275902562304} - \frac{1}{13479973333575319897333507543509815336818572211270286240551805124608} + \frac{1}{26959946667150639794667015087019630673637144422540572481103610249216} - \frac{1}{53919893334301279589334030174039261347274288845081144962207220498432} + \frac{1}{107839786668602559178668060348078522694548577690162289924414440996864} - \frac{1}{215679573337205118357336120696157045389097155380324579848828881993728} + \frac{1}{431359146674410236714672241392314090778194310760649159697657763987456} - \frac{1}{862718293348820473429344482784628181556388621521298319395315527974912} + \frac{1}{1725436586697640946858688965569256363112777243042596638790631055949824} - \frac{1}{3450873173395281893717377931138512726225554486085193277581262111899648} + \frac{1}{6901746346790563787434755862277025452451108972170386555162524223799296} - \frac{1}{13803492693581127574869511724554050904902217944340773110325048447598592} + \frac{1}{27606985387162255149739023449108101809804435888681546220650096895197184} - \frac{1}{55213970774324510299478046898216203619608871777363092441300193790394368} + \frac{1}{110427941548649020598956093796432407239217743554726184882600387580788736} - \frac{1}{220855883097298041197912187592864814478435487109452369765200775161577472} + \frac{1}{441711766194596082395824375185729628956870974218904739530401550323154944} - \frac{1}{883423532389192164791648750371459257913741948437809479060803100646309888} + \frac{1}{1766847064778384329583297500742918515827483896875618958121606201292619776} - \frac{1}{3533694129556768659166595001485837031654967793751237916243212402585239552} + \frac{1}{7067388259113537318333190002971674063309935587502475832486424805170479104} - \frac{1}{14134776518227074636666380005943348126619871175004951664972849610340958208} + \frac{1}{28269553036454149273332760011886696253239742350009903329945699220681916416} - \frac{1}{56539106072908298546665520023773392506479484700019806659891398441363832832} + \frac{1}{113078212145816597093331040047546785012958969400039613319782796882727665664} - \frac{1}{226156424291633194186662080095093570025917938800079226639565593765455331328} + \frac{1}{452312848583266388373324160190187140051835877600158453279131187530910662656} - \frac{1}{904625697166532776746648320380374280103671755200316906558262375061821325312} + \frac{1}{1809251394333065553493296640760748560207343510400633813116524750123642650624} - \frac{1}{3618502788666131106986593281521497120414687020801267626233049500247285301248} + \frac{1}{7237005577332262213973186563042994240829374041602535252466099000494570602496} - \frac{1}{14474011154664524427946373126085988481658748083205070504932198000989141204992} + \frac{1}{28948022309329048855892746252171976963317496166410141009864396001978282409984} - \frac{1}{57896044618658097711785492504343953926634992332820282019728792003956564819968} + \frac{1}{115792089237316195423570985008687907853269984665640564039457584007913129639936} - \frac{1}{231584178474632390847141970017375815706539969331281128078915168015826259279872} + \frac{1}{463168356949264781694283940034751631413079938662562256157830336031652518559744} - \frac{1}{926336713898529563388567880069503262826159877325124512315660672063305037119488} + \frac{1}{1852673427797059126777135760139006525652319754650249024631321344126610074238976} - \frac{1}{3705346855594118253554271520278013051304639509300498049262642688253220148477952} + \frac{1}{7410693711188236507108543040556026102609279018600996098525285376506440296955904} - \frac{1}{1482$



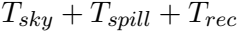
Reciprocal











$$T_{rec} = \frac{P_{cold} T_{hot} - P_{hot} T_{cold}}{P_{hot} - P_{cold}}$$

$$T_{sky} = (T_{hot} + T_{rec}) \frac{P_{sky}}{P_{hot}} - T_{rec} - T_{spill}$$



$$T_{\text{err}} = \frac{T_{\text{sky}}}{\eta_f}$$

Тотта

снэ, а







$$T_{emi} = \frac{T_{atm_{emi,s}} + g_{im} T_{atm_{emi,i}}}{1 + g_{im}}$$





$$T_{sys,s} = \frac{e^{\tau_s} (T_{hot} - T_{sky} - T_{spill}) (1 + G_{im})}{\eta_f} \frac{P_{sky}}{P_{hot} - P_{sky}}$$

$$T_{sys,i} = \frac{e^{\tau_i} (T_{hot} - T_{sky} - T_{spill}) \left(1 + \frac{1}{g_{im}}\right) P_{sky}}{\eta_f P_{hot} - P_{sky}}$$

$$T_{sky} + T_{spill} = (1 - \eta_f) \left(\frac{T_{atm, s} + g_{im} T_{atm, i}}{1 + g_{im}} \right) + \eta_f T_{ground}$$





$$T_{ijk} = \frac{C_{ijk}}{\sqrt{C_{ik}C_{jk}}} \sqrt{T_{sys}(i)T_{sys}(j)}$$















$$T_{triple} = \frac{1 - \left(\frac{\nu_1}{\nu_2}\right)^2}{1 - \left(\frac{\nu_2}{\nu_3}\right)^2} \left(T_2 - T_3 \left(\frac{\nu_2}{\nu_3}\right)^2 \right) - \left(T_1 - T_2 \left(\frac{\nu_1}{\nu_2}\right)^2 \right)$$

