

1 DMXUDQZ DMUMKHUP DQUDGLDMRQ DVD P P Z DYHQIQJ VK

6HJH 1 * DYUQQ

ORVFRW B QHYHRB L VQQ L QHHUL Q<DURVOD B YKRNVAHR VFB ZVVL D

\$EVWU7KFAVD WZD VVKH WPDGQ DQV KRPC SHUD QKUH
GHJU8HHO/DLQZDYHORQ PPKDE/HHQSHULPHQWDOO
LQYHVW7LKEPW B GXUHZPHUQD/W/URLXRCO CH|SHULPHQWDO
LQVWDZLOVDK/D B QR B HDW H B HR MKUH WPDGQ D LWD R Q
VHQVLRNLYH Q/YLQZ D WPHUP SHZIDAVXUMHEUDF B QWDFW
WKHUP R L P P W H L V M B HD WFRUD X7PKG HSHQ B MQUFDGLR
EULJKWGHF S H UDRVPKZHD WMIKHUPRGWQIDPSIHXD W XUH
EHHQV WDE QWZDKM GR ZQK D/VQGH SHQ B HZDFVWHDJGLR
EULJKWQHPSVH UIDV BZDM W/KHUPRG VQHDPSHF ULDWXUH
QRQ OZ KILHFRUJ UH VSPKCHRVFIRV E FIDQQR WVKQKH
WKH WPDGQRL V V ZRLG U N QMF L HQMKNW X Q/LHPS HUDWXUH
UDQJ G V KVKHUPRGV G B B HD D QXHU GHJ BHHOWLXV
WKH DGR MCOHD CELRLJKW B P S N ZIDMVERLXWH O YSLQJ
GHJ B H B V L W V GHJU HDIE R XWHO YSLQJ H J B H B V, WXV
ZDVKRZQK V VSHU D F W V R D V O P S H G B V X Q B R H Z D F M H U
WKHUB D D G L DLWISRO V U B QFRQLW RU ZQJV M W WHPV
.H\ZRUBZDWHFS HULW H B SVH WDKM XUD B Q D W L R Q

, QWURGXFWRQ

: DMU/DNH HOPHQR/DQ WUHWMDQX VMPV WH EDV/RI QH RQ (DMK 3K VFDQ
PHRGV/RI Z DMUHWDFK LQFOXGHP HDXUQ VHLQWQIF UGRHP LWRQRI Z DMU> @
7KHZ DMUWDMG QP LFDVJGHMUP LQGEA KHDVQGP DAVDQ/HURQVHXUDFHR WH
Z DMUULQMDH 7KHSURFHWV/RI DEVRSLMRQ DQHP LWRQRI HOFWRP DJQWV ZDYH/RQ
WHZ DMUWUDFHVJQIFDQD GHMUP LQHWHDUZ DMUHQJH H FKOJH
6HD WHUP DO HOFWRP DJQWV LQ QDMUH HP LWRQ RI Z DMU GSHQV/RQ WH RZ Q
WHUP RG QP L F Z DMU WP SHDMUH PHDXUG LQ WH Z DMU EXON RU LQ Z DMU WUDFH
WP SHDMUH Q HJ
5DGR EUJKQHW WP SHDMUH LV WH PHDXUH RI Z DMU HOFWRP DJQWV HP LWRQ LQ D
FHUWQIUHTXCF UQJH , VQDQHP HDXUGZ LK KJK DFXDA EA UGRPHWIF PHRGV/
7KH LQRUP DMQ DERXWG SHQGQH RI WH UGR EUJKQHW WP SHDMUH IURP WH Z DMU
WHUP RG QP L F WP SHDMUH FQEHKHS XORUHWDEQ KQJ WH WAKFVHRI WHZ DMU VQV
FRQMQVGHMWRQ RI IP SXUWHV DQ WH SUHCFH RI WP SHDMUH VQQLW GHMWRQ RI
IP SXUWHV DQ WH SUHCFH RI WP SHDMUH KHMRJQHWHV 5DGRPHWIF PHRGV/PDNH/V
SRWEGNRP HDXUH DGR EUJKQHW WP SHDMUHUP RMD > @

&RUUHV SRQV [SRUJ L O L Q 6 1 # P J V X U X](https://doi.org/10.1051/bioconf/202410703004)

7KH LQNIQMF WHUP DOUDGDNRQ RI Z DMUFDQEHFKQDFMUJ HGE LQMJUDQ-P LXYLW LQD
Z LGH IUHTXHQF UDQJH RI HGFWRP DJQNF UDGDNRQ > @\$ Q LP SRUDQFKQDFMUJMF RI
WHUP DOUDGDNRQLVWHVSHFNDQG-QLVRI WHUP DOUDGDNRQ> @
, QMLVSDSHU WHGSHQGQFHRI WHILQNIQMF UDGRIHP LWRQRI Z DMUQWHVAP SHUDMUH
UDQJHRI GHUHV&HXLVQR PP Z DYH/KDVEHQH SHUP HQDQ LQHWMDMG

0 D W H U L Q D G H W K R G V

7KHRU

7KHWHRU RI Z DMUUDGR HP LWRQKDVETHQGHYHDSHGLO> @5 HGFWRQDQGDEVRUSWRQ
RI UDGDNRQEA WHZ DMUUDFHGHSHQG/RQWHGHGFWIF FRQMDQW @WP SHUDMUH> @DQ
VDDQW > @RI WH Z DMU 6DDQW GHMPLQH> @WH FRQGFMYLW RI Z DMU ,RQF
FRQGFMYLW GHMPLQH/WH GSH RI WH VNLQ Q HU Z KFK LVWHVXUJHRI WHUP DOUDGR
HP LWRQ
) RU Z DMU DU ERXQGV WH EUJKQHW WP SHUDMUH 7_{EU} > @GSHQG/IURP WH Z DMU
WHUP RG QDIF WP SHUDMUH 7_{DV}

$$7_{EU} (7$$

ZKHU

(HP LWRQFRHILFHQW

, I WRPHGD DUDDG Z DMU FRYHDKD VDFHDFK IRUDGRUP DOZ DYH LQFLG-QMMH
HP LWRQFRHILFHQW

$$(5$$

ZKHU

$$5 \left| \frac{(1 - \sqrt{\varepsilon})}{(1 + \sqrt{\varepsilon})} \right|$$

) UHQDUHGFWRQFRHILFHQW

0 GHDFWIF FRQMDQW

7KHGHDFWIF FRQMDQW LV WHIXQFWRQRI VHYUDYDUDEQW 7KHGHDFWIF FRQMDQW LV
H SHUWHGE WH' HE HHTXDNRQ> @

$$0 \varepsilon K \quad \varepsilon \sqrt{\varepsilon} K \quad L Q \quad L 2\pi v \varepsilon^*$$

where

v IUHTXHQF > @

ε_{hf} KJK IUHTXHQF GHDFWIF FRQMDQW

$\varepsilon \sqrt{\varepsilon}$ WDNF GHDFWIF FRQMDQW

T WP HRI UHQ DNQR

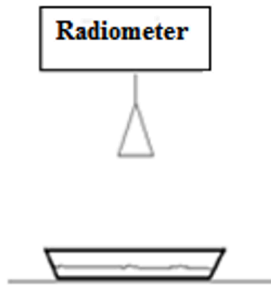
1 \pm FRQGFMYLW

ε^* SHUP LXYLWRI IUH VDFH

7KHFRHILFHQWLVQ DUHHP SUWFOYDQHV> @

0 HMKRG

5HDFKRI WHUDGDNRQ WP SHUDMUHGSHQGQFHRI QMDQZ DMUDVZ DYHQVRI
PP LQWHVAP SHUDMUH UDQJHW . H & ZLVKD [PP QMDQDQDP HGDWHHQGLU
ZHUFDUWHGRXW



) L J 7 K M F K H P L Q V W D X O C H G M E H R S C H U L F F R O P S E O V H O X W K R U

: D M U Z D V S R X U H G L Q R D I R P F R O M C H U 7 K H Z D M U M P S H D M U H Z D V F R Q U R O G D V M F D U H X O
 P I L Q J 7 K H J H U R O M H O U H D M Y H V R Z K L F K V H E U J K Q H W M P S H D M U H L Q F U P H Q V Z D V
 F D X O M G Z D V I L H G E V H E U J K Q H W M P S H D M U H R I V H Z D M U D V P E L H Q V D U M P S H D M U H

$t_{air} \quad H \&$

7 K H F D E U D M R Q Z D V F D U I L G R V X V L Q J P H D M U P H Q V R I V H M P S H D M U H R I D E O F N

ERG > @

7 K H M P S H D M U H R I V H Z D M U S R X U H G L Q R V H F R O M C H U Z D V U H X O M G E D B G Q J K R W
 Z D M U P I L Q J Z L V F R O Z D M U D G G E F K D Q I L Q J V H M P S H D M U H R I V H Z D M U G X U I Q J F R R O J
 \$ V D U H X O V L V Z D V S R M E C H V R F D U I R X W U D G R E U J K Q H W P H D M U P H Q V L Q D M P S H D M U H
 U D Q J H I U R P f & V R f &

7 K H J H U R U H H U C H F R O M R O Z D V F K F N G E V H U D G R E U J K Q H W M P S H D M U H R I V H Z D M U
 D V P E L H Q V M P S H D M U H $t_{air} \quad H \&$

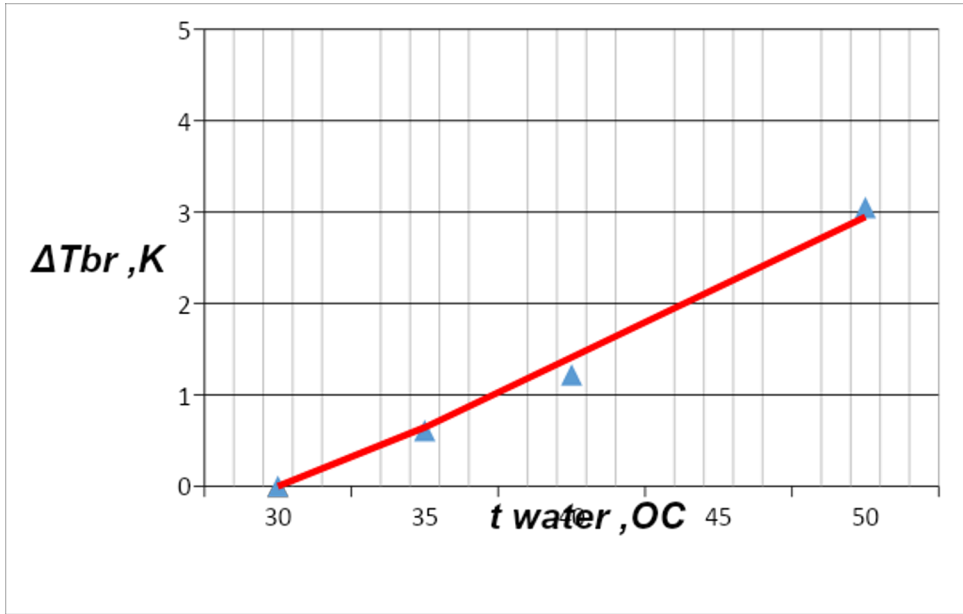
5 H V X O W V

7 K H P H D M U P H Q V V H X O V L Q V H M P S H D M U H L Q M Y D O $H \&$ D U H V K R Z Q L Q V H J U D S K) L J
 D B Q V H Y H U V D Q J L V R I Z K L F K U D G R E U J K Q H W M P S H D M U H D U H G S R V M G

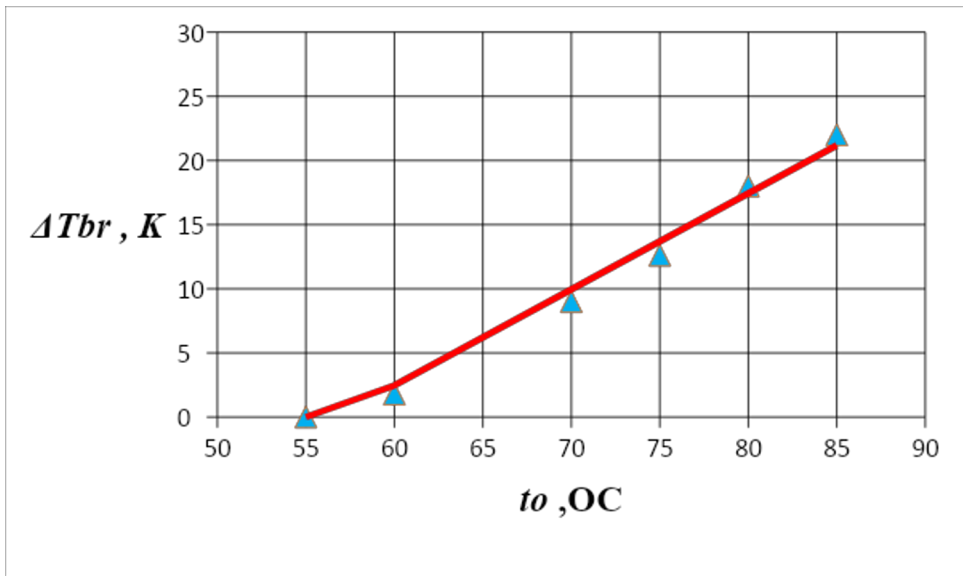
$$\hat{u}_{7_{EU}} W \& \quad 7_{EU} Z D M U W \& \quad \pm 7_{EU} Z D M U W \quad H \&$$

Table 1. 7 K H U P R G V O H P S I F R I D M V O L O M G iation of the radio brightness temperature
 $^{\circ}C \quad F R P S E O V H O X W K R U$

7 K H U P R G V O B P S I F R Z D W H U $W_{DMU} \quad H \&$	' H Y L D V R U I R Q U H I D C E U L J K W W I O P S H U I



)LJ 'HSHQG RQWIKG HYLDP MROHDGE RLJK WQHP SWUD R/WKZ HDWHU
WKHUPRGV BSSHEWDXUH & FRPSEOWHX WKRU



)LJ 'HSHQG RQWIKG HYLDP MROHDGE RLJK WQHP SWUD R/WKZ HDWHU
WKHUPRGV BSSHEWDXUH & FRPSEOWHX WKRU

RI ZDMU ZKFK LV HJ SUHVG LQ VHP DOUDGDMRQ LQMQLW LQFUDH Z LK DQ LQFUDH RI
ZDMUWP SHDMUH

& R Q F O X V L R Q V

7KH HJ SHUP HQWGP RQADM/ D VLJQLFDQVGLIHUHQH LQ VHP LQMQLW RI ZDMU UDGR
HP LMRQ IRUZDMUWP SHDMUH FOMH VR DQG IDU URP DP ELHQDLUWP SHDMUH) RUZDMU
WP SHDMUH/RI GHJUHV & HOLXV VHP JUDGHQ/RI VHP UDGR EUJKQHWP SHDMUH LV
VHYUDWP HV KJKHVMQDQ VHP JUDGHQ/RU VHP ZDMUWP SHDMUH UDQH RI GHJUHV
& HOLXV

7KH VHQULYUW RI VHP XVHG HTXSP HQW @P DNH/ LMSRMEOH VR UFRUG ERK VP DO
JUDGHQ/RI UDGR EUJKQHWP SHDMUH LQ VHP UDQH RI GHJUHV & HOLXV DQG OJH
RQH/IRUZDMUWP SHDMUH/RI GHJUHV & HOLXV

' HSHGHQH/RI VHP UDGR EUJKQHWP SHDMUH RQ VHP VHP RG QDP LF WP SHDMUH LQ
JHQUDO FRUHSRG VR VHP VHP RUHPDQDFDQDQ/RQ/SHURUP HG XLQ VHP VHP UQ P RGHO) RU
GHJUHV & HOLXV UDQH VHP HJ SHUP HQWDOXH/RI VHP UDGR EUJKQHWP SHDMUH
DUHQKQ OZ HVMQDQ VHPDQDQGYDQH

7KH GSHGHQH/RI VHP UDGR EUJKQHWP SHDMUH RQ VHP VHP RG QDP LF WP SHDMUH
RI ZDMU FDQ EH XVHG IRU VHP UP RM GHMUP LQDMRQ RI VHP FKUDFAMUWP RI DTXRXV
VQMRQ/ VFK DV SHUP LQULW > @DQ IRQF FRGGVAMUW 7KH KJK VHQULYUW RI VHP
UHPHYLQ HTXSP HQWDOZ V LQ JHQUDO VR UFRUG ZDMU UDGR EUJKQHWP SHDMUH Z LK
DQ DFXUA RI VHYUDWQMV RI . HOLQ RYU D Z LGH UDQH RI ZDMU VHP RG QDP LF
WP SHDMUH

5 H I H U H Q F H V

1. , 7 %XENLQ . 6 6DQHYLFK - &RP PXQ 7HFKRO(@FWRQ
KMSV GRLRJ 6 ;

2. , 7 %XENLQ . 6 6DQHYLFK - &RP PXQ 7HFKRO(@FWRQ
KMSV GRLRJ 6 ;

' 0 / H9LQH 5 + / DQJ < =KRX (3 ' LQDWDQ 7 0 HXCHU,(((7UDQ * HRVL
5HPRM6HQ/

KMSV GRLRJ 7* 56

61 * DYUQ (6: HERI & RQ

KMSV GRLRJ H VFRQ

61 * DYUQ - 3KV & RQ 6HU

KMSV LRSVLFQH LRS RJ DUVOH SG

\$ 6VRUQ,(((7UDQDFWRQ/RQ 0 LFURZDYH7KRV DQ 7HFKQTXH

KMSV GRLRJ 70 77

* &DWRQH - 6SRQH 6 7UXVR) 6DND 3KV & K-P & K-P 3KV ±

KMSV GRLRJ F FS G

< =KRX 5 + / DQJ (3 ' LQDWDQ' 0 / H9LQH,(((7UDQ * HRVL 5HPRM
6HQ/

KMSV GRLRJ 7* 56

- %RXMCHVDD ,(((7UDQ/ * HRVL 5HP RM6HQ/
 KMSV GRLRJ 7* 56
 : 7DQJ HVDD 5HP RM6HQ/
 KMSV GRLRJ U/
 1 5HXCHVDD 5HP RM6HQ/ (QYLRQ
 KMSV GRLRJ MJH
 / . QIQ & 6ZIUW,(((7UDQ/DFWRQ/RQ\$ QMCCV DQG 3URSDJ DNRQ

KMSV GRLRJ 7\$3
 3 - : ' HE H 3RDUO RQFXQV 1HZ <RUN 1 < 86\$ 7KH&K-P LFDD&DNRJ
 &RP SDQ

KMSV RSHQDEUDV RJ ERRN/2/ 0 3RDUBP RQFXQV
 ' 0 / 9IQ (3 ' LQDDW 5HP RM6HQ/
 KMSV GRLRJ U/
 \$ 6WRU UQ ,(((7UDQ/ 0 LFURZ 7KH-RU 7HFQ 0 77
 KMSV GRLRJ 70 77
 &K ' LHQIQ = 3RSRYü (* URMP DQ \$ SSO2 SW
 KMSV GRLRJ \$2
 , 7 %XENLQ . 6 6VQNHLEK - &RP P XQ 7HFQRO (QFWRQ ±

KMSV GRLRJ 6
 6 =HCFKQNR 7UDQ/DFWRQ/RI VWH. U QRY 6VDM 5HFDJF &HQJH ±

KMSV HDE VSEWUX GONUF SG GRZ QBDG
 * \$ \$ QGUHY 2 . 6VQNHLEK - RI &RP P 7HFQ (QFWJ
 KMSV ZZZ UHFDJFJ DMQHV SXEODNRQ
 20. 36 5D. \$ SSOHG2 SMFV
 KMSV GRLRJ \$2