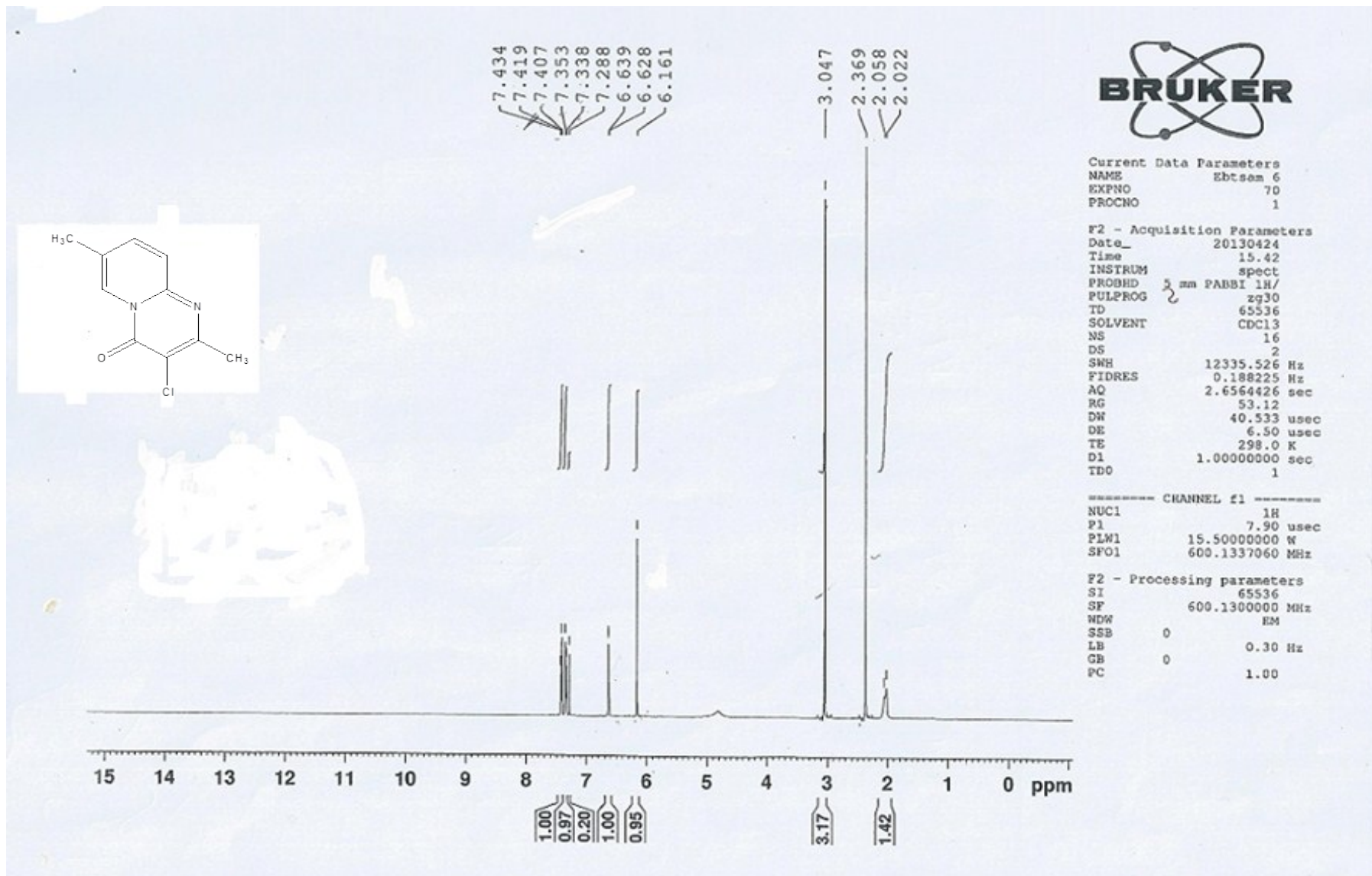
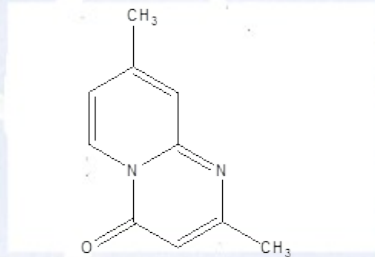


Figure S1: FTIR spectra of fresh and used Al₃PW catalyst

Proton NMR spectra





8.087
8.083
8.074
8.071
7.512
7.507
7.498
7.460
7.448
7.434
7.288
6.747
6.662
6.651



15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm

1.00
2.02
0.48
0.09
0.48
0.48

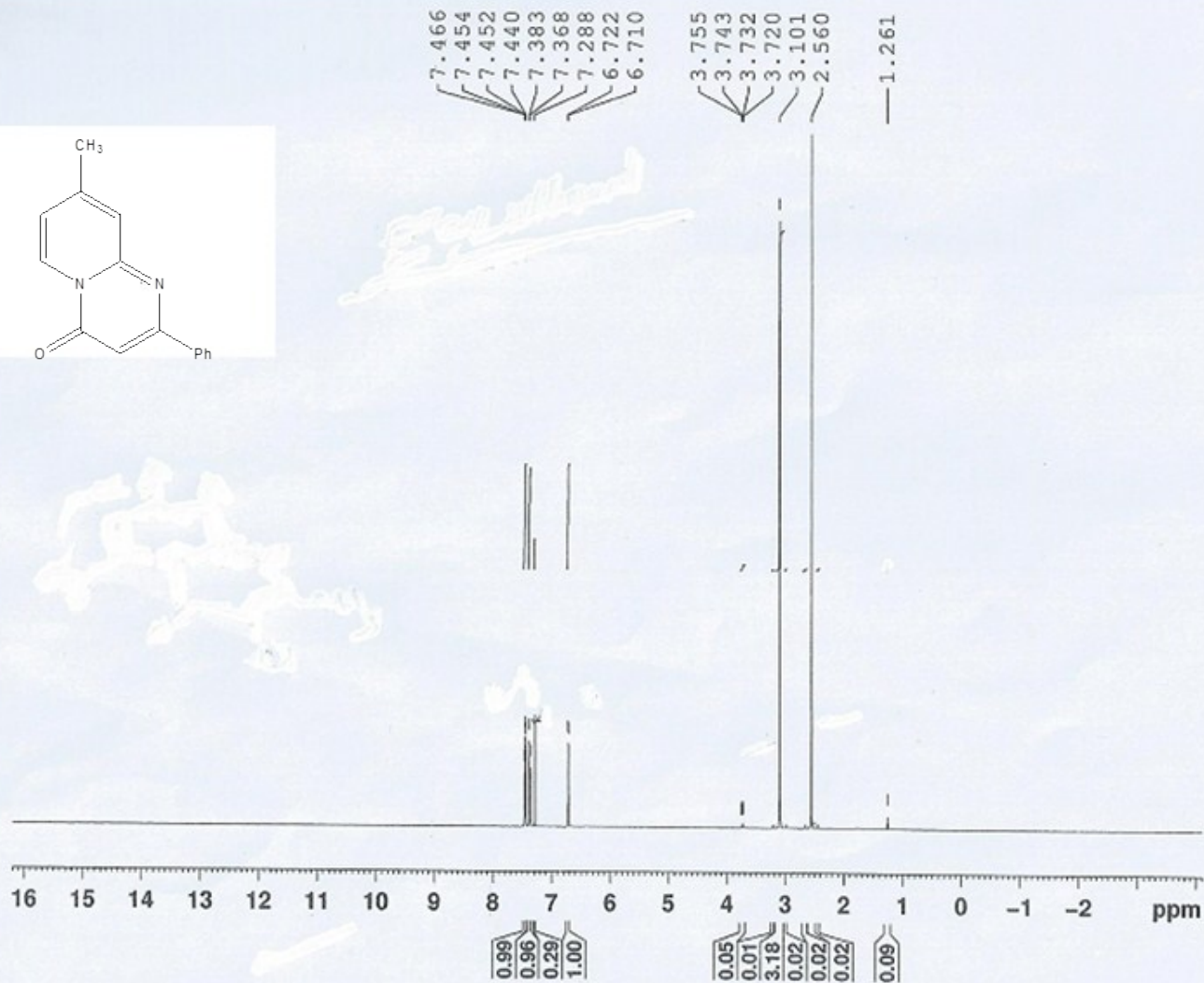
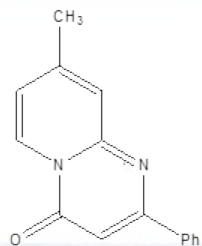


Current Data Parameters
NAME Edtsen 3
EXPNO 70
PROCNO 1

F2 - Acquisition Parameters
Date_ 20130424
Time 14.48
INSTRUM spect
PROBHD 5 mm PABBI 1H/
PULPROG zg30
TD 65536
SOLVENT CDCl3
NS 16
DS 2
SWH 12335.526 Hz
FIDRES 0.188225 Hz
AQ 2.6564426 sec
RG 74.07
DW 40.533 usec
DE 6.50 usec
TE 298.0 K
D1 1.00000000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 1H
P1 7.90 usec
PLW1 15.50000000 W
SFO1 600.1337060 MHz

F2 - Processing parameters
SI 65536
SF 600.1300000 MHz
WDW EM
SSB 0
LB 0.30 Hz
GB 0
PC 1.00



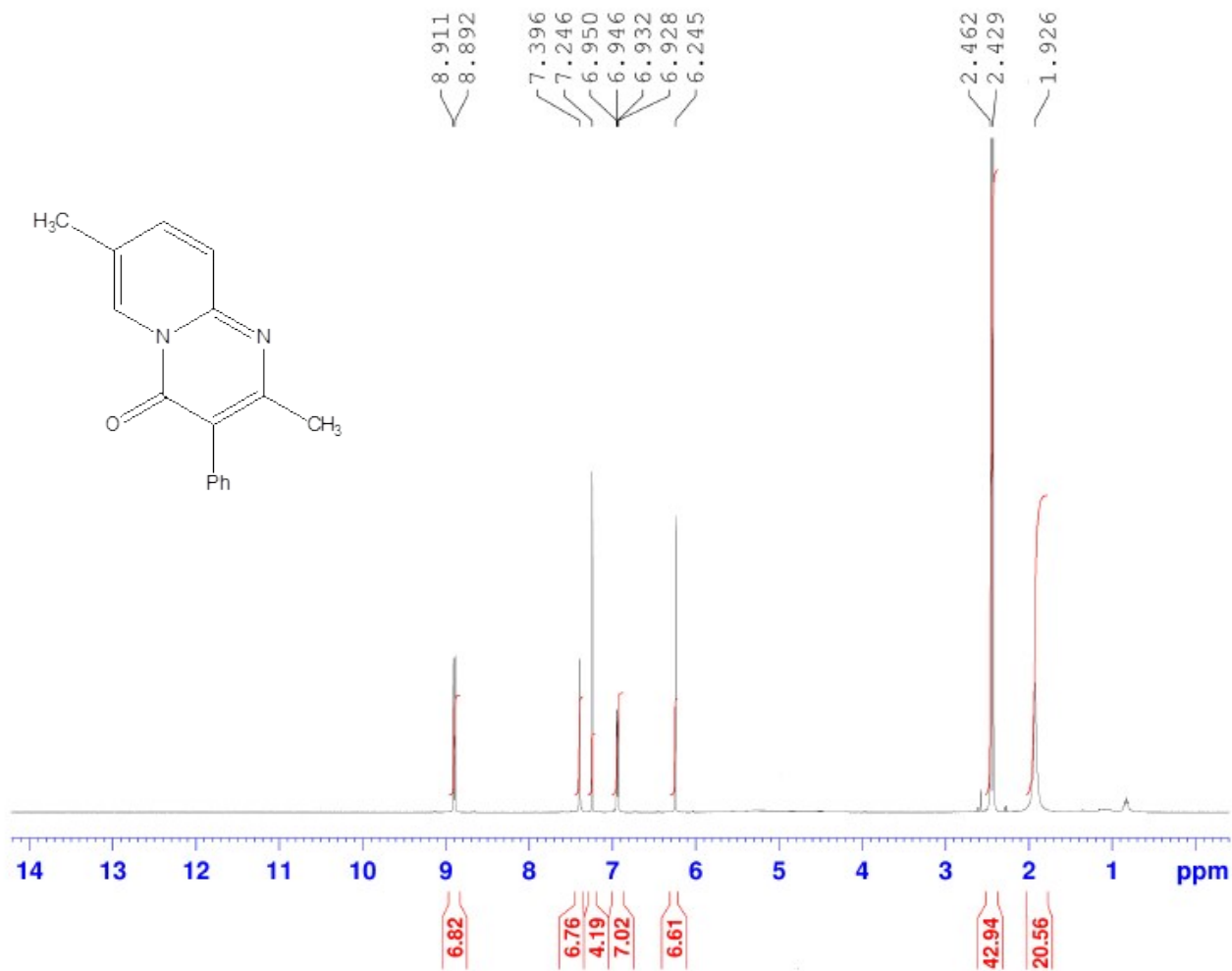
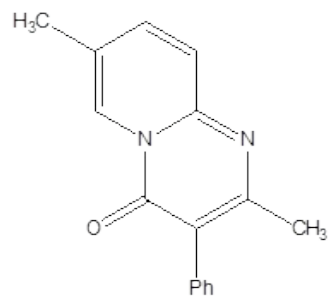
Current Data Parameters
 NAME Ebtam 1
 EXPNO 10
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20130424
 Time 13.59
 INSTRUM spect
 PROBHD 5 mm PABBI 1H/
 PULPROG zg30
 TD 65536
 SOLVENT CDCl3
 NS 16
 DS 2
 SWH 12335.526 Hz
 FIDRES 0.188225 Hz
 AQ 2.6564426 sec
 RG 173.48
 DW 40.533 usec
 DE 6.50 usec
 TE 298.0 K
 D1 1.00000000 sec
 T00 1

----- CHANNEL f1 -----
 NUC1 1H
 P1 7.90 usec
 PLW1 15.50000000 W
 SFO1 600.1337060 MHz

F2 - Processing parameters
 SI 65536
 SF 600.1300000 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 1.00

Dr. Raoo
 Sample : N-21 CDCL3
 PROTON CDCL3 D:\ nmr



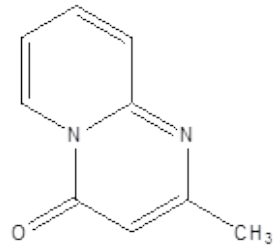
Current Data Parameters
 NAME RAOO N-21 06-01-2016
 EXPNO 10
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20160106
 Time 14.56
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zg30
 TD 65536
 SOLVENT CDCL3
 NS 64
 DS 2
 SWH 8223.685 Hz
 FIDRES 0.125483 Hz
 AQ 3.9846387 sec
 RG 141.04
 DW 60.800 usec
 DE 6.50 usec
 TE 298.0 K
 D1 1.00000000 sec

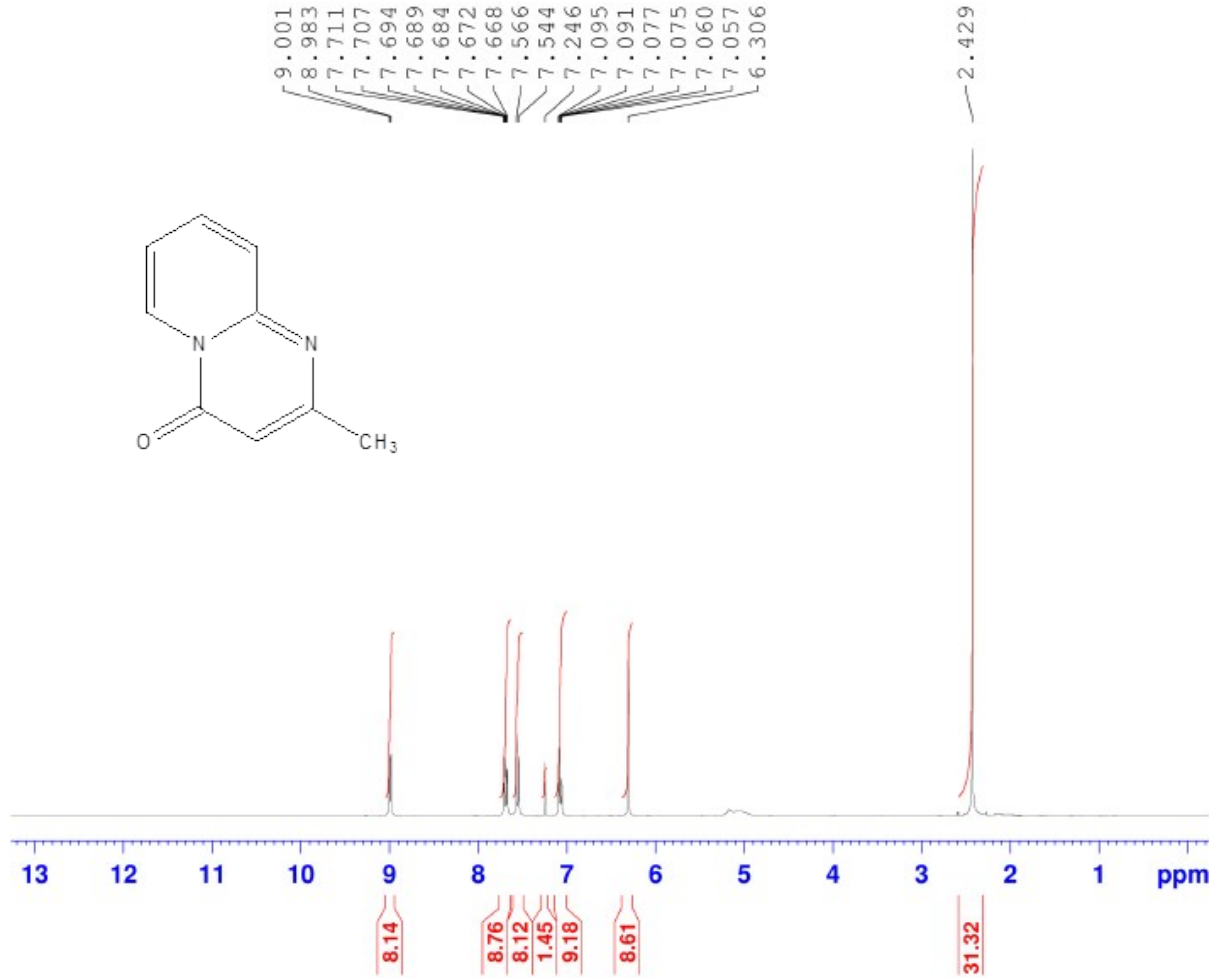
----- CHANNEL f1 -----
 NUC1 1H
 P1 13.84 usec
 PLW1 12.39000034 W
 SF01 400.1824713 MHz

F2 - Processing parameters
 SI 65536
 SF 400.1800200 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 2.00

Dr.Raoo
 Sample : N-11 CDCL3
 PROTON CDCl3 D:\ nmr



9.001
 8.983
 7.711
 7.707
 7.694
 7.689
 7.684
 7.672
 7.668
 7.566
 7.544
 7.246
 7.095
 7.091
 7.077
 7.075
 7.060
 7.057
 6.306



Current Data Parameters
 NAME RAOO N-11 06-01-2016
 EXPNO 10
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20160106
 Time 13.23
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zg30
 ID 65536
 SOLVENT CDCl3
 NS 64
 DS 2
 SWH 8223.685 Hz
 FIDRES 0.125483 Hz
 AQ 3.9846387 sec
 RG 102.07
 DW 60.800 usec
 DE 6.50 usec
 TE 298.1 K
 D1 1.0000000 sec

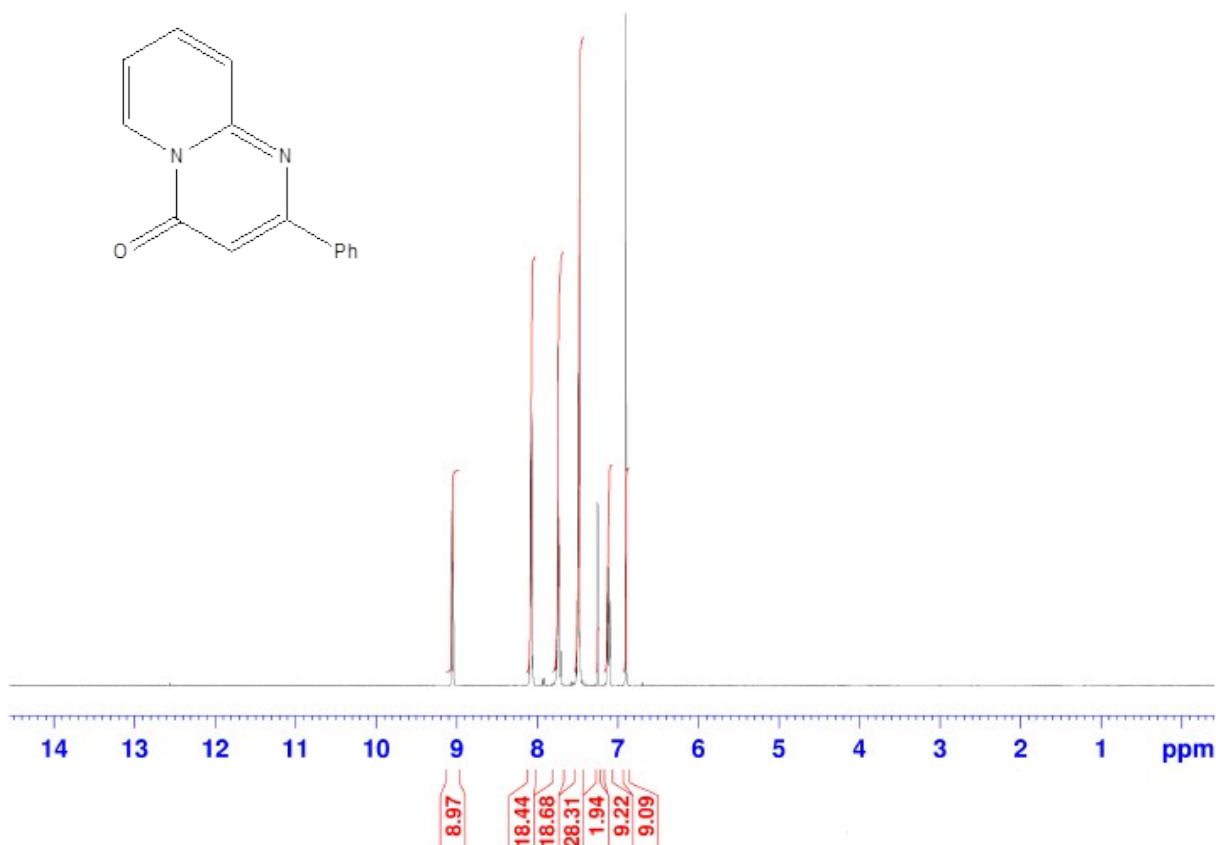
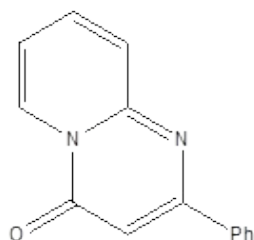
----- CHANNEL f1 -----
 NUC1 1H
 P1 13.84 usec
 PLW1 12.39000034 W
 SFO1 400.1824713 MHz

F2 - Processing parameters
 SI 65536
 SF 400.1800200 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 2.00

Dr.Rao
 Sample : N-13 CDCL3
 PROTON CDC13 D:\ nmr



9.064
 9.062
 9.059
 9.044
 8.099
 8.087
 8.081
 8.078
 8.076
 8.072
 8.068
 8.062
 8.053
 7.764
 7.746
 7.743
 7.732
 7.729
 7.721
 7.710
 7.706
 7.515
 7.512
 7.510
 7.500
 7.496
 7.491
 7.487
 7.479
 7.474
 7.469
 7.464
 7.455
 7.246
 7.136
 7.130
 7.122
 7.118
 7.116
 7.112
 7.104
 7.098
 6.896



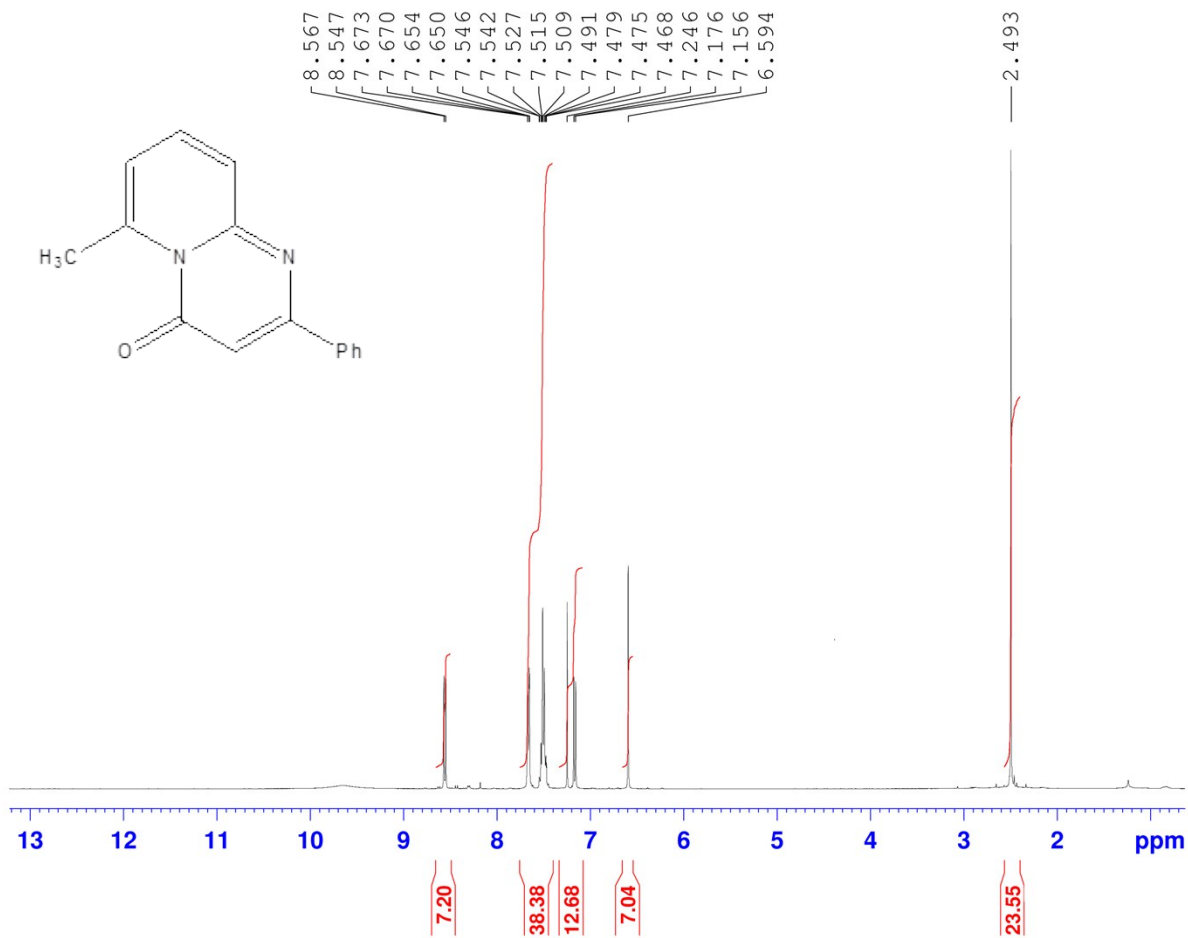
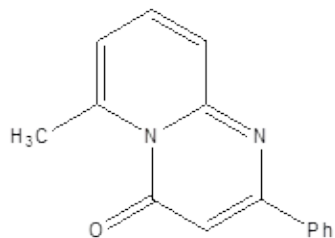
Current Data Parameters
 NAME RAO N-13 06-01-2016
 EXPNO 10
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20160106
 Time 14.30
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zg30
 TD 65536
 SOLVENT CDCL3
 NS 64
 DS 2
 SWH 8224.885 Hz
 FIDRES 0.125483 Hz
 AQ 3.9846387 sec
 RG 115.23
 DW 60.800 usec
 DE 6.50 usec
 TE 298.1 K
 D1 1.00000000 sec

----- CHANNEL f1 -----
 NUC1 1H
 P1 13.84 usec
 PLW1 12.39000034 W
 SFO1 400.1824713 MHz

F2 - Processing parameters
 SI 65536
 SF 400.1800200 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 2.00

Dr. Raoo
 Sample : N-23 CDCL3
 PROTON CDC13 D:\ nmr



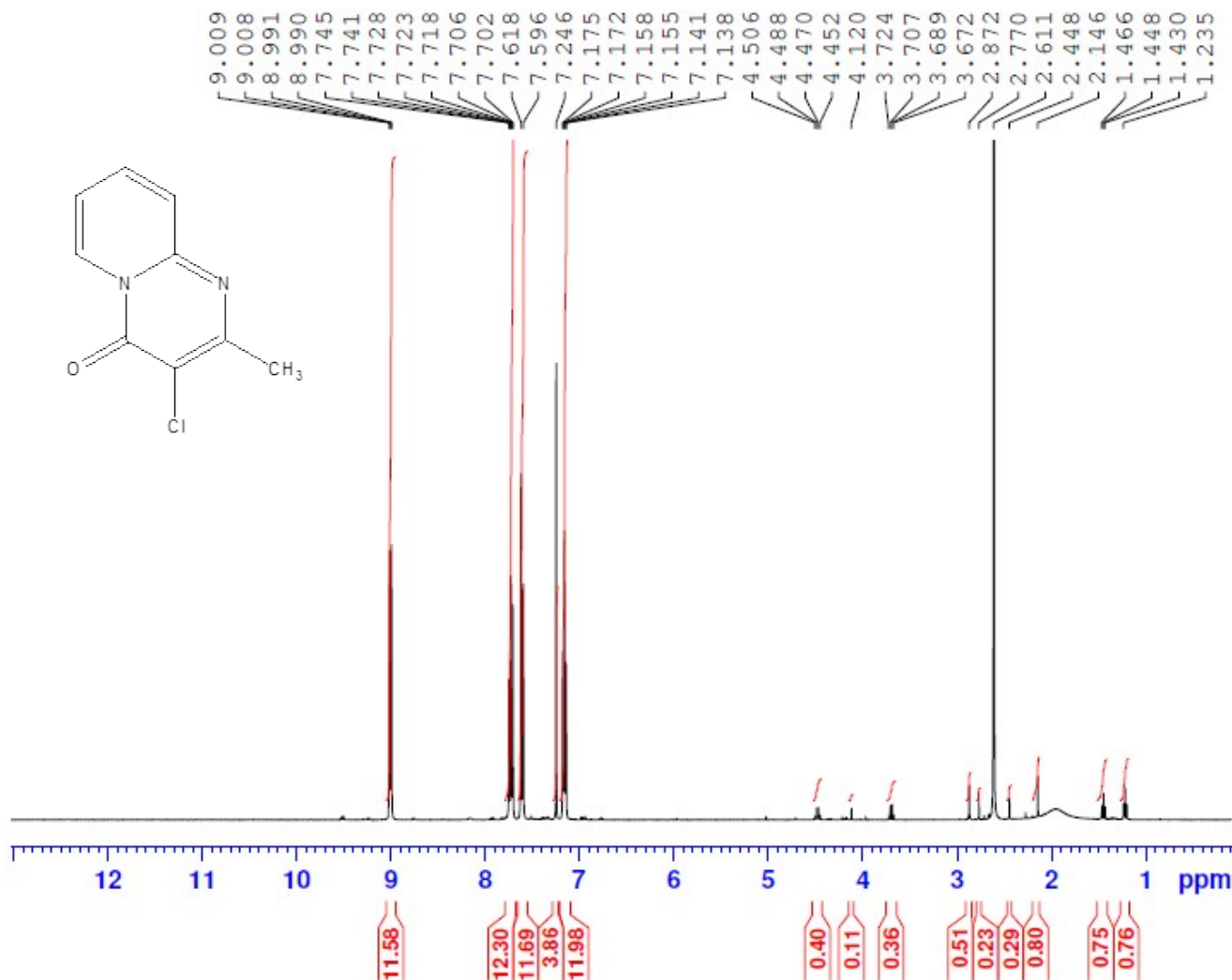
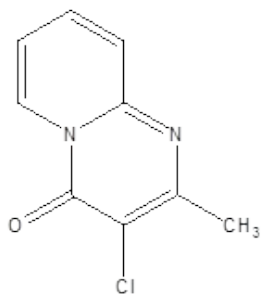
Current Data Parameters
 NAME RAOO N-23 06-01-20
 EXPNO 10
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20160106
 Time 19.59
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zg30
 TD 65536
 SOLVENT CDC13
 NS 64
 DS 2
 SWH 8223.685 Hz
 FIDRES 0.125483 Hz
 AQ 3.9846387 sec
 RG 185.19
 DW 60.800 usec
 DE 6.50 usec
 TE 298.0 K
 D1 1.00000000 sec

===== CHANNEL f1 =====
 NUC1 1H
 P1 13.84 usec
 PLW1 12.39000034 W
 SFO1 400.1824713 MHz

F2 - Processing parameters
 SI 65536
 SF 400.1800200 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 2.00

Dr. Rao
 Sample : N-12 CDCL3
 PROTON CDC13 D:\ nmr



Current Data Parameters
 NAME RAOO N-12 06-01-2016
 EXPNO 10
 PROCNO 1

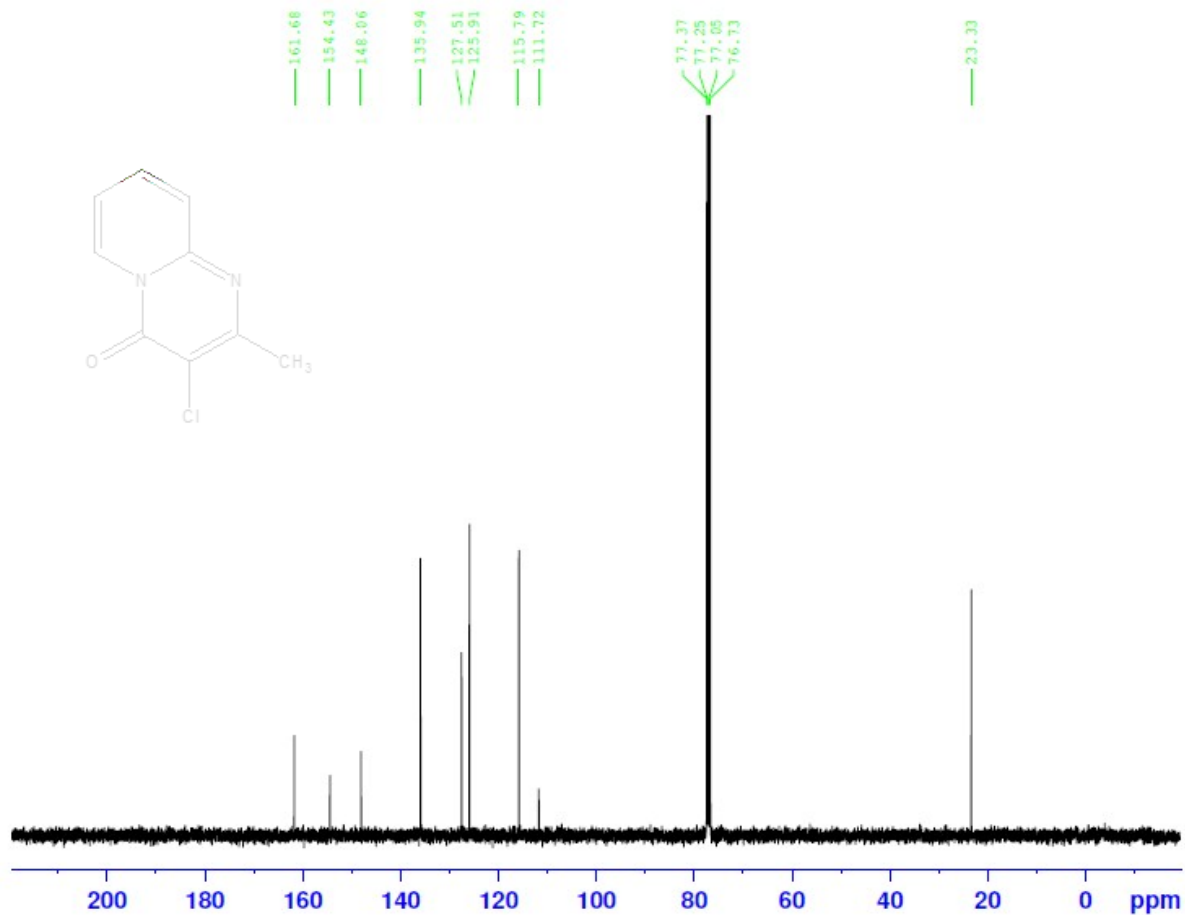
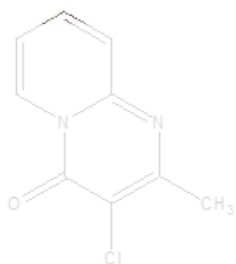
F2 - Acquisition Parameters
 Date_ 20160106
 Time 13.48
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zg30
 TD 65536
 SOLVENT CDC13
 NS 64
 DS 2
 SWH 8223.685 Hz
 FIDRES 0.125483 Hz
 AQ 3.9846387 sec
 RG 141.04
 DW 60.800 usec
 DE 6.50 usec
 TE 298.0 K
 D1 1.00000000 sec

==== CHANNEL f1 =====
 NUC1 1H
 P1 13.84 usec
 PLW1 12.39000034 W
 SFO1 400.1824713 MHz

F2 - Processing parameters
 SI 65536
 SF 400.1800200 MHz
 WDW EM
 SSB 0
 LB 0.30 Hz
 GB 0
 PC 2.00

13C NMR spectra

Dr. Raoo
 Sample : N-12 CDCL3
 C13CPD CDC13 D:\ nmr



Current Data Parameters
 NAME RAOO N-12 06-01-2016
 EXPNO 11
 PROCNO 1

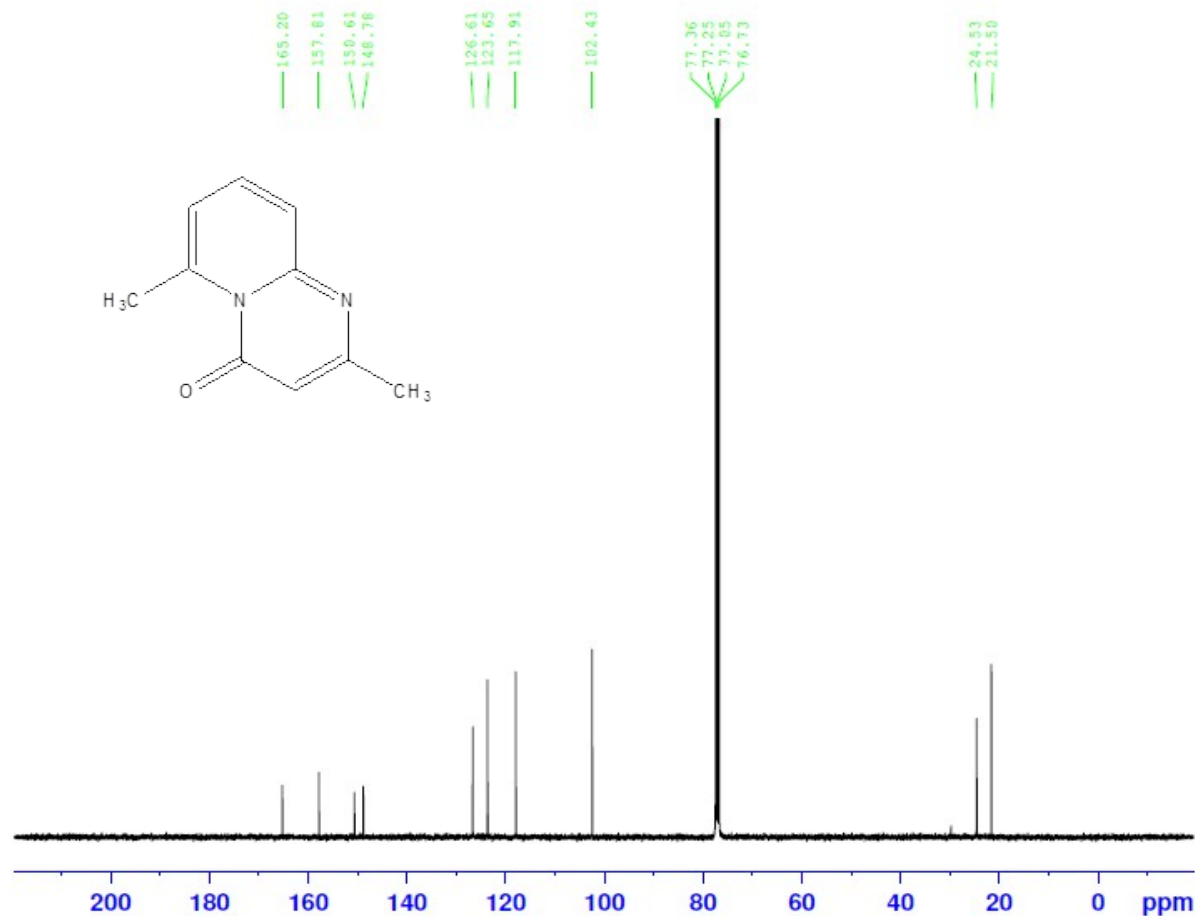
F2 - Acquisition Parameters
 Date_ 20160106
 Time 13.55
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zgpg30
 TD 65536
 SOLVENT CDCL3
 NS 510
 DS 4
 SWH 24038.461 Hz
 FIDRES 0.366798 Hz
 AQ 1.3631988 sec
 RG 185.19
 LW 20.800 usec
 DE 6.50 usec
 TE 298.0 K
 D1 2.0000000 sec
 D11 0.0300000 sec

==== CHANNEL f1 ====
 NUC1 13C
 P1 8.87 usec
 PLW1 61.0000000 W
 SFO1 100.6354031 MHz

==== CHANNEL f2 ====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 90.00 usec
 PLW2 12.39000034 W
 PLW12 0.29299000 W
 PLW13 0.14654000 W
 SFO2 400.1816007 MHz

F2 - Processing parameters
 SI 32768
 SF 100.6253410 MHz
 WDW EM
 SSB 0
 LB 1.00 Hz
 GB 0
 PC 1.40

Dr. Rao
Sample : N-21 CDCL3
C13CPD CDC13 D:\ nmr



Current Data Parameters
NAME RAOO N-21 06-01-2016
EXPNO 11
PROCNO 1

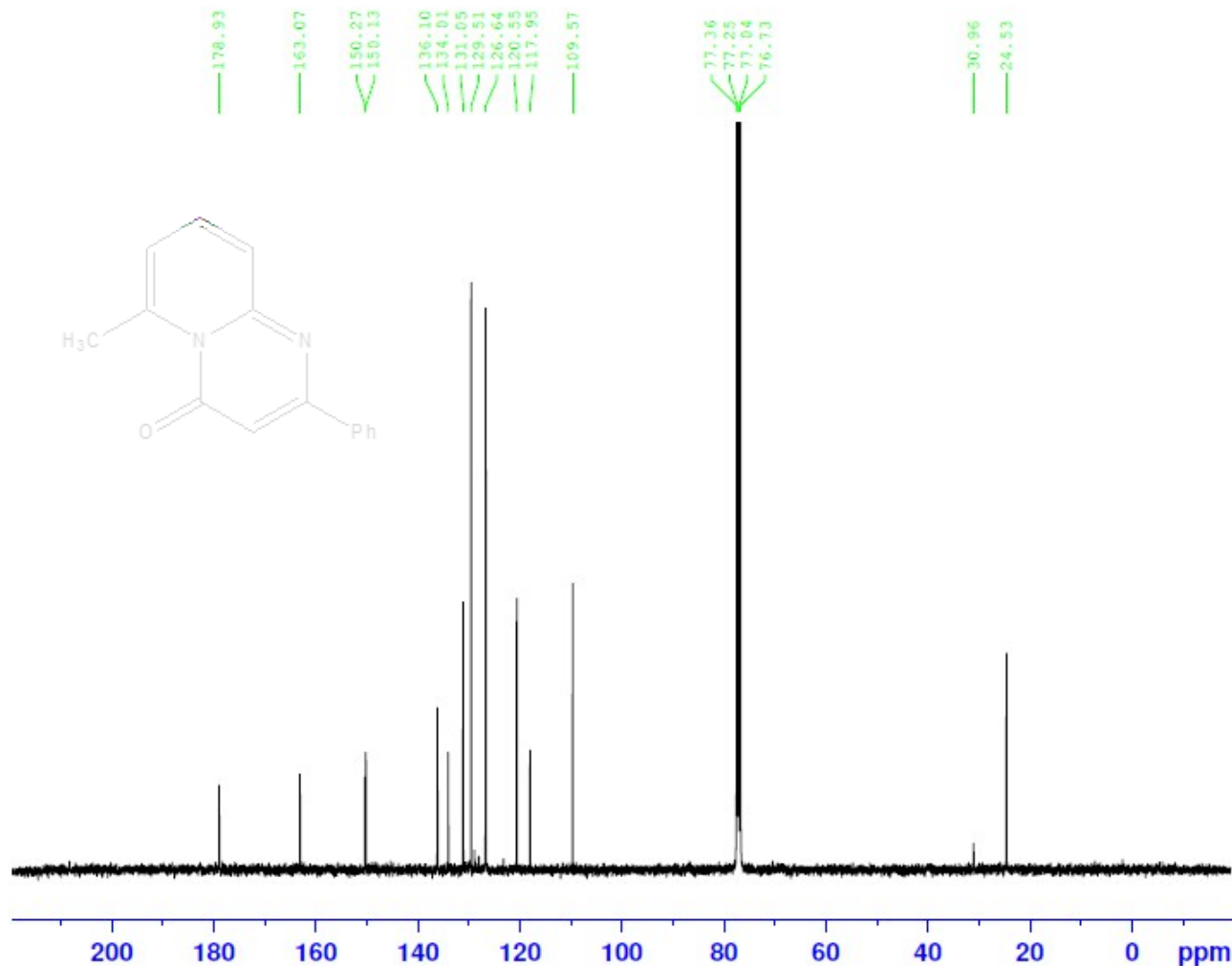
F2 - Acquisition Parameters
Date_ 20160106
Time 15.08
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDCL3
NS 5120
DS 4
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 198.36
DW 20.800 usec
DE 6.50 usec
TE 298.0 K
D1 2.0000000 sec
D11 0.0300000 sec

==== CHANNEL f1 =====
NUC1 13C
P1 8.87 usec
PLW1 61.0000000 W
SFO1 100.6354031 MHz

==== CHANNEL f2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 90.00 usec
PLW2 12.39000034 W
PLW12 0.29299000 W
PLW13 0.14654000 W
SFO2 400.1816007 MHz

F2 - Processing parameters
SI 32768
SF 100.6253410 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 2.00

Dr. Raoo
 Sample : N-23 CDCL3
 C13CPD CDC13 D:\ nmr



Current Data Parameters
 NAME RA00 N-23 06-01-2016
 EXPNO 11
 PROCNO 1

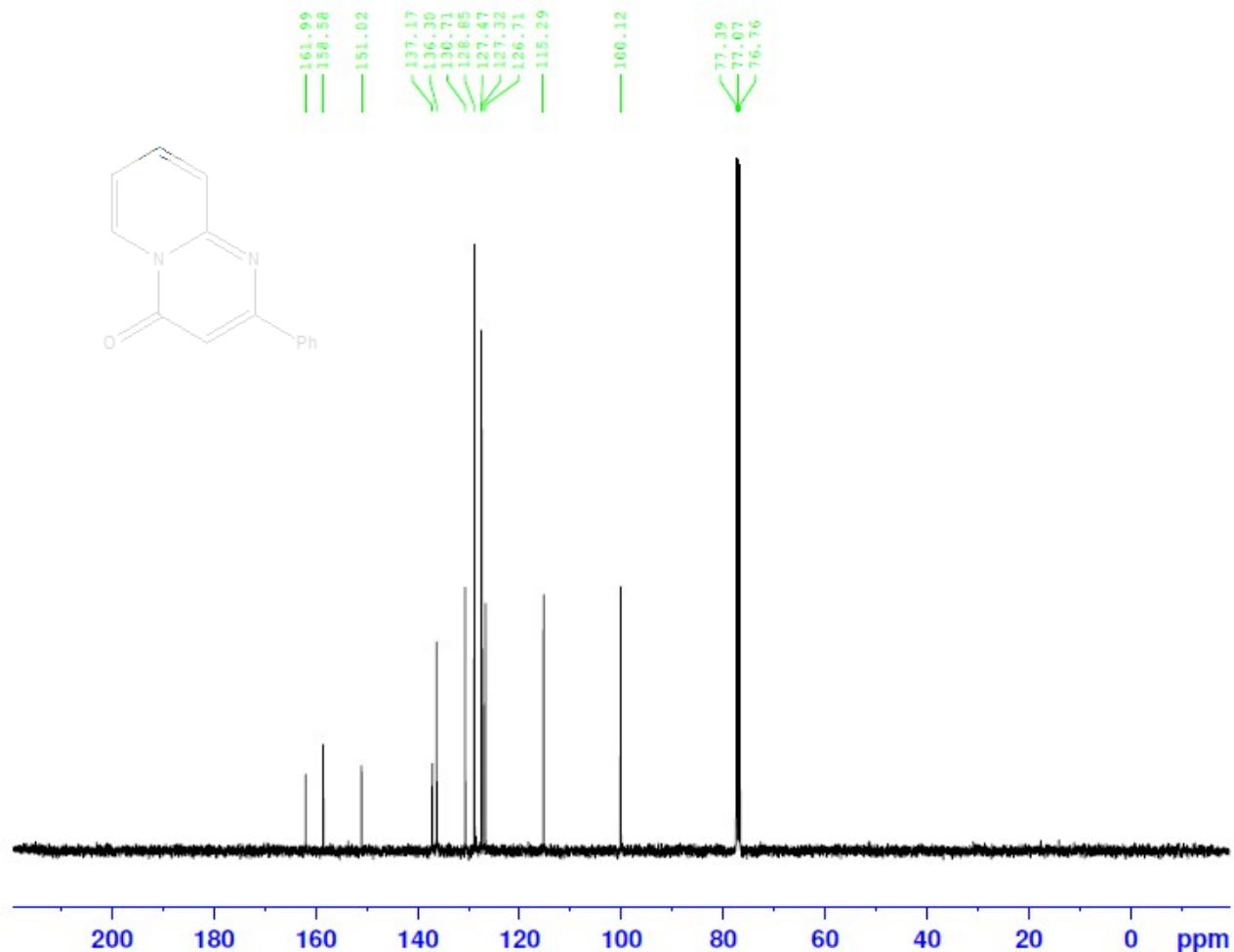
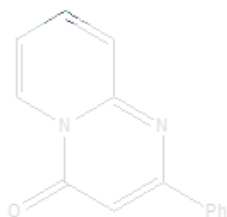
F2 - Acquisition Parameters
 Date_ 20160107
 Time 0.53
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zgpg30
 TD 65536
 SOLVENT CDC13
 NS 5120
 DS 4
 SWH 24038.461 Hz
 FIDRES 0.366798 Hz
 AQ 1.3631988 sec
 RG 115.23
 DW 20.800 usec
 DE 6.50 usec
 TE 298.0 K
 D1 2.0000000 sec
 D11 0.0300000 sec

==== CHANNEL f1 =====
 NUC1 13C
 P1 8.87 usec
 PLW1 61.0000000 W
 SFO1 100.6354031 MHz

==== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 90.00 usec
 PLW2 12.39000034 W
 PLW12 0.29299000 W
 PLW13 0.14654000 W
 SFO2 400.1816007 MHz

F2 - Processing parameters
 SI 32768
 SF 100.6253410 MHz
 WDW EM
 SSB 0
 LB 1.50 Hz
 GB 0
 PC 2.00

Dr. Raoo
Sample : N-13 CDCL3
C13CPD CDC13 D:\ nmr



Current Data Parameters
NAME RA00 N-13 06-01-2016
EXPNO 11
PROCNO 1

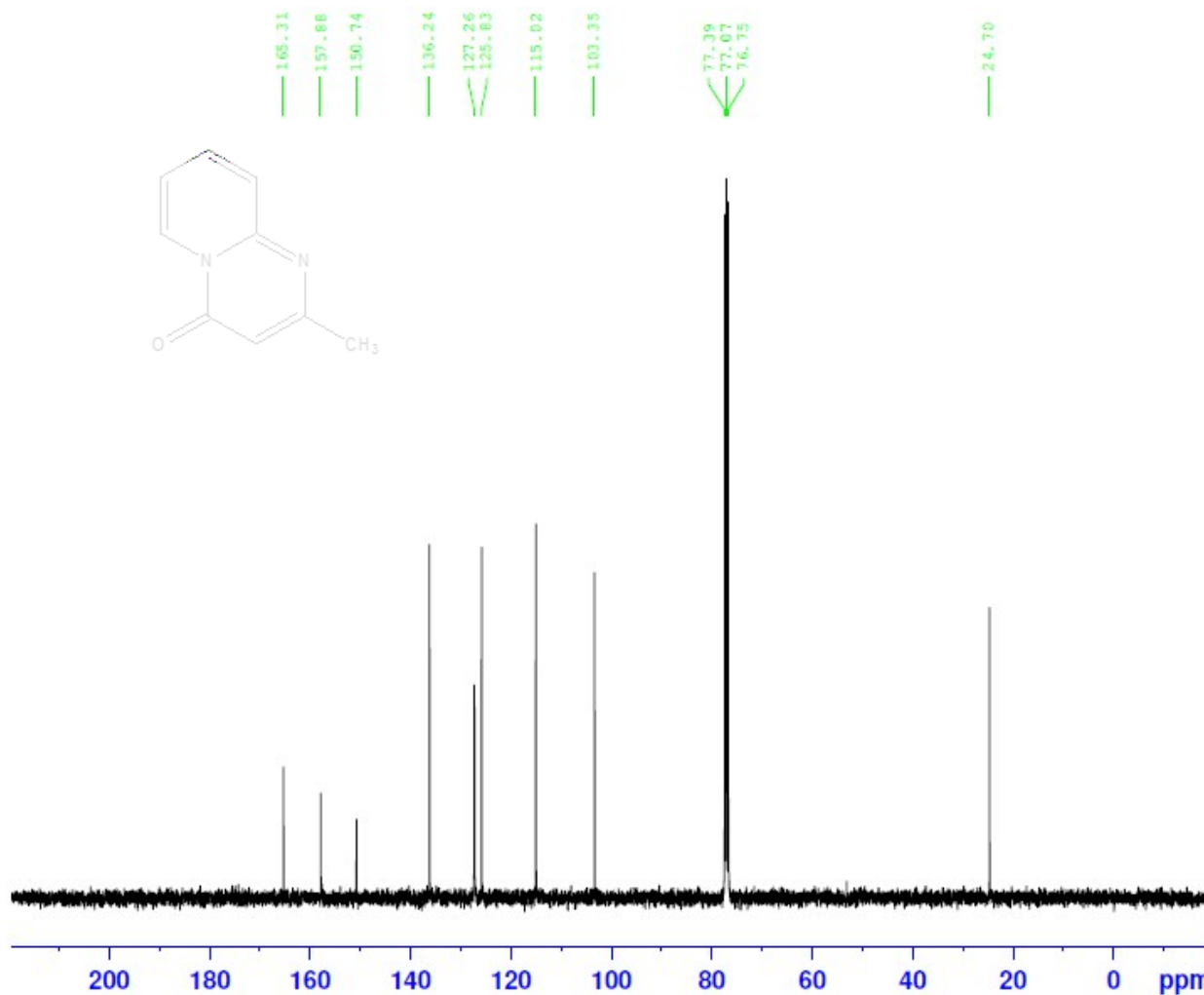
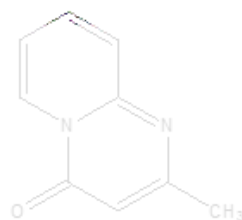
F2 - Acquisition Parameters
Date_ 20160106
Time 14.47
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
TD 65536
SOLVENT CDC13
NS 270
DS 4
SWH 24038.461 Hz
FIDRES 0.366798 Hz
AQ 1.3631988 sec
RG 185.19
DW 20.800 usec
DE 6.50 usec
TE 298.0 K
D1 2.00000000 sec
D11 0.03000000 sec

==== CHANNEL f1 =====
NUC1 13C
P1 8.87 usec
PLW1 61.00000000 W
SFO1 100.6354031 MHz

==== CHANNEL F2 =====
CPDPRG2 waltz16
NUC2 1H
PCPD2 90.00 usec
PLW2 12.39000034 W
PLW12 0.29299000 W
PLW13 0.14654000 W
SFO2 400.1816007 MHz

F2 - Processing parameters
SI 32768
SF 100.6253410 MHz
WDW EM
SSB 0
LB 1.50 Hz
GB 0
PC 2.00

Dr. Raoo
 Sample : N-11 CDCL3
 C13CPD CDC13 D:\ nmr



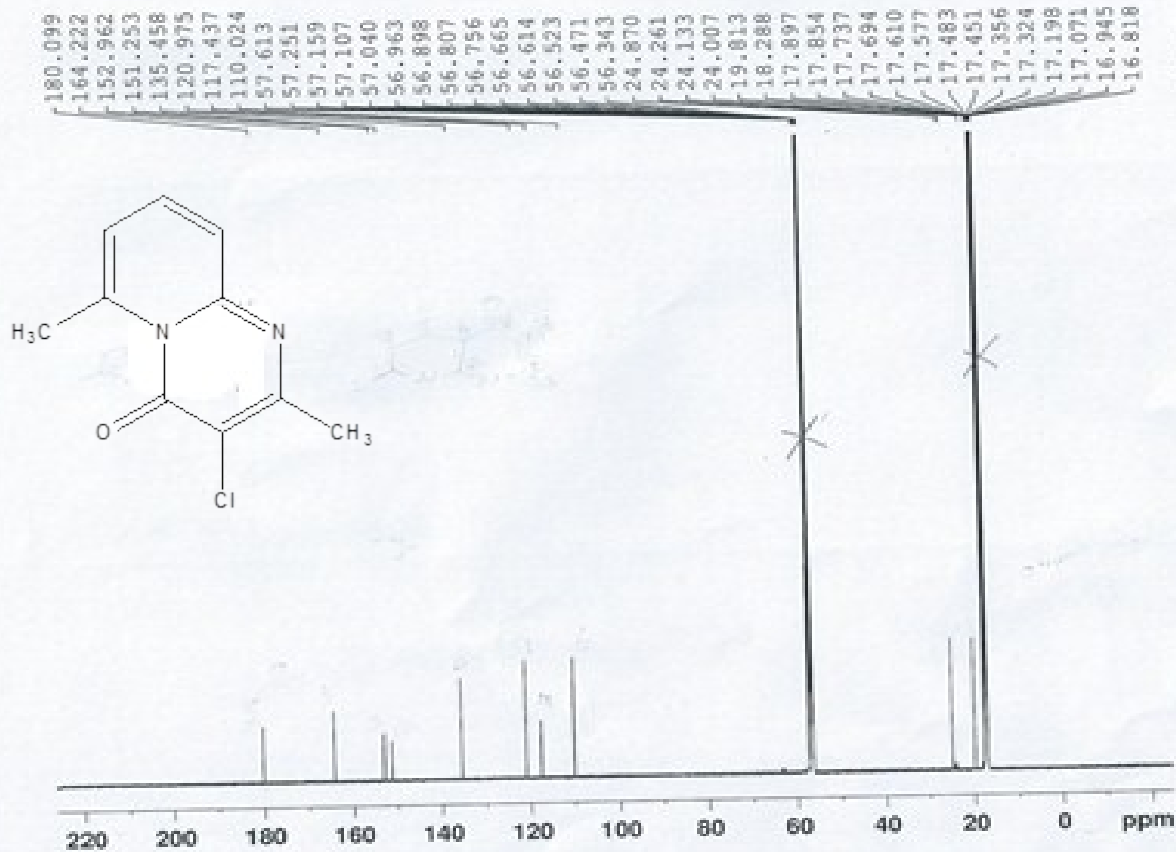
Current Data Parameters
 NAME RAOO N-11 06-01-2016
 EXPNO 11
 PROCNO 1

F2 - Acquisition Parameters
 Date_ 20160106
 Time 13.26
 INSTRUM spect
 PROBHD 5 mm PABBO BB-
 PULPROG zgpg30
 TD 65536
 SOLVENT CDC13
 NS 240
 DS 4
 SWH 24038.461 Hz
 FIDRES 0.366798 Hz
 AQ 1.3631988 sec
 RG 198.36
 DW 20.800 usec
 DE 6.50 usec
 TE 297.9 K
 D1 2.00000000 sec
 D11 0.03000000 sec

==== CHANNEL f1 =====
 NUC1 13C
 P1 8.87 usec
 PLW1 61.00000000 W
 SFO1 100.6354031 MHz

==== CHANNEL f2 =====
 CPDPRG2 waltz16
 NUC2 1H
 PCPD2 90.00 usec
 PLW2 12.39000034 W
 PLW12 0.29299000 W
 PLW13 0.14654000 W
 SFO2 400.1816007 MHz

F2 - Processing parameters
 SI 32768
 SF 100.6253410 MHz
 WDW EM
 SSB 0
 LB 1.50 Hz
 GB 0
 PC 2.00

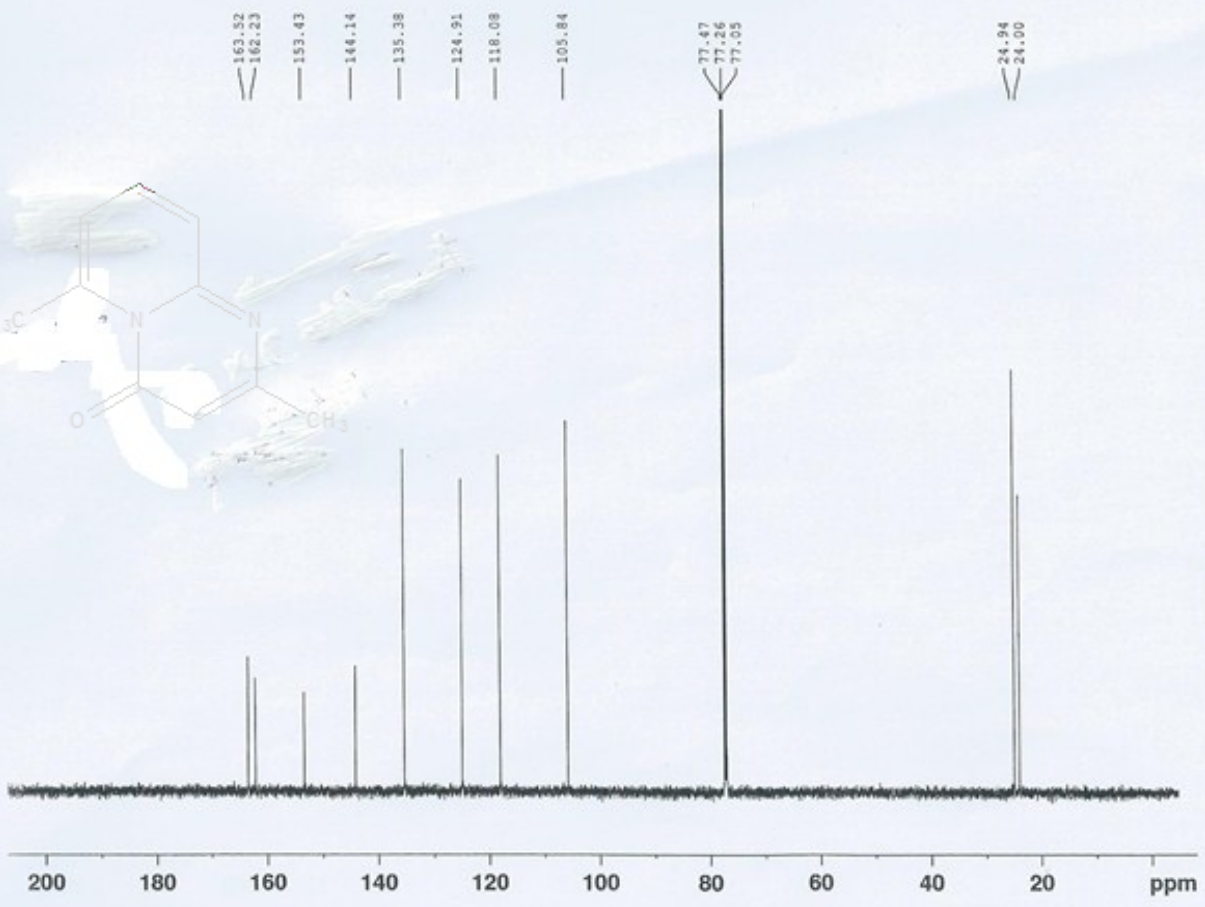
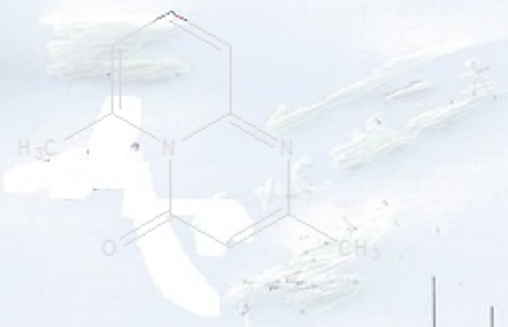


```

EXPNO          11
PROCNO         4
Date_          1
Time
INSTRUM        spect
PROBHD         5 mm CPDOR 13C
PULPROG        zgpg30
TD             131072
SF            125.761 MHz
SOLVENT        CDCl3
NS             4096
DS             4
SWH            31678.789 Hz
FIDRES        0.288992 Hz
AQ            1.7362004 sec
RG            203
DM            13.200 usec
DE            71.32 usec
TE            299.0 K
D1            2.0000000 sec
D11           0.0300000 sec
TD0           1

===== CHANNEL f1 =====
NUC1           13C
P1             9.90 usec
PL1            2.80 dB
PL12W         37.96579361 W
SFO1          125.7610000 MHz

===== CHANNEL f2 =====
CPDPRG2       waltz16
NUC2           1H
PCPD2         70.00 usec
PS2           -0.70 dB
PL12         16.20 dB
PL13         19.20 dB
PL2W         19.62554169 W
PL12W        0.39248162 W
PL13W        0.19670779 W
SFO2         400.6824000 MHz
SI            131072
SF           150.8900967 MHz
WDW           EM
SSB           0
LB            1.00 Hz
GB            0
PC            1.40
  
```



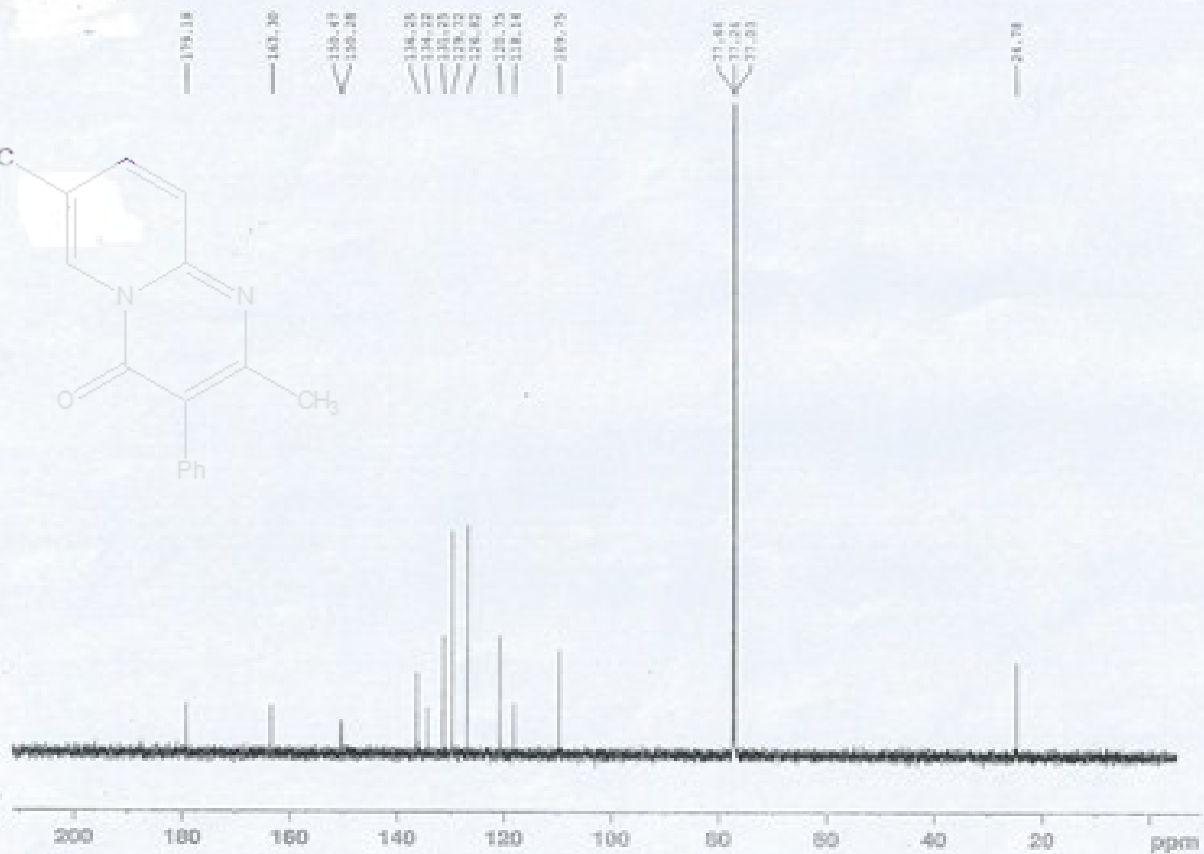
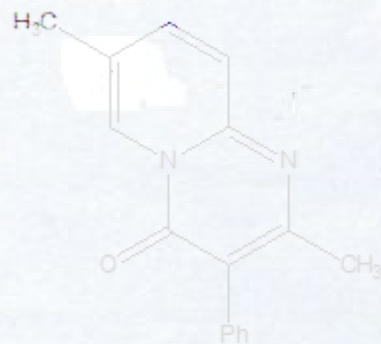
Current Data Parameters
NAME Ectans6
EXPNO 12
PROCNO 1

F2 - Acquisition Parameters
NAME spect
INSTRUM spect
PROBHD 5 mm PABBI 1H/
PULPROG zgpg30
TD 32768
SOLVENT CDCl3
NS 512
DS 4
SWH 34722.223 Hz
FIDRES 1.059638 Hz
AQ 0.4719002 sec
RG 173.48
DW 14.400 usec
DE 6.50 usec
TE 298.0 K
D1 2.0000000 sec
D11 0.0300000 sec
TD0 1

----- CHANNEL f1 -----
NUC1 13C
P1 14.90 usec
PLW1 101.0000000 W
SFO1 150.9194083 MHz

----- CHANNEL f2 -----
CPDPRG2 waltz16
NUC2 1H
PCPD2 70.00 usec
PLW2 15.5000000 W
PLW12 0.19742000 W
PLW13 0.03673600 W
SFO2 400.1319193 MHz

F2 - Processing parameters
SI 32768
SF 150.9027168 MHz
WDW EM
SSB 0
LB 1.00 Hz
GB 0
PC 1.40



Current Data Parameters
 NAME: T00000_2
 EXPR: 12
 PROCNO: 1

F2 - Acquisition Parameters
 F2: 127.75 MHz
 DATE_1: 20000101
 TIME: 10.00
 PULPROG: zgpg30
 FULPROG: zgpg30
 PSYPRG: zgpg30
 PC: 32768
 SOLVENT: CDCl3
 NS: 612
 DS: 4
 SWH: 34702.251 Hz
 FIDRES: 1.258800 Hz
 AQ: 0.4710000 sec
 RG: 313.88
 SF: 14.4600 MHz
 CF: 4.50 MHz
 CB: 299.0 Hz
 CD: 0.0000000 sec
 C1: 0.0000000 sec
 C2: 0.0000000 sec
 C3: 0.0000000 sec
 C4: 0.0000000 sec

===== CHANNEL F1 =====
 NUCL1: 13C
 P1: 14.00 usec
 PL1: 100.0000000 W
 PR1: 100.0000000 Hz

===== CHANNEL F2 =====
 CPDPRG2: waltz16
 NUCL2: 1H
 P2P2P2: 79.00 usec
 PL2: 10.00000000 W
 PL3: 0.19742000 W
 PR3: 0.00000000 Hz
 PR4: 0.00000000 Hz
 PR5: 400.0000000 MHz

F2 - Processing parameters
 SI: 32768
 SF: 127.7500000 MHz
 WHW: 4
 DS: 4
 LA: 1.00 Hz
 GB: 0
 PC: 1.40