Supplementary Material

Ultrasound-assisted, $ZnBr_2$-catalyzed regio- and stereoselective synthesis of novel 3,3′-dispiropyrrolidine bisoxindole derivatives via 1,3-dipolar cycloaddition reaction of an azomethine ylide

Mostafa Kiamehr,[a,*] Mohammad R. Khodabakhshi,[b] Firouz M. Moghaddam,[c] Alexander Villinger,[d] and Peter Langer [d,e]

[a] Department of Chemistry, Faculty of Science, University of Qom, Ghadir Blvd, Qom, Iran

[b] Applied Biotechnology Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

[c] Laboratory of Organic Synthesis and Natural Products, Department of Chemistry , Sharif University of Technology, P. O. Box 11155-9516 Tehran, Iran

[d] Institut für Chemie der Universität Rostock, Albert-Einstein-Strasse 3a, D-18059 Rostock, Germany

[e] Leibniz Institut für Katalyse an der Universität Rostock, Albert-Einstein-Strasse 29a, D-18059 Rostock, Germany

Email: mkiamehr@yahoo.com m.kiamehr@qom.ac.ir

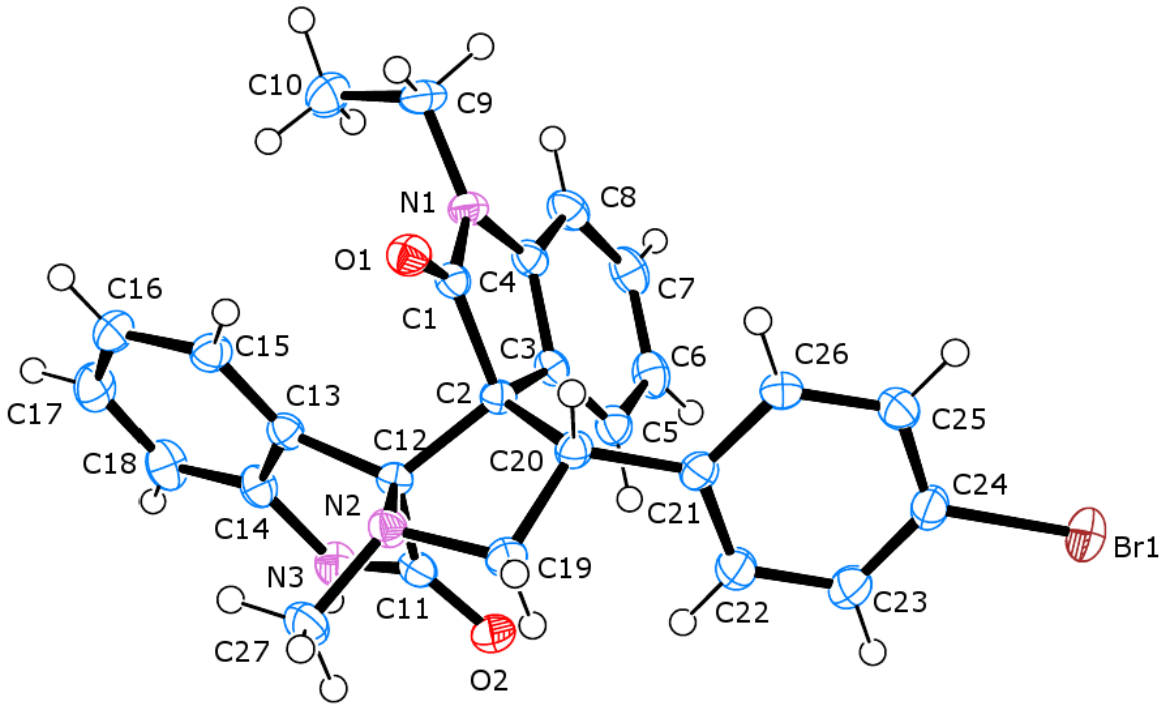
Table of Contents

(A) Experimental

General. The reagents and solvents were commercially available and purchased from *Sigma–Aldrich* and *Merck,* and were used without any additional purification. Ultrasonication was performed in a Parsonic 7500s Ultrasonic Bath with a frequency of 28 kHz and a power of 100 W. The liquid holding capacity of the ultrasonic cleaner tank were 6L. TLC: Silica-gel plates *60 F_{254}* (SiO_2; *Merck*). M.p.*: Büchi* melting point *B-540* apparatus; in sealed capillaries; uncorrected. ^{1}H and ^{13}C NMR Spectra: *Bruker* (*DRX-500 Avance*) spectrometer at 500 (^{1}H) and 125 (^{13}C) MHz, in $CDCl_3$ soln., at ambient temp.; δ in ppm rel. to Me_4Si as internal standard, *J* in Hz. Signals of the ^{13}C NMR spectra corresponding to CH, CH_2 , or CH_3 groups are assigned from DEPT. Infrared spectra were recorded in an ATR apparatus. Mass spectrometric data (MS) were obtained by electron ionization (EI, 70 eV), chemical ionization (CI, isobutane) or electrospray ionization (ESI).

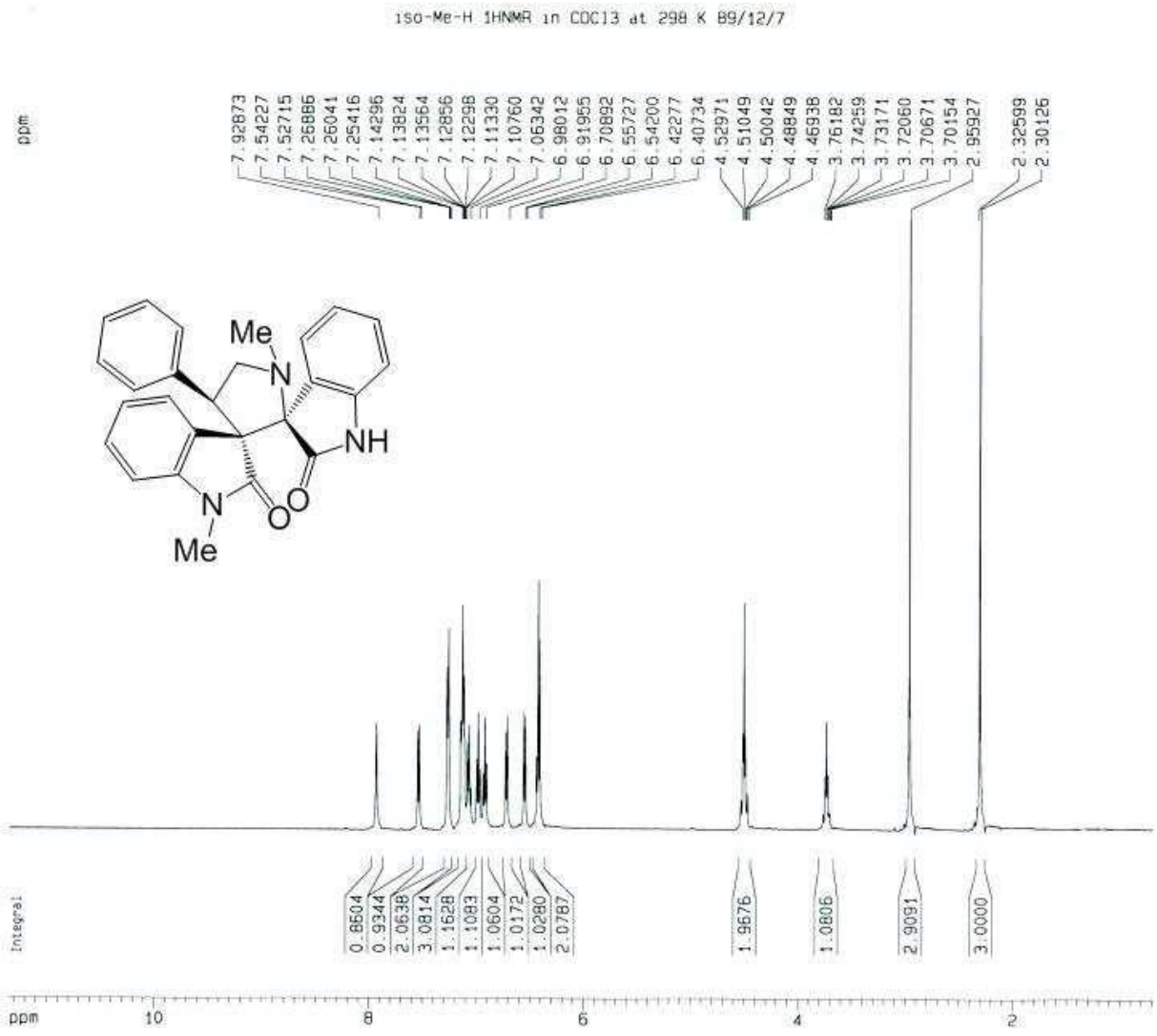
General procedure for synthesis of the 3,3′-dispiropyrrolidine bisoxindole (8a-l): A mixture of *(E)*-3-benzylidene-indolin-2-one **7a-l** (1 mmol), isatin (147 mg, 1 mmol), sarcosine (89 mg, 1 mmol) and anhydrous $ZnBr_2$ (20%, 45 mg, 0.2 mmol) in methanol (10 ml) was sonicated for 30 minute at room temperature (25-30 ^{o}C). After completion of the reaction as monitored by TLC, the mixture was poured in ice cold water and the precipitates were filtered and air dried. Then the product was recrystallized from methanol to afford the pure product **8a-l**.

(B) X-Ray structure of compound 8i

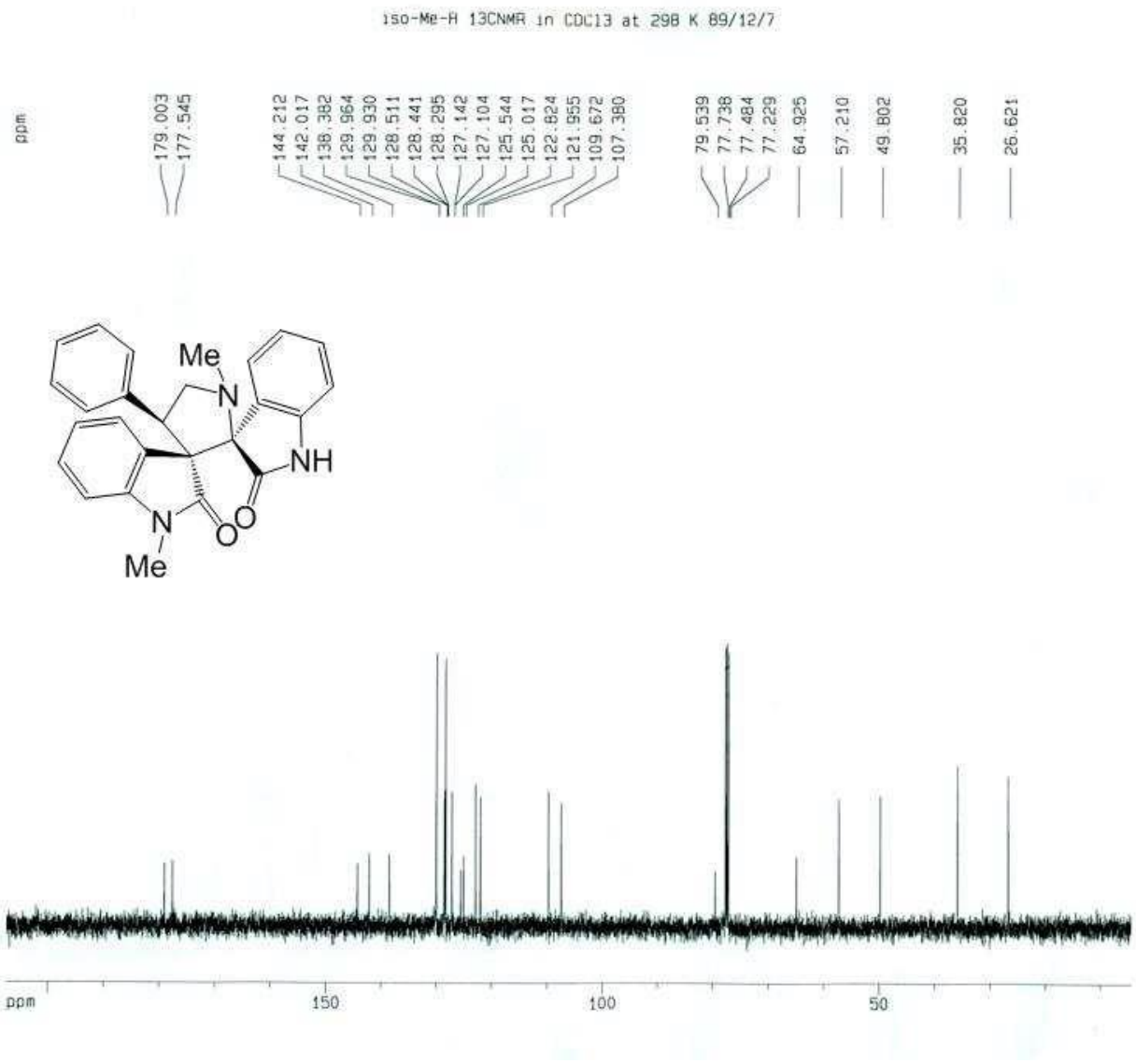


X-Ray Crystallography Structure of Compound **8i**

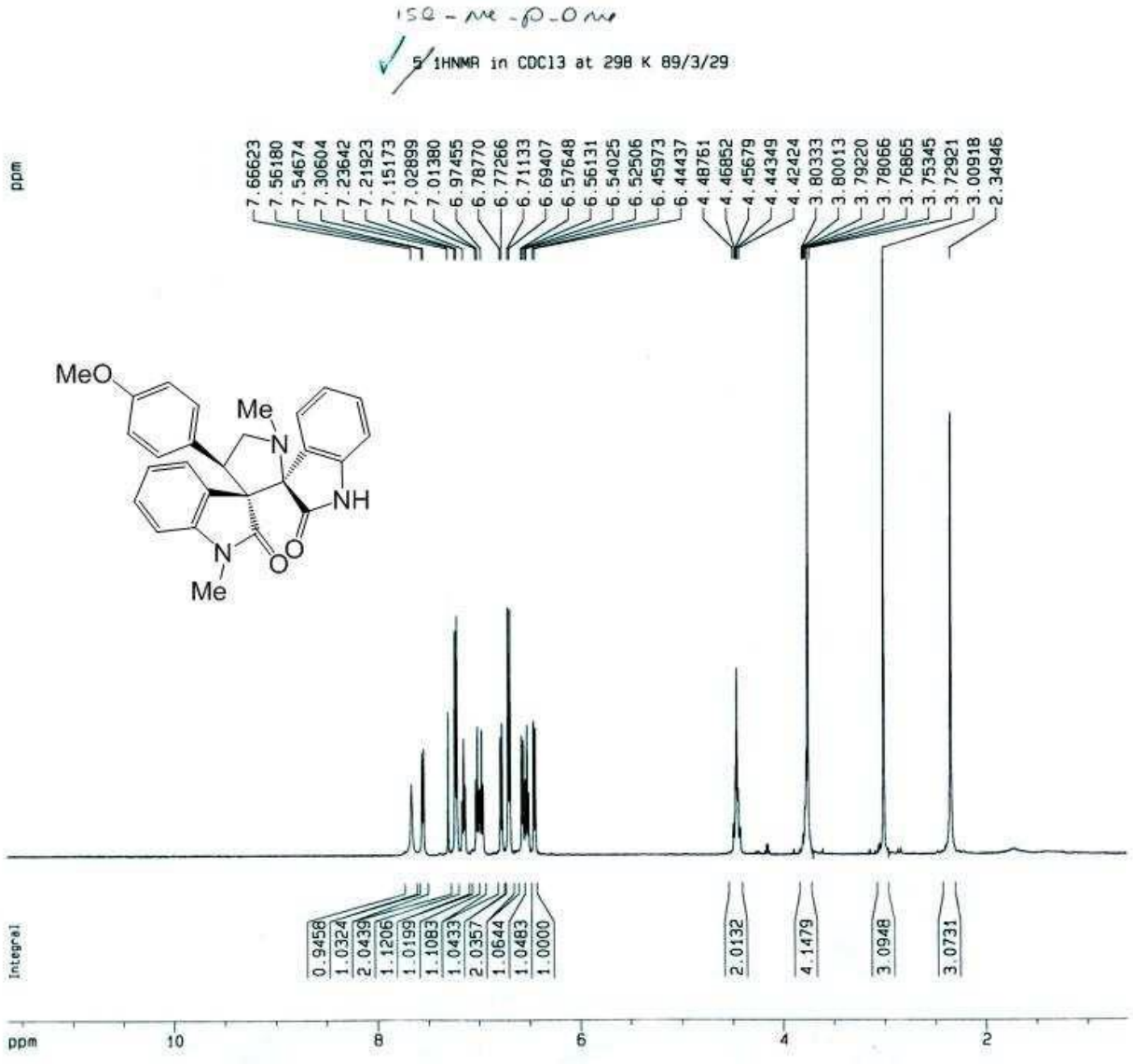
(C) Copies of ^{1}H and ^{13}C NMR spectra for compounds 8



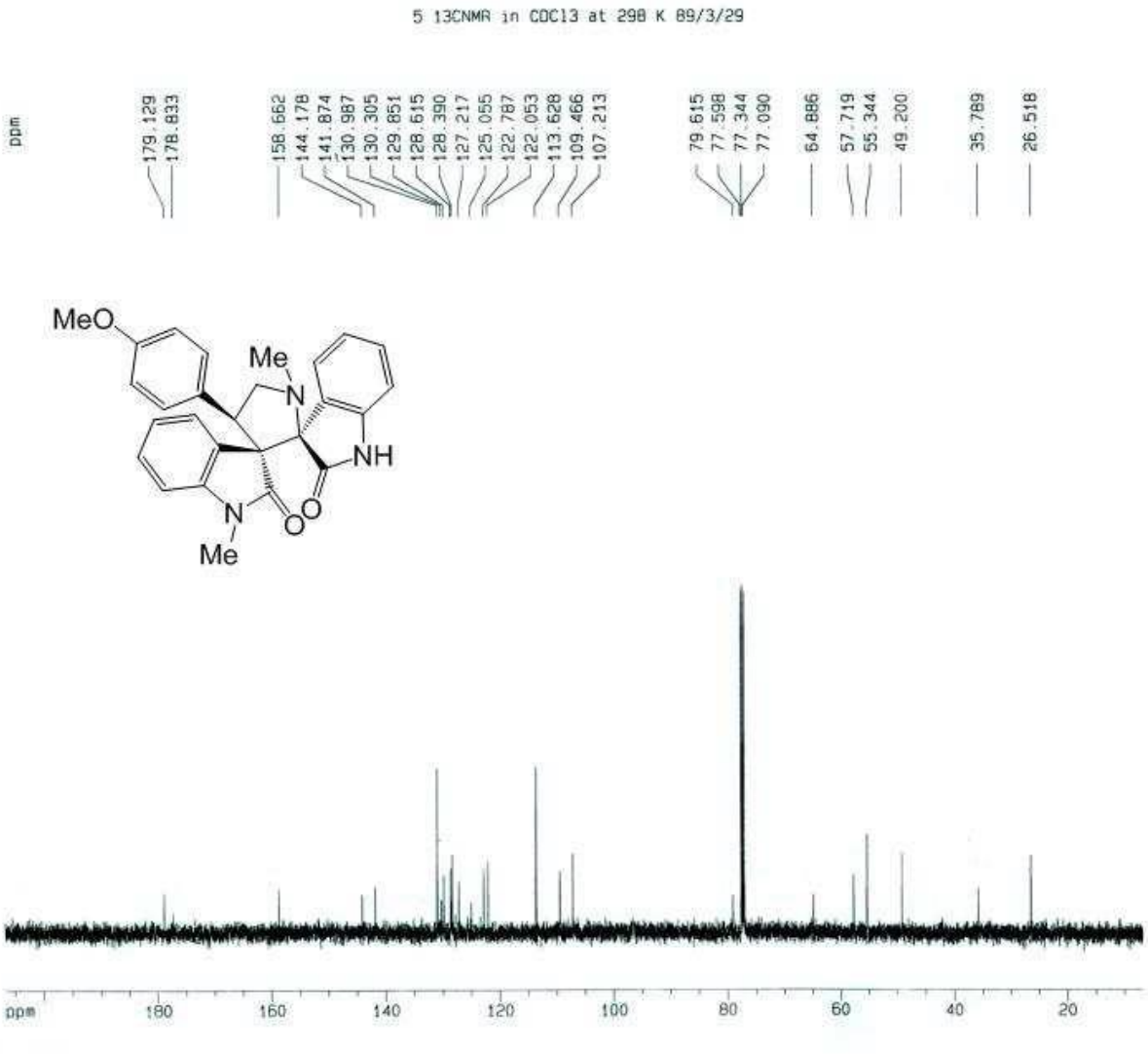
^{1}H NMR spectra for compound 8a



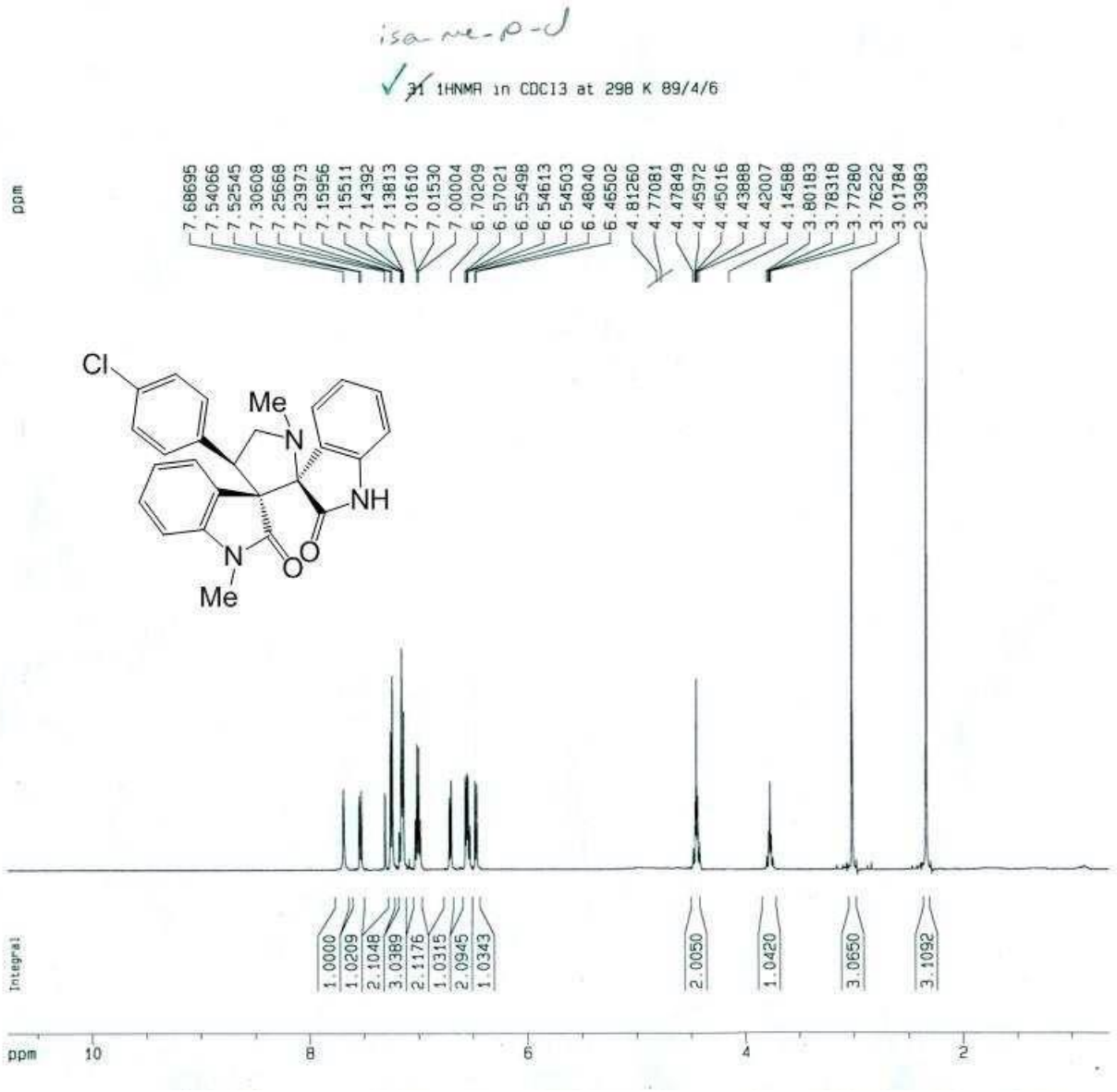
^{13}C NMR spectra for compound 8a



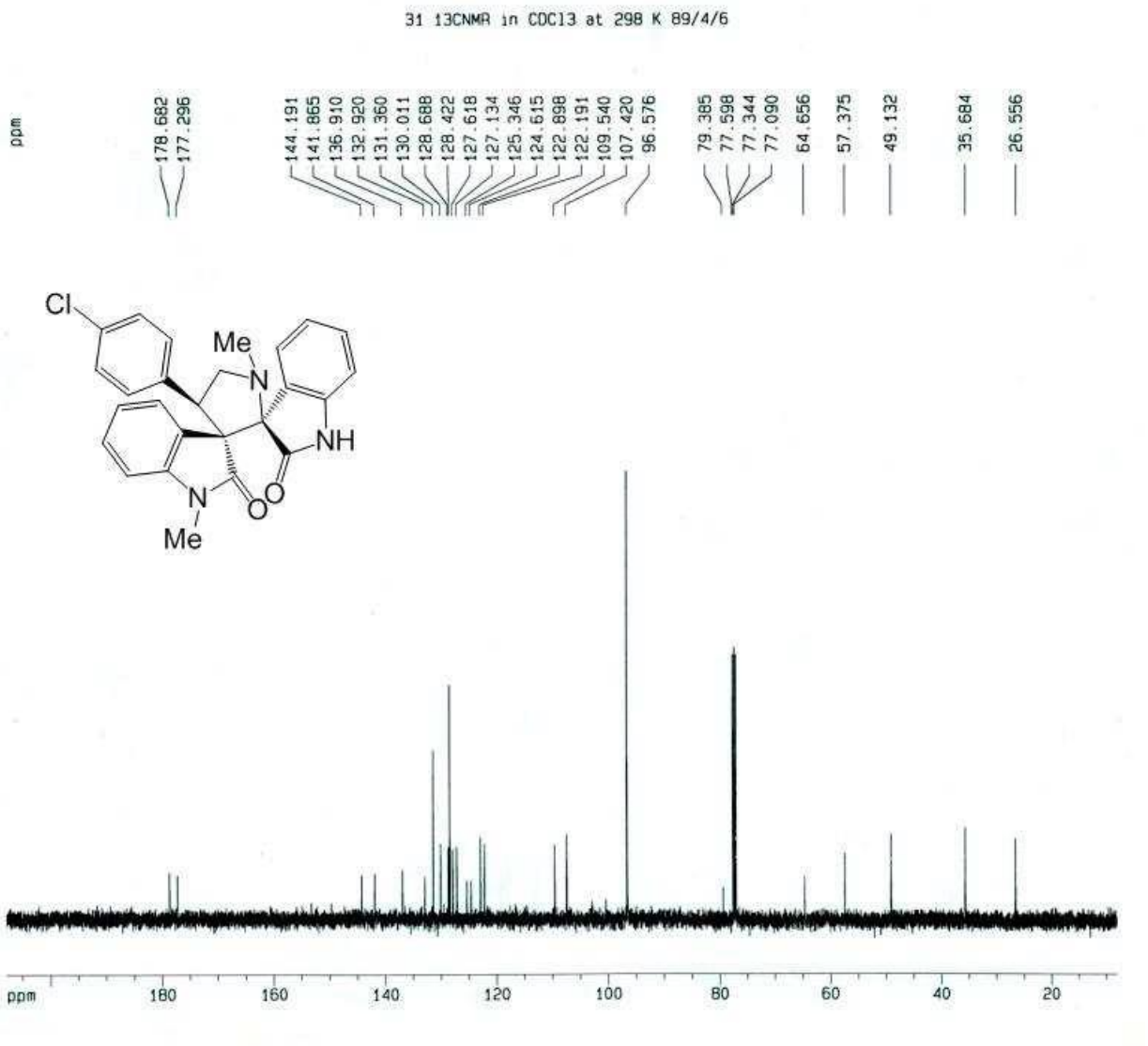
^{1}H NMR spectra for compound 8b



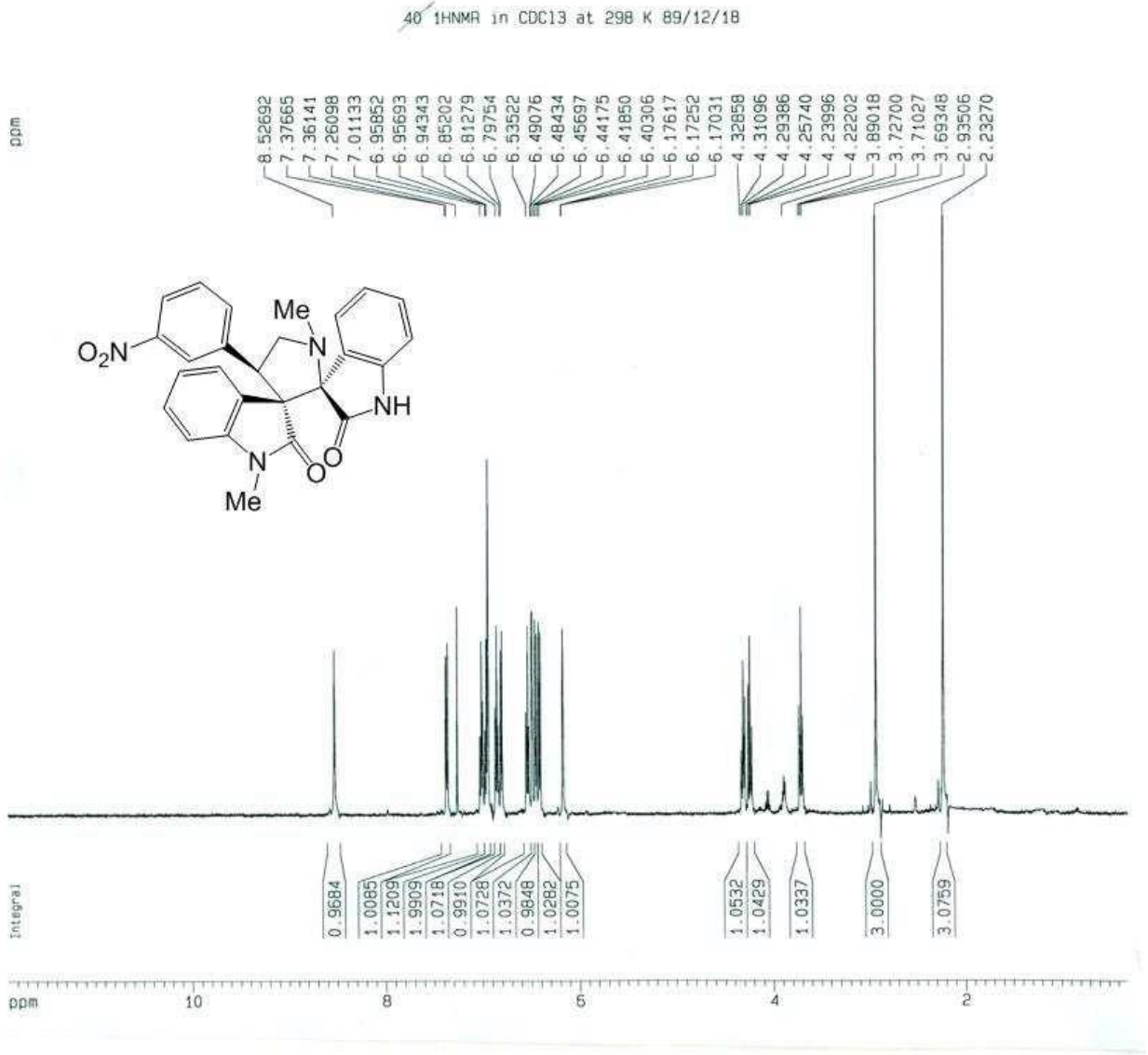
^{13}C NMR spectra for compound 8b



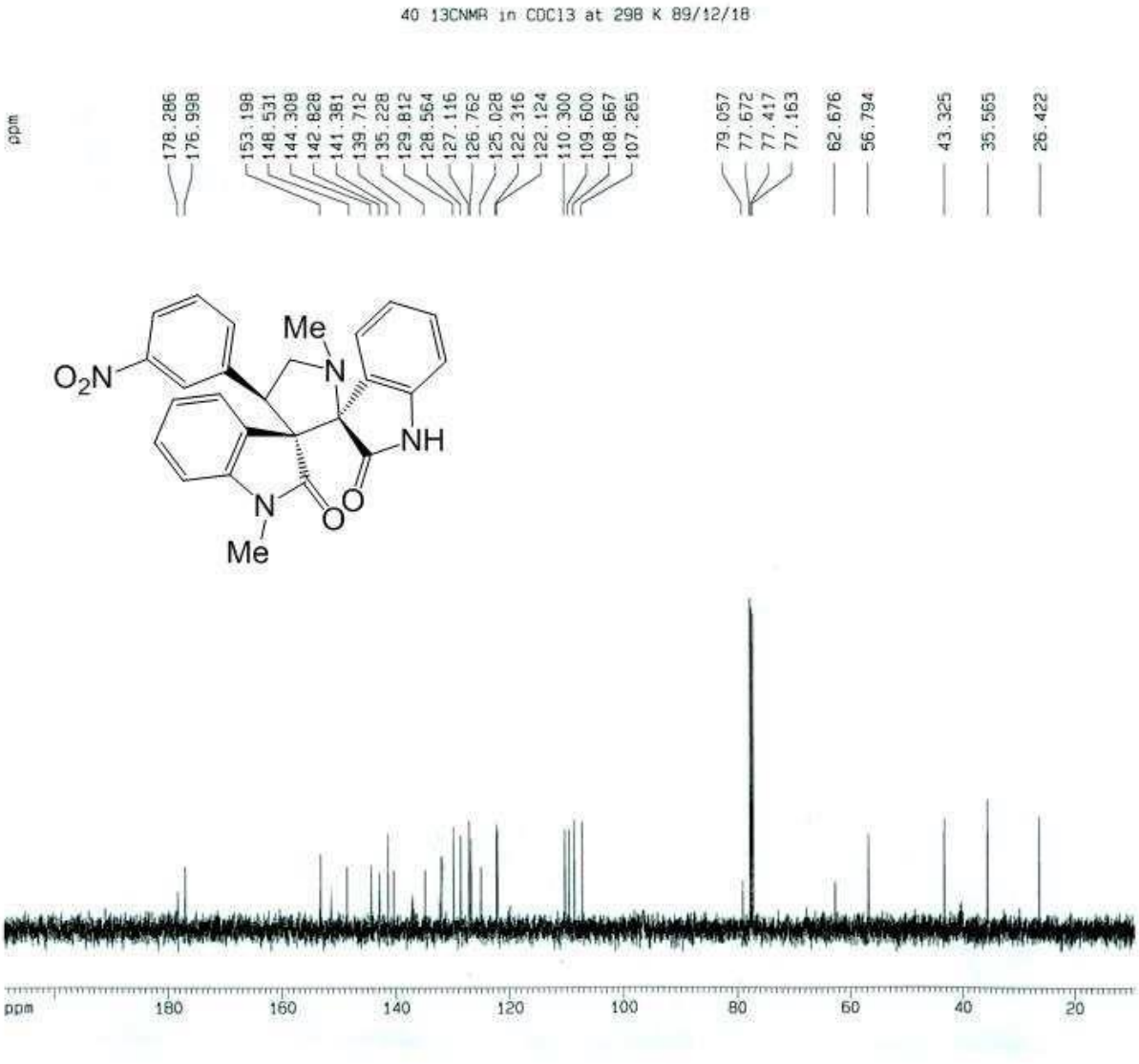
^{1}H NMR spectra for compound 8c



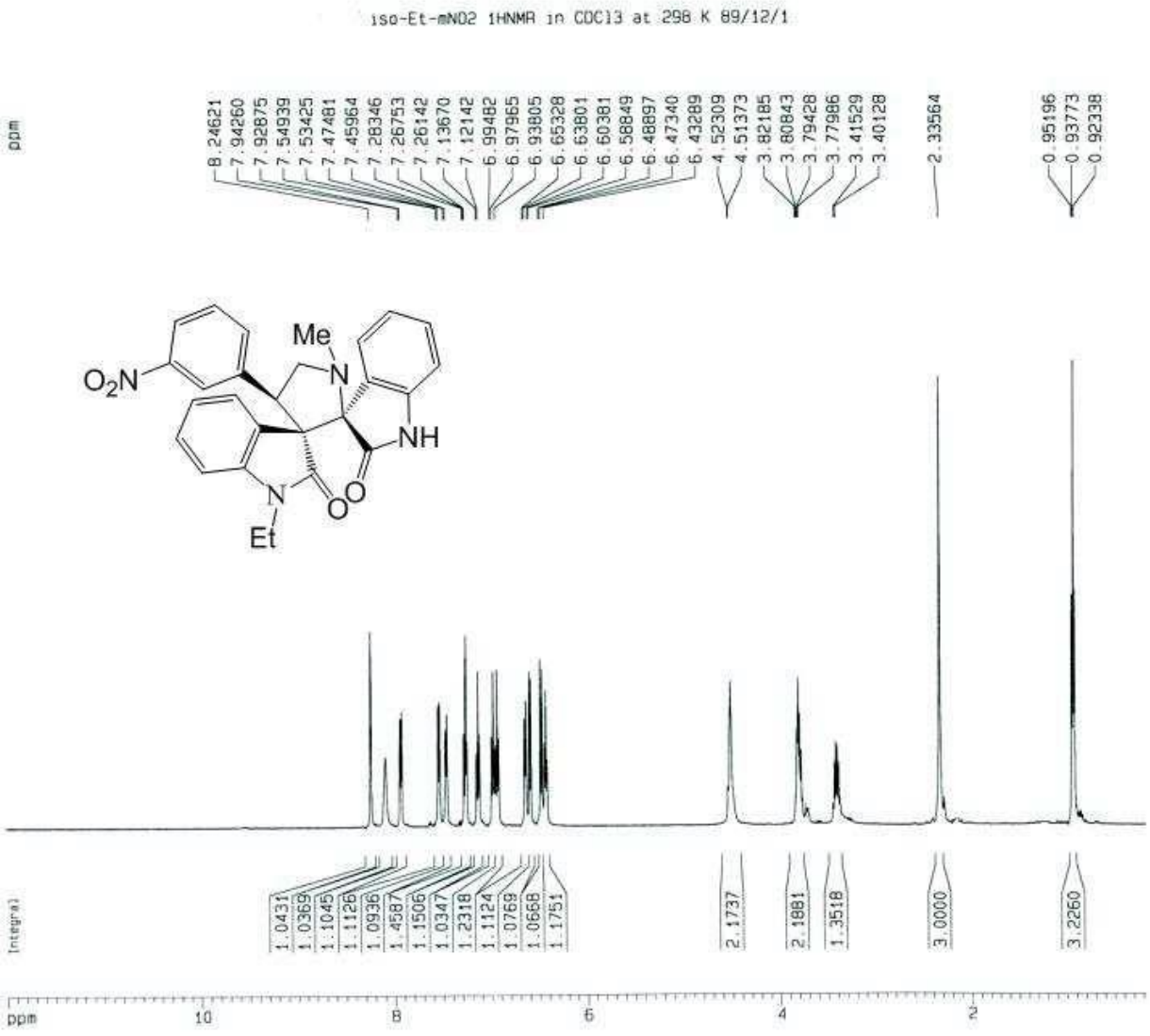
^{13}C NMR spectra for compound 8c



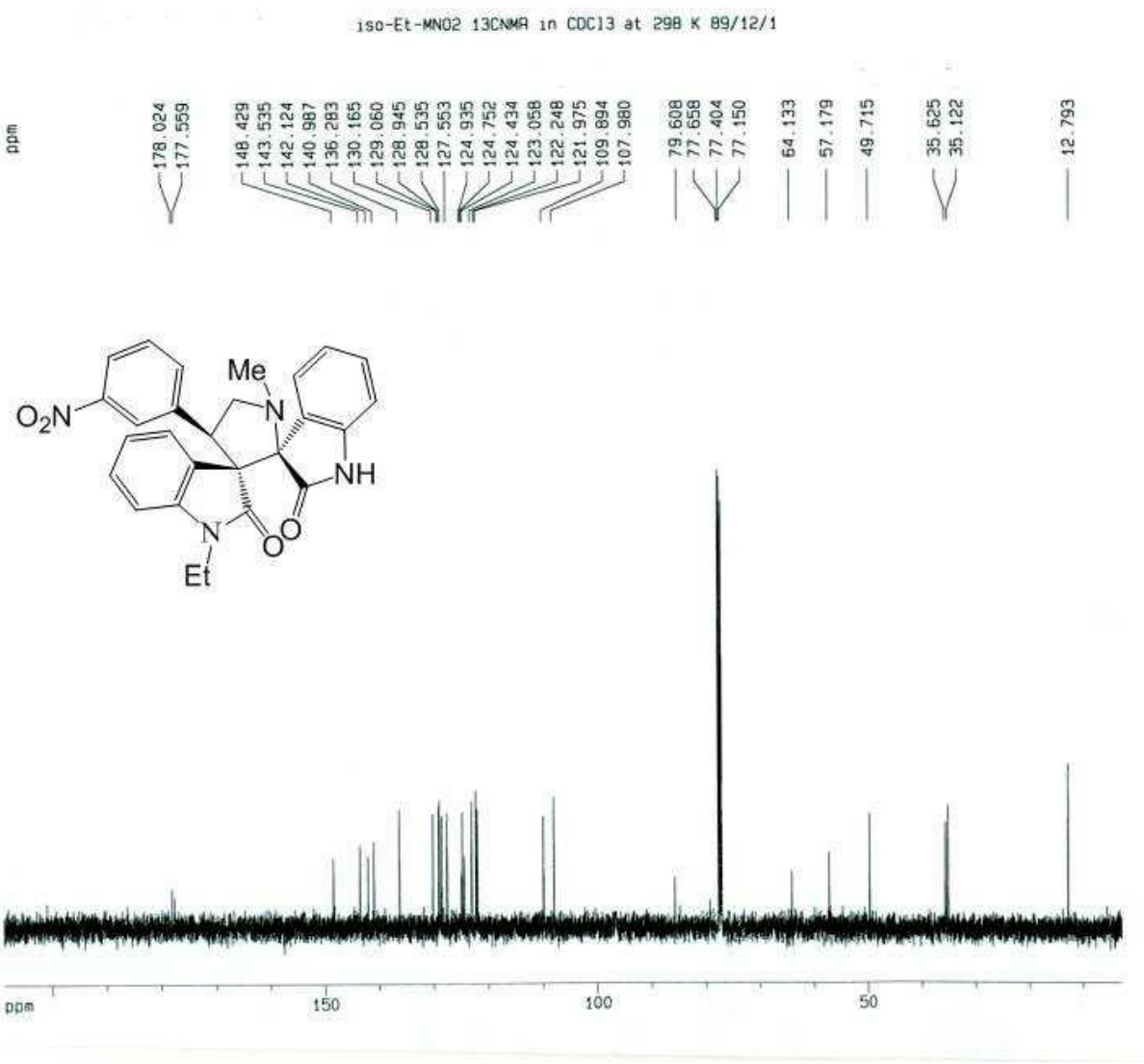
^{1}H NMR spectra for compound 8d



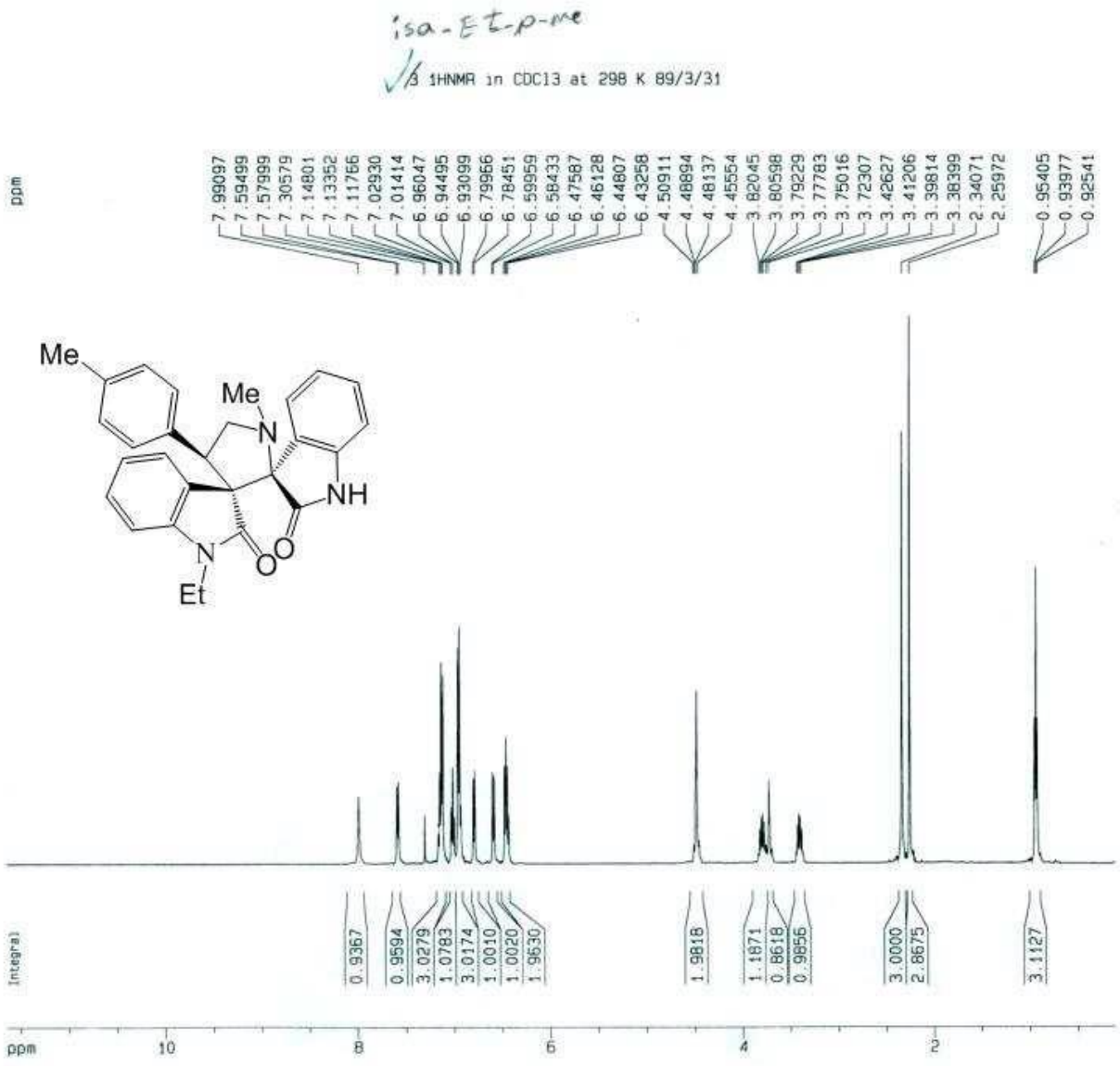
^{13}C NMR spectra for compound 8d



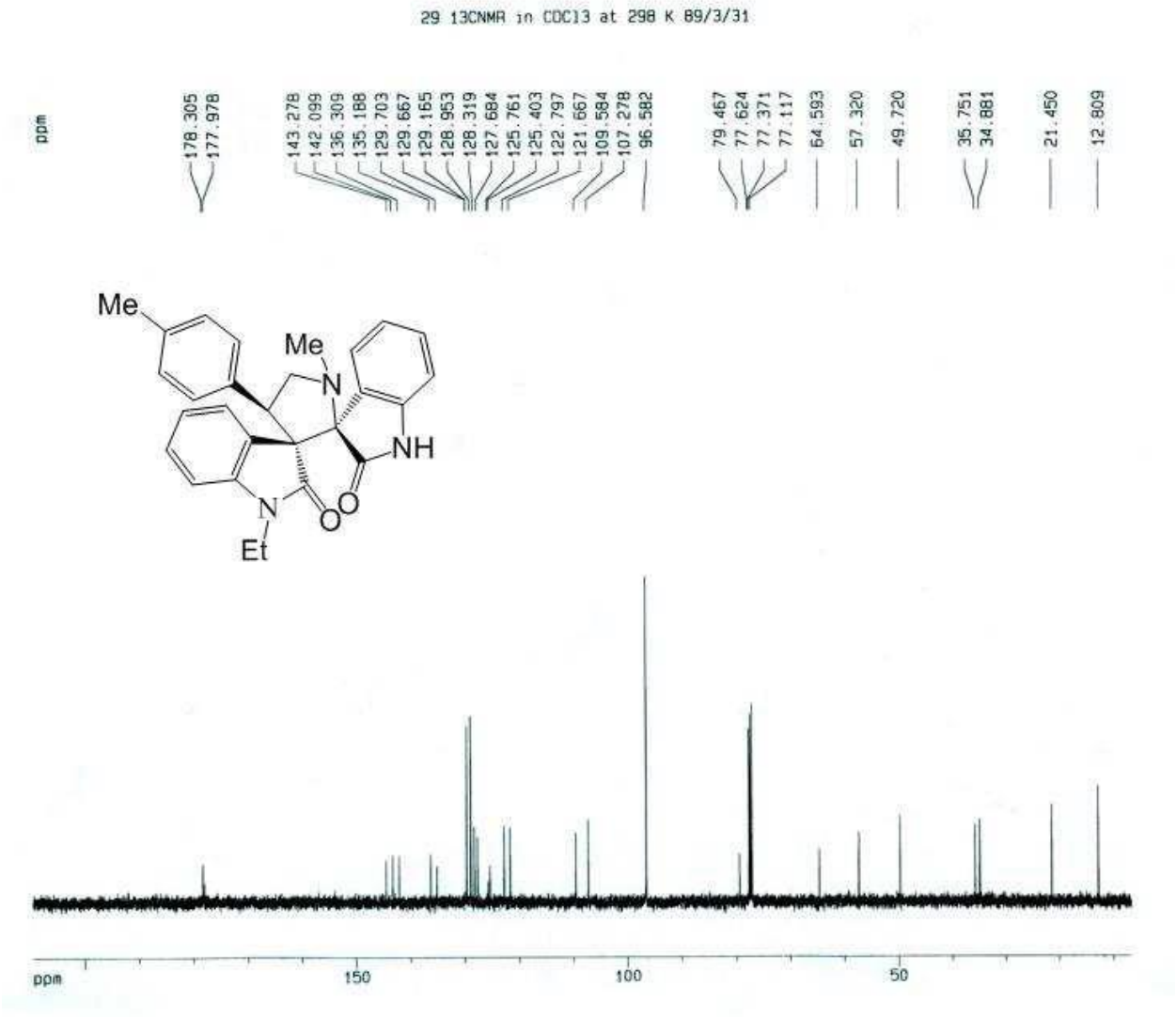
^{1}H NMR spectra for compound 8e



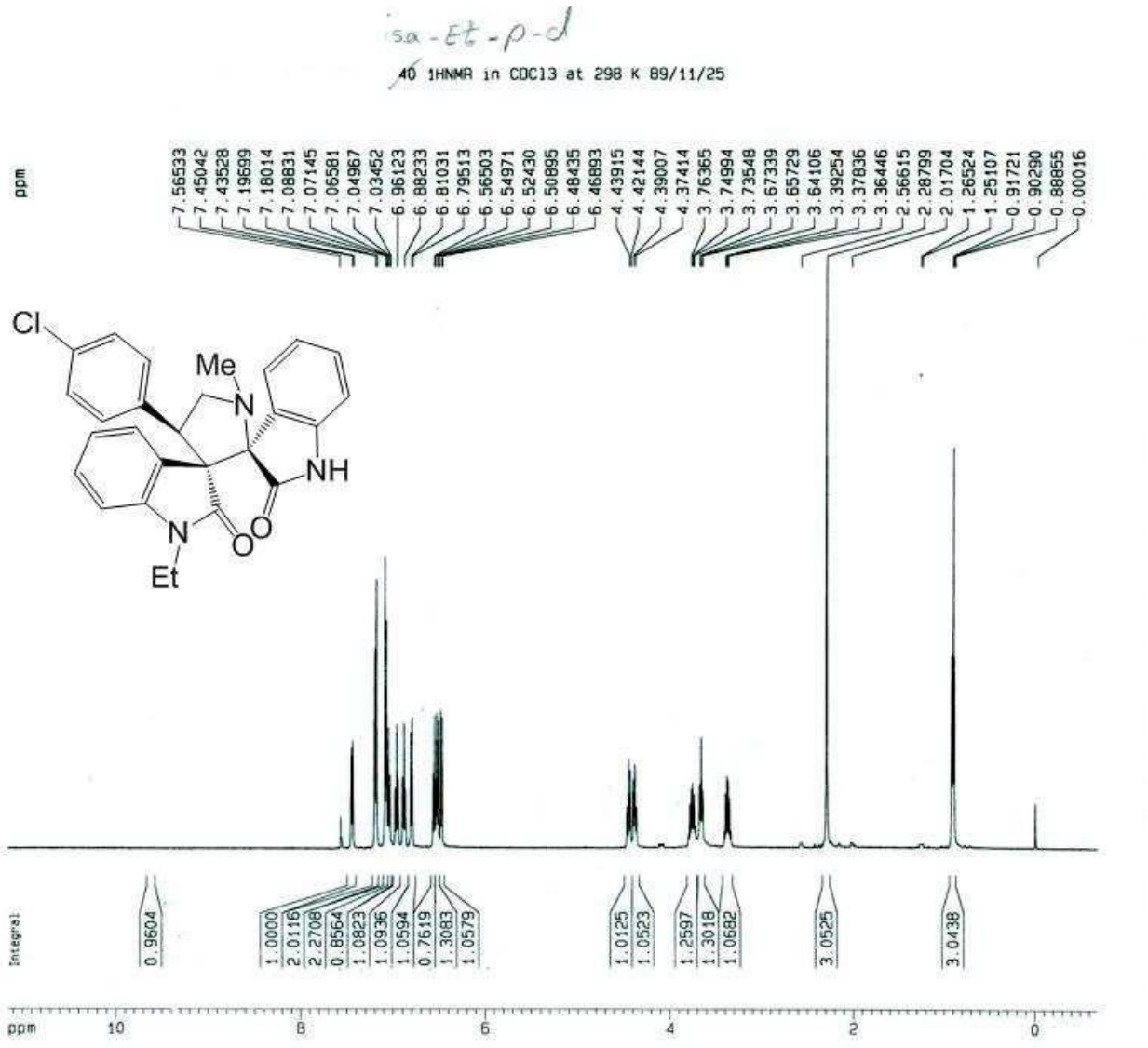
^{13}C NMR spectra for compound 8e



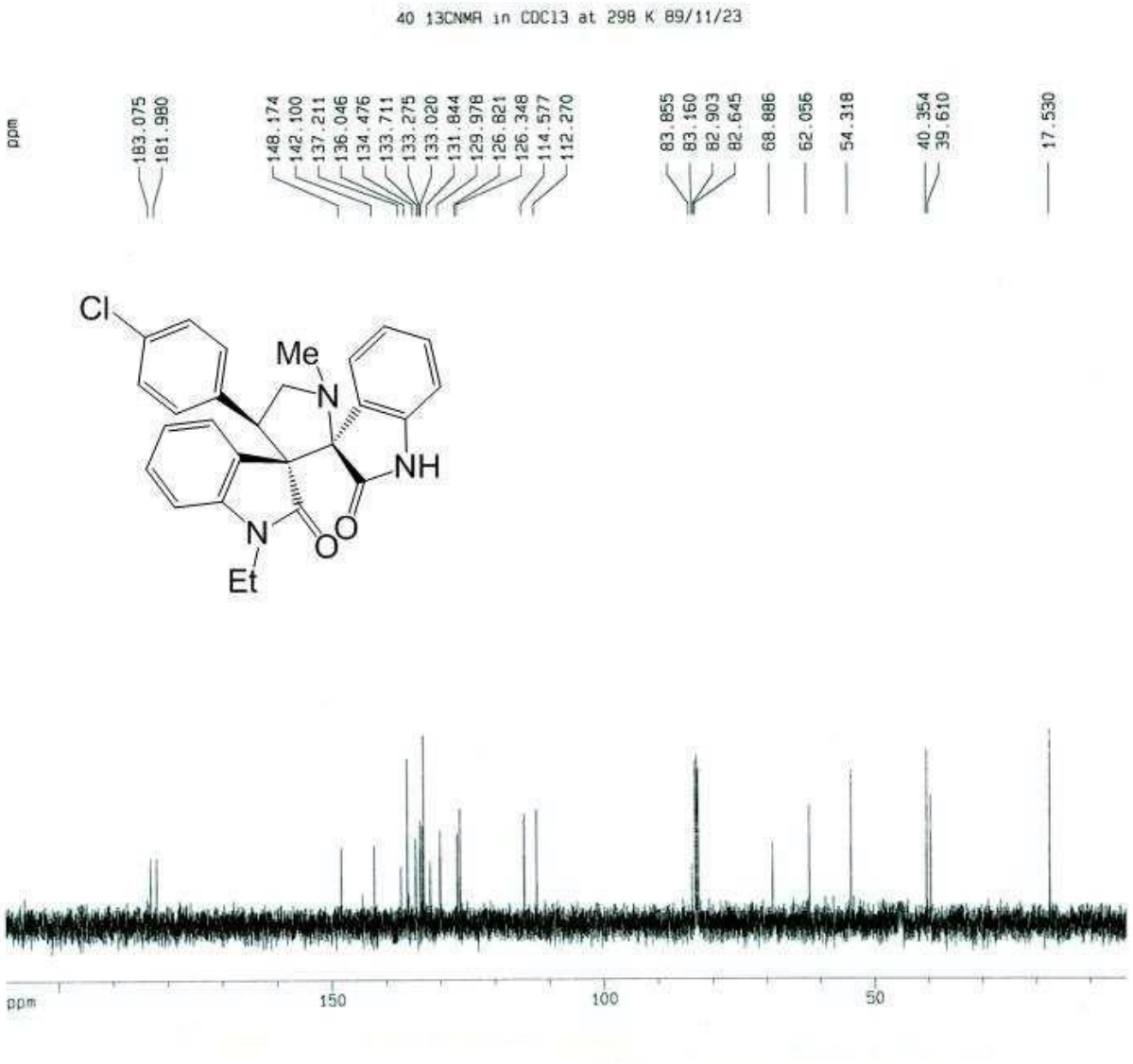
^{1}H NMR spectra for compound 8f



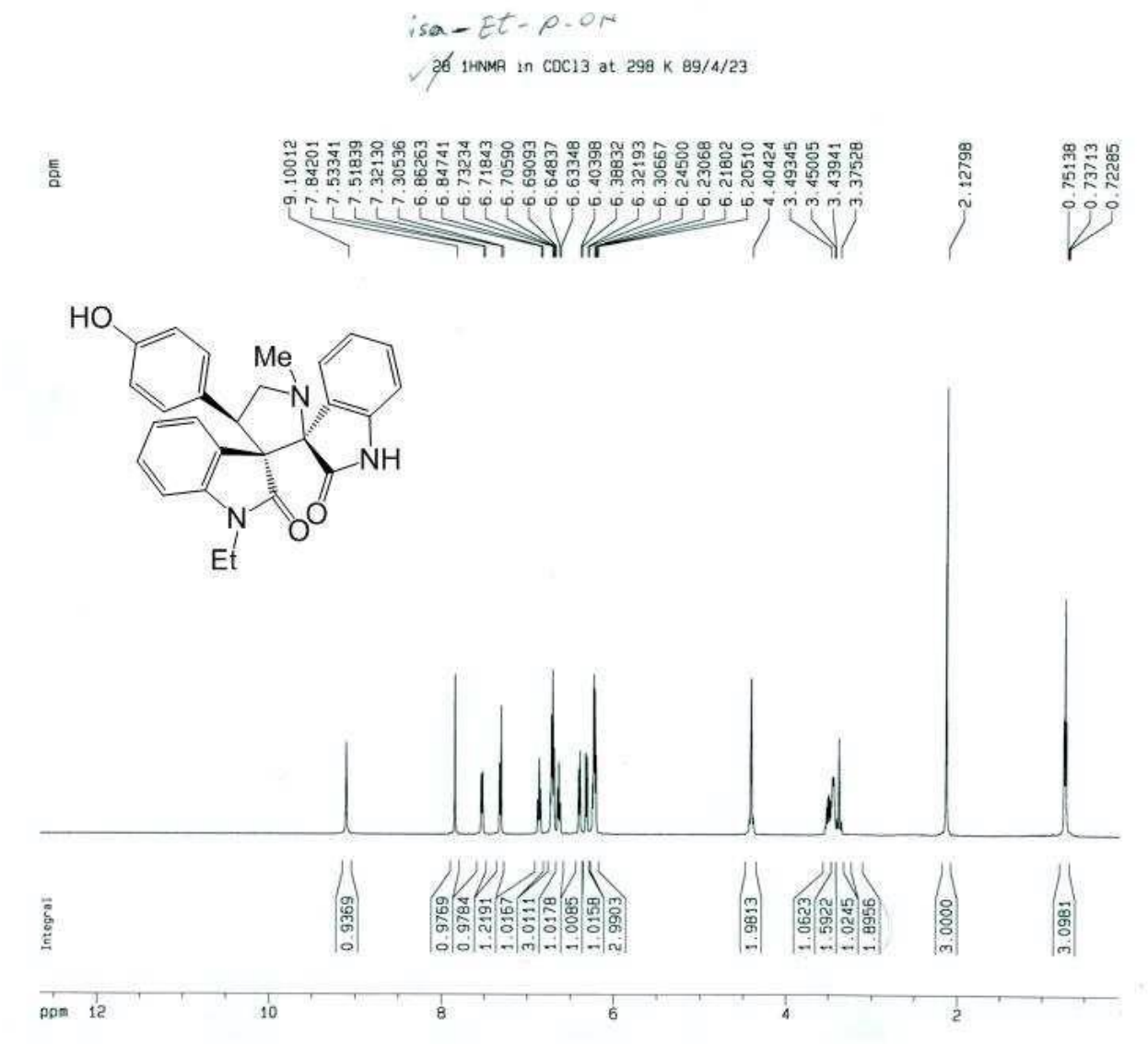
^{13}C NMR spectra for compound 8f



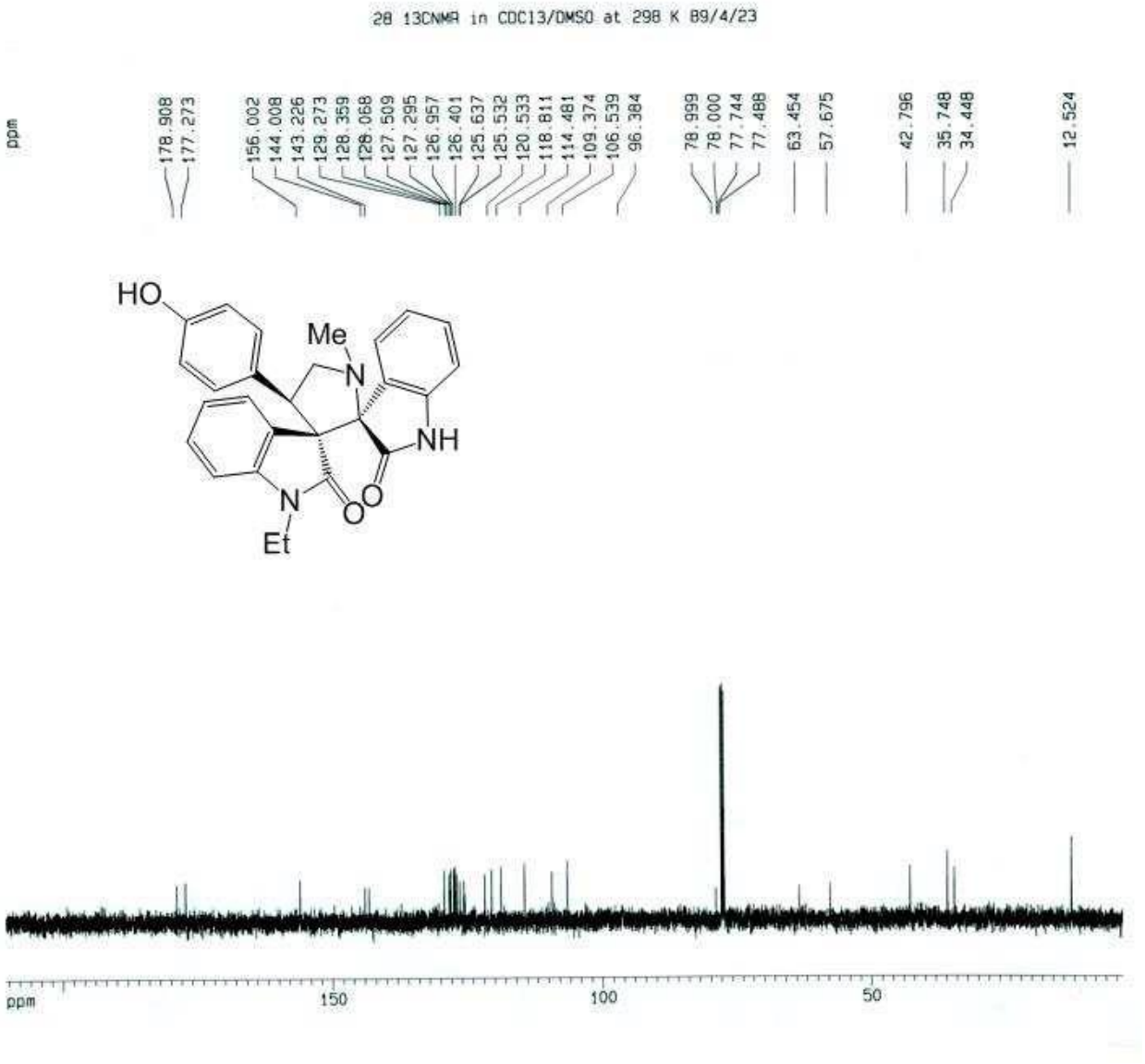
^{1}H NMR spectra for compound 8g



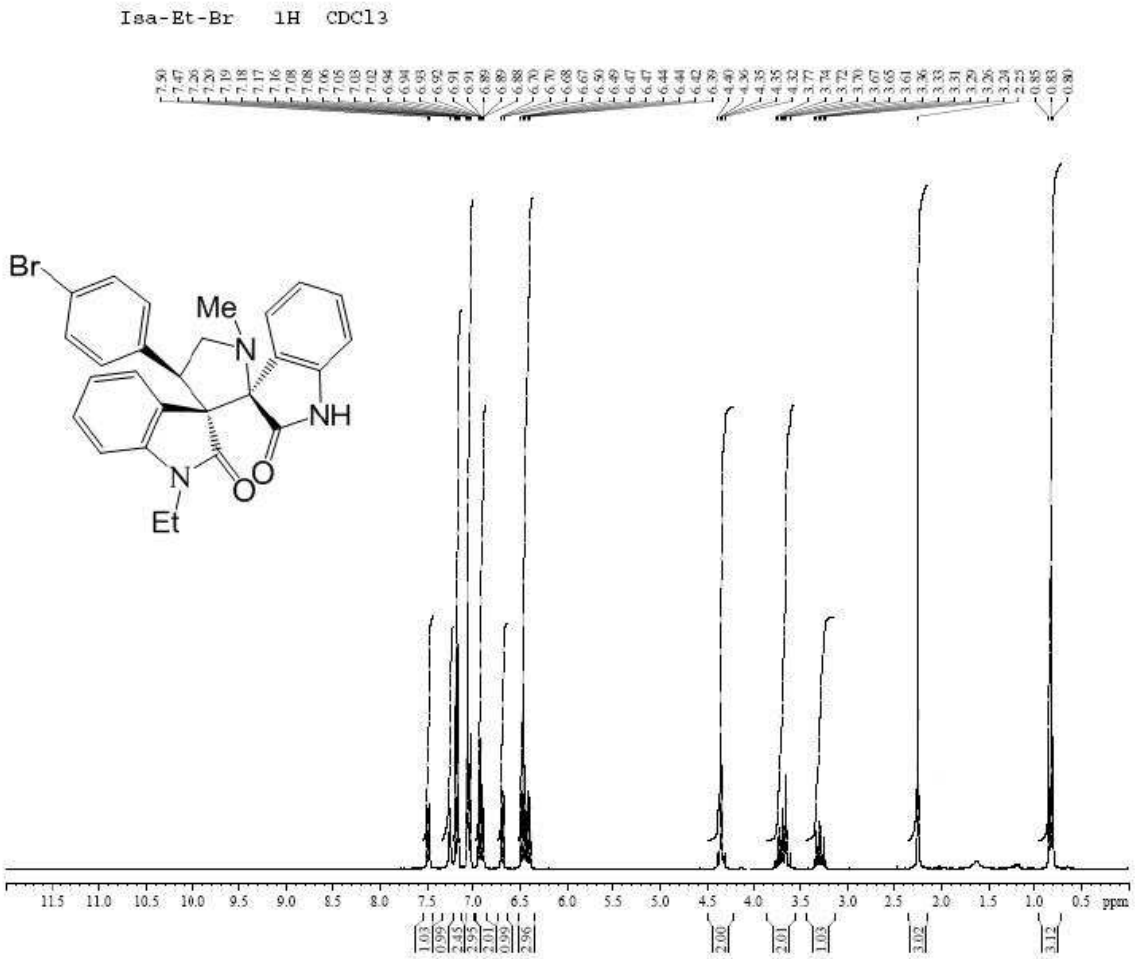
^{13}C NMR spectra for compound 8g



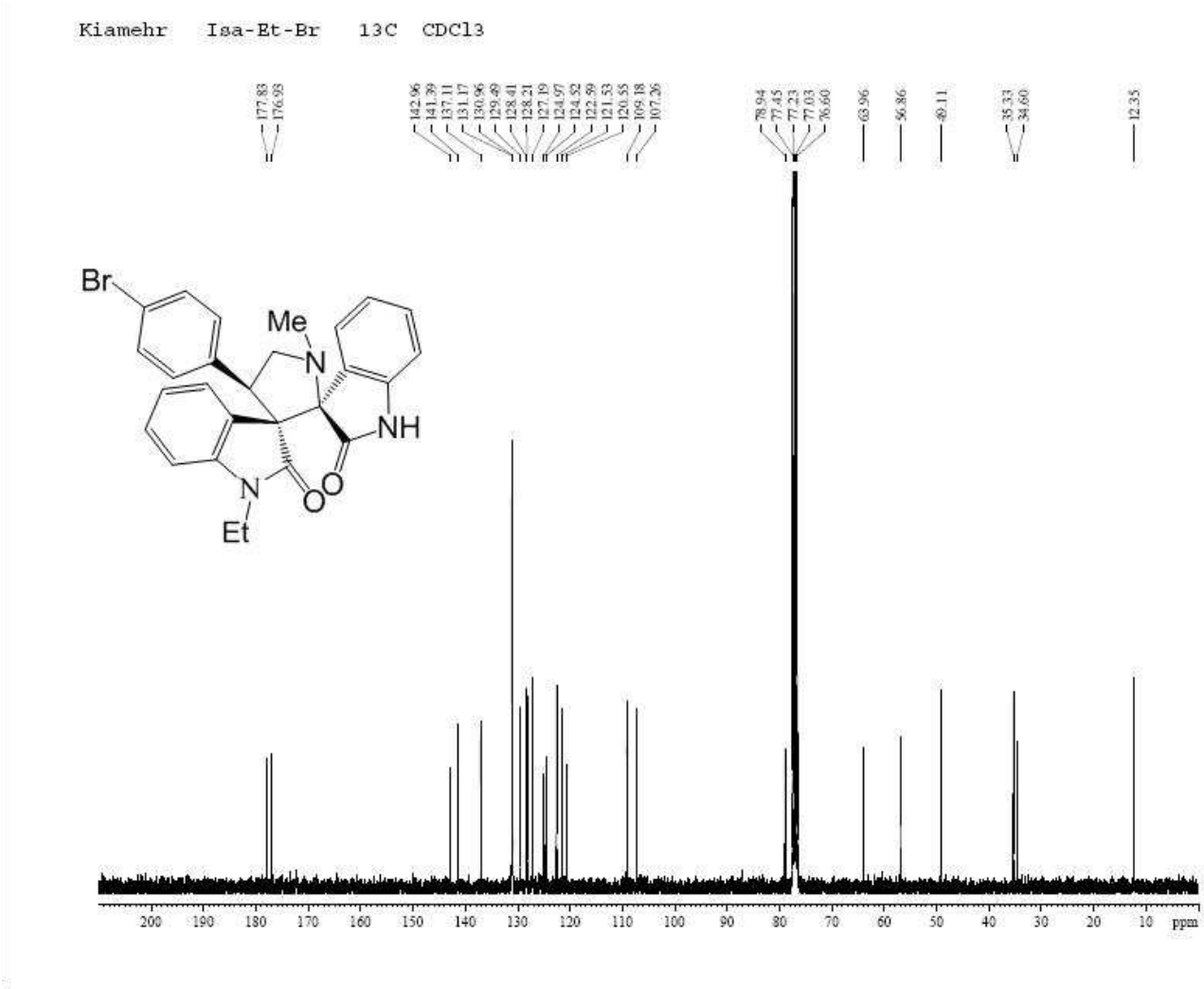
^{1}H NMR spectra for compound 8h



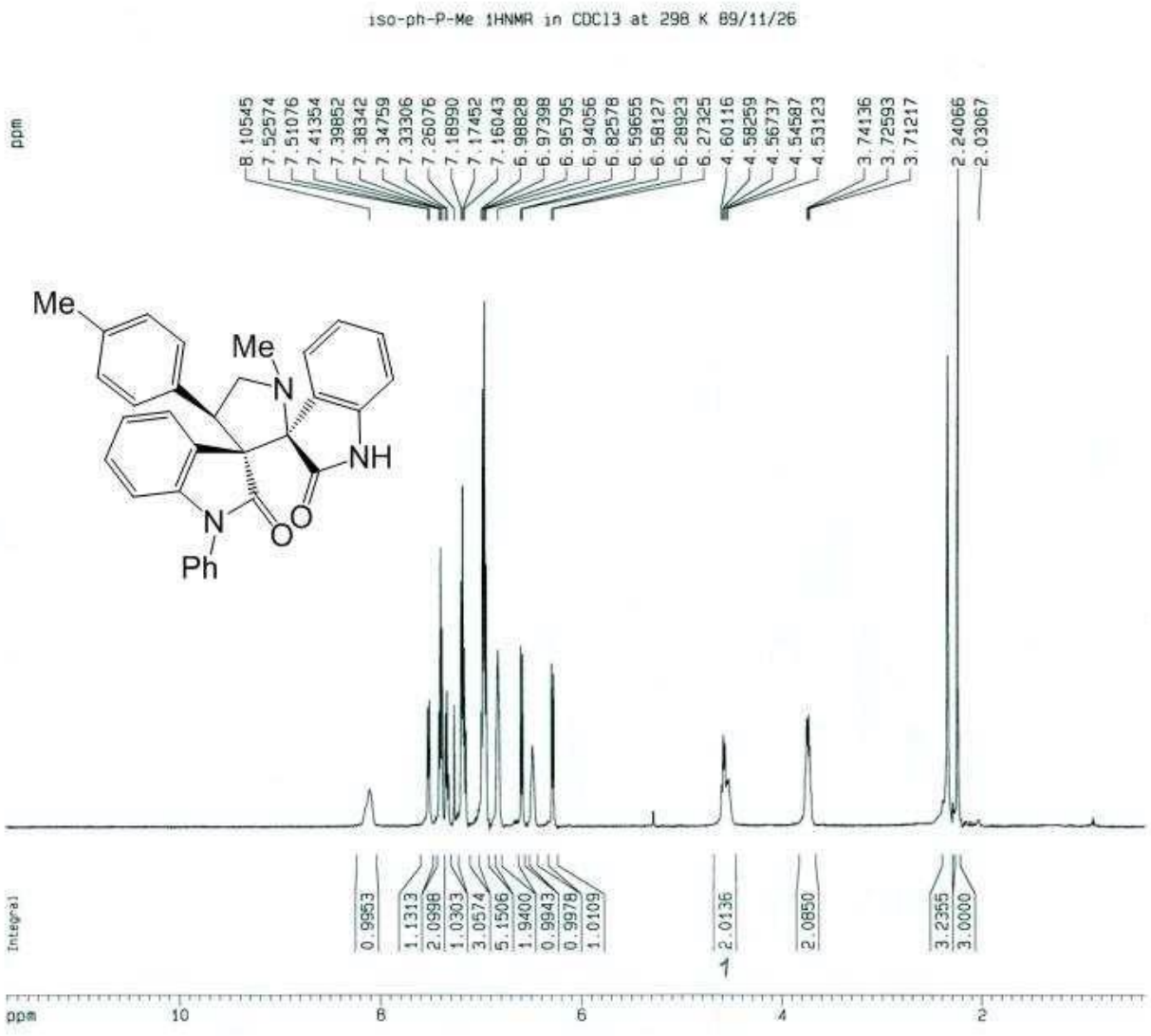
^{13}C NMR spectra for compound 8h



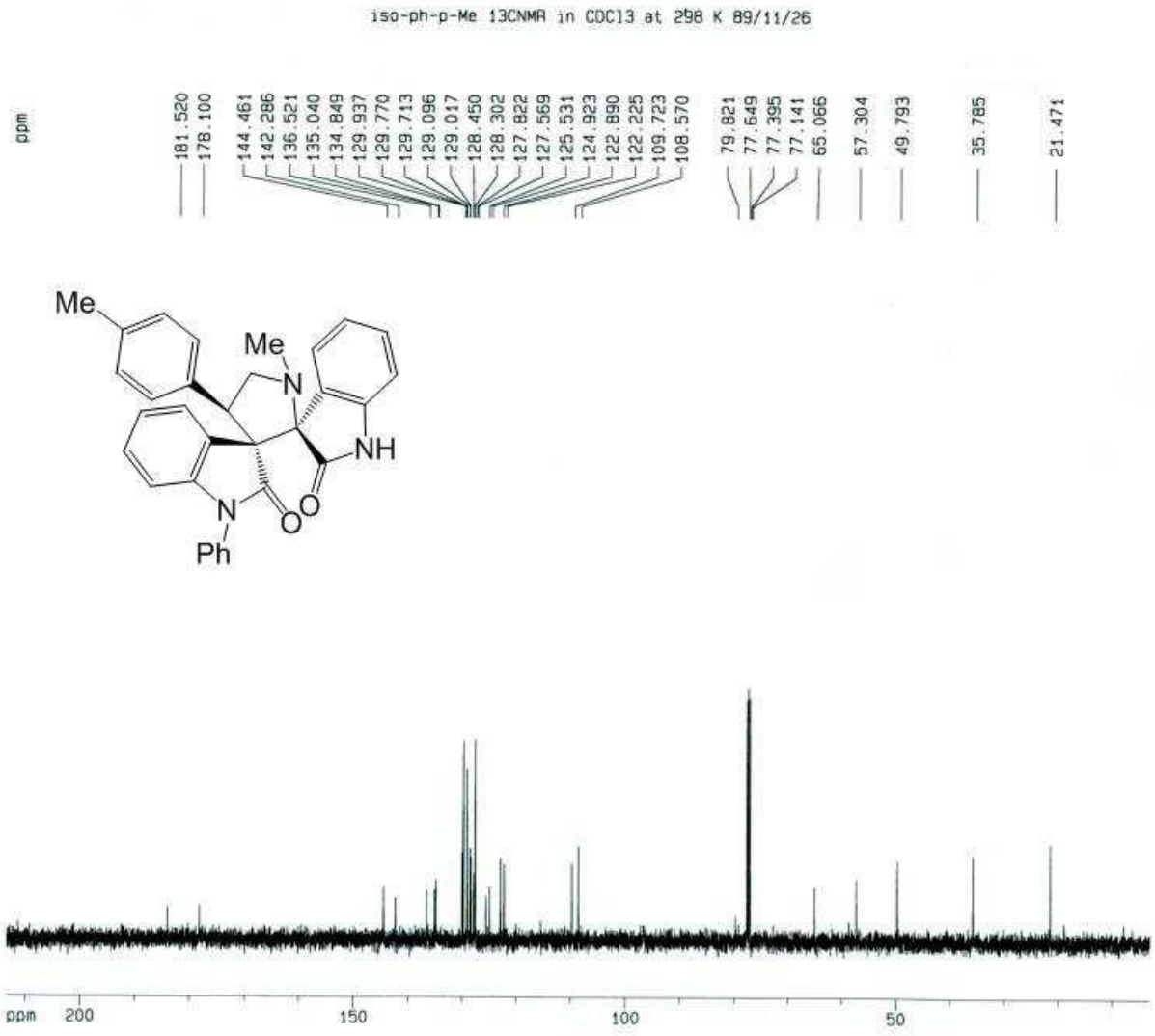
^{1}H NMR spectra for compound 8i



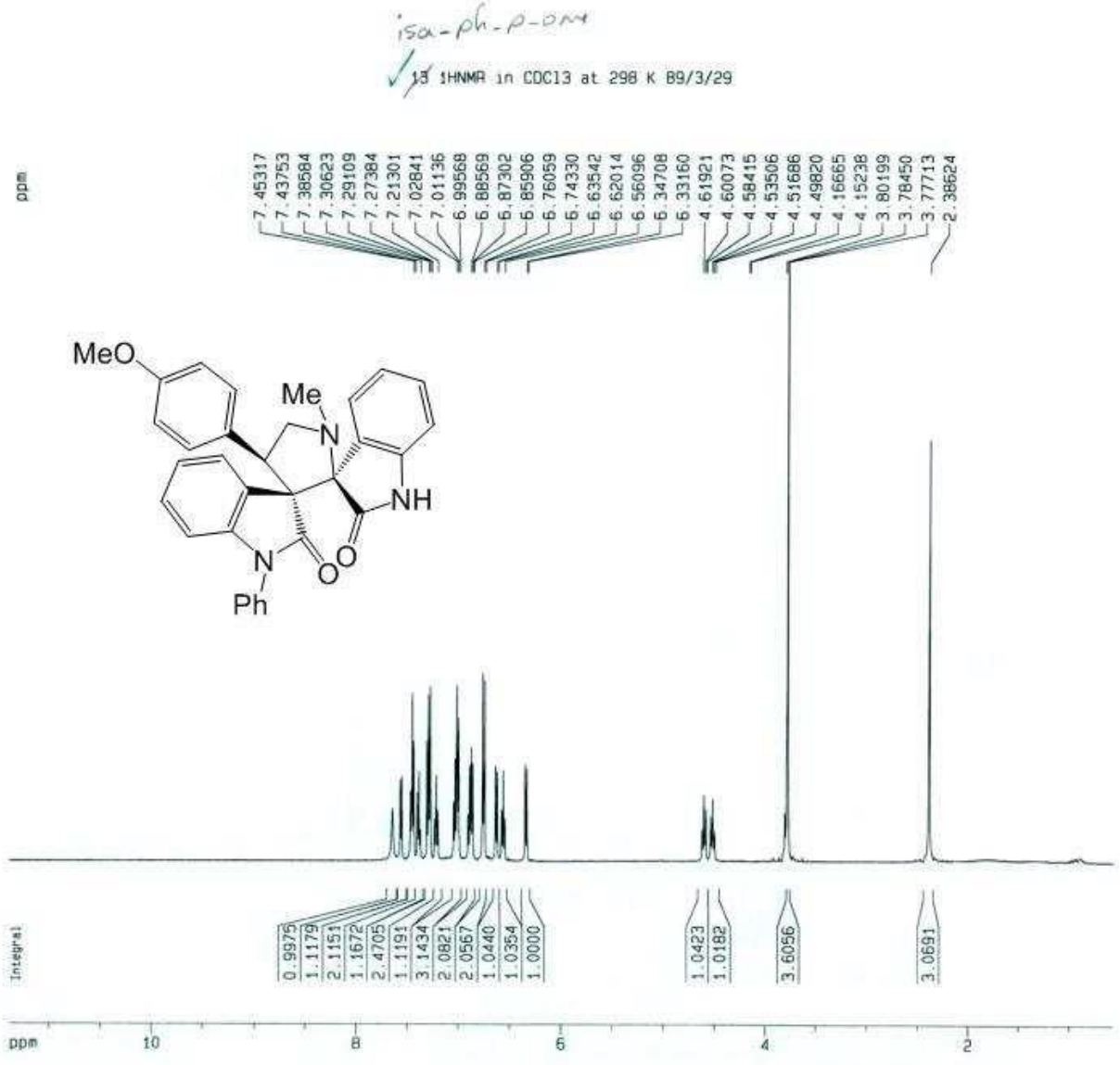
^{13}C NMR spectra for compound 8i



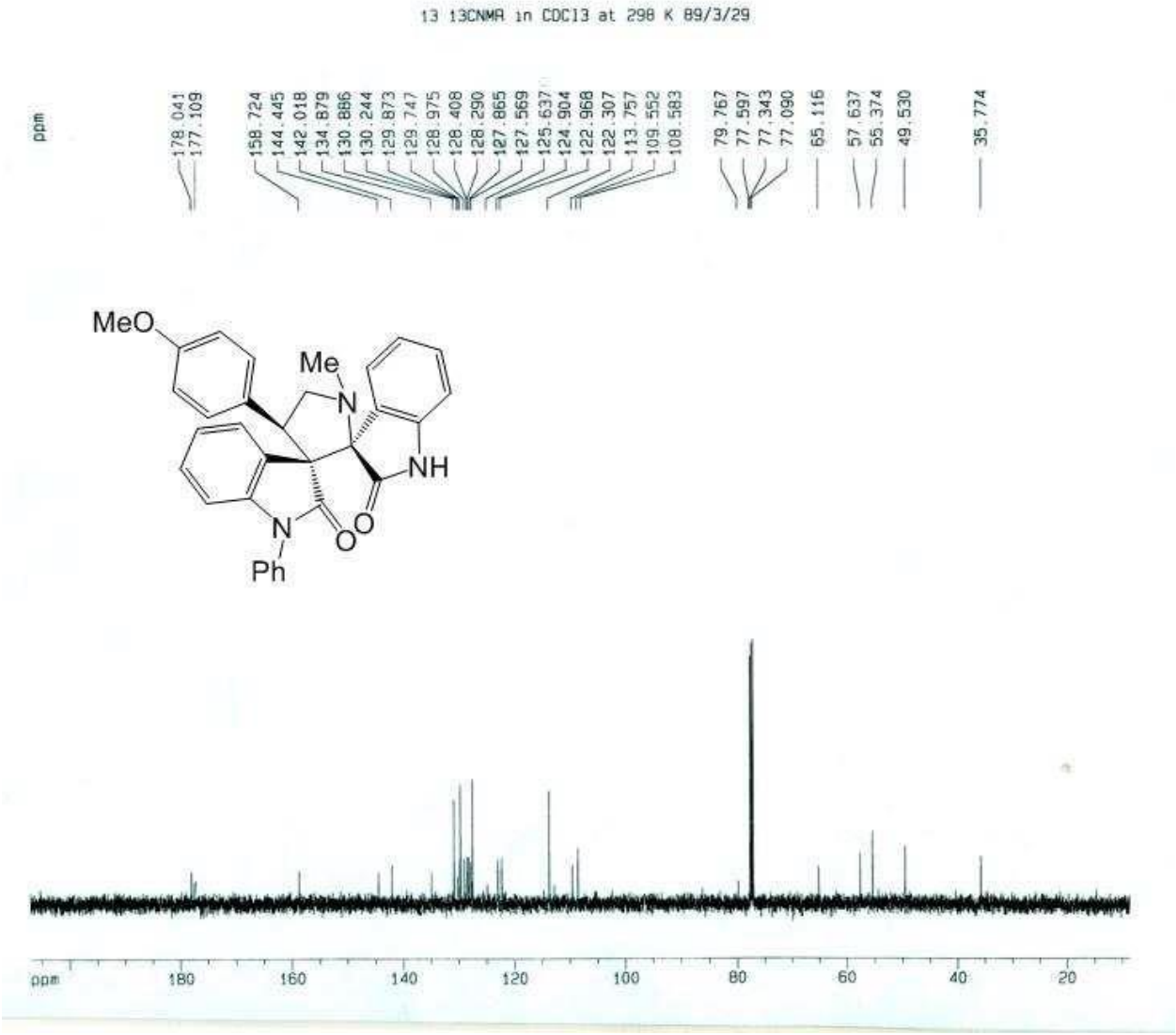
^{1}H NMR spectra for compound 8j



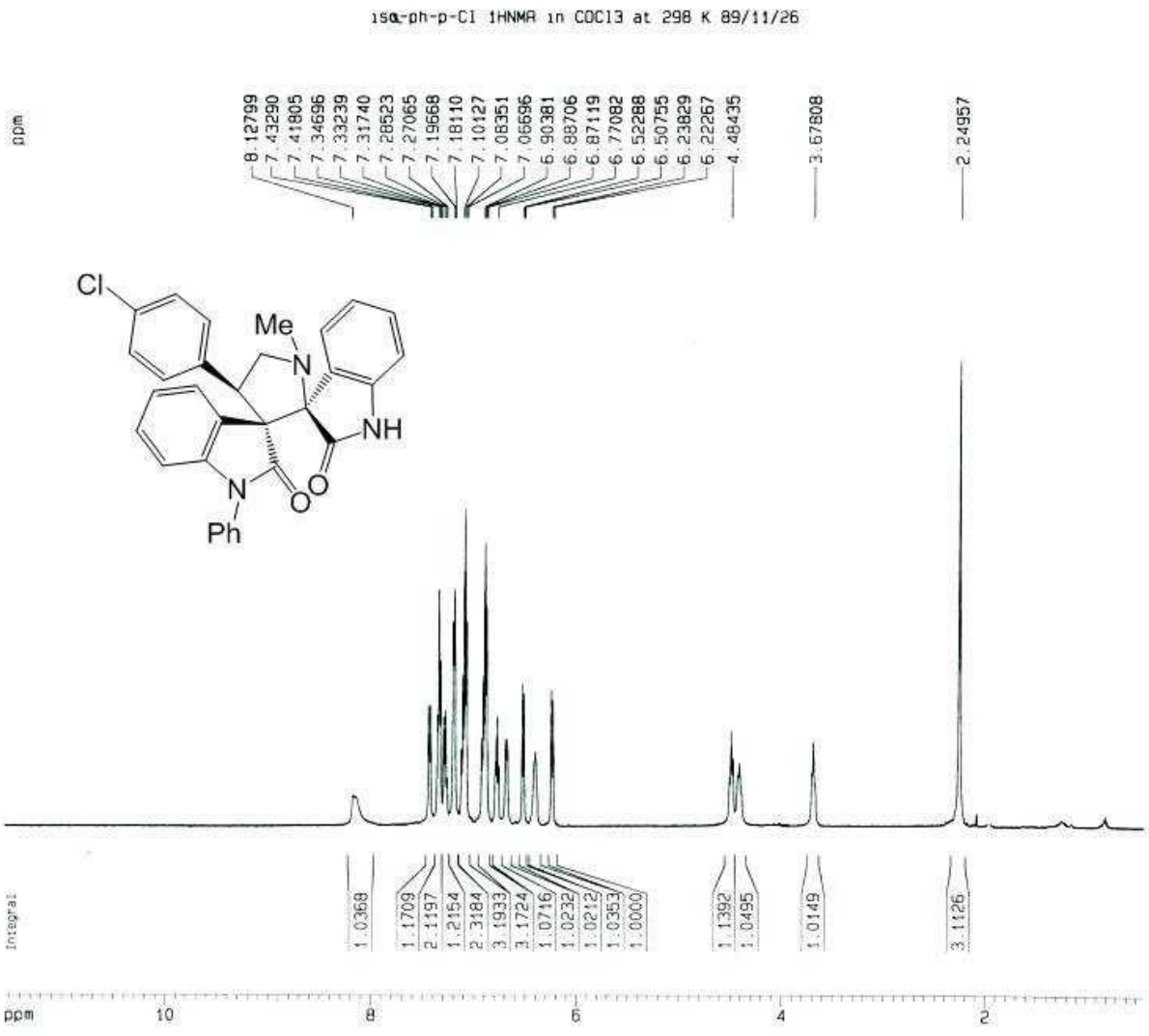
^{13}C NMR spectra for compound 8j



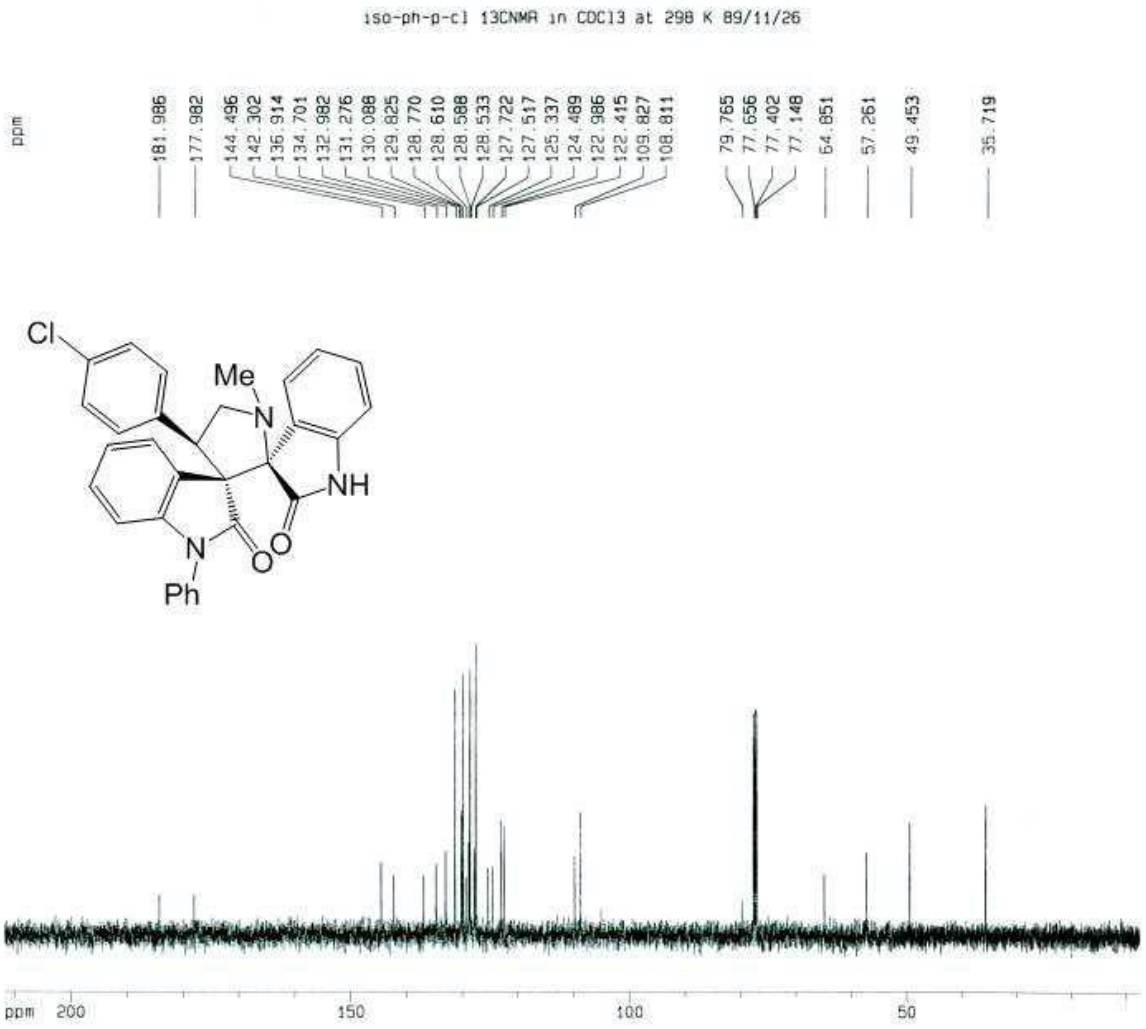
^{1}H NMR spectra for compound 8k



^{13}C NMR spectra for compound 8k



^{1}H NMR spectra for compound 8l



^{13}C NMR spectra for compound 8l

