Pyridine Synthesis from Oximes and Alkynes via Rhodium (III) Catalysis: 
Cp* and Cp¹ Provide Complementary Selectivity

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General Methods. All reactions were carried out in 1.5 dram sealed vials under an atmosphere of air with magnetic stirring in an aluminum-heating block without drying or degassing of the vial. ACS grade 2,2,2-trifluoroethanol was purchased from Sigma Aldrich Chemical Company and used without further purification. Phenyl-1-propyne (2a), methylphenyl propiolate (2d), di-phenyl acetylene (2e), 1-and 5-decyne (2g), 4-methyl-2-pentyne (2i), were purchased Sigma-Aldrich Chemical Company and used without further purification. 1-methoxy-4-((4-(trifluoromethyl)phenyl)ethynyl)benzene,\(^1\) (cyclopropylethynyl)-benzene,\(^2\) and tert-butyl (3-phenylprop-2-yn-1-yl)carbamate,\(^3\) was prepared via literature procedure. \([\text{RhCp}^*\text{Cl}_2]_2,\) \(^4\) di(tert-butyl)cyclopentadiene,\(^5\) \([\text{RhCp}^\text{t}\text{Cl}_2]_2,\) \(^6\) and \([\text{RhCp}^{\text{CF}_3}\text{Cl}_2]_2\) \(^7\) were prepared via literature procedure. Column chromatography was performed on SiliCycle® Silica Flash® 40-63\(\mu\)m 60A. Thin Layer chromatography was performed on SiliCycle® 250 \(\mu\)m 60A plates. Visualization was accomplished with UV light (254 nm), KMnO\(_4\), and CAM.

\(^1\)H NMR and \(^{13}\)C NMR spectra were recorded on a Varian 300 and 400 MHz spectrometers at ambient temperature. \(^1\)H NMR data are reported as the following: chemical shift in parts per million (\(\delta\), ppm) from chloroform (CHCl\(_3\)) taken as 7.26 ppm, integration, multiplicity (s=singlet, d=doublet, t=triplet, q=quartet, m=multiplet, dd=doublet of doublets) and coupling constant (Hz). \(^{13}\)C NMR are reported as the following: chemical shifts are reported in ppm from CDCl\(_3\) taken as 77.0 ppm. Mass spectra were obtained on a Fisons VG Autospec. Infrared spectra (IR) were obtained on Bruker Tensor 27 FT-IR spectrometer. Regioselectivity was determined from nOe spectroscopy. Regiomerical ratios were determined by GC/MS, with absolute regiochemistry determined by NOESY, analogy to complementary substrates, or previously reported \(^1\)H NMR.

\(^6\)Qing-an, K.; Guo-xin, J. Yingyong Huaxue 2001, 18, 322.
General procedure for synthesis of oximes:

All oximes were generated from the corresponding ketone or aldehyde. A 50 ml flask was charged with a stirbar, ketone or aldehyde (1 equiv), NH₂OH•HCl (1.2 equiv), NaOAc (1.2 equiv), and ethanol (.4 M). The flask was placed into an 80 °C oil bath and stirred until the reaction was complete as determined by TLC. The flask was removed from the oil bath and allowed to cool to room temperature. The solvent was removed in vacuo, and the residue was dissolved in CH₂Cl₂ and H₂O (4:1). The mixture was extracted with CH₂Cl₂ trice, washed with Na₂CO₃ twice. The organic layer was washed with brine, dried over MgSO₄, and concentrated in vacuo. The residue was purified via silica gel column chromatography (2:1 Hex/EtOAc) to yield pure oxime as a mixture of isomers.

α,β Unsaturated Oxime Characterization

(E)-1-(cyclohex-1-en-1-yl)ethanone oxime (1a): ¹H (300 MHz, CDCl₃) δ 6.20 (m, 1H), 2.27-2.23 (comp m, 2H), 2.19-2.16 (comp m, 2H), 2.02 (s, 3H), 1.66-1.58 (comp m, 4H); ¹³C NMR (100 MHz, CDCl₃) δ 134.2, 130.2, 25.9, 24.3, 22.3, 21.9, 9.8.

(3E,4E)-hex-4-en-3-one oxime (1b): Isolated as a 1:1 mixture of isomers. ¹H (400 MHz, CDCl₃) δ 6.08 (dd, J = 6.1, 1.4 Hz, 1H), 6.03 (d, J = 1.3 Hz, 1H), 2.54-2.46 (m, 2H), 2.42-2.34 (m, 2H), 1.91-1.88 (m, 3H), 1.87-1.81 (m, 5H), 1.13-1.02 (m, 7H). ¹³C NMR (100 MHz, CDCl₃) δ 132.0, 128.1, 124.7, 21.6, 19.2, 16.3, 15.8, 14.9, 8.4.

(E)-3-methylbut-3-en-2-one oxime (1c): ¹H (400 MHz, CDCl₃) δ 5.41 (t, J = 0.8 Hz, 1H), 5.31 (t, J = 1.2 Hz, 1H), 2.11 (s, 3H), 1.98 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 156.8, 140.8, 117.5, 19.2, 10.1.

(2E,3E)-non-3-en-2-one oxime (1d): ¹H (400 MHz, CDCl₃) δ 6.07 (d, J = 8.0 Hz, 2H), 2.14 (q, J = 6.7 Hz, 2H), 1.97 (s, 3H), 1.41 (dt, J = 14.5, 7.2 Hz, 2H), 1.28-1.27 (m, 4H), 0.86 (t, J = 7.0 Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 154.1, 134.2, 124.5, 116.5, 30.2, 28.80, 28.75, 26.0, 19.9, 11.4, 7.0.

(1E,2E)-2-benzylidene cyclohexanone oxime (1e): ¹H (400 MHz, CDCl₃) δ 7.38-7.32 (m, 5H), 6.93 (s, 1H), 2.71-2.66 (m, 4H), 1.76-1.64 (m, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 127.1, 125.5, 124.6, 26.4, 22.39, 22.28, 20.7.

(1E,4E)-1,5-diphenylpenta-1,4-dien-3-one oxime (1f): ¹H (400 MHz, CDCl₃) δ 7.56-7.54 (m, 2H), 7.52-7.50 (m, 2H), 7.41-7.32 (m, 8H), 7.13 (d, J = 17.8 Hz, 2H). ¹³C NMR (100 MHz, CDCl₃) δ 154.9, 137.8, 136.3, 136.1, 135.4, 129.1, 128.76, 128.72, 128.63, 128.57, 127.36, 127.22, 127.0, 121.9, 116.7.

(1E,2E)-2-methyl-3-phenylacrylaldehyde oxime (1g): ¹H (400 MHz, CDCl₃) δ 8.10 (s, br, 1H), 7.84 (s, 1H), 7.27 (m, 5H), 6.62 (s, 1H), 2.03 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 155.1, 136.7, 136.2, 131.7, 129.2,
1.78 (ddd, 7.47-7.45 (m, 2H), 7.34 (dd, J = 8.0, 6.6 Hz, 3H), 6.87 (d, J = 7.2 Hz, 2H), 2.15 (s, 3H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.7, 136.3, 133.4, 128.4, 127.5, 126.8, 125.7, 9.7.

(2\(E\),3\(E\))-4-phenylbut-3-en-2-one oxime (1h): \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.47-7.45 (m, 2H), 7.34 (dd, J = 8.0, 6.6 Hz, 3H), 6.87 (d, J = 7.2 Hz, 2H), 2.15 (s, 3H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 156.7, 136.3, 133.4, 128.4, 127.5, 126.8, 125.7, 9.7.

(2\(E\),4\(E\))-ethyl 4-(hydroxyimino)pent-2-enoate (1i): \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.26 (d, J = 16.1 Hz, 1H), 6.13 (d, J = 16.1 Hz, 1H), 4.18 (q, J = 7.1 Hz, 2H), 1.97 (s, 3H), 1.24 (t, J = 7.1 Hz, 3H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 166.3, 155.1, 141.4, 132.18, 132.08, 128.54, 128.42, 122.9, 60.8, 14.2, 9.6.

(2\(E\),4\(E\))-4-(hydroxyimino)-\(N\),\(N\)-dimethylpent-2-enamide (1j): \(^1\)H (300 MHz, MeOH) \(\delta\) 7.17 (dd, J = 15.7, 1.0 Hz, 1H), 6.82-6.77 (m, 1H), 3.18 (s, 3H), 3.02 (s, 3H), 2.02 (s, 3H).

(2\(E\),4\(E\))-1,1,1-trifluoroocct-2-en-4-one oxime (1k): Isolated as a 2.3:1 mixture of oximes isomers. \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.47 (dd, J = 16.6, 2.1 Hz, 1H minor), 6.76 (dd, J = 16.3, 2.0 Hz, 1H, major), 6.13 (dd, J = 16.6, 6.3 Hz, 1H, minor), 6.04 (dt, J = 17.8, 9.7 Hz, 1H, major), 2.53 (t, J = 7.8 Hz, 2H, major), 2.41 (t, J = 7.7 Hz, 2H, minor), 1.58-1.47 (m, 2H, major and minor), 1.39 (dt, J = 14.7, 7.2 Hz, 2H, major and minor), 0.94 (td, J = 7.3, 3.5 Hz, 3H, major and minor). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 157.9, 153.4, 134.41(q, major), 127.05, 126.87, 126.80, 124.94 (q, minor), 124.38, 124.24, 123.1, 122.8, 122.44, 122.40, 121.70, 121.55, 120.7, 120.3, 120.0, 119.6, 40.4, 39.1, 30.4, 28.9, 28.1, 23.9, 22.8, 22.3, 13.65, 13.60

PYRIDINE

General Procedure:

A 1.5 dram vial was charged with a stirbar, free oxime (1 equiv), [RhCp\(^\ast\)Cl\(_2\)] or [RhCp\(^\ast\)Cl\(_2\)] (2.5 mol %), and K\(_2\)CO\(_3\) (2 equiv). TFE was added followed by alkyne (1.1 equiv). The reaction was sealed, warmed to 45 °C, and stirred until the reaction was complete as determined by TLC. Once complete the reaction was allowed to cool to room temperature and transferred to a 25 ml round bottom flask with excess CH\(_2\)Cl\(_2\). Residual solvent was removed and the residue was purified via silica gel column chromatography.

1,3-dimethyl-4-phenyl-5,6,7,8-tetrahydroisoquinoline (3a): This compound was previously characterized by Cheng and co-workers. \(^1\)H NMR is provided. \((\text{Cp}^\ast = 2:1, 87\%; \text{Cp}^\dagger = 1:4, 82\%)\). \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.42-7.40 (m, 2H), 7.38-7.31 (m, 1H), 7.11 (dd, J = 8.2, 1.3 Hz, 2H), 2.66 (t, J = 6.5 Hz, 2H), 2.47 (s, 3H), 2.29 (t, J = 6.3 Hz, 2H), 2.19 (s, 3H), 1.78 (ddd, J = 6.6, 5.5, 5.3 Hz, 2H), 1.66-1.62 (m, 2H).

6-ethyl-3,4-dimethyl-2-phenylpyridine (3b): A 1.5 dram vial was charged with a stirbar, free oxime (1 equiv), [RhCp\(^\ast\)Cl\(_2\)] or [RhCp\(^\ast\)Cl\(_2\)] (.025 mol %), and K\(_2\)CO\(_3\) (2 equiv). TFE was added followed by alkyne (1.1 equiv). The reaction was sealed, warmed to 80 °C, and stirred until the reaction was complete as determined by TLC. Once complete the reaction was allowed to cool to room temperature and transferred to a 25 ml round bottom flask with excess CH\(_2\)Cl\(_2\). Residual solvent was removed and the residue was purified via silica gel column chromatography.

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complete as determined by TLC. Once complete the reaction was allowed to cool to room temperature and transferred to a 25 ml round bottom flask with excess CH$_2$Cl$_2$. Residual solvent was removed and the residue was purified via silica gel column chromatography. Regioselectivity confirmed by analogy. (Cp* $1:1$, 80%; Cp¹ $4:1$; 83%). R$_f$ = .18 (9:1 Hexanes/EtOAc); $^1$H (400 MHz, CDCl$_3$) $\delta$ 7.48-7.41 (m, 4H, major), 7.39-7.35 (m, 4H, minor), 7.16 (d, $J = 1.5$ Hz, 1H, major), 7.16-7.14 (m, 1H, minor), 6.97 (s, 1H, minor), 6.93 (s, 1H, major), 2.81 (q, $J = 7.6$, 3H, major), 2.80 (q, $J = 7.6$, 3H, minor) 2.33 (s, 3H, minor), 2.26 (s, 3H, major), 2.18 (s, 3H, minor), 2.02 (s, 3H, major), 1.33 (t, $J = 7.6$ Hz, 3H, major), 1.32 (t, $J = 7.6$ Hz, 3H, minor). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 161.2, 159.9, 158.0, 155.2, 146.8, 145.7, 141.5, 139.1, 134.2, 129.14, 129.08, 128.6, 128.0, 127.4, 127.0, 126.7, 121.9, 120.6, 31.03, 30.96, 23.4, 20.27, 20.15, 15.8, 14.27, 14.19. IR (thin film) 2969, 1592, 1462, 1071, 761, 702 cm$^{-1}$; HRMS (ESI) m/e calcd (M+H) 212.1434; found 212.1432.

2,3,5-trimethyl-6-phenylpyridine (3c): Prepared using the general procedure. Pyridine 3b was isolated as a viscous orange liquid. (Cp* $2:1$, 87%; Cp¹ $1:4$, 85%). R$_f$ = .10 (9:1 Hexanes/EtOAc); $^1$H (400 MHz, CDCl$_3$) $\delta$ 7.50 (dd, $J = 8.3$, 1.4 Hz, 1H, minor), 7.45-7.41 (m, 3H, major), 7.38-7.36 (m, 1H, minor), 7.31 (dt, $J = 6.5$, 1.6 Hz, 2H, major), 7.28 (s, 1H), 2.54 (s, 3H, major), 2.52 (s, 1H, minor), 2.47 (s, 3H, major), 2.30 (s, 1H, minor), 2.29 (s, 3H, major), 2.27 (s, 1H, minor). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 152.4, 149.3, 137.5, 137.1, 136.1, 131.8, 127.1, 126.47, 126.41, 125.87, 125.68, 125.48, 124.9, 124.5, 20.0, 19.57, 19.48, 16.7, 16.06, 15.95. IR (thin film) 2966, 1553, 1431, 1073, 746 cm$^{-1}$; HRMS (ESI) m/e calcd (M+H) 198.1277; found 198.1280.

2,6-dimethyl-4-pentyl-3-phenylpyridine (3d): Prepared using the general procedure. Pyridine 3b was isolated as a viscous orange liquid. Regiochemistry determined by analogy. (Cp* $1:1.2$, 92%; Cp¹ $3:4:1$, 93%). R$_f$ = .15 (9:1 Hexanes/EtOAc); $^1$H (400 MHz, CDCl$_3$) $\delta$ 7.44-7.39 (m, 3H), 7.38-7.33 (m, 2H), 7.15-7.12 (m, 2H), 6.92 (s, 1H), 2.54 (s, 3H), 2.29-2.24 (m, 2H), 2.23 (s, 3H), 1.44-1.35 (m, 6H), 1.20-1.11 (m, 5H), 0.79 (dd, $J = 8.3$, 5.7 Hz, 3H). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 153.3, 152.9, 152.0, 148.5, 147.5, 136.2, 131.1, 126.8, 126.5, 125.8, 124.8, 124.5, 119.6, 118.3, 30.7, 30.3, 28.9, 27.3, 21.6, 21.0, 19.9, 19.6, 11.39, 11.22. IR (thin film) 2928, 1592, 1458, 1008, 703 cm$^{-1}$; HRMS (ESI) m/e calcd (M+H) 254.1903; found 254.1907.

3-methyl-2,4-diphenyl-5,6,7,8-tetrahydroquinoline (3e): This compound was previously characterized by Cheng and co-workers. Provided is a $^1$H NMR. (Cp* $4:1$, 75%; Cp¹ $1:1$, 70%). $^1$H (400 MHz, CDCl$_3$) $\delta$ 7.51-7.35 (m, 8H), 7.16-7.13 (m, 2H), 3.01 (t, $J = 6.4$ Hz, 2H), 2.36 (t, $J = 6.4$ Hz, 2H), 1.91 (s, 3H), 1.89-1.86 (m, 2H), 1.72 (qd, $J = 6.1$, 2.6 Hz, 2H).

3-methyl-2,4-diphenyl-6-styrylpyridine (3f): Prepared using the general procedure. Pyridine 3b was isolated as a viscous orange liquid. Regiochemistry determined by analogy (Cp* $3:5:1$, 77%; Cp¹ $1:3:4$, 76%). R$_f$ = .15 (9:1 Hexanes/EtOAc); $^1$H (400 MHz, CDCl$_3$) $\delta$ 7.67-7.05 (m, 18H), 2.46 (s, 3H, minor), 2.19 (s, 3H, major). $^{13}$C NMR (100 MHz, CDCl$_3$) $\delta$ 159.6, 152.6, 151.2, 141.3, 140.1, 139.5, 136.87, 136.77, 133.8, 132.1, 130.2, 129.23, 129.18, 128.97, 128.94, 128.83, 128.70, 128.69, 128.63, 128.40, 128.36, 128.22,
5-methyl-2,3,4-triphenylpyridine (3g): A 1.5 dram vial with a stir bar was charged with K₂CO₃ (0.11 mmol, 0.5 equiv), and [RhCp*Cl₂] (0.0055 mmol, 2.5 mol %). The 2,2,2 trifluoroethanol (1.5 ml) was added followed by oxime (0.24 mmol, 1.1 equiv) and alkyne (0.22 mmol, 1 equiv). The vial was sealed and placed into a 80 °C heating block for 24 h. The reaction was concentrated in vacuo. The residue was dissolved in 1 ml of dichloromethane and loaded onto a neutral column of silica gel and eluted with a suitable solution of ethyl acetate and hexanes (typically 20:1 EtOAc/Hexanes with 1% Et₃N). Evaporation of solvent afforded the product. (45%); Rf = 0.60 (9:1 Hexanes/EtOAc w/ 5% Et₃N); ¹H (400 MHz, CDCl₃) δ 8.82 (s, 1H), 7.46 (m, 3H), 7.39-7.35 (m, 6H), 7.17-7.16 (m, 4H), 7.03-7.00 (2H), 2.36 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 155.6, 149.3, 140.7, 138.09, 138.04, 134.6, 131.1, 129.7, 129.1, 127.7, 127.5, 127.2, 126.1, 17.7; IR (thin film) 1640, 1442, 1072, 760, 697 cm⁻¹; HRMS (ESI) m/e calcd (M+H) 348.1747; found 348.1743.

3,6-dimethyl-2,4-diphenylpyridine (3h): According to the general procedure, the desired pyridine was isolated as a yellow oil (Cp* 3.1:1, 91%; Cp¹ =1:3.3, 90%). Rf = 0.25 (9:1 Hexanes/EtOAc); ¹H (400 MHz, CDCl₃) δ 7.54-7.35 (m, 11H, minor), 7.24-7.20 (m, 3H, major), 7.18-7.14 (m, 3H, major), 7.06-7.03 (m, 5H, major), 2.61 (s, 3H, major), 2.60 (s, 3H, minor), 2.39 (s, 3H, major), 2.14 (s, 3H, minor). ¹³C NMR (100 MHz, CDCl₃) δ 159.2, 156.25, 156.14, 154.8, 151.0, 149.1, 141.4, 140.1, 139.5, 138.5, 132.3, 130.47, 130.34, 129.21, 129.16, 129.05, 128.93, 128.7, 128.29, 128.21, 128.13, 127.97, 127.92, 127.80, 127.70, 127.68, 127.64, 127.1, 126.7, 125.1, 122.8, 121.7, 24.22, 24.12, 23.9, 17.5. IR (thin film) 1586, 1493, 1073, 700 cm⁻¹; HRMS (ESI) m/e calcd (M+H) 260.1434; found 260.1438.

N,N,3,6-tetramethyl-2-phenylisonicotinamide (3i): According to the general procedure, the desired pyridine was isolated as a yellow oil (Cp* 6.6:1, 72%; Cp¹ =1:1, 74%). Rf = 0.25 (9:1 Hexanes/EtOAc); ¹H (400 MHz, CDCl₃) δ 7.47-7.45 (m, 5H), 6.98 (s, 1H), 3.16 (s, 3H), 2.92 (s, 3H), 2.59 (s, 3H), 2.20 (s, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 169.6, 159.3, 155.8, 146.0, 128.9, 128.2, 128.0, 123.2, 118.4, 38.2, 34.4, 30.0, 24.1, 16.0. IR (thin film) 1640, 1442, 1072, 760, 697 cm⁻¹; HRMS (ESI) m/e calcd (M+H) 255.1492; found 255.1493.

6-butyl-2-methyl-3-phenyl-4-(trifluoromethyl)pyridine (3j): According to the general procedure, the desired pyridine was isolated as a yellow oil (Cp* 10:1, 72%; Cp¹ =1:1, 68%). ¹H (400 MHz, CDCl₃) δ 7.46-7.40 (m, 5H), 7.35 (s, 1H), 2.86 (t, J = 7.9 Hz, 2H), 2.36 (d, J = 1.6 Hz, 3H), 1.73 (ddt, J = 9.9, 7.8, 5.6 Hz, 2H), 1.41 (dd, J = 15.0, 7.4 Hz, 2H), 0.95 (t, J = 7.4 Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 160.8, 160.3, 140.1, 137.6 (q), 129.1, 128.25, 128.15, 125.3, 125.0, 117.22, 117.16, 37.9, 32.0, 22.5, 15.67, 15.64, 13.9. IR (thin film) 2961, 1593, 1445, 1251, 764 cm⁻¹; HRMS (ESI) m/e calcd (M+H) 294.1467; found 294.1464.

3-((tert-butyldimethylsilyl)oxy)methyl)-6-methyl-2,4-diphenylpyridine (3k): According to the general procedure, the desired pyridine was isolated as a yellow oil (80%, 2.5:1); Rf = 0.78 (9:1
3-cyclopropyl-6-methyl-2,4-diphenylpyridine (3l): According to the general procedure, the desired pyridine was isolated as a yellow oil 81%, 4.4:1); R_f = .23 (19:1 Hexanes/EtOAc w/ 1% Et3N); 1H (400 MHz, CDCl3) δ 7.93-7.91 (m, 2H), 7.75-7.62 (m, 8H), 7.31 (s, 1H), 2.86 (s, 3H), 2.26-2.22 (m, 1H), 0.65-0.62 (m, 2H), 0.03-0.13 (m, 2H); 13C NMR (100 MHz, CDCl3) δ 160.4, 155.1, 152.3, 141.2, 139.9, 128.9, 128.4, 127.5, 127.2, 127.0, 122.1, 23.7, 12.8, 9.9, 9.6; IR (thin film) 1586, 1493, 1072, 753, 700 cm-1; HRMS (ESI) m/e calcld (M+H) 286.159; found 286.1597.

methyl 6-methyl-2,4-diphenylnicotinate (3m): According to the general procedure, the desired pyridine was isolated as a yellow oil (89%, 5:1); R_f = .15 (19:1 Hexanes/EtOAc w/ 1% Et3N); 1H (400 MHz, CDCl3) δ 7.53 (dd, J = 7.8, 1.7 Hz, 2H), 7.37-7.31 (m, 8H), 7.19 (s, 1H), 7.09 (s, 1H), 3.37 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 169.3, 159.0, 156.4, 148.8, 139.8, 138.3, 128.99, 128.94, 128.84, 128.74, 128.64, 128.61, 128.53, 128.46, 128.34, 128.28, 128.21, 127.84, 127.76, 125.6, 122.32, 122.27, 52.1, 24.6; IR (thin film) 1730, 1587, 1266, 1107, 699 cm-1; HRMS (ESI) m/e calcld (M+H) 303.1259; found 303.1256.

6-methyl-2,3,4-triphenylpyridine (3n): According to the general procedure, the desired pyridine was isolated as a white solid (89%); R_f = .35 (19:1 Hexanes/EtOAc w/ 1% Et3N); 1H (400 MHz, CDCl3) δ 7.27-7.25 (m, 3H), 7.21-7.17 (m, 6H), 7.08-7.02 (m, 5H), 6.85 (dd, J = 7.8, 1.7 Hz, 2H), 2.71 (s, 3H); 13C NMR (100 MHz, CDCl3) δ 157.8, 157.7, 156.4, 148.8, 139.8, 138.3, 129.86, 129.82, 129.2, 127.8, 127.6, 127.25, 127.18, 126.4, 123.3, 24.2; IR (thin film) 1671, 1446, 1103, 749, 701 cm-1; HRMS (ESI) m/e calcld (M+H) 322.159; found 322.159.

6-methyl-4-phenyl-3-propyl-2,3'-bipyridine (3o): According to the general procedure, the desired pyridine was isolated as a yellow oil (66%, 2.5:1); R_f = .76 (9:1 Hexanes/EtOAc w/ 5% Et3N); 1H (400 MHz, CDCl3) δ 8.76 (s, 1H), 8.65 (d, J = 3.8 Hz, 1H), 7.85 (dt, J = 7.8, 1.8 Hz, 1H), 7.47-7.39 (m, 4H), 7.32 (dd, J = 7.9, 1.6 Hz, 2H), 7.04 (s, 1H), 2.60 (s, 3H), 2.55-2.51 (m, 2H), 1.13-1.07 (m, 2H), 0.50 (t, J = 7.3 Hz, 3H); 13C NMR (100 MHz, CDCl3) δ 189.6, 155.7, 155.0, 151.6, 149.4, 148.6, 139.7, 136.7, 131.0, 128.36, 128.31, 127.8, 124.3, 123.2, 30.7, 23.87, 23.67, 13.9; IR (thin film) 1671, 1446, 1103, 749, 701 cm-1; HRMS (ESI) m/e calcld (M+H) 289.1699; found 289.1696.
2,3-dibutyl-6-methyl-4-phenylpyridine (3p): According to the general procedure, the desired pyridine was isolated as a yellow oil. (65%); Rf = .76 (9:1 Hexanes/EtOAc w/ 5% Et3N); 1H (400 MHz, CDCl3) δ 7.34-7.28 (m, 3H), 7.18-7.16 (m, 2H), 6.72 (s, 1H), 2.76-2.72 (m, 2H), 2.42 (q, J = 6.7 Hz, 3H). 

13C NMR (100 MHz, CDCl3) δ 160.4, 154.1, 150.5, 140.5, 130.0, 128.9, 128.43, 128.39, 128.21, 128.15, 128.02, 127.6, 127.3, 123.2, 122.1, 41.5, 35.2, 33.1, 32.8, 28.0, 26.7, 23.9, 23.1, 22.8, 19.1, 14.02, 13.97, 13.53, 13.44. IR (thin film) 1671, 1446, 1103, 749, 701 cm⁻¹; HRMS (ESI) m/e calc (M+H) 282.2210 found 282.2216.

3,6-dimethyl-4-phenyl-2-(4-(trifluoromethyl)phenyl)pyridine (3q): According to the general procedure, the desired pyridine was isolated as a yellow oil (85%, 3.5:1); Rf = .76 (9:1 Hexanes/EtOAc w/ 5% Et3N); 1H (400 MHz, CDCl3) δ 7.64-7.56 (m, 3H), 7.39-7.32 (m, 4H), 7.28-7.25 (m, 2H), 6.99 (s, 1H), 2.51 (s, 3H), 2.05 (s, 3H). 

13C NMR (100 MHz, CDCl3) δ 157.6, 155.2, 151.4, 144.92, 144.91, 139.7, 132.6, 130.8, 129.66, 129.51, 129.07, 128.93, 128.67, 128.61, 128.38, 128.21, 127.94, 127.87, 127.84, 127.5, 126.4, 125.6, 125.25, 125.21, 125.17, 125.13, 125.10, 124.99, 124.96, 123.42, 123.32, 121.9, 24.0, 17.3. HRMS (ESI) m/e calc (M+H) 328.1307 found 328.1308.

2-isopropyl-3,6-dimethyl-4-phenylpyridine (3r): According to the general procedure, the desired pyridine was isolated as an off white solid (73%, 10.8:1); Rf = .70 (9:1 Hexanes/EtOAc w/ 5% Et3N); 1H (400 MHz, CDCl3) δ 7.30 (m, 3H), 7.13 (dd, 2H, J=8.0 Hz, J=2.0 Hz), 6.69 (s, 1H), 3.11 (septet, 1H, J=7.6 Hz), 2.60 (s, 3H), 2.41 (s, 3H). IR (thin film) 2959, 1587, 1444, 1073, 777 cm⁻¹; HRMS (ESI) m/e calc (M+H) 226.159 found 226.1591.

2-(((tert-butyldimethylsilyloxy)(furan-2-yl)methyl)-6-methyl-4-phenyl-3-propylpyridine (3s): According to the general procedure, the desired pyridine was isolated as a yellow oil (71%, 9:1); Rf = .4 (9:1 Hexanes/EtOAc); Regiochemistry assigned via analogy; 1H (400 MHz, CDCl3) δ 7.79-7.75 (m, 5H), 7.66 (s, 1H), 6.75 (dd, J = 3.2, 1.8 Hz, 1H), 6.59 (d, J = 3.1 Hz, 1H), 6.36 (s, 1H), 3.38-3.17 (m, 2H), 2.94 (s, 3H), 1.98 (s, 2H), 1.24 (t, J = 7.3 Hz, 3H), 1.19 (s, 7H), 0.10 (d, J = 35.8 Hz, 5H). 

13C NMR (100 MHz, CDCl3) δ 168.6, 162.5, 161.6, 147.0, 145.0, 134.6, 133.58, 133.55, 133.3, 126.9, 115.8, 111.8, 103.93, 103.92, 72.6, 43.3, 31.31, 31.16, 29.7, 28.8, 23.5, 19.9, 0.6, -0.0. IR (thin film) 1556, 1442, 1024, 753 cm⁻¹; HRMS (ESI) m/e calc (M+H) 422.2504; found 422.251.
Aryl Oxime Characterization

Aryl oximes 4a, 8 4b, 8 4c, 9 4j, 8 4e, 10 4f 11 4k, 12 and 4l 12 were prepared according to literature procedures.

(1E,2E)-chalcone oxime (4d): Prepared using the general procedure. Oxime 4d was isolated as a single isomer. 1H (400 MHz, CDCl 3 ) δ 7.60 (d, J = 16.6 Hz, 1H), 7.46-7.34 (m, 5H), 7.31-7.21 (m, 3H), 6.74 (d, J = 16.6 Hz, 1H); 13C NMR (100 MHz, CDCl 3 ) δ 157.8, 139.7, 136.1, 134.7, 129.2, 129.1, 128.7, 128.6, 128.5, 128.4, 128.3, 128.3, 128.3, 128.2, 127.5, 117.0

(E)-1-(furan-2-yl)ethanone oxime (4g): Prepared using the general procedure. Oxime 4g was isolated as a single isomer. 1H (400 MHz, CDCl 3 ) δ 7.46 (dd, J = 1.8, 0.7 Hz, 1H), 6.64 (dd, J = 3.4, 0.7 Hz, 1H), 6.44 (dd, J = 3.4, 1.8 Hz, 1H), 2.23 (s, 3H). 13C NMR (100 MHz, CDCl 3 ) δ 150.1, 147.4, 143.6, 111.2, 110.0, 11.1.

(E)-1-(1-methyl-1H-pyrrol-2-yl)ethanone oxime (4i): Prepared using the general procedure. Oxime 4i was isolated as a single isomer. 1H (400 MHz, CDCl 3 ) δ 6.65 (t, J = 2.2 Hz, 1H), 6.44 (dd, J = 3.8, 1.8 Hz, 1H), 6.11 (dd, J = 3.8, 2.6 Hz, 1H), 3.80 (s, 3H), 2.22 (s, 3H). 13C NMR (100 MHz, CDCl 3 ) δ 151.2, 128.5, 126.9, 112.5, 107.3, 37.9, 12.9.

ISOQUINOLINES:

General Procedure:

A 1.5 dram vial was charged with a stirbar, free oxime (1 equiv), [RhCp*Cl 2 ] 2 or [RhCpCl 2 ] 2 (.00125 mol %), and K 2 CO 3 (2 equiv). TFE was added followed by alkynne (1.1 equiv). The reaction was sealed, warmed to 45 °C, and stirred until the reaction was complete as determined by TLC. Once complete the reaction was allowed to cool to room temperature and transferred to a 25 ml round bottom flask with excess CH 2 Cl 2 . Residual solvent was removed and the residue was purified via silica gel column chromatography.

4-ethyl-1-methyl-3-phenylisoquinoline (5a): According to the general procedure with the addition of 2 equiv. of CF 3 CO 2 CH 2 CF 3 , the desired

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pyridine was isolated as an off white solid (94%, >10:1 rr). Cheng and coworkers previously prepared this compound.\(^\text{13}\) Included is the \(^1\)H NMR.

4-ethyl-1,3-diphenylisoquinoline (5b): According to the general procedure, the desired pyridine was isolated as a yellow solid (86%, >15:1 rr). \(R_f = (2:1\) Hexanes/\(\text{EtOAc}\); \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 8.19-8.15 (m, 2H), 7.78-7.72 (m, 3H), 7.62 (dt, \(J = 8.1, 1.6\) Hz, 2H), 7.58-7.46 (m, 6H), 7.45-7.40 (m, 1H), 3.13 (q, \(J = 7.5\) Hz, 2H), 1.37 (t, \(J = 7.5\) Hz, 3H); \(^1\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 158.2, 151.1, 141.8, 139.9, 136.0, 130.29, 130.17, 130.07, 129.88, 129.4, 128.50, 128.41, 128.32, 128.26, 128.20, 128.15, 128.07, 127.4, 126.2, 125.9, 123.9, 21.9, 15.7; IR (thin film) cm\(^{-1}\); HRMS (ESI) \(m/e\) calcld 309.1517 (M+) ; found 309.1522.

4-ethyl-3-phenyl-1-styrylisoquinoline (5c): According to the general procedure, the desired pyridine was isolated as a yellow solid (87%, >10:1 rr). \(R_f = (2:1\) Hexanes/\(\text{EtOAc}\); \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 8.45 (d, \(J = 8.3\) Hz, 1H), 8.12 (d, \(J = 8.4\) Hz, 1H), 8.02 (d, \(J = 15.6\) Hz, 1H), 7.95 (d, \(J = 15.6\) Hz, 1H), 7.75 (dd, \(J = 9.4, 6.0\) Hz, 1H), 7.69-7.61 (m, 5H), 7.54-7.37 (m, 5H), 7.34-7.29 (m, 2H), 3.08 (q, \(J = 7.5\) Hz, 2H), 1.31 (dd, \(J = 9.6, 5.4\) Hz, 3H). \(^1\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 152.0, 151.3, 142.0, 137.2, 135.9, 135.6, 129.67, 129.55, 129.46, 129.38, 128.61, 128.42, 128.23, 128.01, 127.96, 127.45, 127.39, 127.32, 126.3, 125.9, 125.1, 124.2, 123.2, 21.9, 15.7. HRMS (ESI) \(m/e\) calcld 335.1674 (M+) ; found 335.1681.

1,4-dimethyl-3-phenylbenzofuro[2,3-c]pyridine (5d): According to the general procedure, the desired pyridine was isolated as a yellow solid (Cp\(^*\) 2.1:1 92% / Cp\(^t\) 1:9.2 90%). \(R_f = (2:1\) Hexanes/\(\text{EtOAc}\); \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.59-7.51 (m, 4H), 7.49-7.44 (m, 1H), 7.40 (dt, \(J = 6.2, 1.7\) Hz, 2H), 7.08 (td, \(J = 7.6, 0.9\) Hz, 1H), 6.95 (ddd, \(J = 7.9, 1.3, 0.6\) Hz, 1H), 2.86 (s, 3H), 2.48 (s, 3H). \(^1\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 150.8, 149.7, 147.5, 147.22, 147.09, 140.9, 139.6, 134.4, 129.53, 129.49, 128.4, 128.1, 127.37, 127.28, 127.0, 121.1, 105.9, 105.5, 22.2, 18.48, 18.45, 16.2. HRMS (ESI) \(m/e\) calcld 274.1226 (M+) ; found 274.1228.

4,7-dimethyl-5-phenylfuro[2,3-c]pyridine (5e): According to the general procedure, the desired pyridine was isolated as a yellow solid (88%, 2.7:1 rr). \(R_f = (2:1\) Hexanes/\(\text{EtOAc}\); \(^1\)H (400 MHz, CDCl\(_3\)) \(\delta\) 7.59-7.51 (m, 4H), 7.49-7.44 (m, 1H), 7.40 (dt, \(J = 6.2, 1.7\) Hz, 2H), 7.08 (td, \(J = 7.6, 0.9\) Hz, 1H), 6.95 (ddd, \(J = 7.9, 1.3, 0.6\) Hz, 1H), 2.86 (s, 3H), 2.48 (s, 3H). \(^1\)C NMR (100 MHz, CDCl\(_3\)) \(\delta\) 150.8, 149.7, 147.5, 147.22, 147.09, 140.9, 140.5, 139.6, 134.4, 129.53, 129.49, 128.4, 128.1, 127.37, 127.28, 127.0, 121.1, 105.9, 105.5, 22.2, 18.48, 18.45, 16.2. HRMS (ESI) \(m/e\) calcld 224.107 (M+) ; found 224.1067.

5,7-dimethyl-4-phenylfuro[2,3-c]pyridine (5e’): According to the general procedure, the desired pyridine was isolated as a yellow solid (90%, 2:4:1 rr). R<sub>f</sub> = (2:1 Hexanes/EtOAc); <sup>1</sup>H (400 MHz, CDCl<sub>3</sub>) δ 7.64 (d, <i>J</i> = 2.1 Hz, 1H), 7.52-7.43 (m, 2H), 7.42-7.35 (m, 3H), 6.52 (d, <i>J</i> = 2.1 Hz, 1H), 2.77 (s, 3H), 2.52 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 150.8, 149.7, 149.2, 147.5, 147.21, 147.09, 140.9, 140.5, 139.6, 137.7, 134.4, 133.9, 129.61, 129.52, 129.40, 128.52, 128.43, 128.1, 127.36, 127.27, 126.9, 121.0, 105.9, 105.5, 22.2, 18.5, 16.2. HRMS (ESI) m/e calcd 224.107 (M+H) ; found 224.1067.

1,4,7-trimethyl-5-phenyl-1H-pyrrolo[2,3-c]pyridine (5f): According to the general procedure, the desired pyridine was isolated as a yellow solid (Cp* 98% 4:1 / Cp′ 96% 1:2.1 ). R<sub>f</sub> = (2:1 Hexanes/EtOAc); <sup>1</sup>H (400 MHz, CDCl<sub>3</sub>) δ 7.48-7.42 (m, 2H), 7.41-7.35 (m, 3H), 7.01 (d, <i>J</i> = 3.0 Hz, 1H), 6.12 (d, <i>J</i> = 3.0 Hz, 1H), 4.06 (s, 3H), 2.98 (s, 3H), 2.48 (s, 3H). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 142.3, 140.5, 138.7, 135.2, 133.6, 133.2, 131.0, 129.8, 128.2, 127.9, 126.90, 126.1, 99.8, 99.5, 36.76, 36.74, 22.6, 21.7, 15.6. HRMS (ESI) m/e calcd 237.1386 (M+H) ; found 237.1381.

4,7-dimethyl-5-phenylthieno[2,3-c]pyridine (5g): According to the general procedure, the desired pyridine was isolated as a yellow solid (Cp* 10:1 93% / Cp′ 1:2.5 95%). R<sub>f</sub> = .3 (19:1 Hexanes/EtOAc w/ 1% Et<sub>3</sub>N); <sup>1</sup>H (400 MHz, CDCl<sub>3</sub>) δ 9.61 (d, <i>J</i> = 1.0 Hz, 1H), 8.77 (d, <i>J</i> = 5.0 Hz, 1H), 8.37 (d, <i>J</i> = 5.8 Hz, 1H), 7.51-7.41 (m, 5H), 3.05 (s, 3H), 2.96 (q, <i>J</i> = 7.5 Hz, 2H), 1.24 (t, <i>J</i> = 7.5 Hz, 3H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 152.1, 149.6, 145.9, 140.8, 134.0, 130.9, 129.69, 129.63, 128.5, 128.1, 127.4, 122.8, 122.1, 23.3, 16.6. HRMS (ESI) m/e calcd 240.0846 (M+H) ; found 240.0841.

6-ethyl-3-methyl-5-phenyl-1,4-naphthyridine (5h): According to the general procedure, the desired pyridine was isolated as an off white solid (73%, 10:1); R<sub>f</sub> = .3 (19:1 Hexanes/EtOAc w/ 1% Et<sub>3</sub>N); <sup>1</sup>H (400 MHz, CDCl<sub>3</sub>) δ 9.13 (dd, <i>J</i> = 4.2, 1.8 Hz, 1H), 8.46 (dd, <i>J</i> = 8.5, 1.8 Hz, 1H), 7.61 – 7.35 (m, 6H), 3.18 (q, <i>J</i> = 7.4 Hz, 2H), 2.97 (s, 3H), 1.27 (t, <i>J</i> = 7.4 Hz, 4H). <sup>13</sup>C NMR (126 MHz, CDCl<sub>3</sub>) δ 156.32, 154.21, 153.27, 150.04, 141.24, 134.11, 131.25, 129.12, 128.23, 127.70, 121.40, 121.37, 21.86, 20.97, 15.68.

8-ethyl-5-methyl-7-phenyl-1,6-naphthyridine (5h’): <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 9.13 (dd, <i>J</i> = 4.2, 1.8 Hz, 1H), 8.46 (dd, <i>J</i> = 8.5, 1.8 Hz, 1H), 7.61 – 7.35 (m, 6H), 3.18 (q, <i>J</i> = 7.4 Hz, 2H), 2.97 (s, 3H), 1.27 (t, <i>J</i> = 7.4 Hz, 4H). <sup>13</sup>C NMR (126 MHz, CDCl<sub>3</sub>) δ 156.32, 154.21, 153.27, 150.04, 141.24, 134.11, 131.25, 129.12, 128.23, 127.70, 121.40, 121.37, 21.86, 20.97, 15.68.
7-ethyl-4-methyl-6-phenyl-1,5-naphthyridine (5i): According to the general procedure, the desired pyridine was isolated as an off white solid (86%, 10:1); Rf = .3 (19:1 Hexanes/EtOAc w/ 1% Et3N); $^1$H (400 MHz, CDCl$_3$) δ 9.59 (s, 1H), 8.72 (d, 1H, $J$=6.0 Hz), 7.89 (dd, 1H, $J$=6.0 Hz, $J$=0.8 Hz), 7.52-7.42 (m, 5H), 3.10 (q, 2H, $J$=7.6 Hz), 2.96 (s, 3H), 1.32 (t, 3H, $J$=7.6 Hz); $^{13}$C NMR (100 MHz, CDCl$_3$) δ 155.6, 152.3, 149.8, 143.7, 140.7, 129.1, 128.2, 127.8, 117.9, 21.8, 20.9, 16.3.; IR (thin film) 2959, 1587, 1444, 1073, 777 cm$^{-1}$; HRMS (ESI) m/e caled (M+H$_3$) 251.1543; found 251.1544.

Internal Competition Experiment:

A one-dram vial with a stir bar was charged with amide (0.22 mmol, 1 equiv), Cu(OAc)$_2$•H$_2$O (0.46 mmol, 210 mol%), and [Cp*RhCl$_2$]$_2$ (0.0055 mmol, 2.5 mol) and 1.5 ml of $t$-amyl alcohol followed by the alkyne (0.275, 1.25 equiv). The vial was sealed and placed into a 110 °C heating block for 16 h. The reaction was allowed to cool and poured into a separatory funnel with excess dichloromethane and extracted twice with 10% NH$_4$OH in saturated NH$_4$Cl. The organic portion was extracted once with brine, dried over magnesium sulfate, and concentrated. The residue was dissolved in 1 ml of dichloromethane and loaded onto a column of silica gel and eluted with a suitable solution of ethyl acetate and hexanes (typically 1:4). Evaporation of solvent afforded the product.

KIE Experiments:

A 1.5 dram vial was charged with a stir-bar, (3E)-4-phenylbut-3-en-2-one oxime or D-(3E)-4-phenylbut-3-en-2-one oxime (.22 mmol), K$_2$CO$_3$ (.44 mmol), and 1,3,5 trimethoxy-benzene (.22 mmol). The vial was fitted with a septa and charged with 2,2,2-trifluoroethanol (2.2 ml). 1-phenyl-1-butyn (0.22 mmol) was added to the reaction solution and the vial was placed into an 45 °C heating block and stirred for 5 min. A separate vial was charged with [RhCp*Cl$_2$]$_2$ (2.5 mol %) and .25 ml of 2,2,2-triflouroethanol to yield a bright yellow solution. This solution was added to the reaction vessel in the heating block. 0.1 ml aliquots were taken every 60 seconds for 4 minutes (after 60, 120, 180, 240 seconds), diluted with ethyl acetate and were interpreted using GC/MS. Aliquots were collected every 4 min for D-(3E)-4-phenylbut-3-en-2-one oxime.
Competition Experiments

A 1.5 dram vial is charged with 1m (0.3 mmol), 1i (0.3 mmol), K$_2$CO$_3$ (200 mol%), 1,3,5 trimethoxybenzene (0.3 mmol), and TFE (3 ml). 1-phenyl-1-butyne was added to this solution and the flask was sealed and placed into 45 °C aluminium heating block. After 2 hours the reaction was allowed to cool, and the reaction was interpreted by GC/MS.
A 1.5 dram vial is charged with **1n** (.3 mmol), **1i** (.3 mmol), K₂CO₃ (200 mol %), 1,3,5 trimethoxybenzene (.3 mmol), and TFE (3 ml). 1-phenyl-1-butyne was added to this solution and the flask was sealed and placed into 45 °C aluminium heating block. After 2 hours the reaction was allowed to cool, and the reaction was interpreted by GC/MS.

**Mechanistic Experiments**

S1 was prepared as described by Cheng and coworkers, and submitted to the standard reaction conditions, then concentrated *in vacuo*. None of the desired 6a was observed.

A 1.5 dram vial is charged with **1a** (.3 mmol), K₂CO₃ (200 mol %), 1,3,5 trimethoxybenzene (.3 mmol), and TFE (3 ml). 1-phenyl-1-butyne (100 mol %), and 4-phenyl pyridine *N-oxide* was added to this solution and the flask was sealed and placed into 45 °C aluminium heating block. After 4 hours the reaction was allowed to cool and was concentrated *in vacuo*. The crude NMR revealed product formation with no reduced pyridine *N-oxide*. 
Oxime 1b
Oxime 1c
Oxime 1d

\[ \text{Oxime 1d} \]

\[ \begin{array}{c}
\text{Me} \\
\text{N} \\
\text{OH}
\end{array} \]

\[ \text{C}_3\text{H}_{11} \]
Oxime 1e
Oxime 1f
Oxime 1g
Oxime 1i
Oxime 1j

\[ \text{F}_3\text{C} \rightleftharpoons \text{N}=\text{N} \text{OH} \]

\text{n-Bu}
Pyridine 3a
Pyridine 3c
Pyridine 3e
Pyridine 3f
Pyridine 3g

![Pyridine 3g structure diagram]
Pyridine 3h
Pyridine 3i

CONMe₂

Me

Ph

Me
Pyridine 3j
Pyridine 3k

![Chemical Structure of Pyridine 3k]
Pyridine 3l

![Pyridine 3l structure]

![NMR spectrum]

![Chemical structure with Me, Ph, and N labels]
Pyridine 3m

![Pyridine 3m structure]

![NMR spectrum of Pyridine 3m]
Pyridine 3n

![Pyridine 3n structure]

![NMR spectrum for Pyridine 3n]
Pyridine 3o

![Pyridine 3o structure image]
Pyridine 3p

Pyridine 3q
Pyridine 3r
Pyridine 3s

Aryl Oxime 4d
Oxime 4g
Oxime 4i
Isoquinoline 5a
Isoquinoline 5b
Isoquinoline 5c
Isoquinoline 5d

![Chemical structure diagram of Isoquinoline 5d]

The diagram depicts the chemical structure of Isoquinoline 5d, showing carbon, nitrogen, oxygen, methyl, and phenyl groups.
Isoquinoline 5e
Isoquolinone 5f
Isoquinoline 5g

![Isoquinoline 5g structure](image)

![NMR spectrum](image)
Isoquinoline 5h
Isoquinoline 5i