Straightforward chemo- and stereoselective fluorocyclopropanation of allylic alcohols: exploiting the electrophilic nature of the not so elusive fluoriodomethylithium

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1. Instrumentation and General Analytical Methods

HRMS spectra were recorded on Agilent 6530 accurate mass Q-TOF instrument. \(^1\)H, \(^{13}\)C, \(^{19}\)F NMR spectra were recorded with an Agilent 500 spectrometer (500 MHz for \(^1\)H, 126 MHz for \(^{13}\)C, 470 MHz for \(^{19}\)F), and a Varian Mercury 300 spectrometer (300 MHz for \(^1\)H, 75 MHz for \(^{13}\)C, 282 MHz for \(^{19}\)F). Infrared spectra of the compounds were recorded by using a PerkinElmer 283 Spectrometer or by using attenuated total reflection spectrophotometer in reciprocal centimeter (cm\(^{-1}\)). The center of the (residual) solvent signal was used as an internal standard which was related to TMS with \(\delta\) 7.26 ppm (\(^1\)H in CDCl\(_3\)), \(\delta\) 77.00 ppm (\(^{13}\)C in CDCl\(_3\)). Absolute referencing was used for the \(^{19}\)F NMR spectra. Spin-spin coupling constants (\(J\)) are given in Hz. As far as possible, full and unambiguous assignment of all resonances was performed by combined application of standard NMR techniques, such as HSQC, COSY and NOESY experiments. The enantiomeric ratio was determined by using HPLC 1260 Infinity with DIODE detector.

THF was distilled over Na/benzophenone.

Fluoriodomethane was purchased from ABCR GmbH Germany and it was stored at -20°C. Lithium diisopropylamide [2 M in hexane/THF/ethylbenzene] was purchased from Sigma Aldrich. Other chemicals were purchased from Sigma-Aldrich, Alfa Aesar, Fluorochem and TCI Europe unless otherwise specified. Solutions were evaporated under reduced pressure with a rotary evaporator. TLC was carried out on aluminium sheets precoated with silica gel 60F254 (Merck); the spots were visualized under UV light (\(\lambda = 254\) nm) and/or KMnO\(_4\) (aq.) was used as revealing system.
2. Optimization of the reaction conditions

![Chemical structure](image)

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[^1] NMR yields calculated on the crude reaction mixture using mesitylene or hexafluorobenzene as internal standards;[^a] Reaction time: 1.5 h at -78°C plus 0.25 h at rt;[^b] Reaction quenched after 20 seconds;[^c] Experiment performed adding FCH₂I to preformed lithium alcoholate;[^d] Reaction carried out adding a THF solution of FCH₂I and cinnamyl alcohol to LDA;[^e] Allylic alcohol added 1s after the LDA addition to FCH₂I;[^f] Reaction run using 2 equivalents of allylic alcohol (FCH₂I as limiting reagent);[^g] Reaction run using 2 equivalents of allylic alcohol (FCH₂I as limiting reagent);[^h] Reaction run using a concentration of 0.3 M for alcohol;[^i] Reaction run using a concentration of 0.01 M for FCH₂I;[^j] Reaction run using a concentration of 0.005 M for FCH₂I.
3. General procedures for the preparation of allylic alcohols through:

3.1 Reduction of $\alpha,\beta$-unsaturated aldehydes and ketones

In a round bottom flask containing NaBH$_4$ (174 mg, 4.6 mmol, 1.15 equiv) at 0°C, a solution of aldehyde or ketone (4 mmol, 1 equiv) in absolute ethanol (10 mL) was added dropwise. After 30 min, sat. aqueous ammonium chloride and water were added. The resulting mixture was stirred at room temperature for additional 30 min, and diluted with dichloromethane (10 mL). The aqueous layer was extracted with dichloromethane (3 x 10 mL). The combined organic phases were washed with water (3 x 15 mL) and dried over Na$_2$SO$_4$. The solvent was removed under reduced pressure to afford the desired alcohol that was used without further purification.

3.2 Reduction of $\alpha,\beta$-unsaturated carboxylic acids

Cinnamyl alcohols were synthesized from the correspondent cinnamic acids following the reported procedure.$^1$

3.3 Nucleophilic addition of organolithiums to ketones

Allylic alcohols were prepared starting from corresponding ketone and alkyl lithium according to the literature procedures.$^2$
Scheme 1. Allylic alcohols
3-Methylcyclohex-2-enol (2a)

Prepared according to general procedure 3.1 to afford allylic alcohol 2a. $^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 5.51-5.49 (m, 1H, CH=C$_6$), 4.17 (m, 1H, CHOH), 1.95-1.91 (m, 2H, CH$_2$), 1.80-1.75 (m, 2H, CH$_2$), 1.68 (d, $J = 0.8$ Hz, 3H, CH$_3$), 1.60-1.56 (m, 2H, CH$_2$); the data are consistent with literature.$^3$

(E)-3-(p-Tolyl)prop-2-en-1-ol (2c)

Prepared according to general procedure 3.1 to afford allylic alcohol 2c. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.29 (d, $J = 8.0$ Hz, 2H, 2 x Ar-H), 7.13 (d, $J = 8.0$ Hz, 2H, 2 x Ar-H), 6.59 (d, $J = 15.9$ Hz, 1H, ArCH=CH), 6.32 (dt, $J = 15.9$, 5.8 Hz, 1H, CH=CHCH$_3$), 4.31 (d, $J = 5.7$ Hz, 2H, CH$_2$OH), 2.34 (s, 3H, CH$_3$); the data are consistent with literature.$^4$

(E)-3-(2-Methoxyphenyl)prop-2-en-1-ol (2d)

Prepared according to general procedure 3.1 to afford allylic alcohol 2d. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.44 (dd, $J = 7.6$, 1.4 Hz, 1H, Ar-H), 7.22 (dd, $J = 8.3$, 1.1 Hz, 1H, Ar-H), 6.96-6.86 (m, 3H, overlapping 2 x Ar-H and ArCH=CH), 6.39 (dt, $J = 16.0$, 5.9 Hz, 1H, CH=CHCH$_3$), 4.33 (d, $J = 5.9$ Hz, 2H, CH$_2$OH), 3.85 (s, 3H, OCH$_3$); the data are consistent with literature.$^5$

(E)-3-(4-Methoxyphenyl)prop-2-en-1-ol (2e)

Prepared according to general procedure 3.1 to afford allylic alcohol 2e. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 7.32 (d, $J = 8.7$ Hz, 2H, 2 x Ar-H), 6.86 (d, $J = 8.7$ Hz, 2H, 2 x Ar-H), 6.55 (d, $J = 15.9$ Hz, 1H, ArCH=CH), 6.23 (dt, $J = 15.8$, 5.9 Hz, 1H, CH=CHCH$_3$), 4.29 (d, $J = 5.9$ Hz, 2H, CH$_2$OH), 3.81 (s, 3H, OCH$_3$); the data are consistent with literature.$^4$
(E)-3-(3,4,5-Trimethoxyphenyl)prop-2-en-1-ol (2f)

\[
\text{H}_2\text{CO} \quad \text{H}_2\text{CO} \quad \text{OCH}_3
\]

Prepared according to general procedure 3.1 to afford allylic alcohol 2f. $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 6.60 (s, 2H, 2 x Ar-H), 6.53 (d, $J = 15.8$ Hz, 1H, ArCH=CH), 6.28 (dt, $J = 15.8$, 5.8 Hz, 1H, CH=CHCH$_3$), 4.31 (dd, $J = 5.7$, 1.1 Hz, 2H, CH$_2$OH), 3.86 (s, 6H, 2 x OCH$_3$), 3.84 (s, 3H, OCH$_3$); the data are consistent with literature.$^6$

(E)-3-(4-(Dimethylamino)phenyl)prop-2-en-1-ol (2g)

Prepared according to general procedure 3.1 to afford allylic alcohol 2g. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 7.29 (d, $J = 8.8$ Hz, 2H, 2 x Ar-H), 6.68 (d, $J = 8.8$ Hz, 2H, 2 x Ar-H), 6.52 (d, $J = 15.8$ Hz, 1H, ArCH=CH), 6.18 (dt, $J = 15.8$, 6.2 Hz, 1H, CH=CHCH$_2$), 4.28 (m, 2H, CH$_2$OH), 2.96 (s, 6H, N(CH$_3$)$_2$); the data are consistent with literature.$^7$

(E)-3-(4-Fluorophenyl)prop-2-en-1-ol (2h)

Prepared according to general procedure 3.2 to afford allylic alcohol 2h. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 7.38-7.33 (m, 2H, 2 x Ar-H), 7.04-6.98 (m, 2H, 2 x Ar-H), 6.59 (d, $J = 15.9$ Hz, 1H, ArCH=CH), 6.28 (dt, $J = 15.8$, 5.6 Hz, 1H, CH=CHCH$_2$), 4.33-4.31 (m, 2H, CH$_2$OH); the data are consistent with literature.$^4$

(E)-3-(4-Chlorophenyl)prop-2-en-1-ol (2i)

Prepared according to general procedure 3.1 to afford allylic alcohol 2i. $^1$H NMR (300 MHz, CDCl$_3$): $\delta$ 7.33-7.27 (m, 4H, 4 x Ar-H), 6.58 (dt, $J = 15.9$, 1.5 Hz, 1H, ArCH=CH), 6.38-6.29 (m, 1H, CH=CHCH$_2$), 4.33 (d, $J = 5.4$ Hz, 2H, CH$_2$OH); the data are consistent with literature.$^8$

(E)-3-(4-Bromophenyl)prop-2-en-1-ol (2j)

Prepared according to general procedure 3.2 to afford allylic alcohol 2j. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 7.44 (d, $J = 7.8$ Hz, 2H, 2 x Ar-H), 7.24-7.23 (m, 2H, 2 x Ar-H), 6.57 (d, $J = 16.7$ Hz, 1H, ArCH=CH), 6.38-6.31 (m, 1H, CH=CHCH$_2$), 4.34-4.32 (m, 2H, CH$_2$OH); the data are consistent with literature.$^5$
(E)-1-Phenylhept-1-en-3-ol (2l)

Prepared according to general procedure 3.3 to afford allylic alcohol 2l. $^1$H NMR (500 MHz, CDCl$_3$) δ 7.39 (d, $J = 7.3$ Hz, 2H, 2 x Ar-H), 7.32 (t, $J = 7.6$ Hz, 2H, 2 x Ar-H), 7.24 (t, $J = 7.3$ Hz, 1H, Ar-H), 6.57 (d, $J = 15.9$ Hz, 1H, ArCH=CH), 6.23 (dd, $J = 15.9$, 6.8 Hz, 1H, CH=CHCH$_3$), 4.28 (m, 1H, CHOH), 1.77 (bs, 1H, OH), 1.72-1.58 (m, 2H, CH$_2$), 1.45-1.34 (m, 4H, 2 x CH$_2$), 0.93 (t, $J = 7.0$ Hz, 3H, CH$_3$); the data are consistent with literature.  

(E)-4-Phenylbut-3-en-2-ol (2m)

Prepared according to general procedure 3.3 to afford allylic alcohol 2m. $^1$H NMR (300 MHz, CDCl$_3$) δ 7.40-7.24 (m, 5H, 5 x Ar-H), 6.56 (d, $J = 16.0$ Hz, 1H, Ar-CH=CH), 6.30-6.22 (m, 1H, Ar-CH=CH), 4.53-4.44 (m, 1H, CHOH), 1.37 (d, $J = 6.4$ Hz, 3H, CH$_3$); the data are consistent with literature. 

(E)-2-Methyl-1-phenylhept-1-en-3-ol (2n)

Prepared according to general procedure 3.3 to afford allylic alcohol 2n. $^1$H NMR (500 MHz, CDCl$_3$) δ 7.35-7.32 (m, 2H, 2 x Ar-H), 7.29-7.27 (m, 2H, 2 x Ar-H), 7.23-7.19 (m, 1H, Ar-H), 6.48 (s, 1H, CH=Cq), 4.17 (t, $J = 6.7$ Hz, 1H, CHOH), 1.87 (d, $J = 1.3$ Hz, 3H, CH$_3$Cq), 1.65-1.62 (m, 2H, CHCH$_2$), 1.43-1.33 (m, 4H, 2 x CH$_2$), 0.92 (t, $J = 7.1$ Hz, 3H, CH$_2$CH$_3$); the data are consistent with literature. 

1-Butylcyclohex-2-enol (2o)

Prepared according to general procedure 3.3 to afford allylic alcohol 2o. $^1$H NMR (500 MHz, CDCl$_3$) δ 5.80-5.77 (m, 1H, C$_6$H$_5$CH=CH), 5.61 (d, $J = 10.0$ Hz, 1H, C$_6$H$_5$CH=CH), 2.05-2.01 (m, 1H, CH$_3$H$_2$), 1.95-1.89 (m, 1H, CH$_3$H$_2$), 1.73-1.45 (m, 6H, 3 x CH$_2$), 1.32-1.31 (m, 4H, 2 x CH$_2$), 0.92-0.89 (m, 3H, CH$_3$); the data are consistent with literature. 

(E)-Dec-2-en-1-ol (2r)
Prepared according to general procedure 3.1 to afford allylic alcohol 2r. $^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 5.72-5.60 (m, 2H, CH=CH), 4.08 (d, $J$ = 4.9 Hz, 2H, CH$_2$OH), 2.06-2.01 (m, 2H, CH$_2$CH=CH), 1.38-1.31 (m, 10H, 5 x CH$_3$), 0.88 (t, $J$ = 6.4 Hz, 3H, CH$_3$); the data are consistent with literature.$^{13}$

**(E)-Dodec-2-en-1-ol (2t)**

Prepared according to general procedure 3.1 to afford allylic alcohol 2t. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 5.73-5.58 (m, 2H, CH=CH), 4.08 (d, $J$ = 4.9 Hz, 2H, CH$_2$OH), 2.07-2.00 (m, 2H, CH$_2$CH=CH), 1.39-1.19 (m, 14H, 7 x CH$_3$), 0.88 (t, $J$ = 6.6 Hz, 3H, CH$_3$); the data are consistent with literature.$^{14}$

**(E)-Hex-2-en-1-ol (2u)**

Prepared according to general procedure 3.1 to afford allylic alcohol 2u. $^1$H NMR (300 MHz, CDCl$_3$) $\delta$ 5.74-5.58 (m, 2H, CH=CH), 4.08 (d, $J$ = 4.4 Hz, 2H, CH$_2$OH), 2.05-1.98 (m, 2H, CH$_2$CH=CH), 1.41-1.36 (m, 2H, CH$_2$CH$_3$), 0.90 (t, $J$ = 7.3 Hz, 3H, CH$_3$); the data are consistent with literature.$^{15}$

**(E)-3-(3-(trifluoromethyl)phenyl)prop-2-en-1-ol (2ad)**

Prepared according to general procedure 3.2 to afford allylic alcohol 2ad. $^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 7.62 (s, 1H, Ar-H), 7.55 (d, $J$ = 7.7 Hz, 1H, Ar-H), 7.49 (d, $J$ = 7.7 Hz, 1H, Ar-H), 7.43 (t, $J$ = 7.7 Hz, 1H, Ar-H), 6.66 (d, $^3J$ trans = 16.0 Hz, 1H, ArCH=CH), 6.44 (dt, $J$ = 16.0, 5.4 Hz, 1H, CH=CHCH$_2$), 4.36 (broad signal, 2H, CH$_2$OH); $^{19}$F NMR (470 MHz, CDCl$_3$) $\delta$ 62.84 (s, 3F, CF$_3$); the data are consistent with literature.$^{16}$

Compounds 2b, 2k, 2p, 2q, 2s, 2v, 2w, 2x, 2y, 2z, 2aa are commercially available.
5. Assignment of stereochemistry for fluorocyclopropanes 4.

The stereochemistry of fluorocyclopropanes 4 was ascertained according to previous stereochemical assignments reported by Charette. The relative configuration of cyclopropanes was established considering the $^1$H and $^{19}$F coupling constants values. Typical $^3$J$_{HH}$ and $^3$J$_{HF}$ values for these systems are reported in the following scheme:

The stereochemical assignment is made assuming that the trans stereochemistry of the starting alkene is maintained in the cyclopropanation reaction, according to the proposed mechanism. For example, in cyclopropane 4d the $^1$H NMR spectrum showed $H_a$ as a quartet, a trans relationship with the fluorine ($^3$J$_{HF} = 6$-8 Hz), and a cis relationship with $H_b$ ($^3$J$_{HH} = 6$-8 Hz). The proposed stereochemistry has also been confirmed by 2D NOESY experiments (See below). Similar considerations apply to all fluorocyclopropanes.
6. General procedure for the preparation of fluorocyclopropanes

To a stirred solution of allylic alcohols (2 mmol, 2 equiv) in dry THF (33 mL) cooled at -50°C, fluoroiodomethane (159.92 mg, 0.67 mL, 1 mmol, 1 equiv) was added. Then, a commercial solution of LDA (2M, in THF/hexane/ethylen benzene, 1.5 mL, 3 mmol, 3 equiv) was added dropwise. After stirring for 15 minutes at -50°C and for 10 minutes at room temperature, the reaction was quenched with water (1 mL). The mixture was poured into water (10 mL) and extracted with EtOAc (3 x 10 mL). The combined organic layers were dried over Na₂SO₄ and concentrated under vacuum. Chromatography purification of the crude afforded the desired fluorocyclopropanes.

7. NMR data for fluorocyclopropanes

(1R*,2R*,6R*,7R*)-7-Fluoro-6-methylbicyclo[4.1.0]heptan-2-ol (4a)

Prepared according to general procedure 6 to afford fluorocyclopropane 4a as pale yellow oil (70 mg, 56%, \( dr = 80:20 \), selected data for major). Compound 4a mixture with allylic alcohol 2a. \( R_f = 0.3 \) (20% AcOEt in hexane); IR (film)/cm⁻¹ 3392, 2924, 2853, 1640, 1462, 1377, 1054; \(^1\)H NMR (500 MHz, CDCl₃) δ 4.51 (dd, \( J \) (H-H) = 65.2 Hz, \( ^3J \) trans (H-H) = 2.2 Hz, 1H, CHF), 4.17-4.16 (m, 1H, CHOH), 1.75-1.71 (m, 1H, CH₂H₂), 1.54-1.51 (m, 2H, CH₂), 1.37-1.30 (m, 1H, CHCHF), 1.27-1.24 (m, 1H, CH₂H₂), 1.21 (d, \( J = 1.7 \) Hz, 3H, C₆H₃), 1.17-1.11 (m, 1H, CH₂H₂), 0.97-0.93 (m, 1H, CH₂H₂); \(^1^C\) NMR (126 MHz, CDCl₃, selected data for major) δ 78.6 (d, \( ^1J \) (C-F) = 225.8 Hz, CHF), 66.0 (CHOH), 31.8 (CH₂), 31.1 (d, \( ^2J \) (C-F) = 9.1 Hz, CHCHF), 30.7 (CH₂), 23.9 (d, \( ^2J \) (C-F) = 9.5 Hz, C₆H₃), 19.5 (d, \( ^3J \) (C-F) = 8.6 Hz, C₆H₃), 19.1 (CH₂); \(^19\)F NMR (470 MHz, CDCl₃, selected data for major) δ -218.15 (dd, \( ^5J \) (H-F) = 65.2 Hz, \( ^3J \) cis (H-F) = 23.4 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₉H₁₃FNaO [M+Na]^+ 167.0843; Found: 167.0842.

((1R*,2S*,3R*)-2-Fluoro-3-phenylcyclopropyl)methanol (4b)

Prepared according to general procedure 6 to afford fluorocyclopropane 4b as colorless oil (115 mg, 80%, \( dr = 90:10 \)). \( R_f = 0.3 \) (30% EtOAc in hexane). IR (film)/cm⁻¹ 3367, 2922, 1603, 1498, 1458, 1260, 1095, 1029, 913, 799, 743; \(^1\)H NMR (500 MHz, CDCl₃) δ 7.32-7.30 (m, 2H, 2 x Ar-H), 7.25-7.22 (m, 3H, 3 x Ar-H), 4.69 (ddd, \( ^2J \) (H-H) = 64.9 Hz, \( ^3J \) cis (H-H) = 6.7 Hz, \( ^3J \) trans (H-H) = 2.5 Hz, 1H, CHF), 3.71-3.65 (m, 2H, CH₂OH), 2.08 (q, \( ^3J \) (C-F) = 6.7 Hz, 1H, ArCHF), 1.98-1.89 (m, 1H, CHCH₂OH); \(^1^C\) NMR (126 MHz, CDCl₃) δ 135.3 (d, \( ^1J \) (C-F) = 3.0 Hz, Ar-C₆), 128.6 (d, \( ^1J \) (C-F) = 1.3 Hz, 2 x Ar-C), 128.4 (2 x Ar-C), 126.7 (Ar-C), 75.5 (d, \( ^1J \) (C-F) = 226.5 Hz, CHF), 62.4 (d, \( ^3J \) (C-F) = 0.8 Hz, CH₂OH), 27.2 (d, \( ^2J \) (C-F) = 8.8 Hz, CHCH₂), 26.5 (d, \( ^2J \) (C-F) = 11.0 Hz, ArCHF); \(^19\)F NMR (470 MHz, CDCl₃) δ -220.75 (dd, \( ^5J \) (H-F) = 64.9 Hz, \( ^3J \) cis (H-F) = 20.7 Hz, \( ^3J \) trans (H-F) = 5.8 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₀H₁₀FO [M-H] 165.0721; Found: 165.0721.
(1R*,2S*,3S*)-2-Fluoro-3-(p-tolyl)cyclopropylmethanol (4c)

Prepared according to general procedure 6 to afford fluorocyclopropane 4c as orange oil (121 mg, 78%, dr = 90:10). Rf = (30% EtOAc in hexane). IR (film)/cm⁻¹ 3367, 2922, 2852, 1518, 1455, 1377, 1215, 1176, 1096, 1036, 988, 817, 737; ¹H NMR (500 MHz, CDCl₃): δ 7.17-7.12 (m, 4H, 2 x Ar-H), 4.67 (ddd, 2J (H-H) = 65.0 Hz, 3J cis (H-H) = 6.7 Hz, 2J trans (H-H) = 2.4 Hz, 1H, CHF), 3.69-3.64 (m, 2H, CH₂OH), 2.34 (s, 3H, Ar-CH₃), 2.05 (q, 3J (H-H) = 3J (H-H) = 6.6 Hz, 1H, ArCH₂CH₂OH), 1.95-1.87 (m, 1H, CHCH₂OH), 1.77 (bs, 1H, OH); ¹³C NMR (126 MHz, CDCl₃): δ 136.3 (Ar-C₆=CH₃), 132.1 (d, 3J (C-C) = 6.6 Hz, Ar=CH₂), 129.1 (2 x Ar-C), 128.5 (d, 4J (C-C) = 1.0 Hz, 2 x Ar-C), 75.5 (d, 2J (C-C) = 226.0 Hz, CHF), 62.4 (d, 3J (C-C) = 0.6 Hz, CH₂OH), 26.9 (d, 2J (C-C) = 8.8 Hz, CHCH₂OH), 26.2 (d, 2J (C-C) = 11.0 Hz, Ar-CH₂CH₂OH), 21.1 (Ar-CH₃); ¹⁹F NMR (470 MHz, CDCl₃): δ -220.82 (ddd, 2J (H-F) = 65.0 Hz, 3J cis (H-F) = 20.7 Hz, 2J trans (H-F) = 6.1 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₁H₁₂FO [M-H] 179.0878; Found: 179.0872.

(1S*,2R*,3S*)-2-Fluoro-3-(2-methoxyphenyl)cyclopropyl)methanol (4d)

Prepared according to general procedure 6 to afford fluorocyclopropane 4d as yellow oil (82 mg, 48%, dr = 90:10). Rf = 0.4 (20% EtOAc in hexane). IR (film)/cm⁻¹ 3368, 2921, 2850, 1601, 1585, 1495, 1463, 1435, 1245, 1110, 1027, 751; ¹H NMR (500 MHz, CDCl₃): δ 7.25-7.22 (m, 2H, 2 x Ar-H), 6.94-6.89 (m, 2H, 2 x Ar-H), 4.76 (ddd, 2J (H-H) = 64.2 Hz, 3J cis (H-H) = 6.5 Hz, 2J trans (H-H) = 2.2 Hz, 1H, CHF), 3.88 (s, 3H, Ar-CH₃), 2.22 (s, 3H, OCH₃), 1.76 (bs, 1H, OH); HRMS (ESI-TOF) m/z Calcd for C₁₁H₁₂FO [M-H] 195.0827; Found: 195.0820.

(1R*,2S*,3R*)-2-Fluoro-3-(4-methoxyphenyl)cyclopropyl)methanol (4e)

Prepared according to general procedure 6 to afford fluorocyclopropane 4e as yellow oil (121 mg, 64%, dr> 95:5). Rf = 0.3 (60% diethyl ether in hexane); IR (film)/cm⁻¹ 3369, 2917, 1611, 1514, 1462, 1245, 1179, 1030, 830; ¹H NMR (300 MHz, CDCl₃): δ 7.18 (d, J = 8.2 Hz, 2H, 2 x Ar-H), 6.86 (d, J = 8.3 Hz, 2H, 2 x Ar-H), 4.66 (dd, 2J (H-H) = 65.0 Hz, 3J cis (H-H) = 6.5 Hz, 1H, CHF), 3.79 (s, 3H, OCH₃), 3.68 (d, J = 4.8 Hz, 2H, CH₂OH), 2.04 (q, 3J (H-H) = 3J (H-H) = 6.5 Hz, 1H, Ar-CH₂CH₂OH), 1.91-1.82 (m, 1H, CHCH₂OH); ¹³C NMR (75 MHz, CDCl₃): δ 158.5 (OCH₃-Ar-
C₉, 129.7 (2 x Ar-C), 127.3 (d, 3J(C-H) = 3.3 Hz, Ar-C₉), 113.9 (2 x Ar-C), 75.4 (d, 1J(C-H) = 225.4 Hz, CHF), 62.5 (CH₂OH), 55.4 (OCH₃), 27.0 (d, 2J(C-H) = 8.8 Hz, CHCH₂OH), 25.8 (d, 3J(C-H) = 11.1 Hz, Ar-CH-CH₂CH₂OH); ¹⁹F NMR (282 MHz, CDCl₃) δ -220.93 (ddd, 2J(II-II) = 64.9 Hz, ⁵J cis (II-II) = 20.7 Hz, ⁵J trans (II-II) = 5.9 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₉H₁₅FNO [M-H] 195.0827; Found: 195.0820.

((1R*,2S*,3R*)-2-Fluoro-3-(3,4,5-trimethoxyphenyl)cyclopropyl)methanol (4f)

Prepared according to general procedure 6 to afford fluorocyclopropane 4f as orange oil (112 mg, 50%, dr> 95:5). Rf = 0.2 (50% EtOAc in hexane); IR (film)/cm⁻¹ 3392, 2923, 2852, 1588, 1510, 1463, 1413, 1235, 1125, 1005; ¹H NMR (500 MHz, CDCl₃): δ 6.48 (s, 2H, 2 x Ar-H), 4.69 (ddd, 3J(II-II) = 64.9 Hz, ⁵J cis (II-II) = 6.6 Hz, ⁵J trans (II-II) = 2.5 Hz, 1H, CHF), 3.85 (s, 6H, 2 x OCH₃), 3.83 (s, 3H, OCH₃), 3.72-3.69 (m, 2H, CH₂OH), 2.07-2.03 (m, 1H, Ar-CH-CH₂OH), 1.90 (m, 1H, CHCH₂OH); ¹³C NMR (126 MHz, CDCl₃): δ 153.2 (2 x Ar-C), 137.0 (Ar-C₉), 131.0 (d, 3J(C-H) = 3.2 Hz, Ar-C₉), 105.8 (d, ⁴J(C-OH) = 1.3 Hz, 2 x Ar-C), 75.5 (d, ²J(C-H) = 226.5 Hz, CHF), 62.3 (d, ⁴J(C-H) = 0.8 Hz, CH₂OH), 61.0 (OCH₃), 56.2 (2 x OCH₃), 27.4 (d, ²J(C-H) = 8.8 Hz, CHCH₂OH), 26.7 (d, ²J(C-H) = 10.9 Hz, Ar-CH-CH₂OH); ¹⁹F NMR (470 MHz, CDCl₃): δ -220.56 (ddd, ²J(II-II) = 64.9 Hz, ³J cis (II-II) = 20.9 Hz, ³J trans (II-II) = 5.9 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₃H₁₆F₂O [M-H] 255.1038; Found: 255.1032

((1R*,2R*,3S*)-2-(4-(Dimethylamino)phenyl)-3-fluorocyclopropyl)methanol (4g)

Prepared according to general procedure 6 to afford fluorocyclopropane 4g as orange oil (108 mg, 60%, dr> 95:5). Rf = 0.4 (30% AcOEt in hexane); IR (film)/cm⁻¹ 3338, 2875, 1614, 1524, 1444, 1349, 1224, 1130, 1094, 1036, 987, 948, 818; ¹H NMR (500 MHz, CDCl₃): δ 7.14 (d, J = 8.6 Hz, 2H, 2 x Ar-H), 6.71 (d, J = 8.7 Hz, 2H, 2 x Ar-H), 4.64 (ddd, ²J(II-II) = 65.0 Hz, ³J cis (II-II) = 6.6 Hz, ³J trans (II-II) = 2.3 Hz, 1H, CHF), 3.71-3.63 (m, 2H, CH₂OH), 2.92 (s, 6H, N(CH₃)₂), 2.01 (q, J = 6.6 Hz, 1H, Ar-CH-CH₂OH), 1.90-1.83 (m, 1H, CHCH₂OH); ¹³C NMR (126 MHz, CDCl₃): δ 149.6 (Ar-C₉), 129.4 (d, ³J(C-H) = 1.0 Hz, 2 x Ar-C), 122.9 (Ar-C₉), 112.9 (2 x Ar-C), 75.5 (d, ³J(C-H) = 225.1 Hz, CHF), 62.7 (d, ²J(C-H) = 0.7 Hz, CH₂OH), 40.9 (N(CH₃)₂), 26.8 (d, ²J(C-H) = 8.9 Hz, CHCH₂OH), 25.8 (d, ²J(C-H) = 11.0 Hz, Ar-CH-CH₂OH); ¹⁹F NMR (282 MHz, CDCl₃): δ -220.88 (ddd, ²J(II-II) = 66.2 Hz, ³J cis (II-II) = 21.8 Hz, ³J trans (II-II) = 6.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₉H₁₈FNO 208.1143; Found: 208.1160.
Prepared according to general procedure 6 to afford fluorocyclopropane 4h as yellow oil (86 mg, 54%, dr> 95:5). Rf = 0.4 (60% diethyl ether in hexane); IR (film)/cm⁻¹ 3368, 2918, 1606, 1513, 1226, 1160, 1037, 834; ¹H NMR (500 MHz, CDCl₃) δ 7.23-7.19 (m, 2H, 2 x Ar-H), 7.01-6.98 (m, 2H, 2 x Ar-H), 4.68 (ddd, 3J (H-H) = 64.8 Hz, 3J cis (H-H) = 6.6 Hz, 3J trans (H-H) = 2.4 Hz, 1H, CHF), 3.69 (dd, J = 6.5, 2.2 Hz, 2H, CH₂OH), 2.06 (q, 3J (H-H) = 3J (H-H) = 6.6 Hz, 1H, Ar-CH₂CHF), 1.91-1.82 (m, 1H, CH₂CH₂OH); ¹³C NMR (75 MHz, CDCl₃) δ 161.8 (d, 1J (C-F) = 244.8 Hz, F-Ar-C₃), 130.1 (d, 1J (C-F) = 7.9 Hz, 2 x Ar-C), 115.1 (d, 1J (C-F) = 21.4 Hz, 2 x Ar-C), 75.1 (d, 1J (C-F) = 227.1 Hz, CHF), 62.0 (CH₂OH), 27.1 (d, 2J (C-F) = 8.7 Hz, CH₂CH₂OH), 25.5 (d, 2J (C-F) = 11.0 Hz, Ar-CH₂CHF); ¹⁹F NMR (282 MHz, CDCl₃) δ -116.43 — -116.55 (m, Ar-Br, 1F), -220.91 (ddd, 2J (H-F) = 65.5 Hz, 2J cis (H-F) = 21.5 Hz, 2J trans (H-F) = 7.2 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₀H₁₃F₂O [M-H]⁺ 183.0627; Found: 183.0626.

Prepared according to general procedure 6 to afford fluorocyclopropane 4i as orange oil (70 mg, 40%, dr> 95:5). Rf = 0.4 (50% EtOAc in hexane); IR (film)/cm⁻¹ 3338, 2918, 1494, 1213, 1178, 1090, 1014, 913, 826, 742; ¹H NMR (500 MHz, CDCl₃) δ 7.27 (d, J = 8.5 Hz, 2H, 2 x Ar-H), 7.18 (d, J = 8.5 Hz, 2H, 2 x Ar-H), 4.69 (ddd, 3J (H-H) = 64.8 Hz, 3J cis (H-H) = 6.6 Hz, 3J trans (H-H) = 2.4 Hz, 1H, CHF), 3.70 (s, 2H, CH₂OH), 2.08-2.04 (m, 1H, Ar-CH₂CHF), 1.93-1.84 (m, 1H, CH₂CH₂OH); ¹³C NMR (126 MHz, CDCl₃) δ 133.9 (d, 3J (C-F) = 3.1 Hz, Ar-C₃), 123.5 (Ar-C₃-Cl), 129.9 (d, 3J (C-F) = 1.4 Hz, 2 x Ar-C), 128.5 (2 x Ar-C), 75.3 (d, 1J (C-F) = 226.7 Hz, CHF), 62.1 (CH₂OH), 27.4 (d, 2J (C-F) = 8.7 Hz, CH₂CH₂OH), 25.8 (d, 3J (C-F) = 11.0 Hz, Ar-CH₂CHF); ¹⁹F NMR (470 MHz, CDCl₃) δ -220.85 (ddd, 2J (H-F) = 64.8 Hz, 3J cis (H-F) = 20.8 Hz, 3J trans (H-F) = 5.8 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₀H₈F₂O [M-H]⁺ 199.0331; Found: 199.0327.

Prepared according to general procedure 6 to afford fluorocyclopropane 4j as yellow oil (85 mg, 54%, dr> 95:5). Rf = 0.3 (60% diethyl ether in hexane); IR (film)/cm⁻¹ 3352, 2924, 2874, 1493, 1397, 1213, 1177, 1094, 1073, 1036, 1010, 824, 763, 717; ¹H NMR (300 MHz, CDCl₃) δ 7.42 (d, J = 8.5 Hz, 2H, 2 x Ar-H), 7.12 (d, J = 8.3 Hz, 2H, 2 x Ar-H), 4.69 (ddd, 3J (H-H) = 64.8 Hz, 3J cis (H-H) = 6.6 Hz, 3J trans (H-H) = 2.5 Hz, 1H, CHF), 3.70 (d, J = 6.2 Hz, 2H, CH₂OH), 2.05 (q, 3J (H-H) = 3J (H-H) = 6.6 Hz, 1H, Ar-CH₂CHF), 1.96-1.81 (m, 1H, CH₂CH₂OH); ¹³C NMR (75 MHz, CDCl₃) δ 134.6 (d, 3J (C-F) = 3.1 Hz, Ar-C₃), 131.4 (2 x Ar-C), 130.4 (2 x Ar-C), 120.5 (Ar-C₃-Bₖ), 75.2 (d, 1J (C-
 Prepared according to general procedure 6 to afford fluorocyclopropane 4k as colorless oil (69 mg, 34%, dr= 80:20, selected data for major). R₇ = 0.3 (30% EtOAc in hexane). IR (film)/cm⁻¹ 3400, 2923, 2852, 1496, 1455, 1178, 1072, 1028, 745, 698; ¹H NMR (500 MHz, CDCl₃, selected data for major) δ 7.45-7.29 (m, 8H, 8 x Ar-H), 7.22-7.19 (m, 2H, 2 x Ar-H), 4.88 (ddd, 3J(¼-H) = 65.1 Hz, 3jcis(¼-H) = 6.8 Hz, 3jtrans(¼-H) = 2.5 Hz, 1H, CHF), 4.64-4.62 (m, 1H, CHOH), 2.25 (q, J = 6.7 Hz, 1H, Ar-CH(CHF)), 2.09-1.99 (m, 1H, CHCHOH); ¹³C NMR (126 MHz, CDCl₃, selected data for major) δ 142.7 (Ar-C₆), 135.3 (d, 3J(¼-C) = 2.9 Hz, Ar-C₃), 128.9 (2 x Ar-C), 128.7 (2 x Ar-C), 128.4 (2 x Ar-C), 128.3 (Ar-C), 126.7 (Ar-C), 126.2 (2 x Ar-C), 75.3 (d, 3J(¼-C) = 227.2 Hz, CHF), 73.0 (CHOH), 31.7 (d, 3J(¼-C) = 8.6 Hz, CHCHOH), 26.2 (d, 3J(¼-C) = 11.0 Hz, Ar-CH(CHF)); ¹⁹F NMR (470 MHz, CDCl₃, selected data for major) δ -221.24 (ddd, 3j(¼-H) = 65.2 Hz, 3jcis(¼-H) = 20.7 Hz, 3jtrans(¼-H) = 6.1 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₅H₁₃FO [M-H]⁺ 241.9826; Found: 242.9840.

(R*)-1-((1R*,2S*,3R*)-2-Fluoro-3-phenylcyclopropyl)pentan-1-ol (4l)

 Prepared according to general procedure 6 to afford fluorocyclopropane 4l as pale yellow oil (67 mg, 35%, dr> 95:5). R₇ = 0.2 (50% EtOAc in hexane); IR (film)/cm⁻¹ 3412, 2928, 2857, 2254, 1468, 1266, 1014, 912, 742; ¹H NMR (500 MHz, CDCl₃): δ 7.33-7.30 (m, 2H, 2 x Ar-H), 7.26-7.22 (m, 3H, 3 x Ar-H), 4.76 (ddd, 3J(¼-H) = 65.3 Hz, 3jcis(¼-H) = 6.7 Hz, 3jtrans(¼-H) = 2.5 Hz, 1H, CHF), 3.39-3.37 (m, 1H, CHO), 2.11-2.05 (m, 1H, Ar-CH(CHF)), 1.80-1.73 (m, 1H, CHCHOH), 1.67-1.62 (m, 2H, CH₂CHOH), 1.49-1.32 (m, 4H, CH₂CH₂CH₂), 0.91 (t, J = 7.1 Hz, 3H, CH₃); ¹³C NMR (126 MHz, CDCl₃): δ 135.6 (Ar-C₆), 128.6 (d, 3J(¼-C) = 1.3 Hz, 2 x Ar-C), 128.4 (2 x Ar-C), 126.6 (Ar-C), 75.2 (d, 3J(¼-C) = 226.3 Hz, CHF), 71.6 (CHOH), 36.7 (CH₂CHOH), 31.2 (d, 3J(¼-C) = 8.1 Hz, CHCHOH), 27.8 (CH₂CH₂CHOH), 26.5 (d, 3J(¼-C) = 11.1 Hz, Ar-CH(CHF)), 22.8 (CH₂CH₃), 14.2 (CH₃); ¹⁹F NMR (470 MHz, CDCl₃): δ -217.80 (ddd, 3J(¼-H) = 27.7 Hz, 3jcis(¼-H) = 22.3 Hz, 3jtrans(¼-H) = 6.0 Hz, CHF minor), -221.06 (ddd, 3J(¼-H) = 65.3 Hz, 3jcis(¼-H) = 21.0 Hz, 3jtrans(¼-H) = 6.0 Hz, CHF major); HRMS (ESI-TOF) m/z Calcd for C₁₄H₁₆FO [M-H]⁺ 221.1347; Found: 221.1341.
(R*)-1-[(1R*,25*,3R*)-2-Fluoro-3-phenylcyclopropyl]ethanol (4m)

Prepared according to general procedure 6 to afford fluorocyclopropane 4m as pale yellow oil (59 mg, 38%, dr = 80:20, inseparable mixture of diastereoisomers). Rf = 0.2 (20 % EtOAc in hexane). IR (film)/cm⁻¹ 3367, 2919, 2851, 1603, 1498, 1431, 1073, 945, 745, 697; ¹H NMR (500 MHz, CDCl₃): δ 7.33-7.23 (m, 5H, 5 x Ar-H, overlapping major and minor), 4.76 (ddd, ²J (H-H) = 65.2 Hz, ³J cis (H-H) = 6.7 Hz, ³J trans (H-H) = 2.5 Hz, 1H, CHF major), 4.69 (ddd, ²J (H-H) = 65.1 Hz, ³J cis (H-H) = 6.7 Hz, ³J trans (H-H) = 2.5 Hz, 1H, CHF minor), 3.74-3.71 (m, 1H, CHCH₃ minor), 3.61-3.58 (m, 1H, CHCH₃ major), 2.22-2.18 (m, 1H, Ar-CHCHF minor), 2.10-2.06 (m, 1H, Ar-CHCHF major), 1.82-1.74 (m, 1H, CHCHCH₃ overlapping major and minor), 1.37 (d, J = 6.2 Hz, 3H, CH₃ minor) 1.35 (d, J = 6.3 Hz, 3H, CH₃ major); ¹³C NMR (126 MHz, CDCl₃): δ 135.7 (d, ²J (C-F) = 3.0 Hz, Ar-C₃ minor), 135.5 (d, ³J (C-F) = 3.1 Hz, Ar-C₃ major), 128.7 (d, ³J (C-F) = 1.2 Hz, 2 x Ar-C minor), 128.3 (2 x Ar-C major) 128.3 (2 x Ar-C minor), 126.6 (Ar-C major), 126.5 (Ar-C minor), 76.1 (d, ²J (C-F) = 226.2 Hz, CHF major), 74.3 (d, ³J (C-F) = 226.1 Hz, CHF minor), 67.6 (CHCH₃ major), 67.1 (d, ³J (C-F) = 1.8 Hz, CHCH₃ minor), 32.4 (d, ³J (C-F) = 8.1 Hz, CHCH₃ minor), 32.3 (d, ³J (C-F) = 8.1 Hz, CHCHCH₃ major), 26.2 (d, ²J (C-F) = 11.2 Hz, Ar-CHCHF major), 26.0 (d, ²J (C-F) = 11.2 Hz, Ar-CHCHF minor), 22.8 (CH₃ minor), 22.5 (d, ²J (C-F) = 0.8 Hz, CH₃ major); ¹⁹F NMR (282 MHz, CDCl₃) δ -220.40 (ddd, ²J (H-F) = 65.4 Hz, ³J cis (H-F) = 21.2 Hz, ³J trans (H-F) = 6.4 Hz, CHF major), -221.37 (ddd, ²J (H-F) = 65.3 Hz, ³J cis (H-F) = 21.8 Hz, ³J trans (H-F) = 6.4 Hz, CHF minor); HRMS (ESI-TOF) m/z Calcd for C₁₁H₁₂FO [M-H]⁺ 179.0878, Found: 179.0872.

(R*)-1-[(1R*,25*,35*)-2-Fluoro-1-methyl-3-phenylcyclopropyl]pentan-1-0l (4n)

Prepared according to general procedure 6 to afford fluorocyclopropane 4n as colorless oil (37 mg, 36%, dr = 90:10). Rf = 0.2 (20% EtOAc in hexane). IR (film)/cm⁻¹ 3400, 2928, 2856, 1464, 1073, 737, 698; ¹H NMR (500 MHz, CDCl₃): δ 7.35-7.28 (m, 3H, 3 x Ar-H), 7.25-7.22 (m, 2H, 2 x Ar-H), 4.74 (dd, ²J (H-F) = 65.5 Hz, ³J cis (H-F) = 6.6 Hz, 1H, CHF), 3.04-3.02 (m, 1H, CHOH), 1.98 (t, J = 7.1 Hz, 1H, Ar-CHCHF), 1.65-1.62 (m, 2H, CH₂), 1.38-1.35 (m, 4H, 2 x CH₂), 0.96-0.93 (m, 6H, 2 x CH₃); ¹⁳C NMR (126 MHz, CDCl₃) δ 134.5 (Ar-C₃), 128.3 (2 x Ar-C), 128.3 (2 x Ar-C), 126.5 (Ar-C), 78.3 (d, ²J (C-F) = 237.8 Hz, CHF), 77.0 (CHOH), 32.9 (d, ²J (C-F) = 1.9 Hz, CHCH₂), 27.7 (d, ²J (C-F) = 9.4 Hz, Ar-CHCHF), 22.9 (2 x CH₂), 22.8 (CH₂CH₂), 14.2 (CH₂CH₂), 7.13 (d, J = 8.6 Hz, C₃H₃); ¹⁹F NMR (470 MHz, CDCl₃) δ -227.51 (dd, ²J (H-F) = 65.4 Hz, ³J trans (H-F) = 7.5 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₃₅H₃₀FO [M-H]⁺ 235.1504; Found: 235.1497.
(1R*,2R*,6R*,7R*)-2-Butyl-7-fluorocyclo[4.1.0]heptan-2-ol ((4o)-minor)

Prepared according to general procedure 6 to afford fluorocyclopropane 4o-(minor) as yellow oil (66 mg, 41%, dr = 60:40). Rf = 0.4 (30% EtOAc in hexane). IR (film)/cm⁻¹ 3398, 2913, 2855, 1457, 1371, 1050; ¹H NMR (500 MHz, CDCl₃): δ 4.66 (dt, ²J (H-F) = 68.2 Hz, ³J cis (H-H) = 6.4 Hz, 1H, CHF), 1.91-1.84 (m, 1H, CH₂H₂), 1.70-1.66 (m, 2H, CH₂), 1.53-1.26 (m, 9H, overlapping CH₃), 1.18-1.11 (m, 1H, CH₂CHCHF), 1.00-0.97 (m, 1H, C₆HCHCHF), 0.93 (t, J = 7.3 Hz, 3H, CH₃); ¹³C NMR (126 MHz, CDCl₃): δ 76.8 (d, ¹J (C-F) = 219.0 Hz, CHF), 71.3 (d, ¹J (C-F) = 3.3 Hz, C₂), 42.2 (CH₃), 36.7 (d, ²J (C-F) = 3.2 Hz, CH₂), 25.6 (CH₂), 23.4 (CH₂), 22.1 (d, ³J (C-F) = 8.4 Hz, C₆CHCHF), 21.6 (CH₂), 16.2 (d, ²J (C-F) = 5.8 Hz, CH₃) 15.1 (d, ²J (C-F) = 10.2 Hz, CH₂CHCHF), 14.3 (CH₃); ¹⁹F NMR (470 MHz, CDCl₃): δ -233.43 (d, ¹J (H-F) = 68.1 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₃H₁₈FO [M-H] 185.1342; Found: 185.1466.

(1R*,2R*,6R*,7S*)-2-Butyl-7-fluorocyclo[4.1.0]heptan-2-ol ((4o)-major and (4o)-minor)

Prepared according to general procedure 6 to afford fluorocyclopropane 4o-(major) and 4o-(minor) as yellow oil (66 mg, 41%, dr = 60:40 according to ¹⁹F NMR of the crude). Rf = 0.6 (30% EtOAc in hexane). IR (film)/cm⁻¹ 3442, 2932, 2870, 1662, 1458, 1408, 1378, 1162, 1137, 1088, 1029, 786, 751; ¹H NMR (500 MHz, CDCl₃, mixture of diastereoisomers) δ 4.66 (dt, ²J (H-F) = 68.2 Hz, ³J cis (H-H) = 6.4 Hz, 1H, CHF minor) 4.58 (d, ²J (H-F) = 64.3 Hz, 1H, CHF major), 1.91-1.85 (m, 1H, CH₃H₆, overlapping major and minor), 1.79-1.65 (m, 3H, CH₂, overlapping major and minor), 1.54-1.50 (m, 2H, CH₂, overlapping major and minor), 1.45-1.41 (m, 2H, CH₂, overlapping major and minor), 1.36-1.26 (m, 4H, 2 x CH₂, overlapping major and minor), 1.18-1.11 (m, 1H, CH₂CHCHF, overlapping major and minor), 1.00-0.97 (m, 1H, C₆HCHCHF, overlapping major and minor), 0.93 (t, J = 7.5 Hz, 3H, CH₃, overlapping major and minor); ¹³C NMR (126 MHz, CDCl₃, mixture of diastereoisomers) δ 76.1 (d, ¹J (C-F) = 220.7 Hz, CHF major) 75.1 (d, ¹J (C-F) = 219.0 Hz, CHF minor), 71.3 (d, ²J (C-F) = 3.1 Hz, C₂ minor), 69.1 (C₁₃ major), 43.9 (CH₂ major), 42.2 (CH₂ minor), 36.7 (d, ²J (C-F) = 3.1 Hz, CH₂ minor), 35.1 (CH₂ major), 25.6 (CH₂ minor), 25.5 (CH₂ major), 23.4 (CH₂ minor), 23.3 (CH₂ major), 22.1 (d, ²J (C-F) = 8.5 Hz, C₆CHCHF overlapping major and minor), 21.6 (CH₂ minor), 20.7 (CH₂ major), 18.0 (CH₂ major), 16.2 (d, ²J (C-F) = 5.8 Hz, CH₂ minor) 15.1 (d, ²J (C-F) = 10.2 Hz, CH₂CHCHF overlapping major and minor), 14.3 (CH₃ minor), 14.2 (CH₃ major); ¹⁹F NMR (470 MHz, CDCl₃, mixture of diastereoisomers) δ -206.79 (dt, ²J (H-F) = 64.5 Hz, ³J cis (H-F) = 22.5 Hz, CHF major), -233.44 (d, ²J (H-F) = 69.6 Hz, CHF minor); HRMS (ESI-TOF) m/z Calcd for C₁₃H₁₈FO [M+Na]⁺ 209.1312; Found: 209.1313.
**((1R*,2S*,3S*)-2-Fluoro-3-((E)-prop-1-en-1-yl)cyclopropyl)methanol (4p)**

Prepared according to general procedure 6 to afford fluorocyclopropane 4p as orange oil (82 mg, 73%, dr>95:5). Rf = 0.4 (20% AcOEt in hexane); IR (film)/cm⁻¹ 3401, 2924, 2854, 1650, 1053; ¹H NMR (500 MHz, CDCl₃) δ 5.67 (m, 1H, CH₂CH=), 5.29-5.24 (m, 1H, CH₂CH=CH), 4.52 (ddd, ²J (H-H) = 63.9 Hz, ³J cis (H-H) = 6.4 Hz, ³J trans (H-H) = 2.4 Hz, 1H, CHF), 3.56-3.54 (m, 2H, CH₂OH), 1.70 (d, J = 1.7 Hz, 3H, CH₃), 1.55-1.46 (m, 2H, overlapping CHCHF and CHCH₂OH); ¹³C NMR (126 MHz, CDCl₃) δ 127.3 (CH₃CH=), 125.5 (d, ³J (C-F) = 7.7 Hz, CH₃CH=CH), 75.7 (d, ³J (C-F) = 224.4 Hz, CHF), 62.2 (CH₂OH), 27.5 (d, ³J (C-F) = 9.5 Hz, CHCH₂OH), 24.9 (d, ³J (C-F) = 10.6 Hz, CHCH=CHCH₂); ¹⁹F NMR (470 MHz, CDCl₃) δ -221.26 (ddd, ²J (H-F) = 64.8 Hz, ³J cis (H-F) = 20.8 Hz, ³J trans (H-F) = 5.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₇H₁₀FO [M-H]⁺ 129.0716; Found: 129.0919.

**((1R*,2S*,3S*)-2-Fluoro-3-pentylcyclopropyl)methanol (4q)**

Prepared according to general procedure 6 to afford fluorocyclopropane 4q as yellow oil (98 mg, 70%, dr>95:5). Rf = 0.4 (20% EtOAc in hexane). IR (film)/cm⁻¹ 3370, 2925, 2855, 1457, 1073; ¹H NMR (500 MHz, CDCl₃) δ 4.54-4.39 (m, 1H, CHF), 3.48 (d, J = 7.0 Hz, 2H, CH₂OH), 1.52-1.31 (m, 8H, 4 x CH₂), 1.20-1.14 (m, 1H, CHCH₂OH), 0.91-0.88 (m, 3H, CH₃), 0.88-0.78 (m, 1H, CH₃(CH₂)₂CH); ¹³C NMR (126 MHz, CDCl₃) δ 76.0 (d, ¹J (C-F) = 222.5 Hz, CHF), 62.9 (CH₂OH), 31.7 (CH₂), 29.4 (CH₂), 26.4 (d, ²J (C-F) = 9.1 Hz, CHCH₂OH), 26.1 (d, ³J (C-F) = 6.4 Hz, CH₃(CH₂)₂CH₂), 22.7 (CH₂), 22.0 (d, ³J (C-F) = 10.9 Hz, CH₃(CH₂)₂CHCHF), 14.2 (CH₃); ¹⁹F NMR (470 MHz, CDCl₃) δ -224.98 (ddd, ²J (H-F) = 64.8 Hz, ³J cis (H-F) = 20.8 Hz, ³J trans (H-F) = 5.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₉H₁₈FO [M+H]⁺ 161.1342; Found: 161.0525.

**((1R*,2S*,3S*)-2-fluoro-3-heptylcyclopropyl)methanol (4r)**

Prepared according to general procedure 6 to afford fluorocyclopropane 4r as yellow oil (98 mg, 57%, dr>95:5). Rf = 0.3 (50% diethyl ether in hexane); IR (film)/cm⁻¹ 3401, 2926, 2856, 1463, 1456, 1041, 1037; ¹H NMR (500 MHz, CDCl₃) δ 4.47 (ddd, ²J (H-H) = 64.7 Hz, ³J cis (H-H) = 6.5 Hz, ³J trans (H-H) = 2.0 Hz, 1H, CHF), 3.49 (d, J = 6.5 Hz, 2H, CH₂OH), 1.51-1.48 (m, 2H, CH₂CHCHF), 1.43-1.40 (m, 2H, CH₂CH₂CHCHF), 1.32-1.25 (m, 8H, 4 x CH₂), 1.18-1.15 (m, 1H, CHCH₂OH), 0.88 (t, J = 6.8 Hz, 3H, CH₃), 0.81-0.75 (m, 1H, CH₃(CH₂)₄CHCHF); ¹³C NMR (126 MHz, CDCl₃) δ 76.0 (d, ¹J (C-F) = 226.5 Hz, CHF), 63.0 (CH₂OH), 32.0 (CH₂), 29.7 (CH₂), 29.4 (CH₂), 29.4 (CH₂), 26.4 (d, ³J (C-F) = 9.1 Hz, CHCH₂OH), 26.1 (d, ³J (C-F) = 6.3 Hz, CH₂CHCHF), 22.8 (CH₂), 22.0 (d, ³J (C-F) = 11.0 Hz, CH₃(CH₂)₄CHCHF), 14.3 (CH₃); ¹⁹F NMR (470 MHz, CDCl₃) δ -224.99 (ddd, ²J (H-F) = 64.7 Hz, ³J cis (H-F) = 21.0 Hz, ³J trans (H-F) = 5.4 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₁H₂₀FO [M-H]⁻ 187.1504; Found: 187.1501.
((1R*,2S*,3S*)-2-Fluoro-3-octylcyclopropyl)methanol (4s)

Prepared according to general procedure 6 to afford fluorocyclopropane 4s as pale yellow oil (105 mg, 60%, dr > 95:5). Rf = 0.3 (20% EtOAc in hexane). IR (film)/cm⁻¹ 3367, 2919, 1458, 1031, 666; ¹H NMR (500 MHz, CDCl₃): δ 4.46 (ddd, Jₙ-H = 64.7 Hz, J cis (n-H) = 6.5 Hz, J trans (n-H) = 1.9 Hz, 1H, CHF), 3.47 (d, J = 7.0 Hz, 2H, CH₂OH), 1.51-1.47 (m, 2H, CH₂), 1.45-1.39 (m, 2H, CH₂), 1.34-1.27 (m, 10H, 5 x CH₃), 1.21-1.12 (m, 1H, CHCH₂OH), 0.88 (t, J = 6.9 Hz, 3H, CH₃), 0.81-0.74 (m, 1H, CH₃(CH₂)₂CHCHF); ¹³C NMR (126 MHz, CDCl₃): δ 76.0 (d, J trans (n-H) = 29.7 (CH₂), 29.5 (CH₂), 29.4 (CH₂), 26.4 (d, J cis (n-H) = 9.1 Hz, CHCH₂OH), 26.1 (d, J cis (C-F) = 6.3 Hz, CH₃(CH₂)₂CH₂CH), 22.8 (CH₂), 21.9 (d, J cis (n-H) = 10.9 Hz, CH₃(CH₂)₂CHCHF), 14.2 (CH₂); ¹⁹F NMR (470 MHz, CDCl₃): δ -224.96 (ddd, J trans (n-H) = 64.7 Hz, J cis (n-H) = 20.8 Hz, J trans (n-H) = 5.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₂₁H₂₃FO [M-H] 201.1660; Found: 201.1653.

((1R*,2S*,3S*)-2-Fluoro-3-nonylcyclopropyl)methanol (4t)

Prepared according to general procedure 6 to afford fluorocyclopropane 4t as yellow oil (120 mg, 64%, dr > 95:5). Rf = 0.3 (50% diethyl ether in hexane); IR (film)/cm⁻¹ 3339, 2921, 2852, 1455, 1049; ¹H NMR (300 MHz, CDCl₃) δ 4.47 (ddd, Jₙ-H = 64.7 Hz, J cis (n-H) = 6.5 Hz, J trans (n-H) = 2.0 Hz, 1H, CHF), 3.78-3.47 (m, 6H, overlapping 3 x CH₂), 1.77-1.43 (m, 12H, overlapping 6 x CH₂), 1.16-1.11 (m, 1H, CHCH₂OH), 0.88 (t, J = 6.7 Hz, 3H, CH₃), 0.82-0.74 (m, 1H, CH₃(CH₂)₂CHCHF); ¹³C NMR (75 MHz, CDCl₃) δ 75.9 (d, J cis (C-F) = 222.6 Hz, CHF), 64.4 (CH₂), 63.0 (CH₂), 61.5 (CH₂), 32.1 (CH₂), 29.7 (CH₂), 29.5 (CH₂), 29.4 (CH₂), 26.5 (d, J cis (n-H) = 9.0 Hz, CHCH₂OH), 26.1 (d, J trans (C-F) = 6.3 Hz, CH₂), 22.8 (CH₂), 22.0 (d, J cis (n-H) = 10.9 Hz, CH₃(CH₂)₂CHCHF), 14.2 (CH₂); ¹⁹F NMR (282 MHz, CDCl₃) δ -224.99 (ddd, J cis (n-H) = 65.3 Hz, J trans (n-H) = 21.7 Hz, J trans (n-H) = 6.2 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₂₃H₂₅FO [M-H] 215.1817; Found: 215.1807.

((1R*,2S*,3S*)-2-Fluoro-3-propylcyclopropyl)methanol (4u)

Prepared according to general procedure 6 to afford fluorocyclopropane 4u as colorless oil (93 mg, 81%, dr > 95:5). Rf = 0.4 (60% diethyl ether in hexane); IR (film)/cm⁻¹ 3400, 2957, 2924, 2853, 1730, 1633, 1463, 1377, 1232; ¹H NMR (500 MHz, CDCl₃) δ 4.47 (ddd, Jₙ-H = 64.7 Hz, J cis (n-H) = 6.5 Hz, J trans (n-H) = 1.9 Hz, 1H, CHF), 3.49 (d, J = 7.0 Hz, 2H, CH₂OH), 1.50-1.43 (m, 4H, 2 x CH₂), 1.23-1.14 (m, 1H, CHCH₂OH), 0.95 (t, J = 7.0 Hz, 3H, CH₃), 0.82-0.79 (m, 1H, CH₃(CH₂)₂CH); ¹³C NMR (75 MHz, CDCl₃) δ 75.91 (d, J cis (C-F) = 219.0 Hz, CHF), 63.0 (CH₂OH), 28.2 (d, J cis (C-F) = 6.3 Hz, CH₃CHCHF), 26.4 (d, J cis (C-F) = 9.1 Hz, CH₃CH₂OH), 22.8 (CH₃CH₂) 21.8 (d, J cis (C-F) = 10.9 Hz, CHCH₂CH₂CH₂), 13.9 (CH₃); ¹⁹F NMR (470 MHz, CDCl₃) δ -224.89 (ddd, Jₙ-H = 64.8 Hz, J cis (n-H) = 20.6 Hz, J trans (n-H) = 5.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C₁₇H₂₂FO [M-H] 213.0878; Found: 213.0848.
((1R*,2R*,3R*)-2-Fluoro-3-propylcyclopropyl)methanol (4v)

Prepared according to general procedure 6 to afford fluorocyclopropane 4v as colorless oil (91 mg, 80%, \( dr = 80:20 \), selected data for major). \( R_f = 0.3 \) (50% diethyl ether in hexane); IR (film)/cm\(^{-1}\) 3392, 2923, 2853, 1463, 1377, 1233, 1052; \(^1\)H NMR (500 MHz, CDCl\(_3\), selected data for major) \( \delta \) 6.49 (dt, \(^2\)J\(_{\text{H-H}}\) = 66.2 Hz, \(^3\)J cis\(_{\text{H-H}}\) = 6.0 Hz, 1H, CHF), 3.87 (dd, \( J = 11.3, 6.8 \) Hz, 1H, CH\(_2\)H,OH), 3.79 (dd, \( J = 11.4, 8.9 \) Hz, 1H, CH\(_2\)H,OH) 1.46-1.42 (m, 2H, CH\(_2\)CH\(_3\)), 1.30-1.28 (m, 2H, CH\(_3\)CH(CH\(_2\))CH\(_3\)), 1.18-1.14 (m, 1H, CHCH\(_2\)OH), 0.95 (t, \( J = 7.1 \) Hz, 3H, CH\(_3\)), 0.88-0.84 (m, 1H, CH\(_3\)(CH\(_2\))\(_2\)CHCHF); \(^{13}\)C NMR (126 MHz, CDCl\(_3\), selected data for major) \( \delta \) 73.7 (d, \(^1\)J\(_{\text{C-H}}\) = 217.6 Hz, CHF), 57.5 (d, \(^3\)J\(_{\text{C-F}}\) = 9.3 Hz, CH\(_2\)OH), 29.9 (CH\(_2\)CH\(_2\)CH\(_3\)23.2 (CH\(_2\)CH\(_3\)), 20.5 (d, \(^2\)J\(_{\text{C-F}}\) = 9.7 Hz, CH\(_2\)CH\(_2\)OH), 20.0 (d, \(^3\)J\(_{\text{C-F}}\) = 10.5 Hz, CH\(_3\)(CH\(_2\))\(_2\)CHCHF), 14.0 (CH\(_3\)CH\(_3\)); \(^{19}\)F NMR (470 MHz, CDCl\(_3\), selected data for major) \( \delta \) -239.88 (dt, \(^3\)J\(_{\text{H-F}}\) = 66.2 Hz, \(^3\)J trans\(_{\text{H-F}}\) = 7.9 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C\(_{19}\)H\(_{20}\)FNaO [M+Na\(^+\)] 155.0843; Found: 155.0839.

((1R*,2S*,3S*)-2-Fluoro-3-hexylcyclopropyl)methanol (4w)

Prepared according to general procedure 6 to afford fluorocyclopropane 4w as yellow oil (83 mg, 55%, \( dr = 95:5 \)). \( R_f = 0.3 \) (50% diethyl ether in hexane); IR (film)/cm\(^{-1}\) 3367, 2923, 2855, 1461, 1033; \(^1\)H NMR (500 MHz, CDCl\(_3\)) \( \delta \) 4.47 (ddd, \(^2\)J\(_{\text{H-H}}\) = 64.7 Hz, \(^3\)J cis\(_{\text{H-H}}\) = 6.5 Hz, \(^3\)J trans\(_{\text{H-H}}\) = 1.9 Hz, 1H, CHF), 3.49-3.48 (m, 2H, CH\(_2\)OH), 1.53-1.48 (m, 2H, CH\(_2\)CH\(_3\)), 1.46-1.29 (m, overlapping 4 x CH\(_2\)), 1.21-1.14 (m, 1H, CHCH\(_2\)OH), 0.89 (t, \( J = 6.9 \) Hz, 3H, CH\(_3\)), 0.81-0.77 (m, 1H, CH\(_2\)(CH\(_2\))CH\(_3\)); \(^{13}\)C NMR (126 MHz, CDCl\(_3\)) \( \delta \) 75.9 (d, \(^1\)J\(_{\text{C-H}}\) = 222.7 Hz, CHF), 63.0 (CH\(_2\)OH), 31.9 (CH\(_2\)), 29.7 (CH\(_2\)), 29.1 (CH\(_2\)), 26.4 (d, \(^2\)J\(_{\text{C-F}}\) = 9.1 Hz, CHCH\(_2\)OH), 26.1 (d, \(^3\)J\(_{\text{C-F}}\) = 6.4 Hz, CH\(_3\)(CH\(_2\))\(_2\)CHCHF), 22.8 (CH\(_2\)), 22.0 (d, \(^2\)J\(_{\text{C-F}}\) = 10.9 Hz, CH\(_3\)(CH\(_2\))CH\(_3\)), 14.2 (CH\(_3\)); \(^{19}\)F NMR (470 MHz, CDCl\(_3\)) \( \delta \) -224.99 (ddd, \(^3\)J\(_{\text{H-F}}\) = 64.7 Hz, \(^3\)J cis\(_{\text{H-F}}\) = 20.7 Hz, \(^3\)J trans\(_{\text{H-F}}\) = 5.6 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C\(_{19}\)H\(_{20}\)F [M-H] 173.1347; Found: 173.1350.

((1R*,2R*,3R*)-2-Fluoro-3-hexylcyclopropyl)methanol (4x)

Prepared according to general procedure 6 to afford fluorocyclopropane 4x as yellow oil (122 mg, 81%, \( dr = 70:30 \), selected data for major). \( R_f = 0.3 \) (50% diethyl ether in hexane); IR (film)/cm\(^{-1}\) 3368, 2926, 2857, 1466, 1423, 1378, 1247, 1216, 1136, 1029; \(^1\)H NMR (500 MHz, CDCl\(_3\), selected data for major) \( \delta \) 4.67 (dt, \(^2\)J\(_{\text{H-F}}\) = 66.2 Hz, \(^3\)J cis\(_{\text{H-F}}\) = 6.0 Hz, 1H, CHF), 3.86 (dd, \( J = 11.5, 6.7 \) Hz, 1H, CH\(_2\)H,OH), 3.77 (dd, \( J = 11.6, 8.8 \) Hz, 1H, CH\(_2\)H,OH), 1.52-1.29 (m, 10H, 5 x CH\(_2\)), 1.19-1.11 (m, 1H, CHCH\(_2\)OH), 0.93-0.91 (m, 1H, CH\(_3\)(CH\(_2\))\(_2\)CHCHF), 0.88 (t, \( J = 6.8 \) Hz, 3H, CH\(_3\)); \(^{13}\)C NMR (126 MHz, CDCl\(_3\), selected data for major) \( \delta \) 73.7 (d, \(^1\)J\(_{\text{C-H}}\) = 217.6 Hz, CHF), 57.4 (d, \(^3\)J\(_{\text{C-F}}\) = 9.3 Hz, CH\(_2\)OH), 31.9 (CH\(_3\)), 30.0 (CH\(_3\)), 29.2 (CH\(_3\)), 22.8 (CH\(_3\)), 21.3 (d, \(^3\)J\(_{\text{C-F}}\) = 6.8 Hz, CH\(_3\)CHCHF), 20.5 (d, \(^1\)J\(_{\text{C-F}}\) = 9.7 Hz, CHCH\(_2\)OH), 19.6 (d, \(^2\)J\(_{\text{C-F}}\) = 10.5 Hz, CH\(_3\)(CH\(_2\))\(_2\)CHCHF), 14.2 (CH\(_3\)); \(^{19}\)F NMR (470 MHz, CDCl\(_3\), selected data for major) \( \delta \) -240.00 (dt, \(^2\)J\(_{\text{H-F}}\) = 66.2 Hz, \(^3\)J trans\(_{\text{H-F}}\) = 7.9 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C\(_{19}\)H\(_{20}\)F [M-H] 173.1347; Found: 173.1339.
(1R*,2R*,3R*)-3-Fluoro-2-methyl-2-(4-methylpent-3-en-1-yl)cyclopropyl)methanol (4y-(major))

Prepared according to general procedure 6 to afford fluorocyclopropane 4y-(major) as pale yellow oil (111 mg, 74%, dr = 70:30, selected data for major according to 19F NMR of the crude). Rf = 0.5 (60% diethyl ether in hexane); IR (film)/cm\(^{-1}\) 3369, 2923, 1456, 1041; \(^1\)H NMR (500 MHz, CDCl\(_3\), selected data for major) δ 5.09-5.08 (m, 1H, CH=C(CH\(_2\))\(_2\)), 4.18 (dd, \(^3\)J \(_{H-F}\) = 64.6 Hz, \(^3\)J trans \(_{H-F}\) = 2.5 Hz, 1H, CHF), 3.68-3.65 (m, 1H, CHCH\(_2\)CH\(_2\)OH), 3.59-3.55 (m, 1H, CHCH\(_2\)CH\(_2\)OH), 2.05-1.99 (m, 2H, CH\(_2\)CH=C(CH\(_3\))\(_2\)), 1.69 (s, 3H, (CH\(_2\))\(_2\)C=CH), 1.62 (s, 3H, (CH\(_2\))\(_2\)C=CH), 1.37-1.33 (m, 2H, CH\(_2\)CH=CH=C(CH\(_3\))\(_2\)), 1.23 (d, \(^3\)J = 1.3 Hz, 3H, CH\(_3\)C(CH\(_3\))\(_2\)), 1.21 (m, 1H, CHCH\(_2\)); \(^13\)C NMR (126 MHz, CDCl\(_3\), selected data for major) δ 132.3 ((CH\(_3\))\(_2\)C=CH), 123.9 ((CH\(_3\))\(_2\)C=CH), 81.0 (d, \(^1\)J \(_{C-F}\) = 229.8 Hz, CHF), 60.4 (CH\(_2\)OH), 32.5 (d, \(^3\)J \(_{C-F}\) = 8.9 Hz, CHCH\(_2\)), 29.8 (CH\(_2\)CH=CH=CH\(_2\))\(_2\)), 25.8 (CH\(_3\)C=CH), 24.9 (d, \(^3\)J \(_{C-F}\) = 1.9 Hz, CH\(_3\)CH=C(CH\(_3\))\(_2\)); 19F NMR (470 MHz, CDCl\(_3\), selected data for major) δ -216.96 (dd, \(^3\)J \(_{H-F}\) = 64.7 Hz, \(^3\)J cis \(_{H-F}\) = 22.1 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C\(_{13}H\(_{18}\)FO [M-H] 185.1347; Found: 185.1333.

(1R*,2R*,3S*)-3-Fluoro-2-methyl-2-(4-methylpent-3-en-1-yl)cyclopropyl)methanol (4y-(minor))

Prepared according to general procedure 6 to afford fluorocyclopropane 4y-(minor) as pale yellow oil (111 mg, 74%, dr = 70:30); IR (film)/cm\(^{-1}\) 3369, 2923, 1456, 1041; \(^1\)H NMR (500 MHz, CDCl\(_3\)) δ 5.13 (t, J = 7.2 Hz, 1H, CH=C(CH\(_3\))\(_2\)), 4.36 (dd, \(^3\)J \(_{H-F}\) = 65.8 Hz, \(^3\)J cis \(_{H-F}\) = 6.1 Hz, 1H, CHF), 3.90-3.86 (m, 1H, CHCH\(_2\)CH\(_2\)OH), 3.77-3.73 (m, 1H, CHCH\(_2\)CH\(_2\)OH), 2.14-1.99 (m, 2H, CH\(_2\)CH=C(CH\(_3\))\(_2\)), 1.69 (s, 3H, (CH\(_3\))\(_2\)C=CH), 1.62 (s, 3H, (CH\(_3\))\(_2\)C=CH), 1.54-1.49 (m, 2H, CH\(_2\)CH\(_2\)CH=C(CH\(_3\))\(_2\)), 1.00 (t, J = 4.9 Hz, 3H, CH\(_3\)C(CH\(_3\))\(_2\)), 1.01-0.95 (m, 1H, CHCH\(_2\)); \(^13\)C NMR (126 MHz, CDCl\(_3\)) δ 132.1 ((CH\(_3\))\(_2\)C=CH), 124.2 ((CH\(_3\))\(_2\)C=CH), 79.4 (d, \(^3\)J \(_{C-F}\) = 220.2 Hz, CHF), 57.9 (d, \(^3\)J \(_{C-F}\) = 9.6 Hz, CH\(_2\)OH), 29.3 (d, \(^3\)J \(_{C-F}\) = 9.8 Hz, CHCH\(_2\)), 27.6 (d, \(^3\)J \(_{C-F}\) = 6.8 Hz, CH\(_2\)CH\(_2\)CH=C(CH\(_3\))\(_2\)), 25.8 (CH\(_3\)C=CH), 25.2 (CH\(_2\)CH=C(CH\(_3\))\(_2\)), 22.9 (d, \(^3\)J \(_{C-F}\) = 9.0 Hz, CH\(_3\)C(CH\(_3\))\(_2\)), 22.2 (CH\(_3\)C(CH\(_3\))\(_2\)), 17.7 (CH\(_3\)C=CH); 19F NMR (470 MHz, CDCl\(_3\)) δ -231.11 (dd, \(^3\)J \(_{H-F}\) = 65.5 Hz, \(^3\)J trans \(_{H-F}\) = 5.2 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C\(_{13}H\(_{18}\)FO [M-H] 185.1347; Found: 185.1333.

((1R*,2S*,3R*)-3-Fluoro-2-methyl-2-(4-methylpent-3-en-1-yl)cyclopropyl)methanol (4z-(major))

Prepared according to general procedure 6 to afford fluorocyclopropane 4z-(major) as pale yellow oil (127 mg, 88%, dr = 55:45). Rf = 0.4 (60% diethyl ether in hexane); IR (film)/cm\(^{-1}\) 3371, 2923, 2853, 1730, 1455, 1233, 1046; \(^1\)H NMR (500 MHz, CDCl\(_3\)) δ 5.15 (t, J = 7.1 Hz, 1H, CH=C(CH\(_3\))\(_2\)), 4.18 (dd, \(^3\)J \(_{H-F}\) = 64.3 Hz, \(^3\)J trans \(_{H-F}\) = 2.4 Hz, 1H, CHF), 3.75 (dd, J = 11.5, 6.7 Hz, 1H, CHCH\(_2\)CH\(_2\)OH), 3.47 (t, J = 10.1 Hz, 1H, CHCH\(_2\)CH\(_2\)OH), 2.18-2.10 (m, 2H, CH\(_2\)CH=CH=CH\(_2\))), 1.69 (s, 3H, CH\(_3\)C=CH), 1.63 (s, 3H, CH\(_3\)C=CH), 1.53-1.50 (m, 2H, CH\(_2\)CH=CH=C(CH\(_3\))\(_2\)), 1.30-1.27 (m, 1H, CHCH\(_2\)), 1.04 (d, J = 3.0 Hz, 3H, CH\(_3\)C(CH\(_3\))\(_2\)); \(^13\)C NMR (126 MHz, CDCl\(_3\)) δ 131.9 ((CH\(_3\))\(_2\)C=CH), 124.3 ((CH\(_3\))\(_2\)C=CH), 81.6 (d, \(^3\)J \(_{C-F}\) = 229.5 Hz, CHF), 60.6 (CH\(_2\)OH), 33.7 (d, \(^3\)J \(_{C-F}\) = 6.4 Hz, CH\(_2\)CH\(_2\)CH=C(CH\(_3\))\(_2\)), 31.6 (d, \(^3\)J \(_{C-F}\) = 9.4 Hz, CHCH\(_2\)), 25.8 (CH\(_3\)C=CH), 25.42 (d, \(^3\)J \(_{C-F}\) = 10.1 Hz, CH\(_3\)C(CH\(_3\))\(_2\)));
25.4 (CH₂CH=CH(CH₃)₂), 17.7 (CH₂C=CH), 15.7 (d, δ₁(C₆F) = 1.4 Hz, CH₂C₄CHF); ¹⁹F NMR (470 MHz, CDCl₃) δ -216.25 (dd, δ₂(J(₃F)) = 64.3 Hz, δ₂ cis(J(₃F)) = 22.6 Hz, CHF); HRMS (ESI-TOF) m/z Calc'd for C₁₁H₁₈FO [M-H]¹ 185.1347; Found: 185.1354.

((1R*,2S*,3S*)-3-Fluoro-2-methyl-2-(4-methylpent-3-en-1-yl)cyclopropyl)methanol (4z-(minor))

Prepared according to general procedure 6 to afford fluorocyclopropane 4z-(minor) as pale yellow oil (127 mg, 88%, dr = 55:45). Compound 4z-(minor) mixed with trans-geraniol 2z. R₇ = 0.6 (60% diethyl ether in hexane); IR (film)/cm⁻¹ 3328, 2967, 2917, 1699, 1439, 1377, 1109, 1014, 932; ¹H NMR (500 MHz, CDCl₃, selected data for minor) δ 5.05-5.03 (m, 1H, CH=C(CH₃)₂), 4.31 (dd, δ₂(J(₃F)) = 66.0 Hz, δ₂ cis(J(₃F)) = 6.2 Hz, 1H, CHF), 3.79-3.70 (m, 2H, CH₂OH), 2.01-2.00 (m, 2H, CH₂CH=C(CH₃)₂), 1.67 (s, 6H, (CH₂)₂C=CH), 1.32-1.25 (m, 1H, CH₂CH₂CH₂CH₂CH=C), 1.11 (s, 1H, 3H, CH₂C₆CH₂CHF), 1.07-1.00 (m, 1H, CH₂H₆CH₂CH=CH-C), 0.97-0.91 (m, 1H, CHCHF); ¹³C NMR (126 MHz, CDCl₃) δ 131.9 ((CH₃)₂C=CH), 123.8 ((CH₃)₂C=CH), 78.5 (d, δ₂(J(C₆F)) = 223.1 Hz, CHF), 57.8 (d, δ₂(J(C₆F)) = 9.1 Hz, CH₂OH), 38.6 (CH₂CH₂CH=CH), 27.8 (δ₁(J(C₆F)) = 9.9 Hz, CHFCHF), 24.3 (d, δ₂(J(C₆F)) = 2.0 Hz, CH₂CH₂CH₂CH=CH), 22.8 (d, δ₁(J(C₆F)) = 8.7 Hz, C₆CH₂CHF), 17.7 ((CH₃)₂C=CH), 10.2 (d, δ₂(J(C₆F)) = 9.3 Hz, CH₃CH₂CHF); ¹⁹F NMR (470 MHz, CDCl₃) δ -230.82 (dd, δ₂(J(₃F)) = 66.0 Hz, δ₂ cis(J(₃F)) = 6.7 Hz, CHF); HRMS (ESI-TOF) m/z Calc'd for C₁₁H₁₈FO [M-H]¹ 185.1347; Found: 185.0950.

((1R*,4R*,7R*)-7-Fluoro-4-(prop-1-en-2-yl)bicyclo[4.1.0]heptan-1-yl)methanol (4aa)

Prepared according to general procedure 6 to afford fluorocyclopropane 4aa as yellow oil (69 mg, 36%, dr = 70:30, inseparable mixture of diastereoisomers). R₇ = 0.2 (50% EtOAc in hexane); IR (film)/cm⁻¹ 3434, 2926, 2856, 1644, 1468, 1266, 1014; ¹H NMR (500 MHz, CDCl₃, selected data for major) δ 4.73-4.67 (m, 2H, C₆=CH₂), 4.37 (dd, δ₂(J(₃F)) = 67.2 Hz, δ₂ cis(J(₃F)) = 6.7 Hz, 1H, CHF), 3.37-3.29 (m, 2H, CH₂OH), 2.13-2.09 (m, 1H, CH₂H₆CH₂CH₂C=CH₂), 2.00-1.96 (m, 1H, CH₂H₂CH₂CHFCHF), 1.87-1.79 (m, 2H, overlapping CH₂H₂CH₂CH₂C=CH₂ and CH₂CH₂CH₂CH₂C=CH₂), 1.70 (s, 3H, CH₃), 1.60-1.57 (m, 1H, CH₂CH₂CH₂CH₂CH₂C=CH₂), 1.39-1.33 (m, 1H, CH₂CH₂CH₂CH₂CH₂C=CH₂), 1.18-1.16 (m, 1H, CH₂CH₂CH₂CH₂CH₂C=CH₂), 1.07-1.02 (m, 1H, CHCHF); ¹³C NMR (126 MHz, CDCl₃, selected data for major) δ 150.2 (C₆=CH₂), 108.9 (C₆=CH₂), 77.6 (d, δ₂(J(C₆F)) = 225.1 Hz, CHF), 68.8 (CH₂OH), 41.7 (CH₂=CH₂C₆=CH₂), 27.0 (d, δ₂(J(C₆F)) = 4.8 Hz, CH₂CH₂CH₂CH₂C=CH₂), 23.1 (d, δ₁(J(C₆F)) = 3.6 Hz, CH₂CH₂CH₂CH₂C=CH₂), 22.1 (d, δ₂(J(C₆F)) = 5.2 Hz, CH₂CHCHF), 20.9 (CH₃), 16.9 (d, δ₂(J(C₆F)) = 10.1 Hz, CHCHF); ¹⁹F NMR (470 MHz, CDCl₃) δ -228.33 (dd, δ₂(J(₃F)) = 67.2 Hz, δ₂ trans(J(₃F)) = 9.8 Hz, CHF minor), -229.73 (d, δ₂(J(₃F)) = 67.1 Hz, CHF major); HRMS (ESI-TOF) m/z Calc'd for C₁₃H₂₁FO [M-H]¹ 183.1191; Found: 183.1187.
((1S*,2R*,3S*)-2-fluoro-3-phenylcyclopropyl)methanol (4ad)

Prepared according to general procedure 6 to afford fluorocyclopropane 4ad as colourless oil (21 mg, 15%, dr > 95:5). $R_f = 0.4$ (40% EtOAc in hexane); $^1$H NMR (500 MHz, CDCl$_3$): $\delta$ 7.51-7.49 (m, 2H, 2 x Ar-H), 7.43-7.42 (m, 2H, 2 x Ar-H), 4.75 (ddd, $^2$J (H-F) = 64.6 Hz, $^3$J cis (H-H) = 6.6 Hz, $^3$J trans (H-H) = 2.5 Hz, 1H, CHF), 3.74 (d, $^1$J (H-H) = 6.1 Hz, 2H, CH$_2$OH), 2.18-2.14 (m, 1H, Ar-CHCHF), 2.01-1.92 (m, 1H, CHCH$_2$OH); $^{13}$C NMR (126 MHz, CDCl$_3$): $\delta$ 136.6 (d, $^4$J (C-F) = 2.9 Hz, Ar-C), 131.9 (Ar-C), 128.8 (Ar-C$_3$), 125.6-125.5 (m, Ar-C), 123.4s (q, $^3$J (C-F) = 3.8 Hz, Ar-C), 75.2 (d, $^3$J (C-F) = 227.1 Hz, CHF), 61.9 (CH$_2$OH), 27.5s (d, $^2$J (C-F) = 8.7 Hz, CHCH$_2$OH), 26.1s (d, $^2$J (C-F) = 11.0 Hz, Ar-CHCHF); $^{19}$F NMR (470 MHz, CDCl$_3$): $\delta$ 62.70 (s, 3F, CF$_3$), -220.77 (ddd, $^3$J (H-F) = 64.6 Hz, $^3$J cis (H-F) = 20.8 Hz, $^3$J trans (H-F) = 6.0 Hz, CHF); HRMS (ESI-TOF) m/z Calcd for C$_{11}$H$_9$F$_4$O [M-H] 233.0595; Found: 233.0591.
8. Synthesis of chiral allylic alcohol and fluorocyclopropane

Chiral allylic alcohol \((R)-2m\) was prepared using the correspondent ketone, \((S)\)-CBS-Butyl and catecholborane according to the literature procedure.$^1$\textsuperscript{8}

\[
\begin{align*}
\text{Chiral allylic alcohol} & \xrightarrow{(S)\text{-CBS-Butyl} \atop \text{catecholborane}} \text{Tolene, -78°C, 15h} \\
& \quad \xrightarrow{\text{>95%}} \text{(R)-2m} \\
\end{align*}
\]

\((R)-2m\)

\[\alpha_d = +6.1^\circ \ (c = 0.2, \text{CHCl}_3)\]

Chiralpak AD-H column; 99:1 = hexane:iPrOH, 1mL/min flux.
(R)-2m \[ \xrightarrow{\text{(1 equiv) } \text{FCH}_2\text{I}, \text{(2 equiv) } \text{LDA}} \] \[ \text{THF, } -78^\circ\text{C, 15'} \text{ rt, 10'} \]

\( \alpha_D = -3^\circ \) (c=0.3, CHCl_3)

\( \text{er} = 92:8 \)

\( \text{Chiralpak AD-H column; 99:1 } = \text{hexane:iPrOH, 1mL/min flux.} \)
Computational Studies

1.1 Computational Methods

Density functional theory (DFT)\textsuperscript{19} calculations were performed using Gaussian 09 (revision E.01)\textsuperscript{20} and the Gaussview\textsuperscript{21} was used to generate input geometries and visualize output structures. Regarding geometry optimizations and frequency calculations for fluoroiodomethane and fluoroiodomethylithium, B3LYP functional\textsuperscript{22-25} was used with the 6-311++G(d,p)+LANL2DZ (for I) mixed basis set.\textsuperscript{26} For comparative purpose and to model solvation effect, the calculations were carried out in THF as a solvent, by applying the most commonly used integral equation formalism (IEF) version of polarized continuum model (PCM).\textsuperscript{27,28} All stationary points were characterized as minima and thermal corrections were computed from unscaled frequencies, assuming a standard state of 298.15 K and 1 atm.
1.2 Structure optimization, bond lengths (Å) and measured bond angles (°)

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## 1.3 Electrostatic Potential Map

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<td><img src="image1.png" alt="Solid Image" /></td>
<td><img src="image2.png" alt="Mesh Image" /></td>
<td><img src="image3.png" alt="Transparent Image" /></td>
</tr>
<tr>
<td>2</td>
<td>FIC(\text{H}_2) – THF</td>
<td><img src="image4.png" alt="Solid Image" /></td>
<td><img src="image5.png" alt="Mesh Image" /></td>
<td><img src="image6.png" alt="Transparent Image" /></td>
</tr>
<tr>
<td>3</td>
<td>FIC(\text{H}^+) – Gas Phase</td>
<td><img src="image7.png" alt="Solid Image" /></td>
<td><img src="image8.png" alt="Mesh Image" /></td>
<td><img src="image9.png" alt="Transparent Image" /></td>
</tr>
<tr>
<td>4</td>
<td>FIC(\text{H}^+) – THF</td>
<td><img src="image10.png" alt="Solid Image" /></td>
<td><img src="image11.png" alt="Mesh Image" /></td>
<td><img src="image12.png" alt="Transparent Image" /></td>
</tr>
</tbody>
</table>

Red: strong negative  
Blue: strong positive
### 1.4 HOMO – LUMO Analysis

<table>
<thead>
<tr>
<th>No.</th>
<th>Structure</th>
<th>HOMO – LUMO Energy Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FICH₂ – Gas Phase</td>
<td>0.16752 ( \rightarrow ) 0.23902 ( \rightarrow ) 0.07150</td>
</tr>
<tr>
<td>2</td>
<td>FICH₂ – THF</td>
<td>0.17164 ( \rightarrow ) 0.21464 ( \rightarrow ) 0.04300</td>
</tr>
</tbody>
</table>
FICHLi – Gas Phase

FICHLi – THF

3

4
## 1.5 Natural and Mulliken Atomic Charges for FICCH₂

<table>
<thead>
<tr>
<th>Atom</th>
<th>Natural Atomic Charge</th>
<th>Mulliken Atomic Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gaseous Phase</td>
<td>THF (Solvent)</td>
</tr>
<tr>
<td>C</td>
<td>-0.07475</td>
<td>-0.06871</td>
</tr>
<tr>
<td>H</td>
<td>0.17727</td>
<td>0.18879</td>
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<tr>
<td>F</td>
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<td>-0.38313</td>
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<tr>
<td>I</td>
<td>0.09098</td>
<td>0.07427</td>
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<tr>
<td>H</td>
<td>0.17727</td>
<td>0.18879</td>
</tr>
</tbody>
</table>

## 1.6 Natural and Mulliken Atomic Charges for FICHLi

<table>
<thead>
<tr>
<th>Atom</th>
<th>Natural Atomic Charge</th>
<th>Mulliken Atomic Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gaseous Phase</td>
<td>THF (Solvent)</td>
</tr>
<tr>
<td>C</td>
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<td>-0.29347</td>
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<td>H</td>
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<tr>
<td>Li</td>
<td>0.72701</td>
<td>0.93143</td>
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</table>
### 1.7 Computed Energies [values are in Hartree]

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Total Electronic Energy</th>
<th>Sum of Electronic and Zero-point Energies</th>
<th>Sum of Electronic and Thermal Enthalpies</th>
<th>Gibbs Free Energy</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>FICH₂ – Gas Phas</td>
<td>-150.5679248</td>
<td>-150.538204</td>
<td>-150.533635</td>
<td>-150.566043</td>
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<tr>
<td>2</td>
<td>FICH₂ – THF</td>
<td>-150.5715945</td>
<td>-150.541926</td>
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<td>-150.569778</td>
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</table>
### 1.8 Optimized Structures and Cartesian Coordinates

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Optimized Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FICH₂ – Gas Phas</td>
<td><img src="image1.png" alt="Image" /></td>
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</tbody>
</table>

#### Cartesian Coordinates

<table>
<thead>
<tr>
<th>Atom</th>
<th>C</th>
<th>H</th>
<th>F</th>
<th>I</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Optimized Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>FICH₂ – THF</td>
<td><img src="image2.png" alt="Image" /></td>
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</table>

#### Cartesian Coordinates

<table>
<thead>
<tr>
<th>Atom</th>
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<th>F</th>
<th>I</th>
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<tr>
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<td>0.62014500</td>
<td>0.00000000</td>
<td>1.09675600</td>
<td>-1.68255600</td>
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</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Optimized Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>FICHLi – Gas Phase</td>
<td><img src="image3.png" alt="Image" /></td>
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</table>

#### Cartesian Coordinates

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<thead>
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<th>F</th>
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<th>H</th>
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<td>Li</td>
<td>FICHLi – THF</td>
<td></td>
<td></td>
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<tr>
<td>------------------</td>
<td>---------------</td>
<td>--------------</td>
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<td>-0.40664400</td>
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</tr>
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<td>4</td>
<td>FICHLi – THF</td>
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</tbody>
</table>

**Cartesian Coordinates**

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>H</th>
<th>F</th>
<th>I</th>
<th>Li</th>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. Copies of NMR Spectra ($^1$H, $^{13}$C and $^{19}$F) for All the Synthesized Compounds
\( ^1H \text{ NMR (500 MHz, CDCl}_3 \text{)} \)

\( ^1H \text{ NMR (300 MHz, CDCl}_3 \text{)} \)

(2a)

(2c)
(2d)
$^1$H NMR (300 MHz, CDCl$_3$)

(2e)
$^1$H NMR (300 MHz, CDCl$_3$)
(2h)  
$^1$H NMR (300 MHz, CDCl$_3$)

(2i)  
$^1$H NMR (300 MHz, CDCl$_3$)
$1^1$H NMR (300 MHz, CDCl$_3$)

$1^1$H NMR (500 MHz, CDCl$_3$)
(2m)

$^1$H NMR (300 MHz, CDCl$_3$)

(2n)

$^1$H NMR (500 MHz, CDCl$_3$)
(2o)
$^2$H NMR (500 MHz, CDCl$_3$)

(2r)
$^1$H NMR (500 MHz, CDCl$_3$)
(2t)
$^1$H NMR (300 MHz, CDCl$_3$)

(2u)
$^1$H NMR (300 MHz, CDCl$_3$)
$\text{F}_3\text{C}$

(2ad)

$^1\text{H NMR (500 MHz, CDCl}_3\text{)}$

$^1\text{F NMR (470 MHz, CDCl}_3\text{)}$

S44
$^1$H NMR (500 MHz, CDCl$_3$)

$^{13}$C NMR (126 MHz, CDCl$_3$)
$^{19}$F NMR (470 MHz, CDCl$_3$)

(4a)

$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4b)
$^1$H NMR (500 MHz, CDCl$_3$)

(4b)
$^{13}$C NMR (126 MHz, CDCl$_3$)
$^{19}$F NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4c)

$^1$H NMR (500 MHz, CDCl$_3$)

(4c)

$^{13}$C NMR (126 MHz, CDCl$_3$)
(4c)

$^{19}$F NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4d)
$^1$H NMR (500 MHz, CDCl$_3$)

(4d)
$^{13}$C NMR (126 MHz, CDCl$_3$)
(4d)

$^{19}$F NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4e)

$^1$H NMR (300 MHz, CDCl$_3$)

$^1$C NMR (75 MHz, CDCl$_3$)
$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4f)
\[^{1}H\] NMR (500 MHz, CDCl\(_3\))

(4f)
\[^{13}C\] NMR (126 MHz, CDCl\(_3\))
$^{19}\text{F NMR (470 MHz, CDCl}_3\text{)}$

(spectrum of the crude reaction mixture)

(4f) $^{19}\text{F NMR (470 MHz, CDCl}_3\text{)}$
(4g)

$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4h)

$^1$H NMR (500 MHz, CDCl$_3$)

(4h)

$^{13}$C NMR (75 MHz, CDCl$_3$)
(4h)
$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
\( ^1H \text{ NMR (500 MHz, CDCl}\_3) \)

\( ^{13}C \text{ NMR (126 MHz, CDCl}\_3) \)

\( \text{(4i)} \)
(4i)
$^{19}$F NMR (470 MHz, CDCl$_3$) (spectrum of the crude reaction mixture)
(4j)

$^1$H NMR (300 MHz, CDCl$_3$)

(4j)

$^{13}$C NMR (75 MHz, CDCl$_3$)
$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
\(^1\)H NMR (500 MHz, CDCl\(_3\))

\(^{13}\)C NMR (126 MHz, CDCl\(_3\))
(4k)
$^{19}F$ NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4l)

$^1$H NMR (500 MHz, CDCl$_3$)

(4l)

$^{13}$C NMR (126 MHz, CDCl$_3$)
$^{19}$F NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4m) 
\[^{19}\text{F} \text{ NMR (282 MHz, CDCl}_3\text{)}\]

(spectrum of the crude reaction mixture)
$^1$H NMR (500 MHz, CDCl$_3$)

$^{13}$C NMR (126 MHz, CDCl$_3$)

S71
$^{19}$F NMR (470 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4o-(minor))
$^1$H NMR (500 MHz, CDCl$_3$)

(4o-(minor))
$^{13}$C NMR (126 MHz, CDCl$_3$)
(4o-(minor))

$^{19}$F NMR (470 MHz, CDCl$_3$)

(4o-(major) and 4o-(minor))

$^1$H NMR (500 MHz, CDCl$_3$)
^{19}F NMR (470 MHz, CDCl₃)
(spectrum of the crude reaction mixture)

^{1}H NMR (500 MHz, CDCl₃)
(4p)
\[^{13}\text{C}\] NMR (126 MHz, CDCl\textsubscript{3})

(4p)
\[^{19}\text{F}\] NMR (470 MHz, CDCl\textsubscript{3})
(4p)

\[^{19}\text{F NMR (470 MHz, CDCl}_3\)]

(spectrum of the crude reaction mixture)

(4q)

\[^{1}\text{H NMR (500 MHz, CDCl}_3\)]
(4q)
$^{13}$C NMR (126 MHz, CDCl$_3$)

(4q)
$^{19}$F NMR (470 MHz, CDCl$_3$)
(4r)

$^{13}$C NMR (126 MHz, CDCl$_3$)

(4r)

$^{19}$F NMR (470 MHz, CDCl$_3$)
(4r)
$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4s)
$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (126 MHz, CDCl$_3$)

$^{19}$F NMR (470 MHz, CDCl$_3$)
(4s)
\[^{19}\text{F NMR (282 MHz, CDCl}_3\text{)}\]
(spectrum of the crude reaction mixture)

(4t)
\[^{1}\text{H NMR (300 MHz, CDCl}_3\text{)}\]
$^{13}$C NMR (75 MHz, CDCl$_3$)

(4t)

$^{19}$F NMR (282 MHz, CDCl$_3$)

(4t)
(4t)
$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4u)
$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (75 MHz, CDCl$_3$)

$^{19}$F NMR (470 MHz, CDCl$_3$)
$^{19}$F NMR (282MHz, CDCl$_3$) (spectrum of the crude reaction mixture)

$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (126 MHz, CDCl$_3$)

$^{19}$F NMR (470 MHz, CDCl$_3$)
(4v)

$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4w)

$^1$H NMR (500 MHz, CDCl$_3$)
(4w)

$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4x)

$^1$H NMR (500 MHz, CDCl$_3$)
(4x)
$^{13}$C NMR (126 MHz, CDCl$_3$)

(4x)
$^{19}$F NMR (470 MHz, CDCl$_3$)
(4x)

$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4y-(major))

$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (126 MHz, CDCl$_3$)

(4y-(major))

$^{19}$F NMR (470 MHz, CDCl$_3$)

(4y-(major))
(4α-(minor))

$^1$H NMR (500 MHz, CDCl$_3$)

$^{13}$C NMR (126 MHz, CDCl$_3$)
$^{19}$F NMR (470 MHz, CDCl$_3$)

(4y - minor)

$^{19}$F NMR (282 MHz, CDCl$_3$)

(spectrum of the crude reaction mixture)
(4z-(major))
$^1$H NMR (500 MHz, CDCl$_3$)

(4z-(major))
$^{13}$C NMR (126 MHz, CDCl$_3$)
(4z-(major))
$^{19}$F NMR (470 MHz, CDCl$_3$)

(4z-(minor))
$^1$H NMR (500 MHz, CDCl$_3$)
$1^\text{H}$ NMR (400 MHz, CDCl₃)

$^{13}$C NMR (126 MHz, CDCl₃)

$^2$H NMR (470 MHz, CDCl₃)

(4z-(minor))

19F NMR (470 MHz, CDCl₃)

(4z-(minor))

$F_1$ (ppm)
(4z)
$^{19}$F NMR (282 MHz, CDCl$_3$)
(spectrum of the crude reaction mixture)

(4aa)
$^1$H NMR (500 MHz, CDCl$_3$)
(4aa)

$^1$F NMR (470 MHz, CDCl$_3$)  
(spectrum of the crude reaction mixture)

(4ad)

$^1$H NMR (500 MHz, CDCl$_3$)
(4ad)
$^{13}$C NMR (125 MHz, CDCl$_3$)

$^{13}$C NMR (125 MHz, CDCl$_3$)

(4ad)
$^{19}$F NMR (470 MHz, CDCl$_3$)

$^{19}$F NMR (470 MHz, CDCl$_3$)