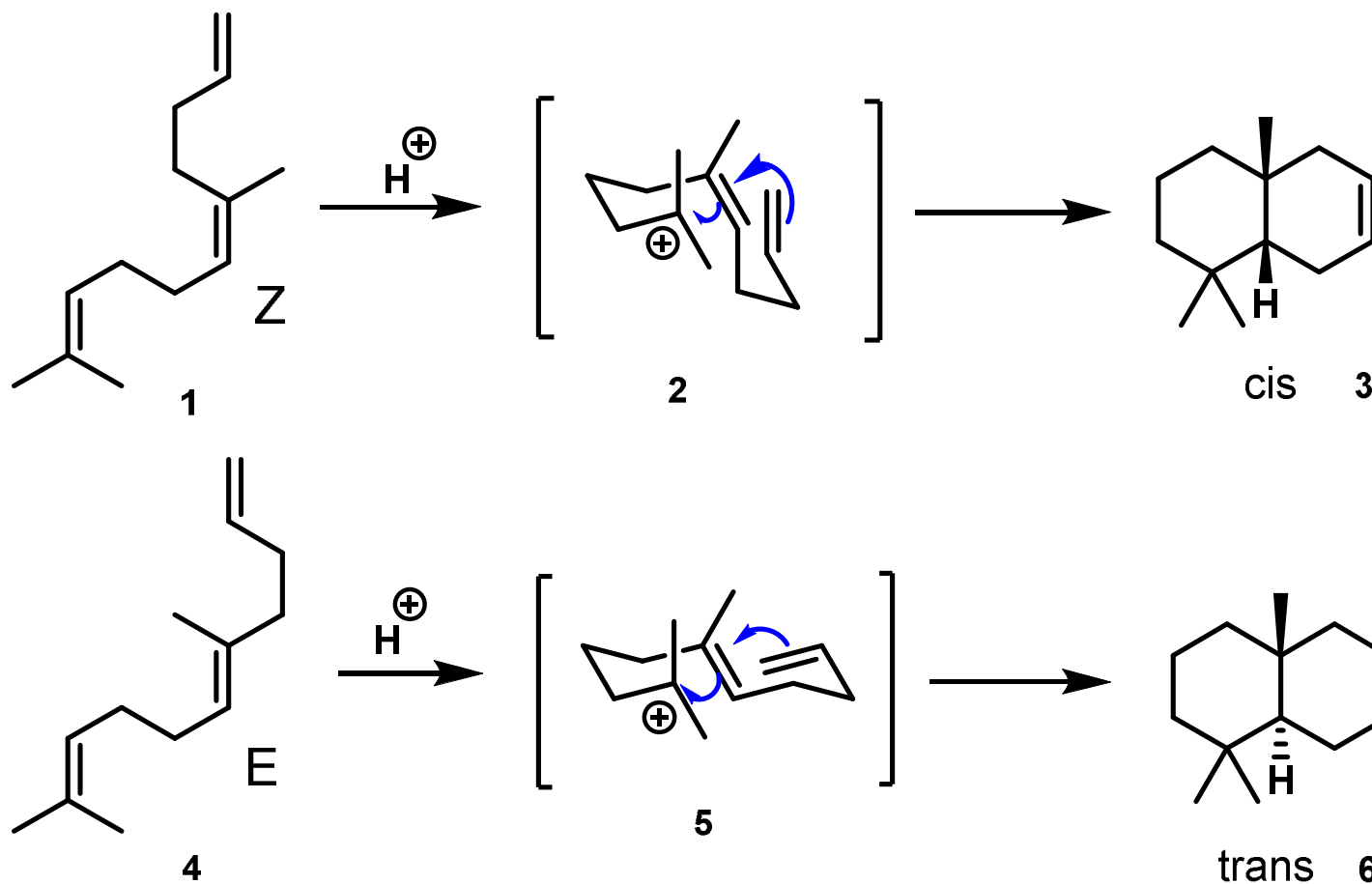

Cationic cyclization cascades

Konstantin Samarin
Gaich-Group Seminar
28.10.2013

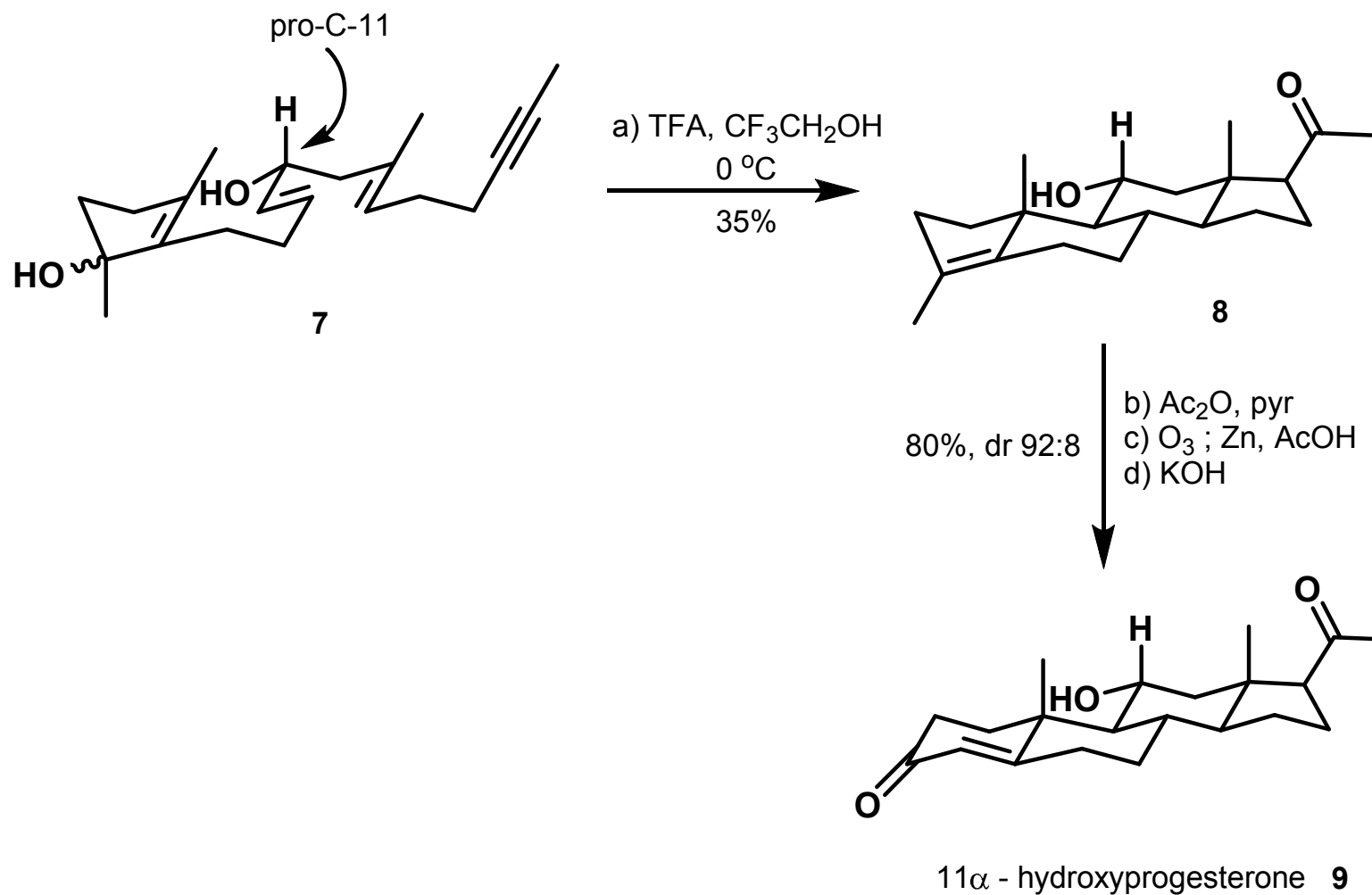
Stork-Eschenmoser Hypothesis



Stork G., Burgstrahler A.W. *J. Am. Chem. Soc.* **1955**, *77*, 5068-5077

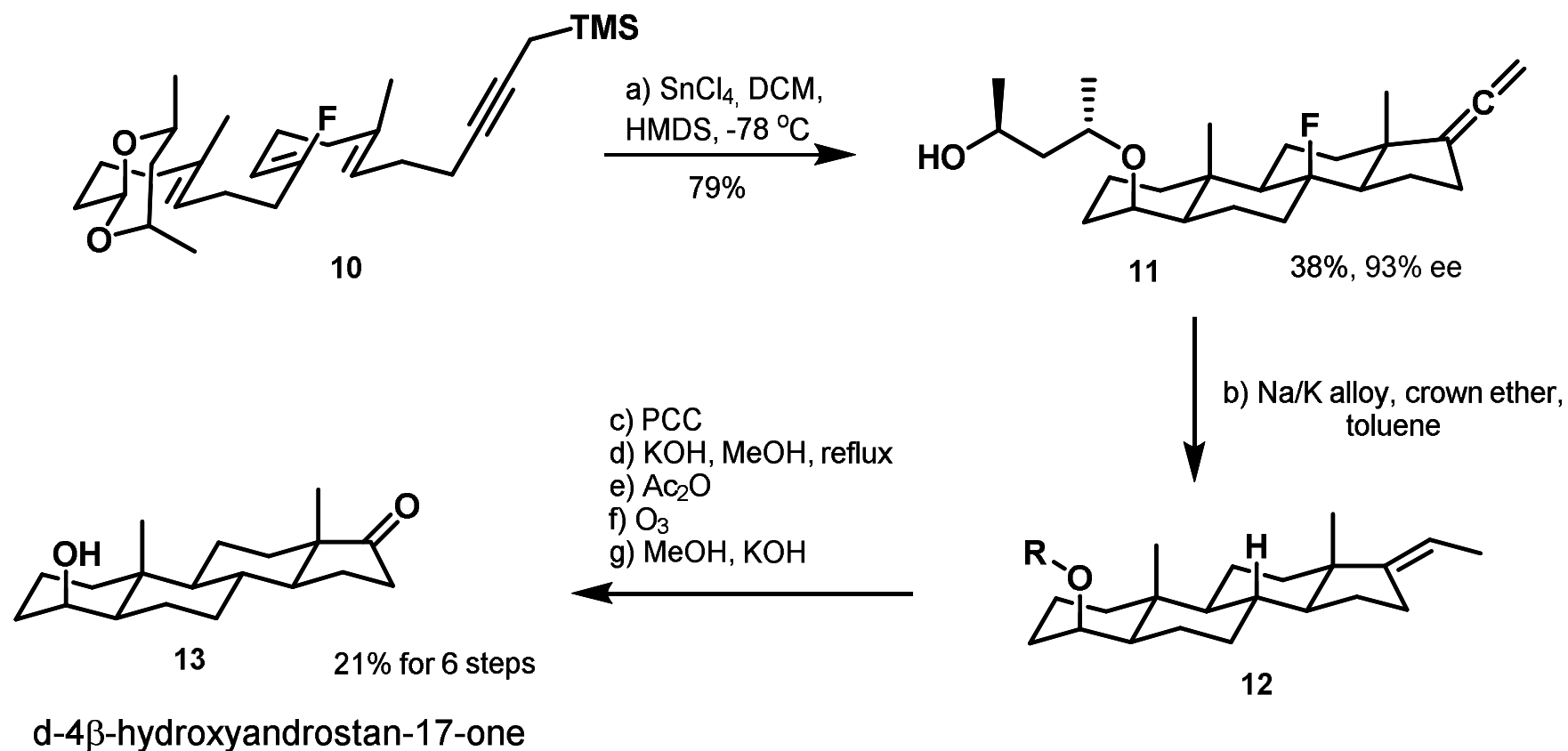
Eschenmoser A., Ruzicka L., Jeger O., Arigoni D. *Helv. Chim. Acta.* **1955**, *38*, 1890-1904

Synthesis of 11 α -hydroxyprogesterone

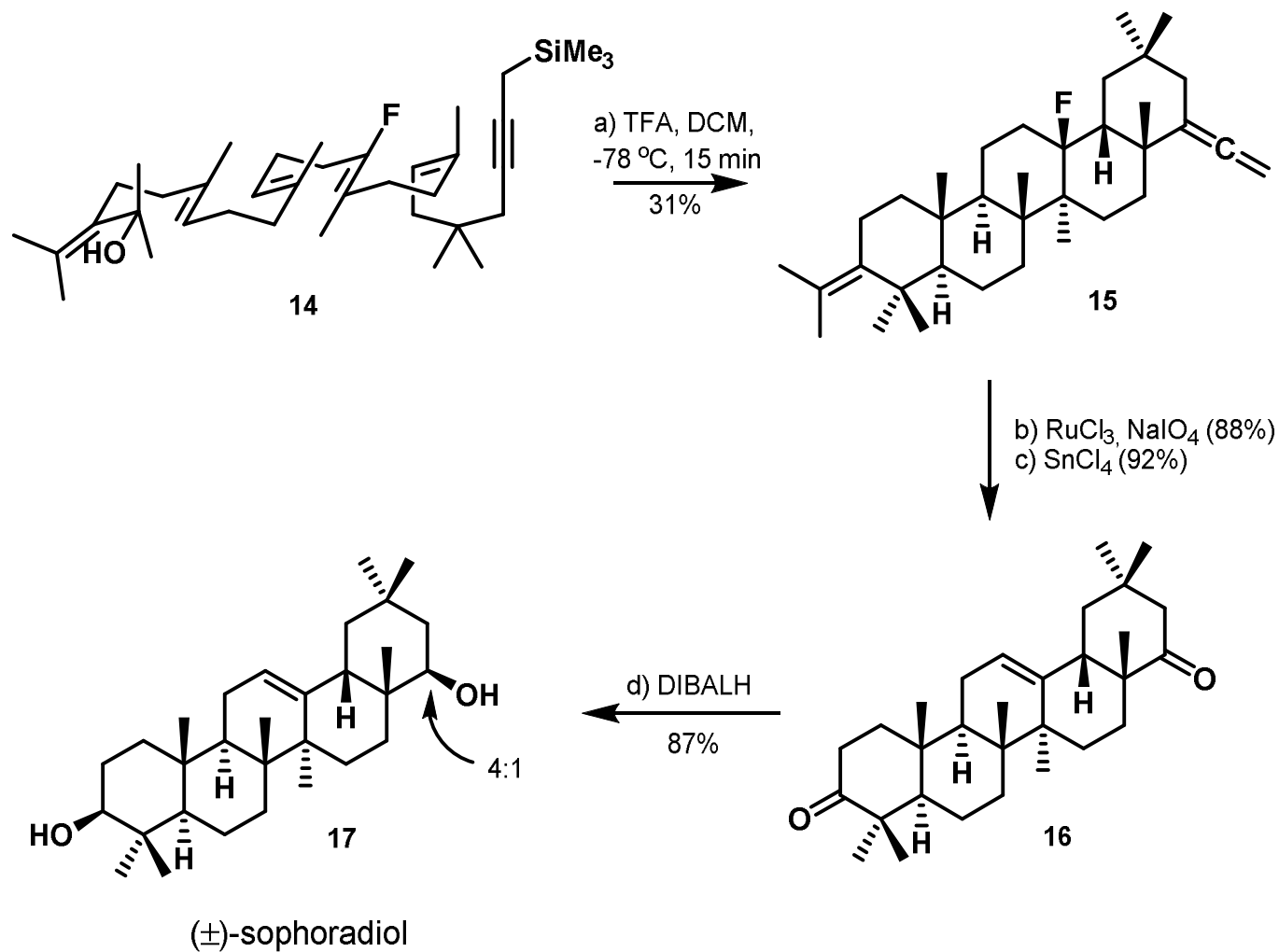


Johnson W.S., Brinkmeyer R.S., Kapoor V.M., Yarnell T.M. *J. Am. Chem. Soc.*
1977, 99, 8341-8343

Synthesis of d-4 β -hydroxyandrostan-17-one

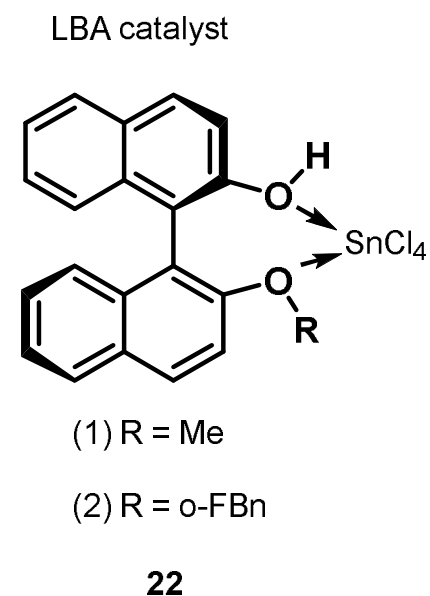
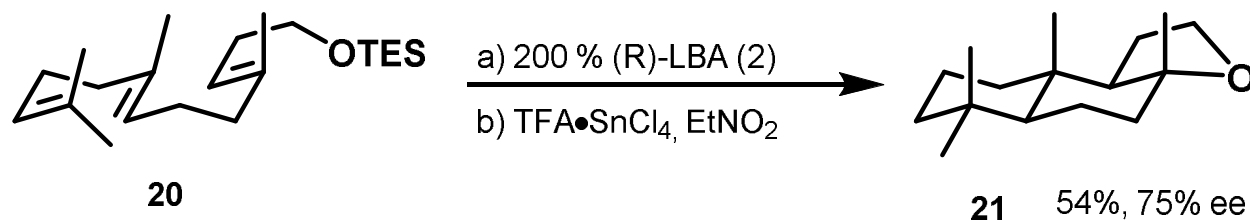
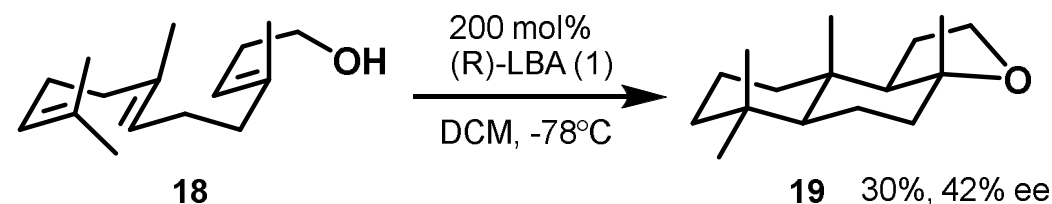


Synthesis of (\pm)-Sophoradiol



Yamamoto's Enantioselective Olefin Protonation-Initiated Polycyclization

Gaich-Group Seminar
Konstantin Samarin

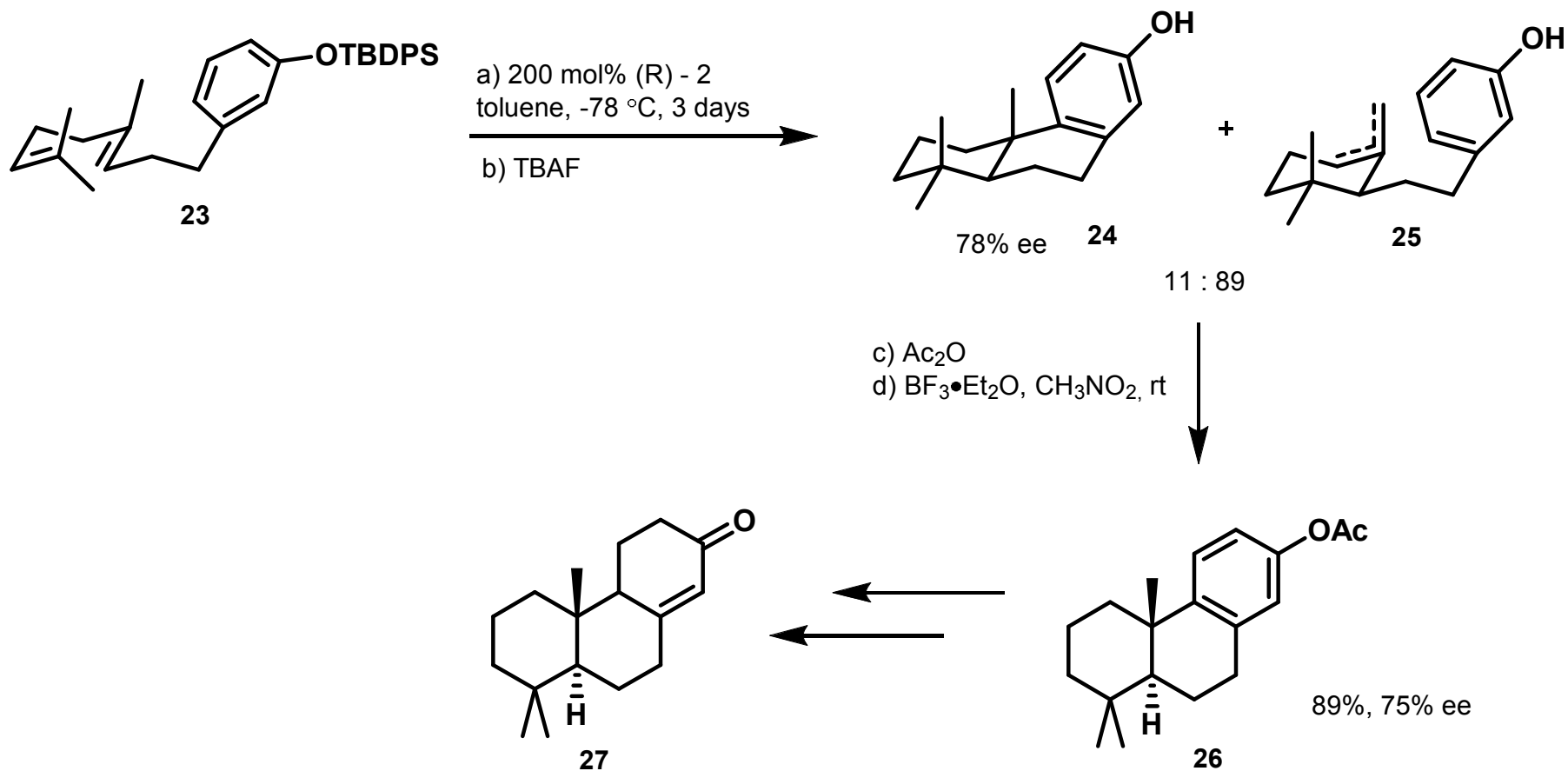


Ishihara K., Nakamura S., Yamamoto H. *J. Am. Chem. Soc.* **1999**, *121*, 4906-4907

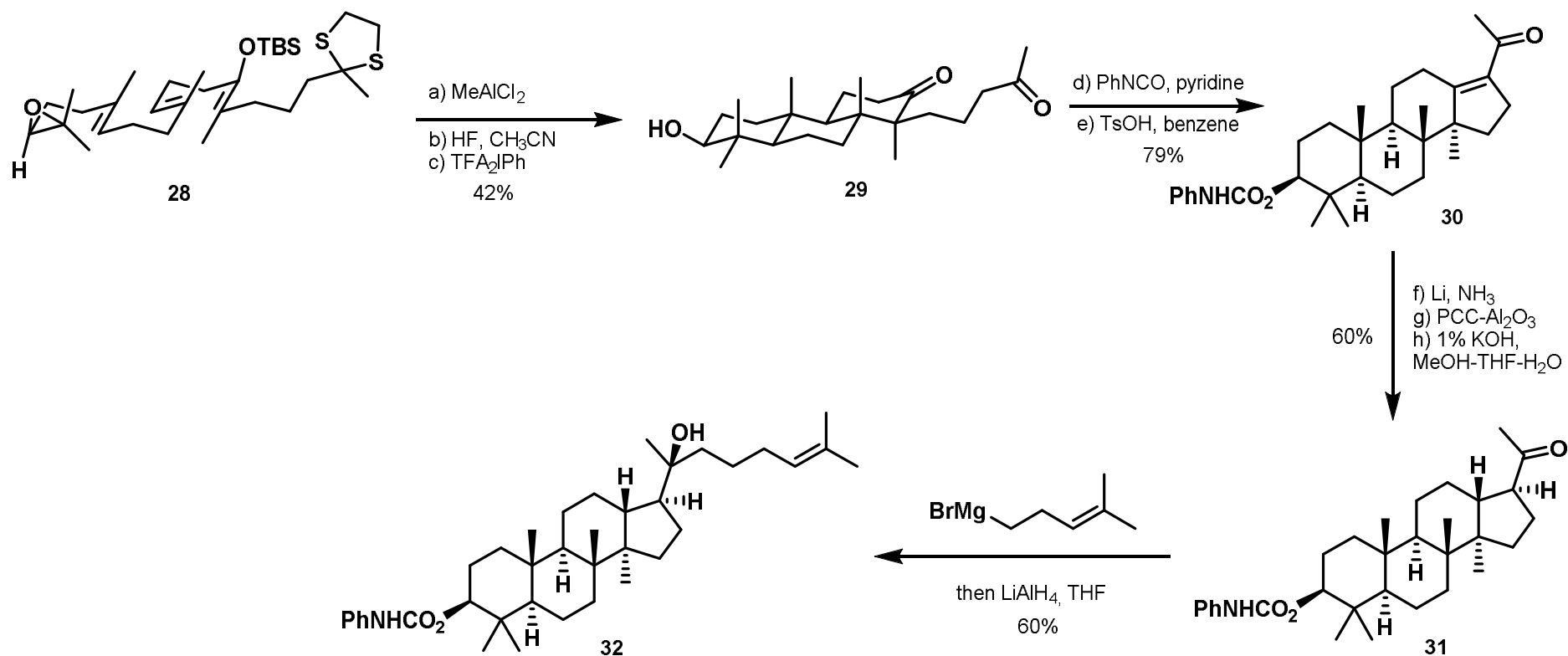
Ishihara K., Ishibashi H., Yamamoto H. *J. Am. Chem. Soc.* **2002**, *124*, 3647-3655

Yamamoto's Enantioselective Olefin Protonation-Initiated Polycyclization

Gaich-Group Seminar
Konstantin Samarin

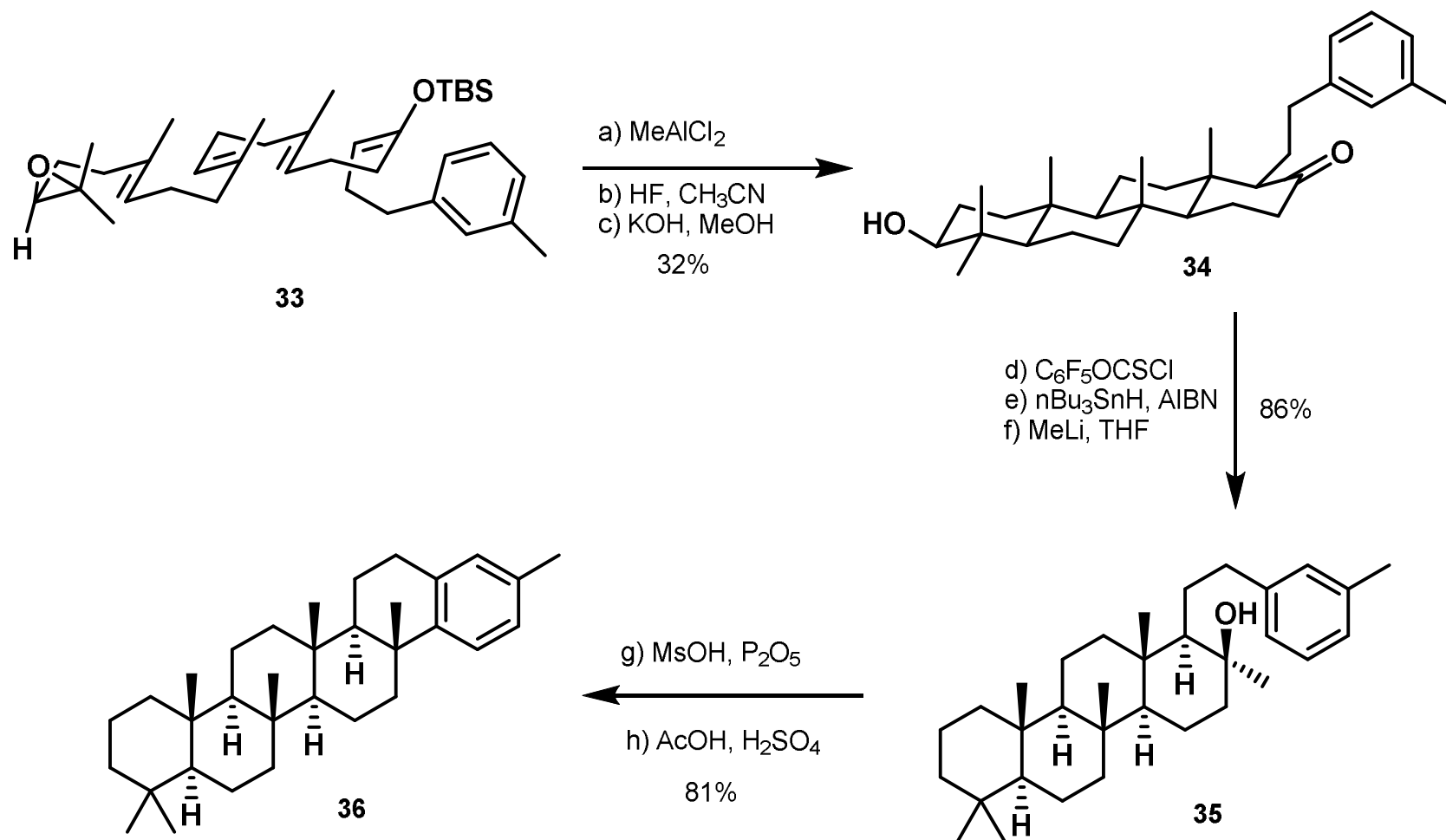


Total Synthesis of Dammarenediol



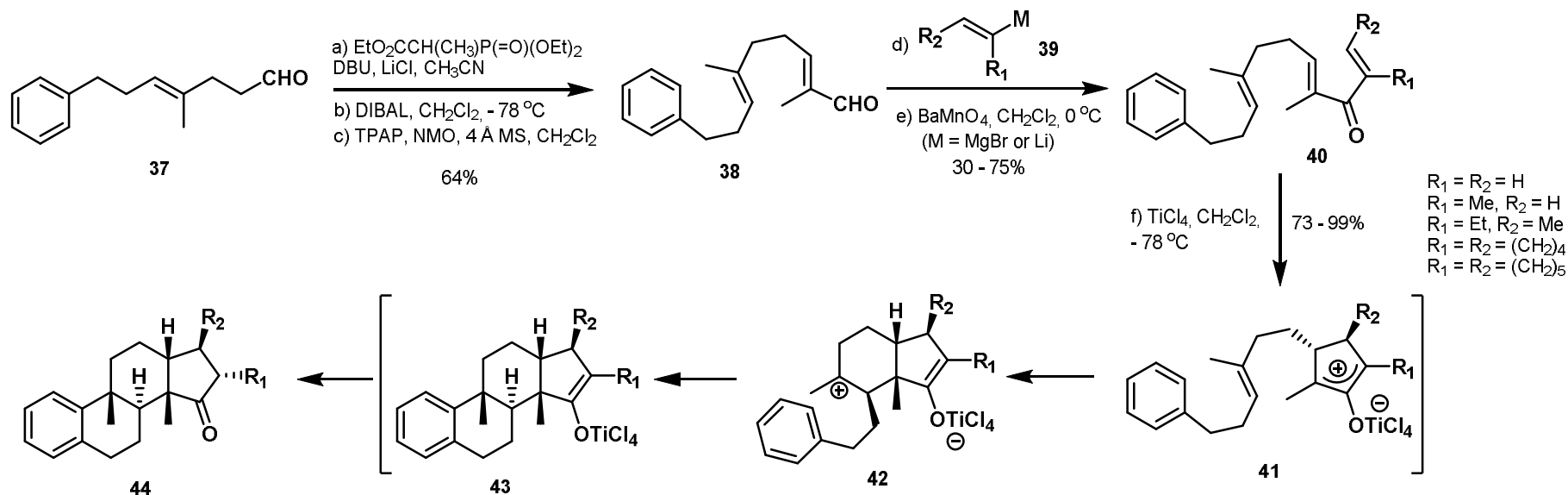
Total Synthesis of Hexacyclic Sedimentary Triterpene

Gaich-Group Seminar
Konstantin Samarin

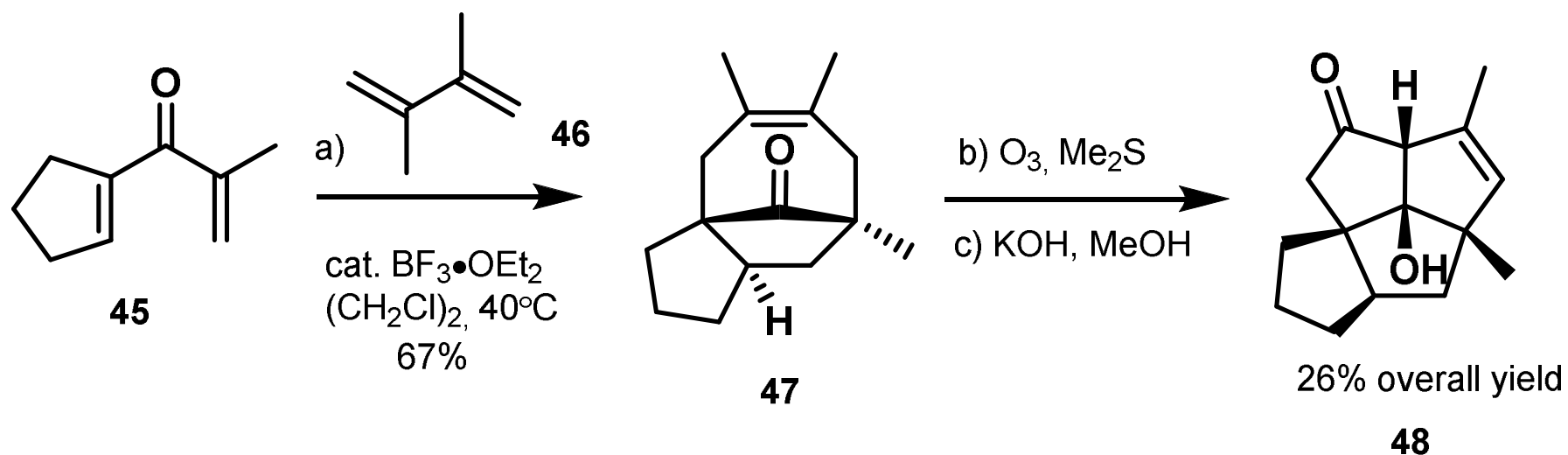


Corey E. J., Luo G., Lin L. S. *Angew. Chem. Int. Ed.* **1998**, *37*, 1126-1128

Nazarov-triggered polycyclization

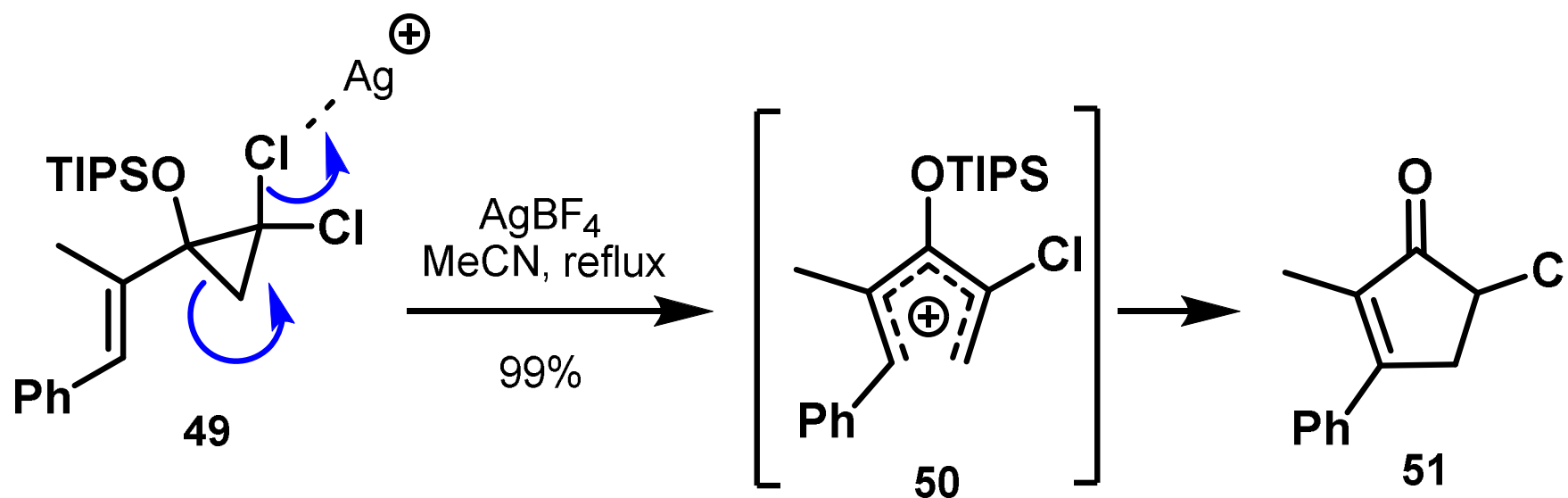


Nazarov–[4 + 3]-cycloaddition

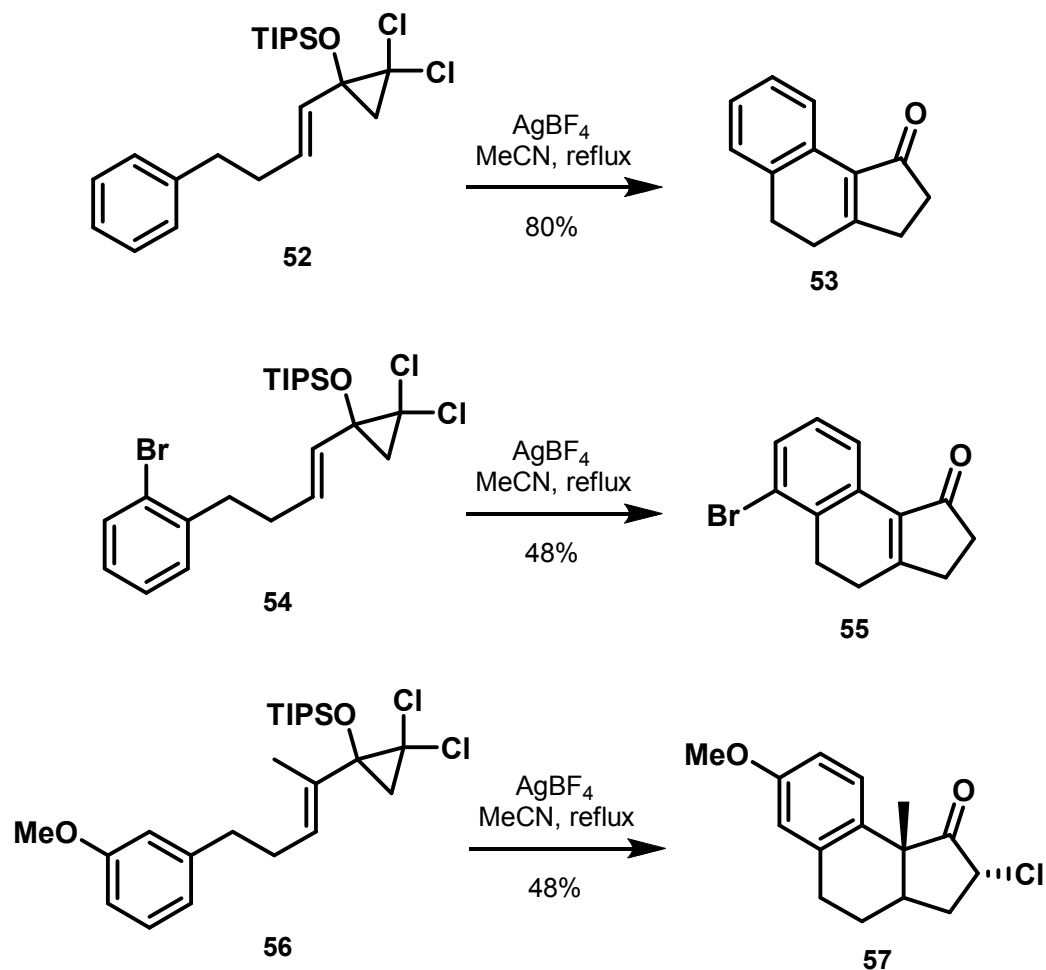


Wang Y., Schill B.D., Arif A.M., West F.G. *Org. Lett.* **2003**, 5, 2747-2750
Yungai A, West F.G. *Tetrahedron Lett.* **2004**, 45, 5445-5448

The halocyclopropane Nazarov reaction

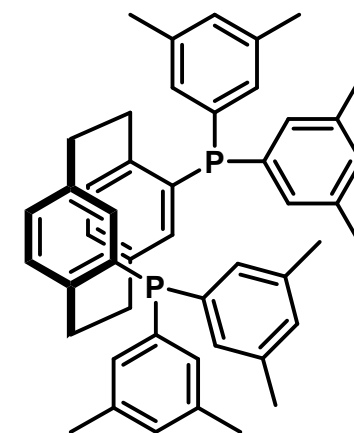
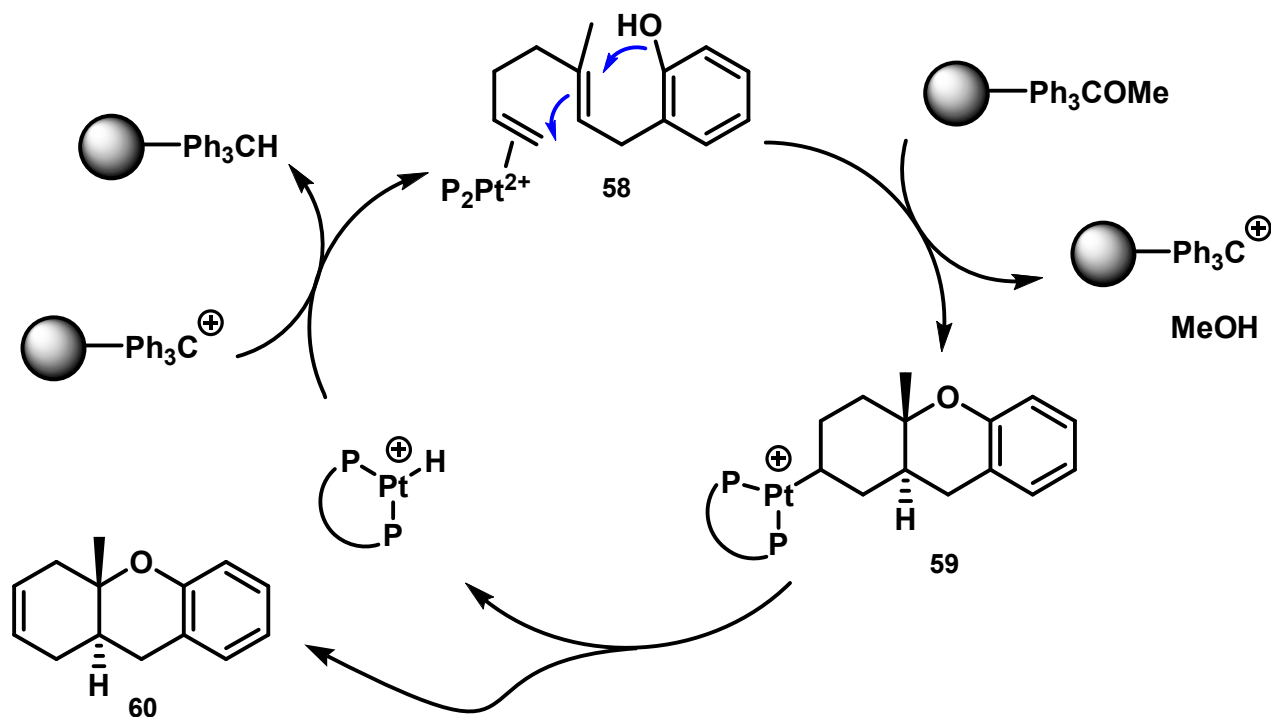


Non-traditional interrupted Nazarov reactions



Platinum-Catalyzed Enantioselective Polycyclization Reactions

Gaich-Group Seminar
Konstantin Samarin

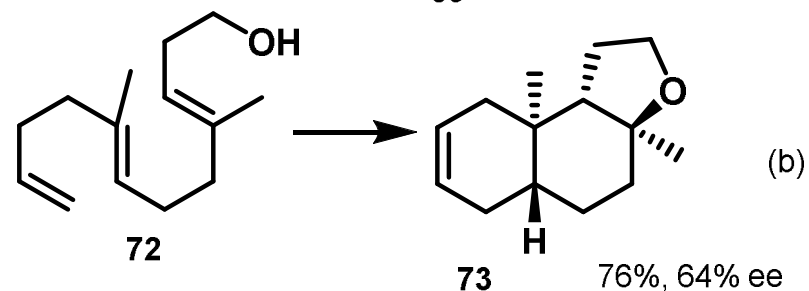
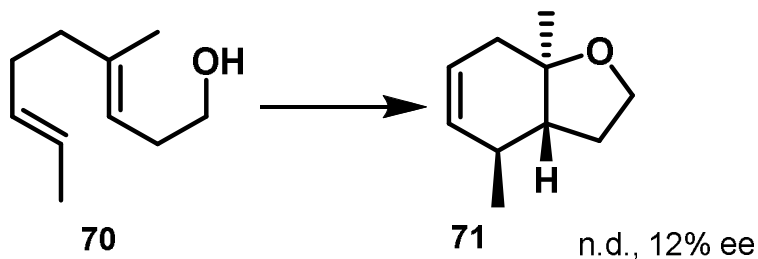
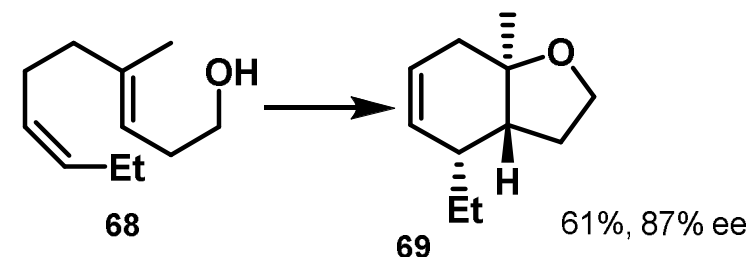
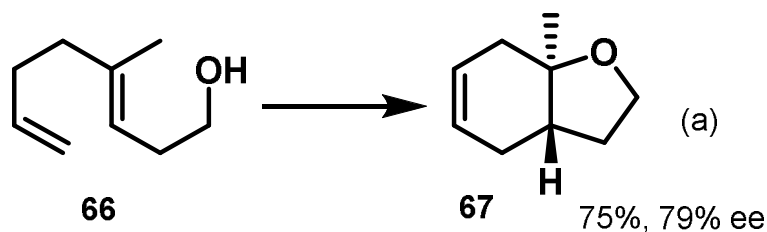
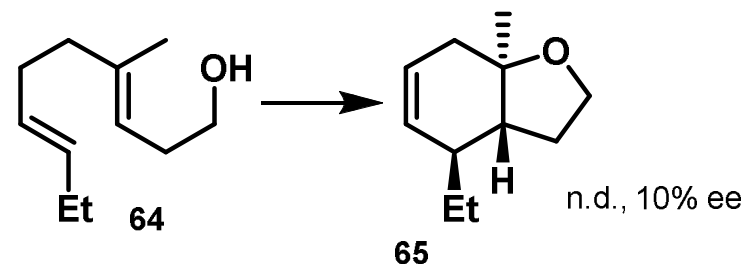
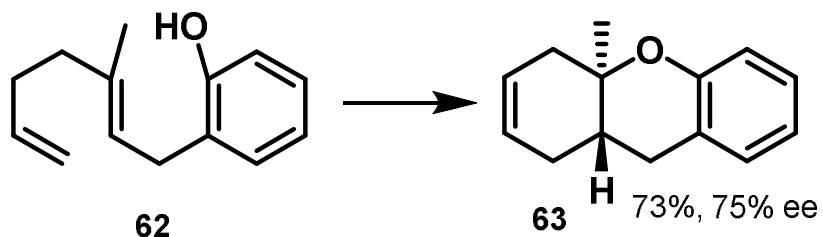


(S)-xylyl-phanephos

61

Platinum-Catalyzed Enantioselective Polycyclization Reactions

Gaich-Group Seminar
Konstantin Samarin

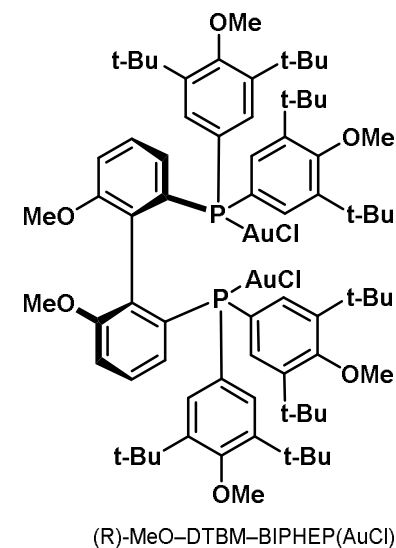
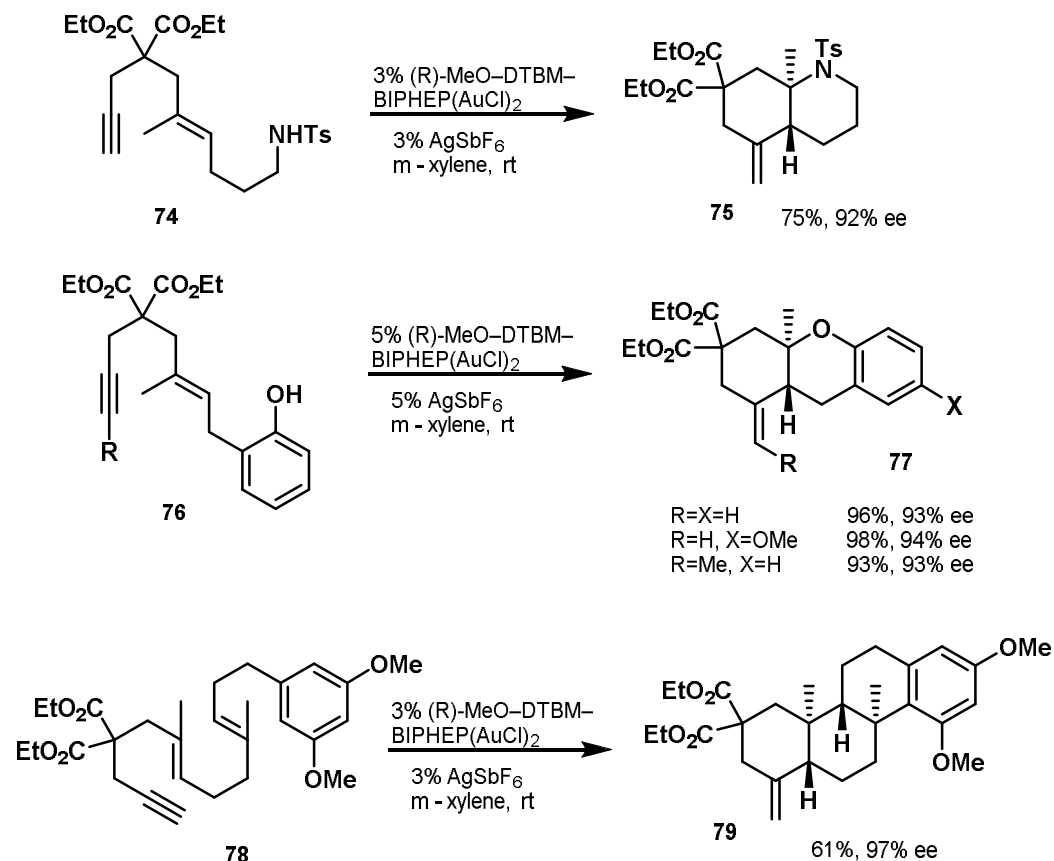


Conditions: 10 mol% [((S)-xylylphanephos)Pt](BF₄)₂,
22mol% AgBF₄, 2.1equiv Ph₃COMe (resin), EtNO₂, rt.

(a) solvent was MeNO₂
(b) ee was determined after hydrogenation of product
n.d. = not determined

Gold(I)-Catalyzed Enantioselective Polycyclization Reactions

Gaich-Group Seminar
Konstantin Samarin

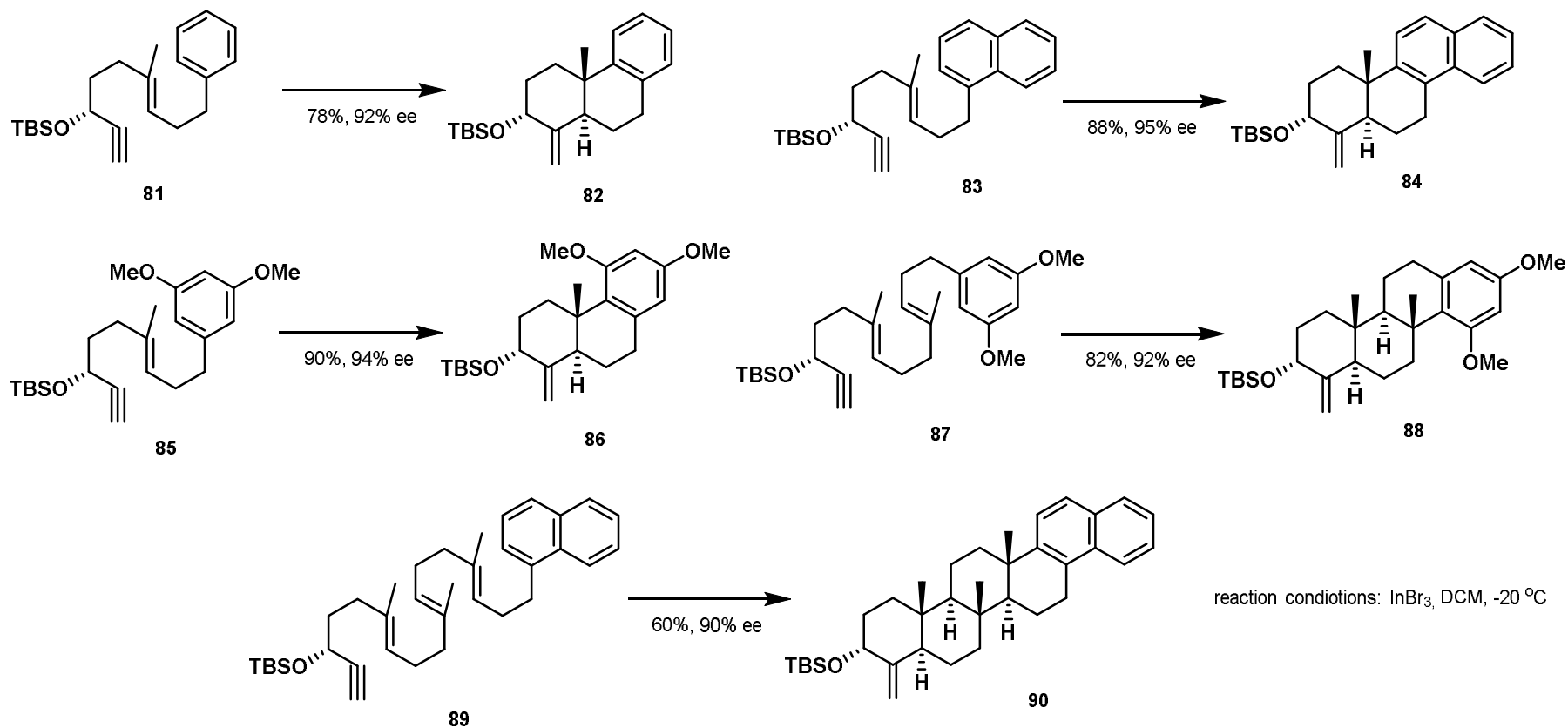


(R)-MeO-DTBM-BIPHEP = 2,2'-bis[di(3,5-di-tert-butyl-4-methoxyphenyl)phosphino]-6,6'-dimethoxy-1,1'-biphenyl

80

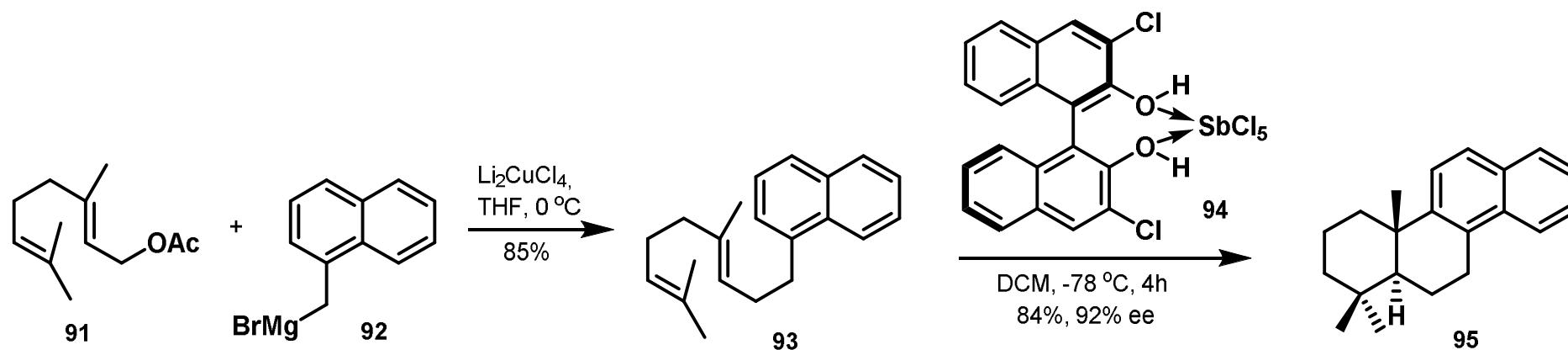
Indium(III)-Catalyzed Cationic Cascade

Gaich-Group Seminar
Konstantin Samarin



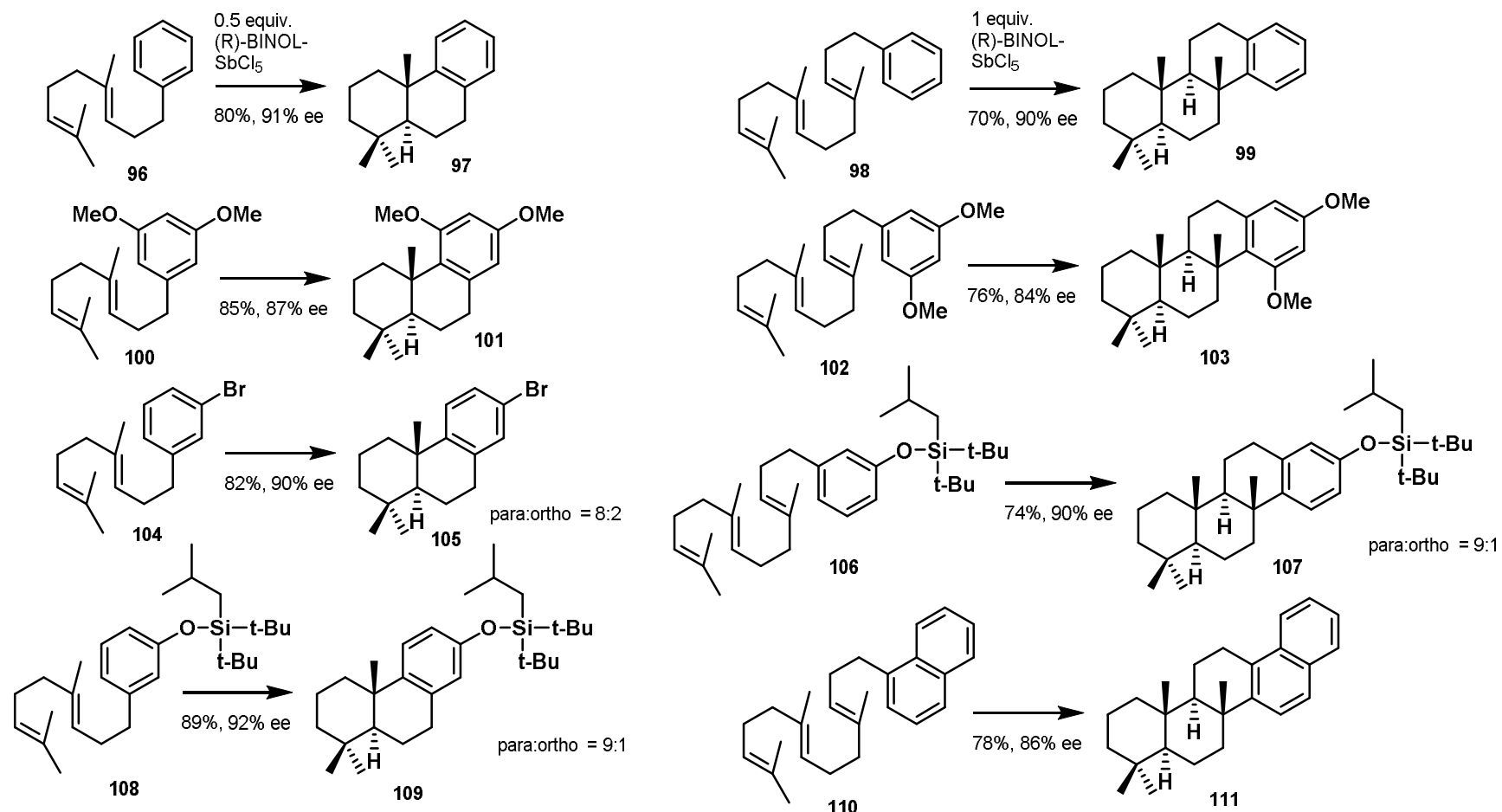
Enantioselective Proton-Initiated Polycyclization of Polyenes

Gaich-Group Seminar
Konstantin Samarin



Enantioselective Proton-Initiated Polycyclization of Polyenes

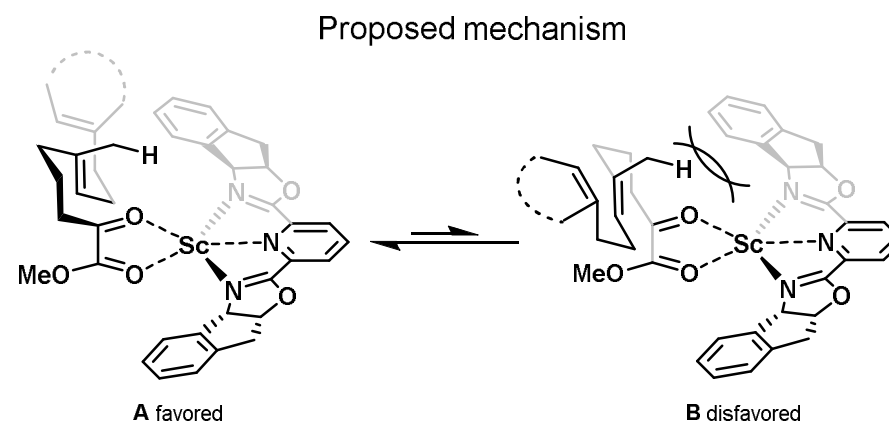
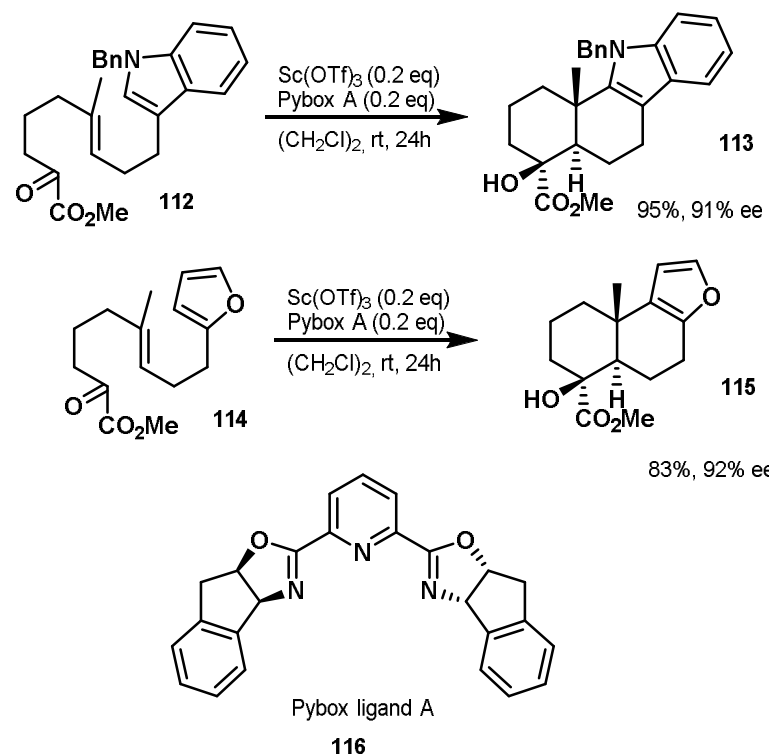
Gaich-Group Seminar
Konstantin Samarin



Surendra K., Corey E.J. *J. Am. Chem. Soc.* **2012**, *134*, 11992-11994

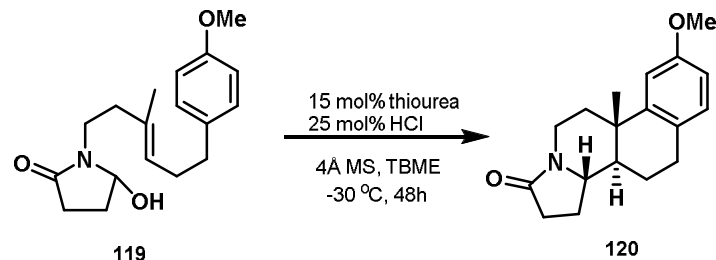
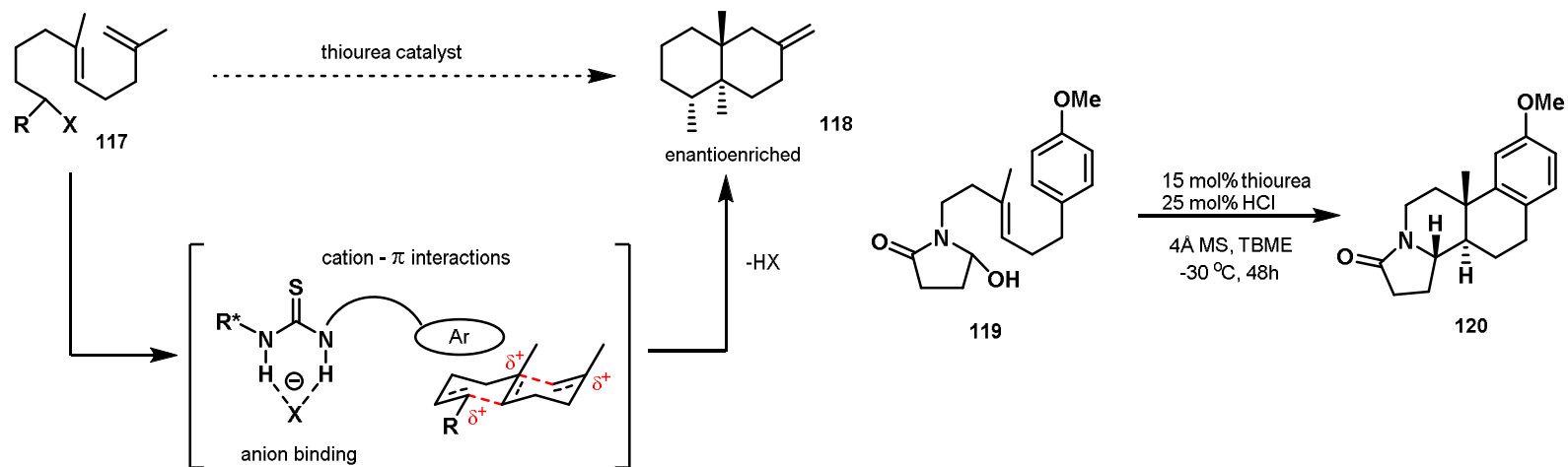
α -Keto-Esters as Initiators of Cationic Polycyclization

Gaich-Group Seminar
Konstantin Samarin

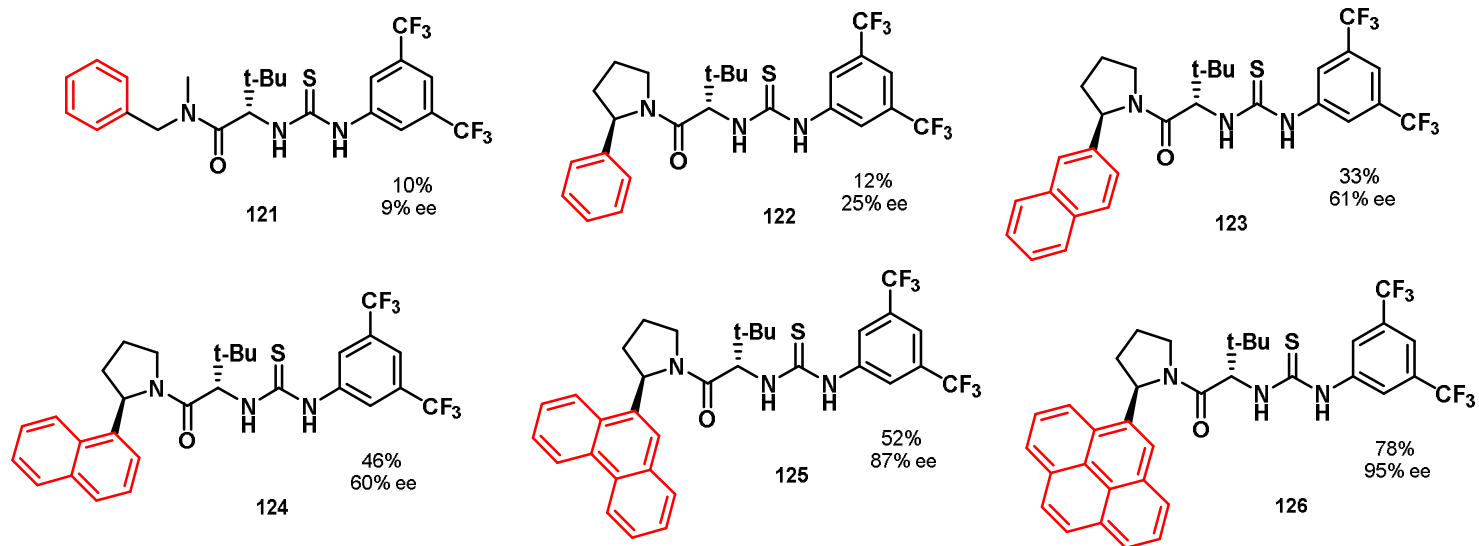


Thiourea-Catalyzed Cationic Polycyclization

Gaich-Group Seminar
Konstantin Samarin



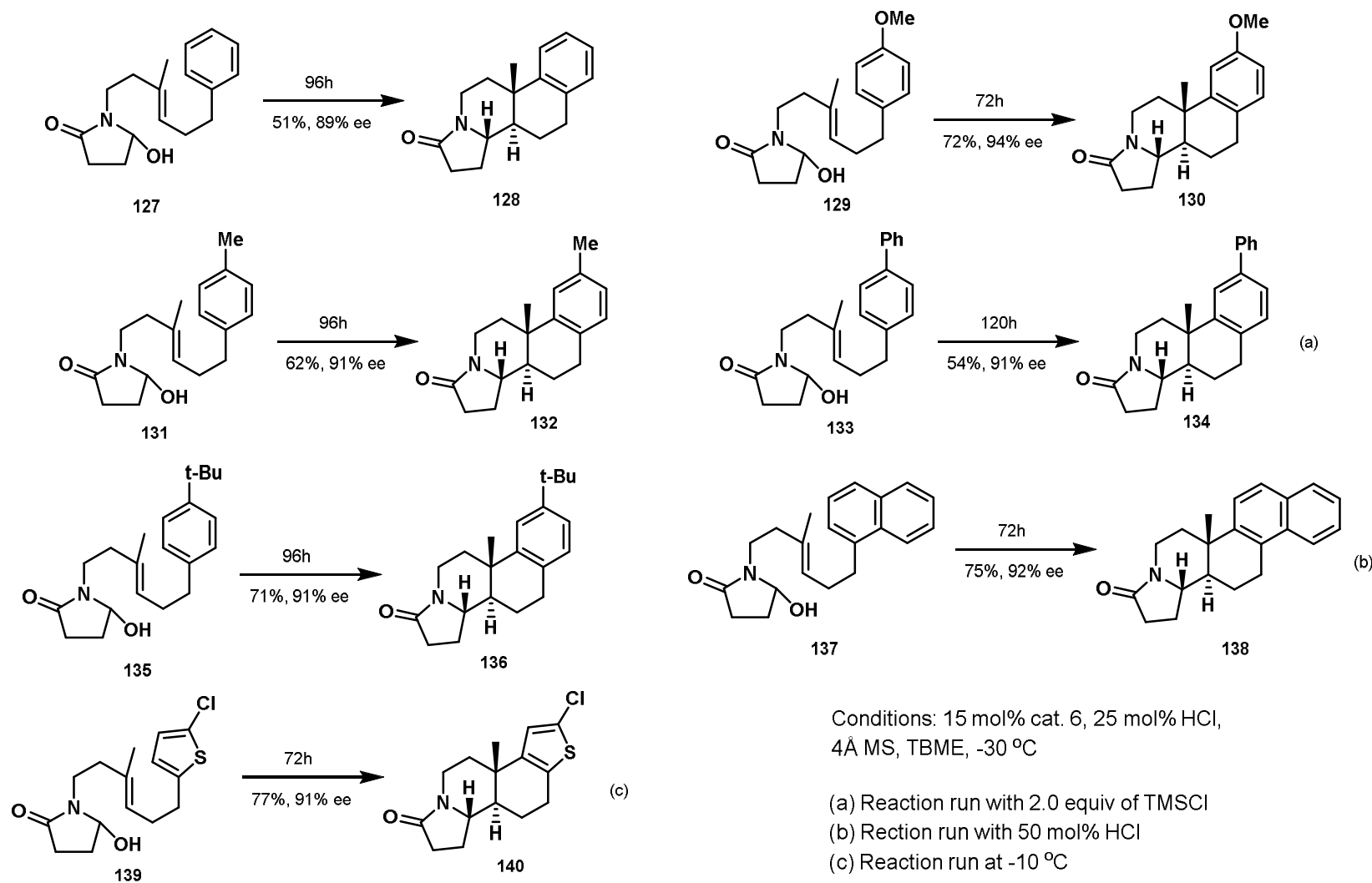
Catalysts



Knowles R.R., Lin S., Jacobsen E.N. *J. Am. Chem. Soc.* **2010**, *132*, 5030-5032

Thiourea-Catalyzed Cationic Polycyclization

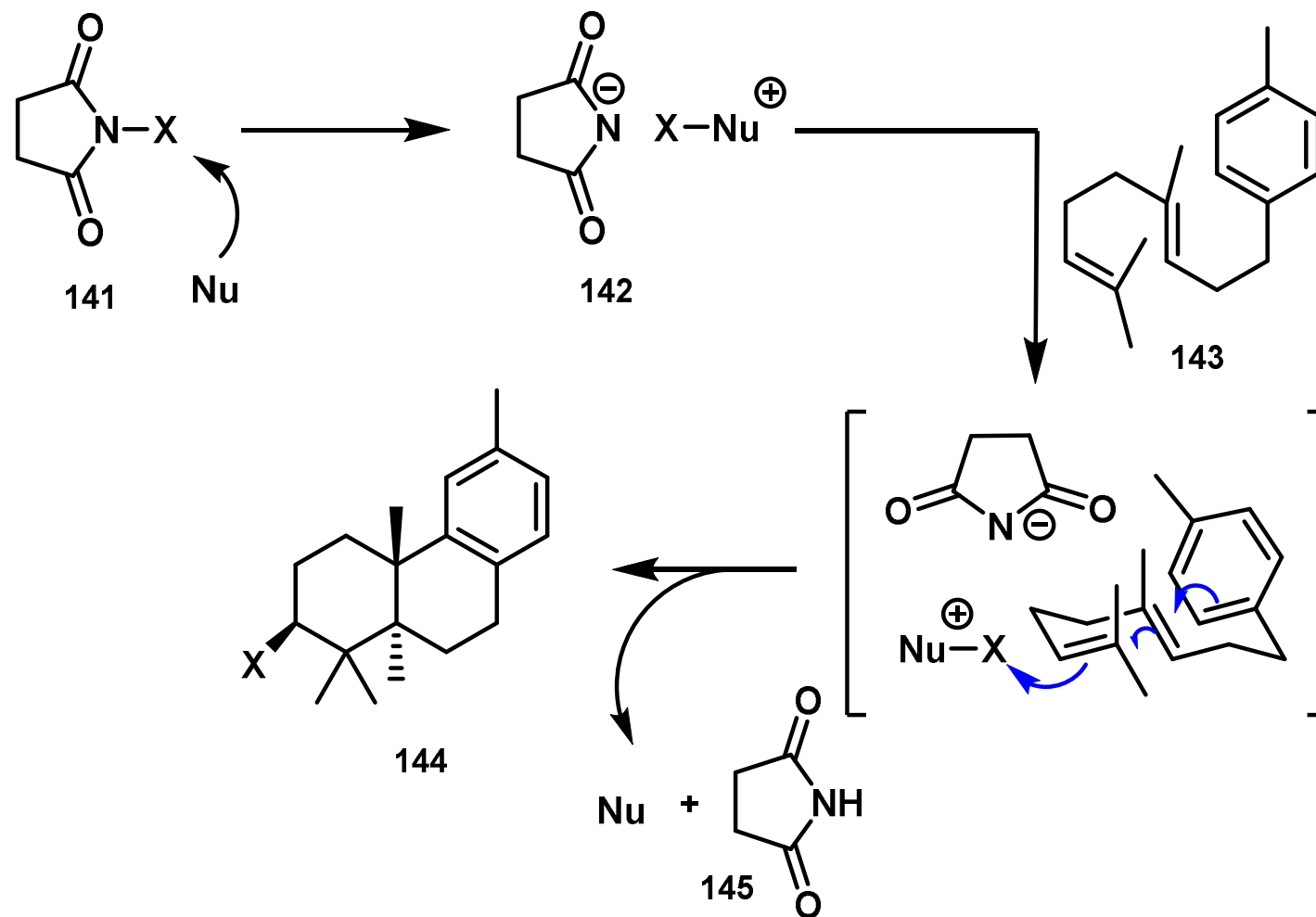
Gaich-Group Seminar
Konstantin Samarin



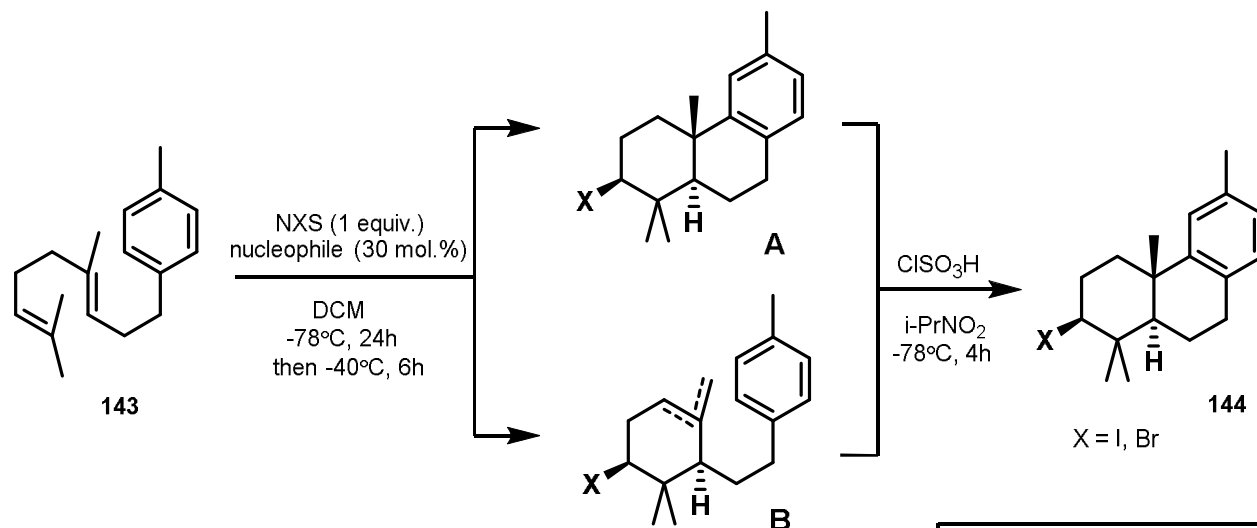
Knowles R.R., Lin S., Jacobsen E.N. *J. Am. Chem. Soc.* **2010**, *132*, 5030-5032

Ishihara's halocyclization method

Gaich-Group Seminar
Konstantin Samarin



Ishihara's halocyclization method



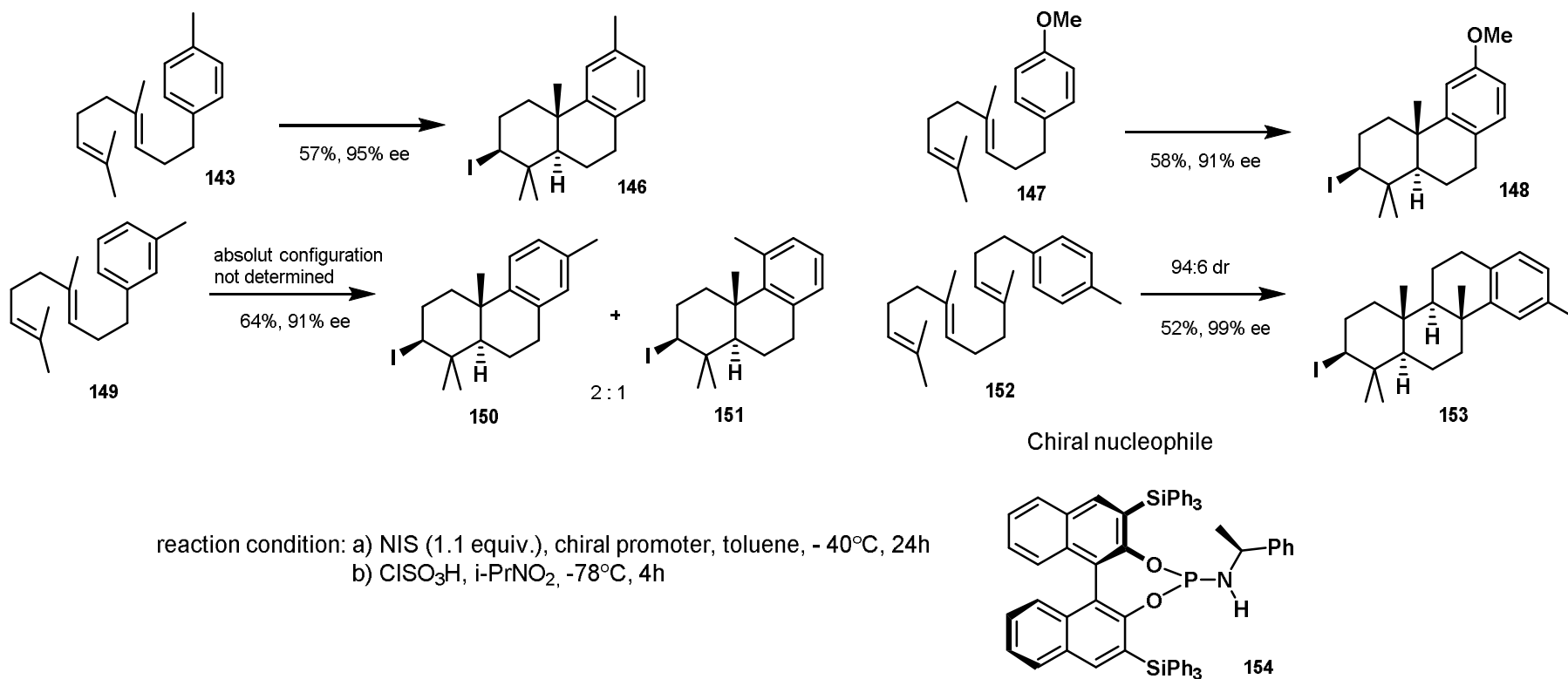
A:B ratio = 7 : 3
in all cases

	Yield	
	X = I	X = Br
PBu ₃	99	81
P(C ₆ H ₄ (p-OMe) ₃)	87	88
PPh ₃	67	71
P(OPh ₃)	51	60

This reaction was conducted in toluene →

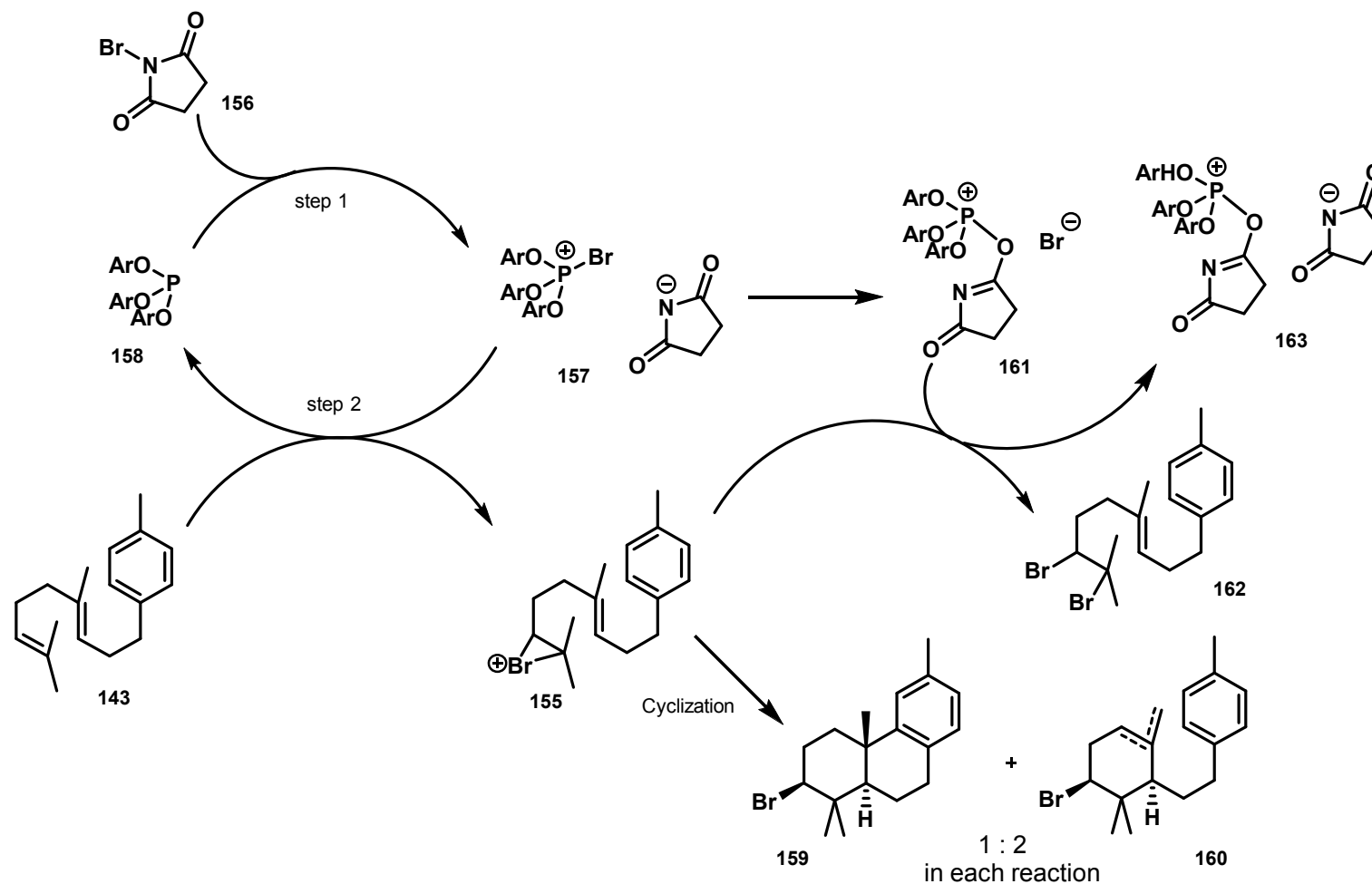
Ishihara's halocyclization method

Gaich-Group Seminar
Konstantin Samarin



Phosphite-urea catalysts for bromocyclization

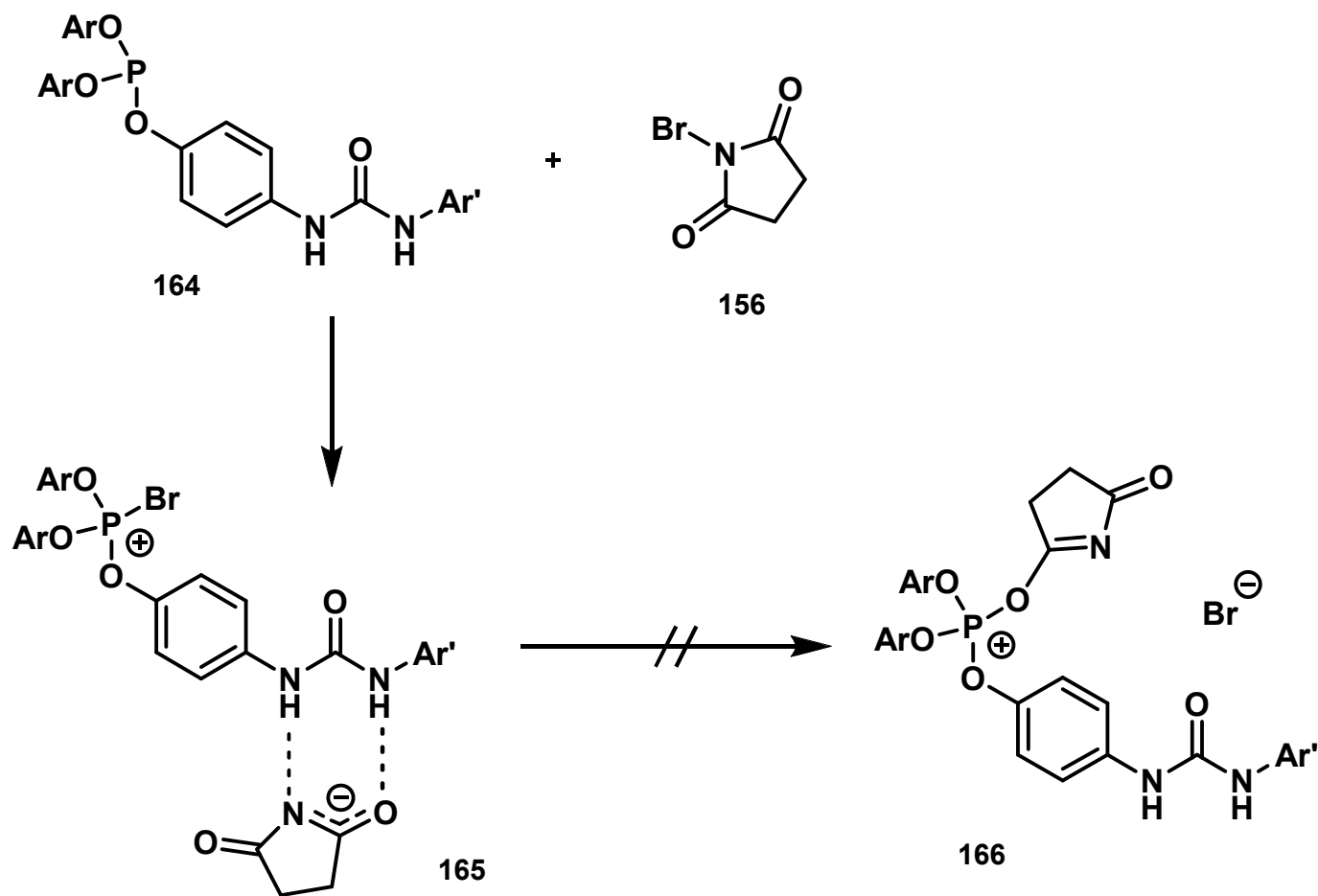
Gaich-Group Seminar
Konstantin Samarin



Sawamura Y., Nakatsuji H., Sakakura A., Ishihara K. *Chem. Sci.* **2013**, 4, 4181-4186

Phosphite-urea catalysts for bromocyclization

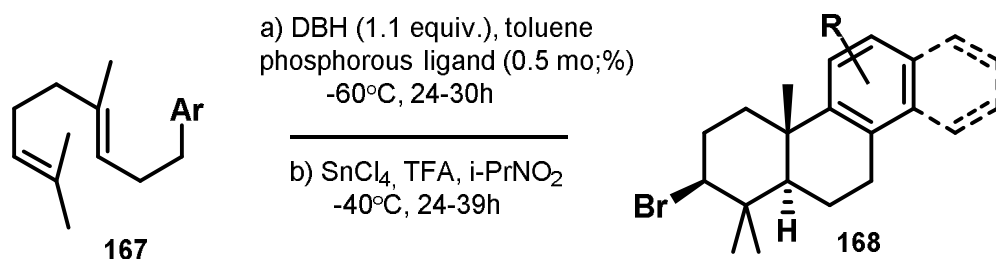
Gaich-Group Seminar
Konstantin Samarin



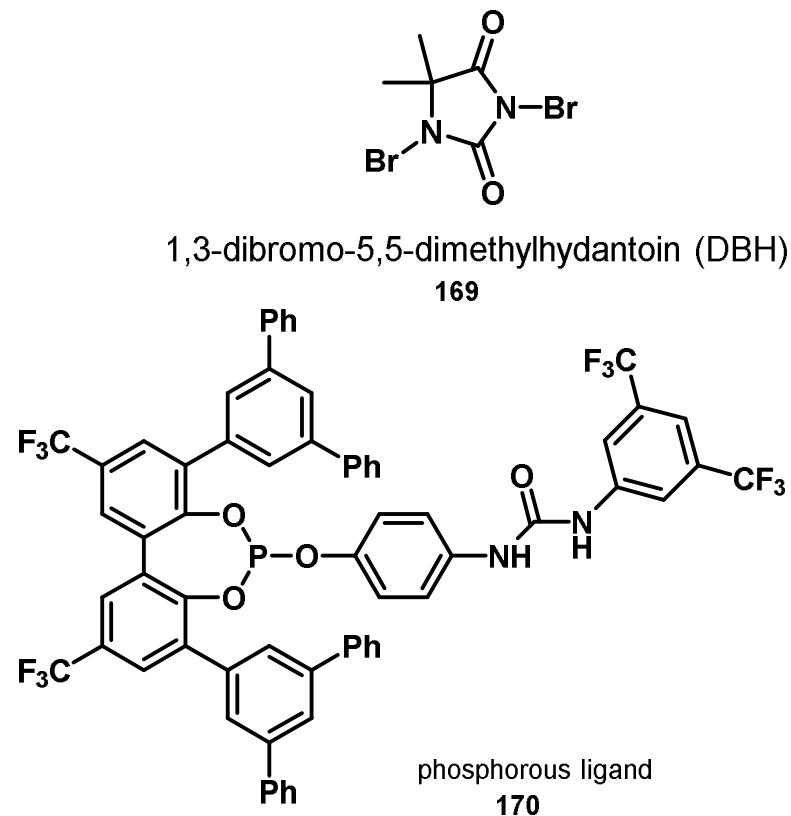
Sawamura Y., Nakatsuji H., Sakakura A., Ishihara K. *Chem. Sci.* **2013**, 4, 4181-4186

Phosphite-urea catalysts for bromocyclization

Gaich-Group Seminar
Konstantin Samarin

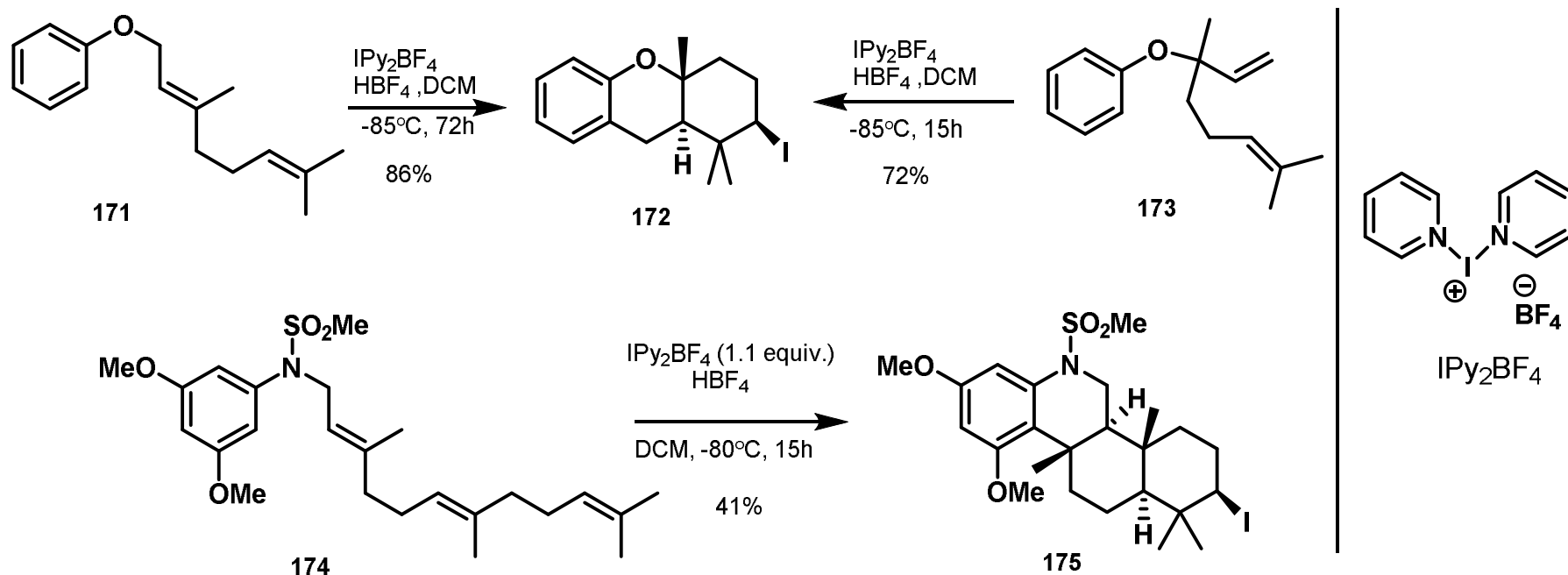


Ar	Yield	dr
4-MeC ₆ H ₄	94	95:5
4-FC ₆ H ₄	91	> 99:1
3,5-Me ₂ C ₆ H ₃	84	> 99:1
1-Naphthyl	91	92:8



Barluenga's Hypervalent Iodonium Reagent

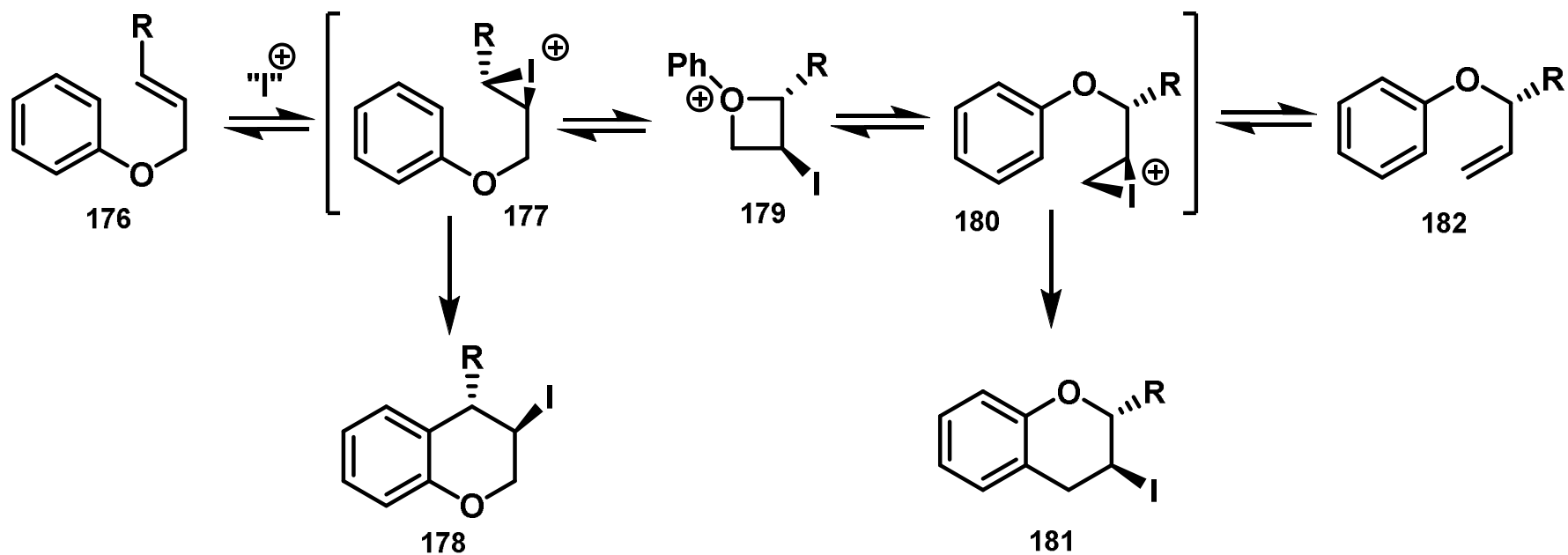
Gaich-Group Seminar
Konstantin Samarin



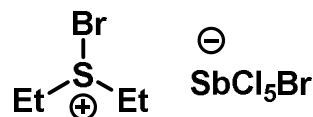
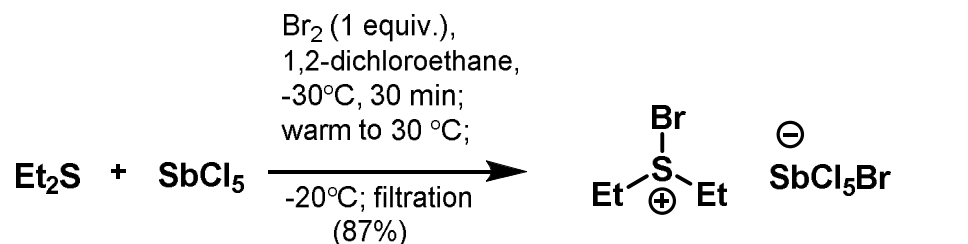
Barluenga's Hypervalent Iodonium Reagent

Gaich-Group Seminar
Konstantin Samarin

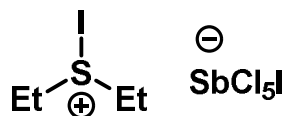
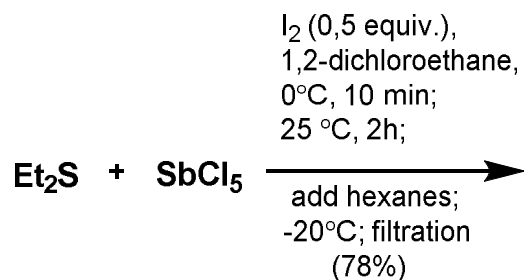
Mechanistic proposal



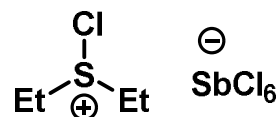
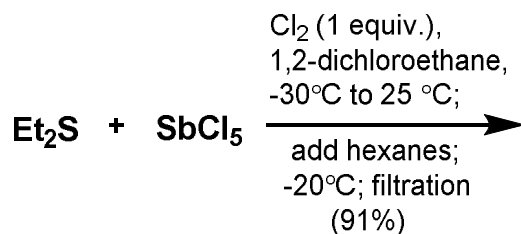
Snyder's reagents for halocyclizations



BDSB (bromodiethylsulfonium bromopentachloroantimonate)
183



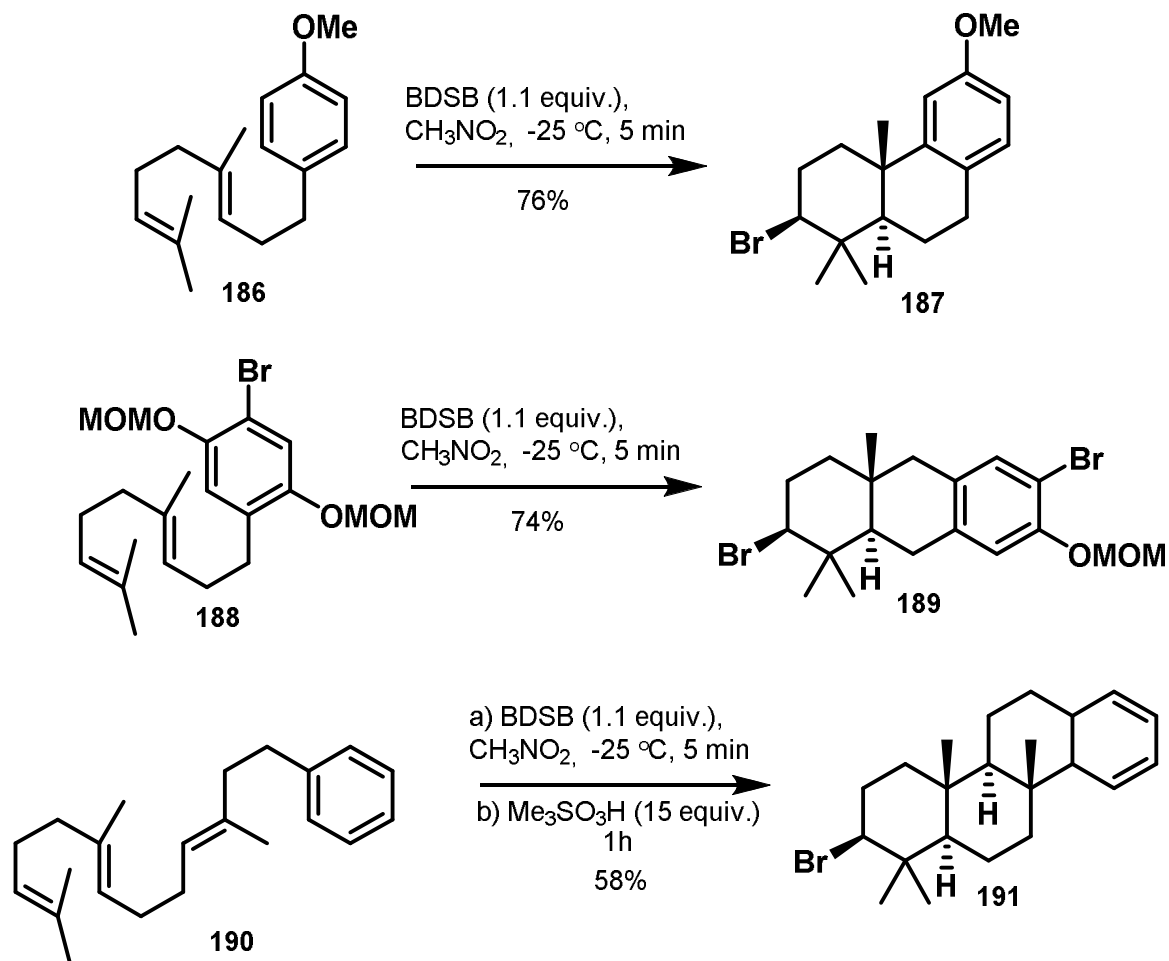
IDSI (iododiethylsulfonium iodopentachloroantimonate)
184



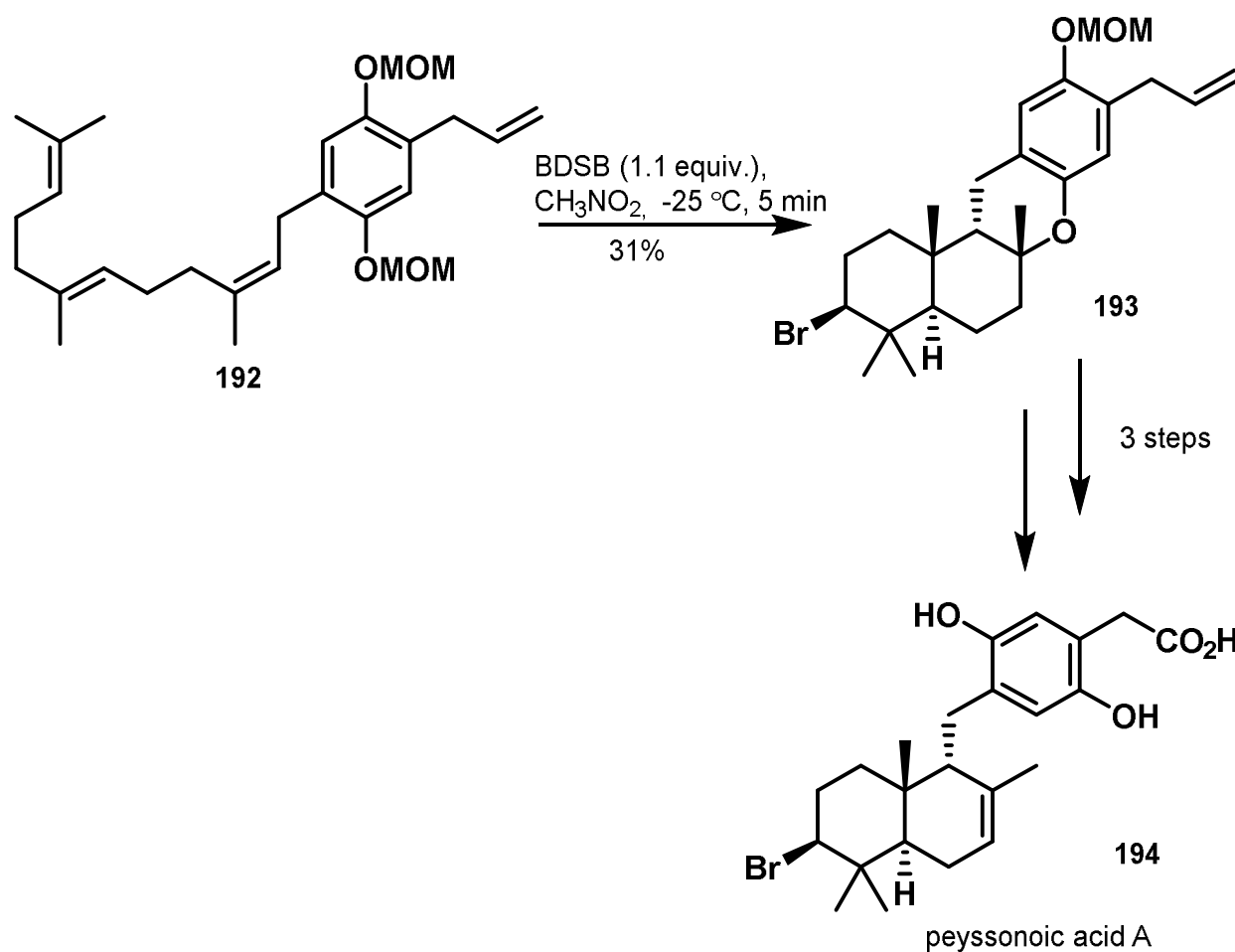
CDSC (chlorodiethylsulfonium chloropentachloroantimonate)
185



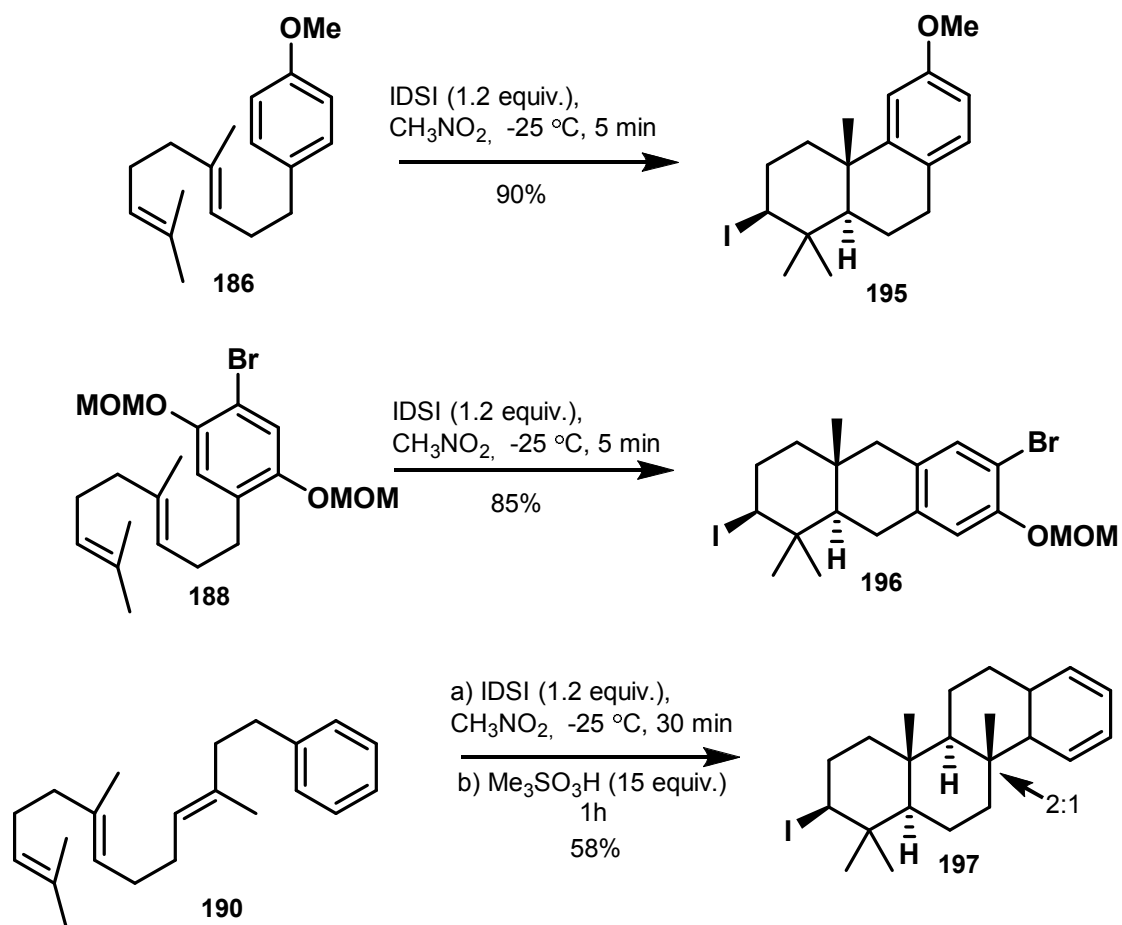
Snyder's reagents for halocyclizations



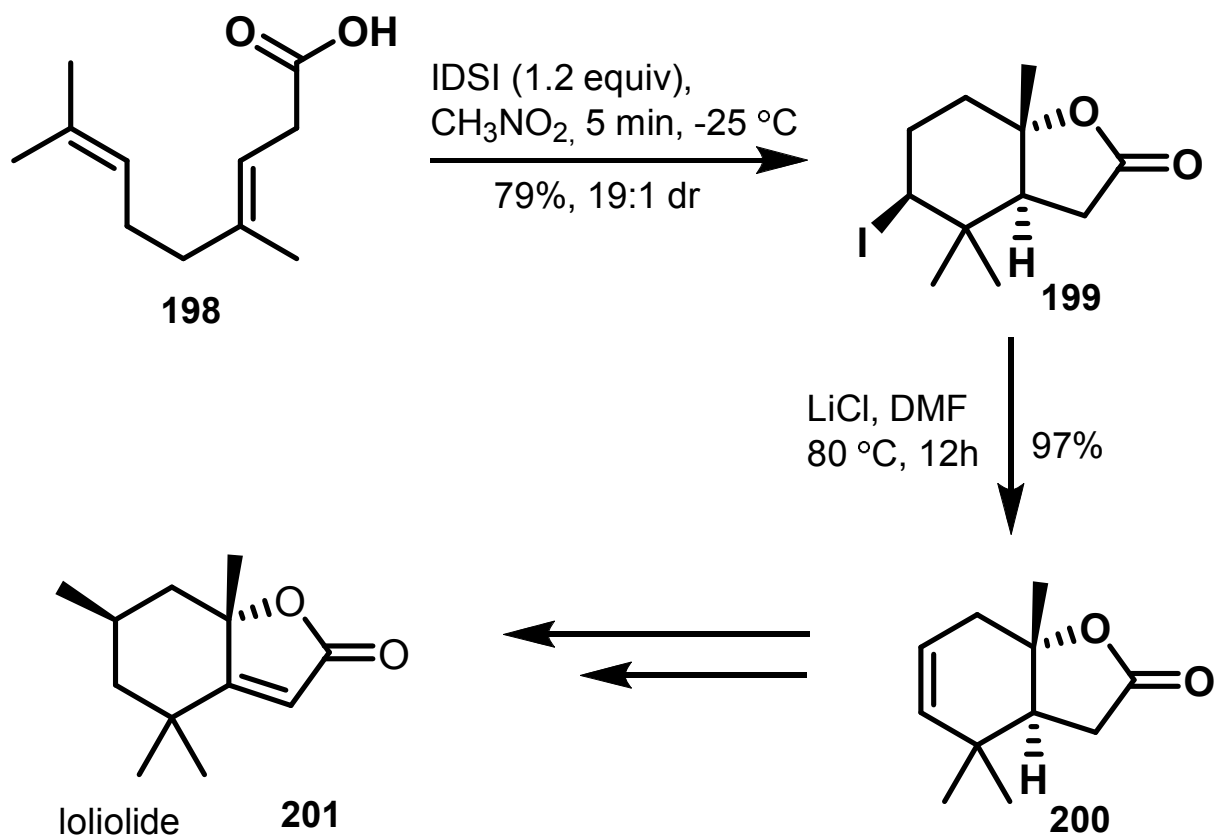
Snyder's reagents for halocyclizations



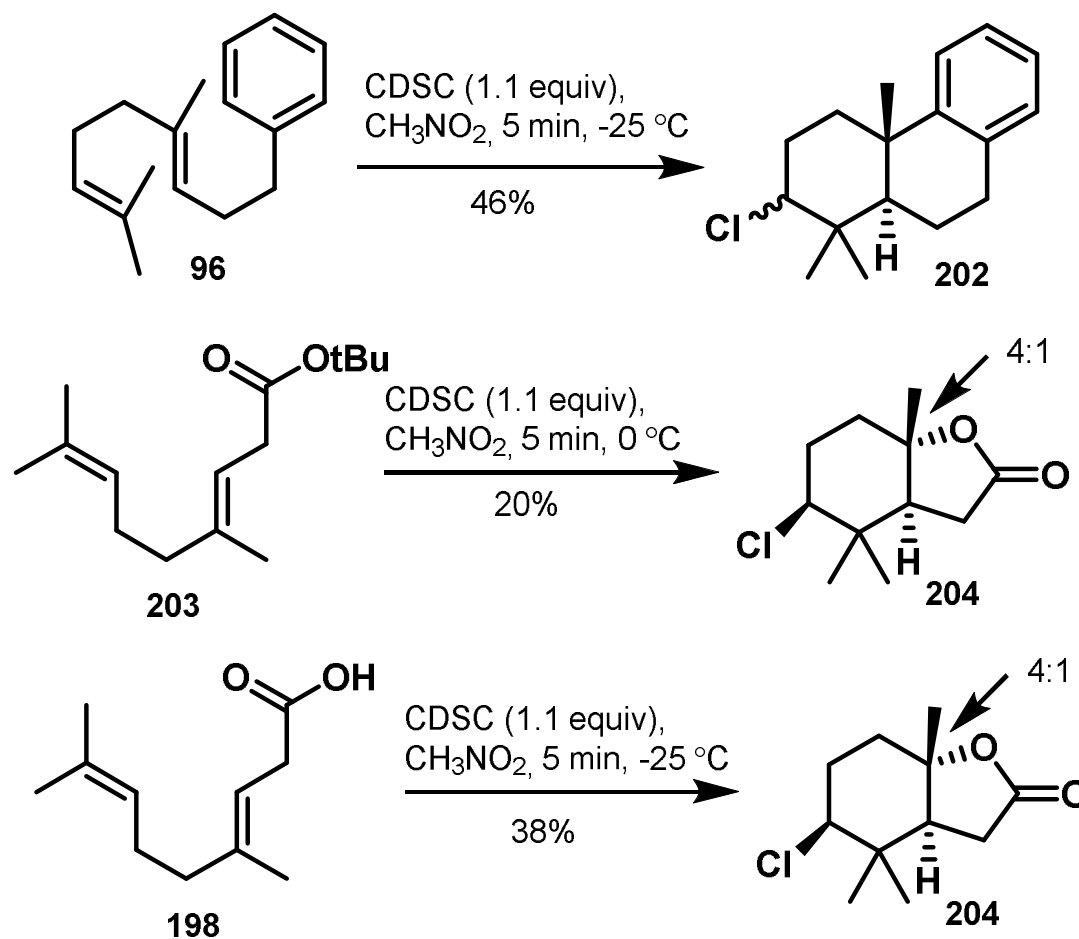
Snyder's reagents for halocyclizations



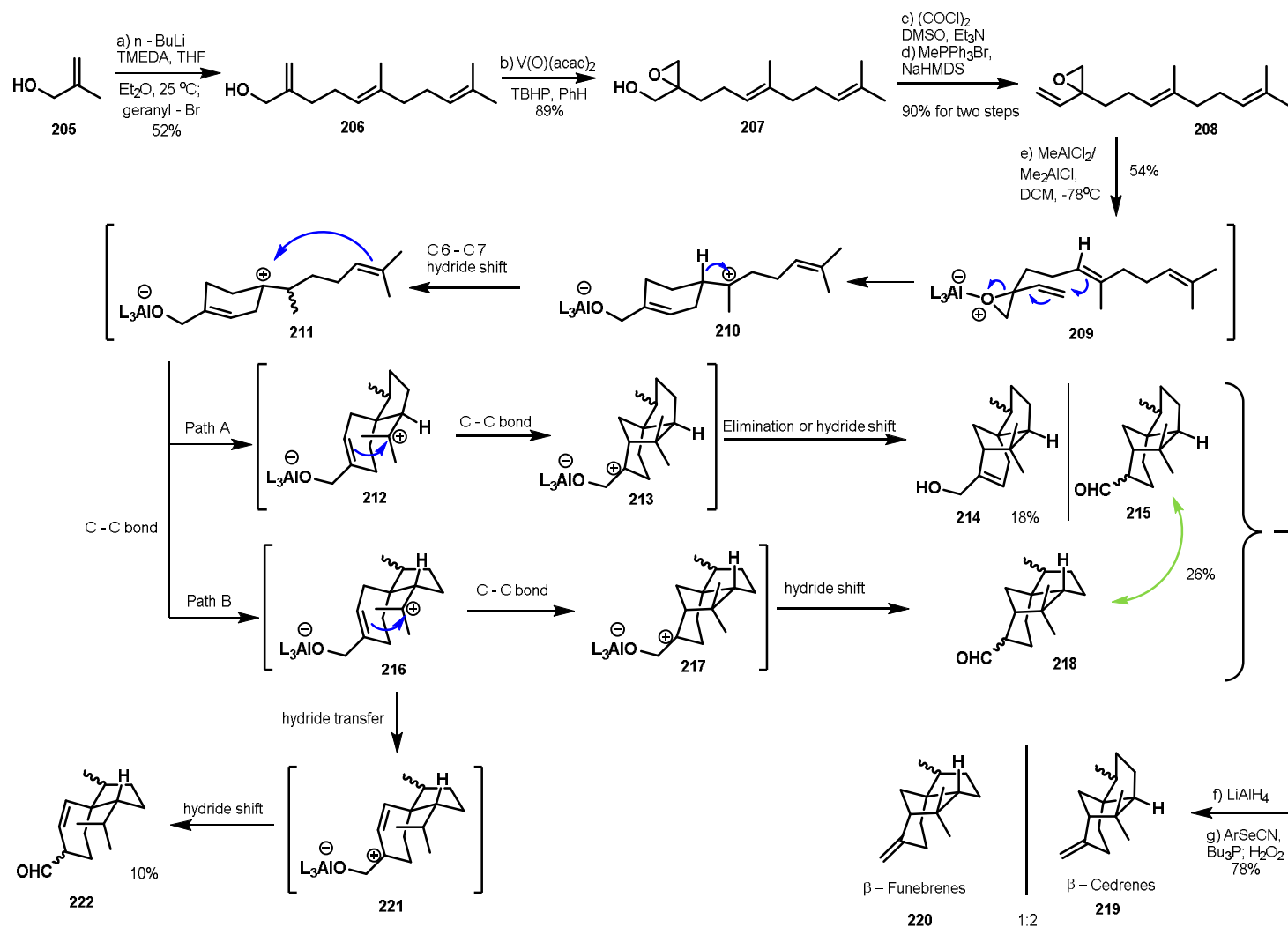
Snyder's reagents for halocyclizations



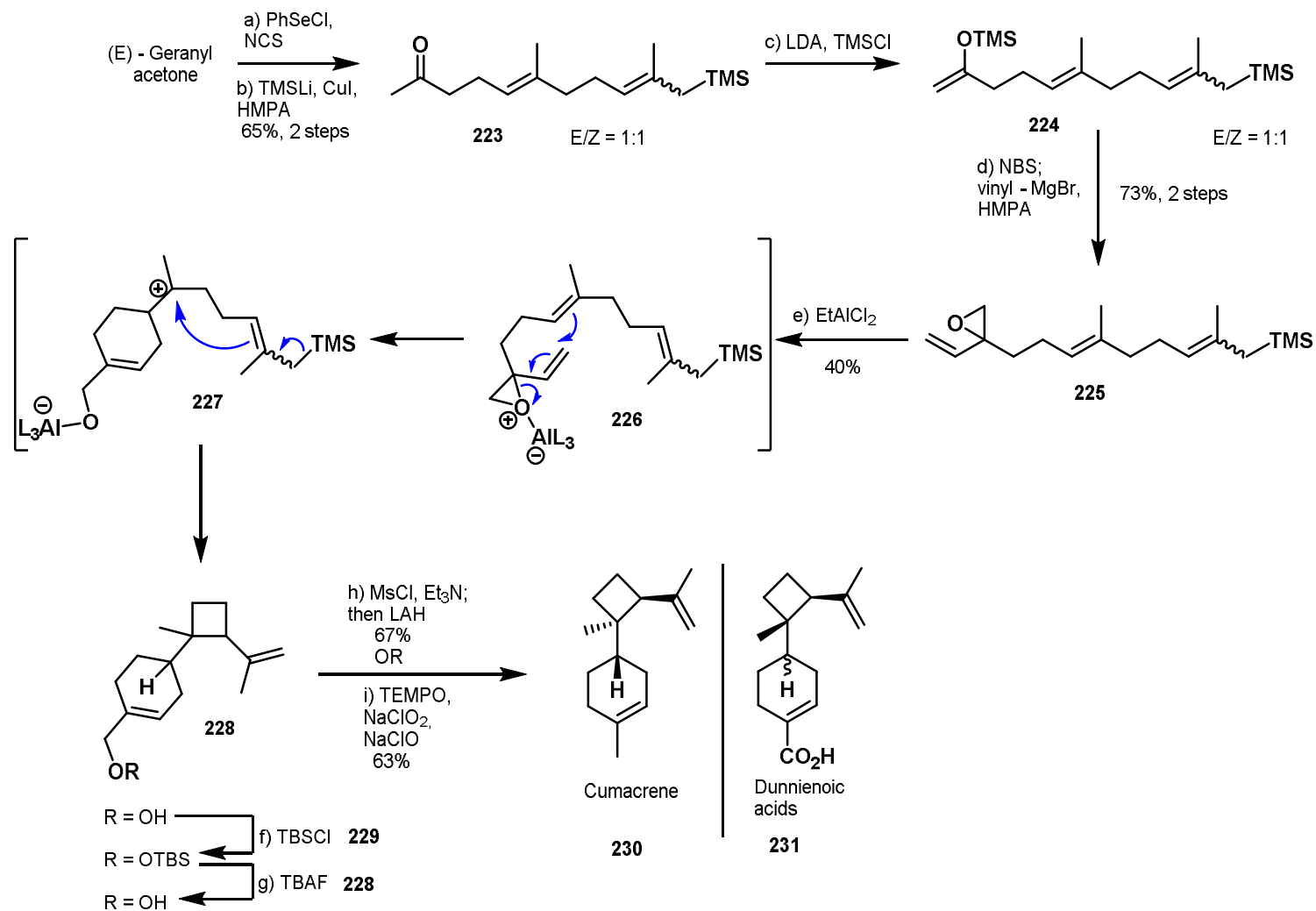
Snyder's reagents for halocyclizations



Non-stop tail-to-head polycyclization



Non-stop tail-to-head polycyclization



Thank you for attention!

Questions?