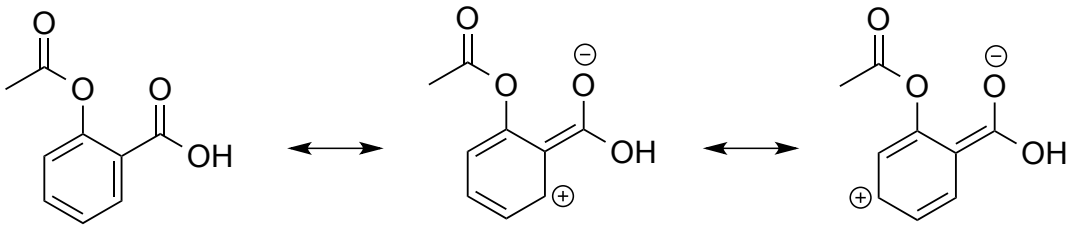
CHEM 8M, Lecture 9
Experiment 6 (Lab Practical) – Synthesis of Aspirin
- ^{1}H NMR Analysis, Reaction Set Up, Work Up, Chemical Tests, IR, ^{13}C NMR

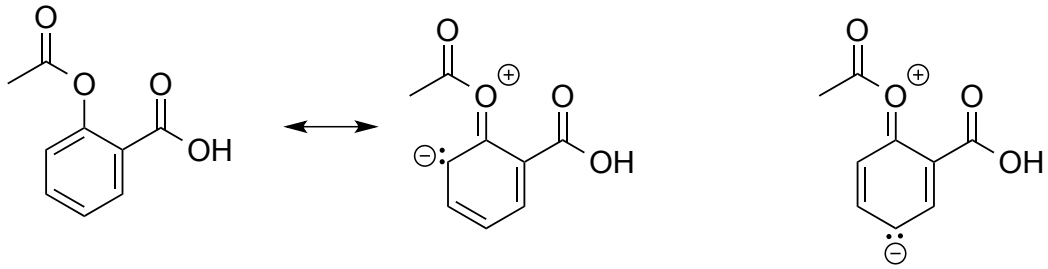
^{1}H NMR Analysis of Aspirin

Last time: **resonance effects relative chemical shifts (deshielding) of aromatic H's**

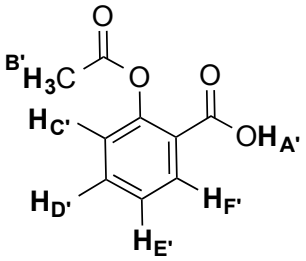
EWG deshields the *ortho* & *para* H's



EDG shields the *ortho* & *para* H's



SUMMARIZE ^{1}H NMR of ASPIRIN

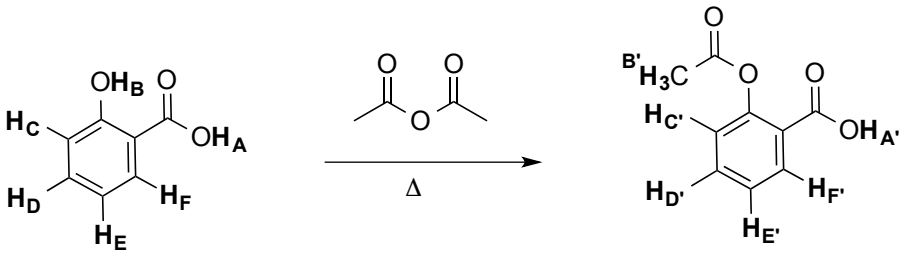


Most deshielded Ar-H
(highest chem shift)

Acetylsalicylic Acid (Aspirin)

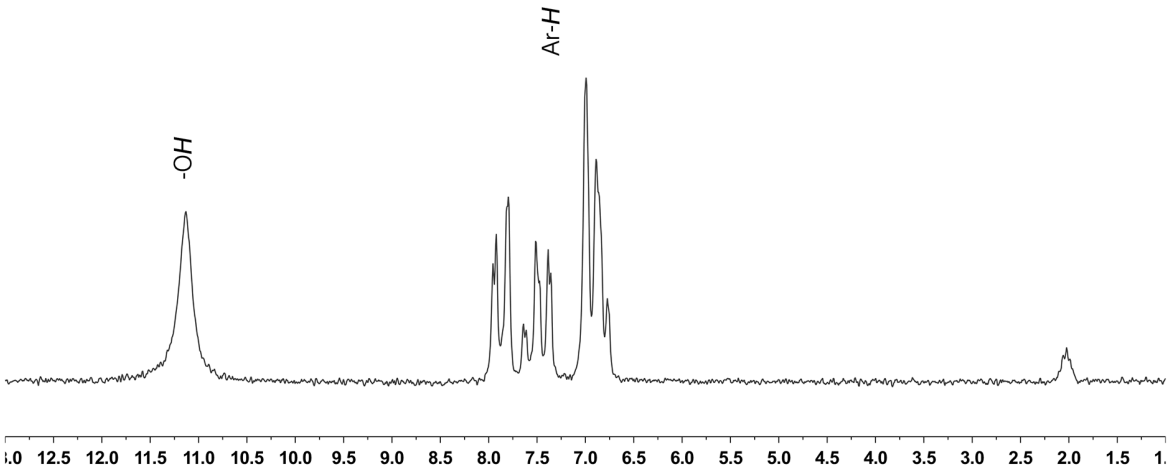
Most shielded Ar-H
(lowest chem shift)

What differences are expected / observed in the ^1H NMR of aspirin & its precursor?

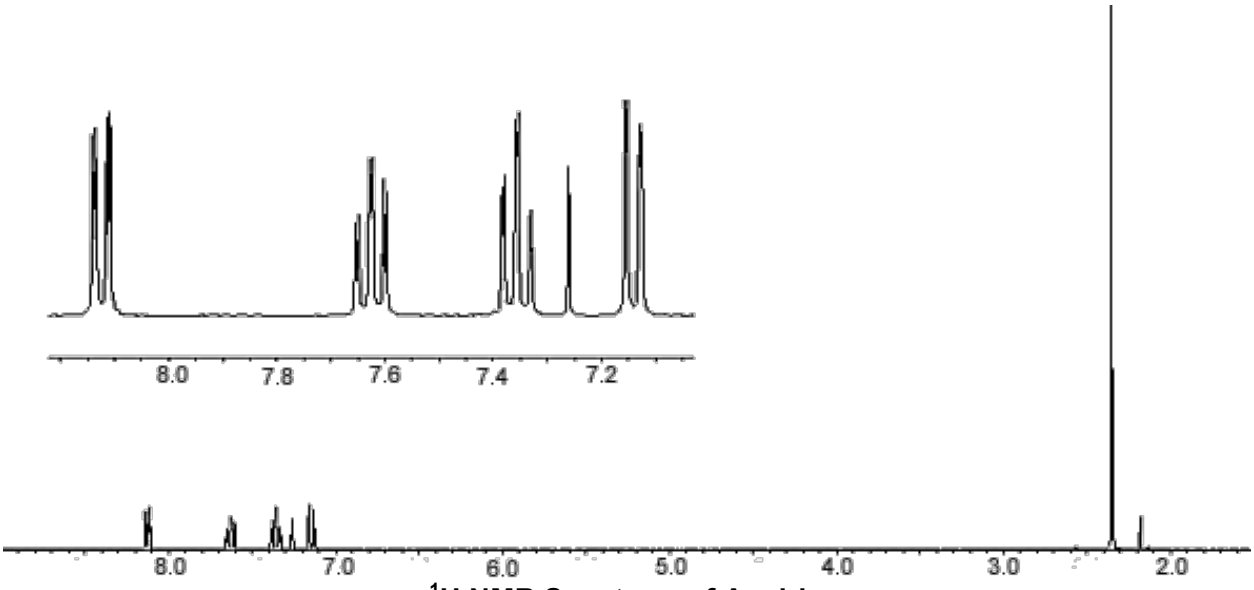


Salicylic Acid

Acetylsalicylic Acid (Aspirin)



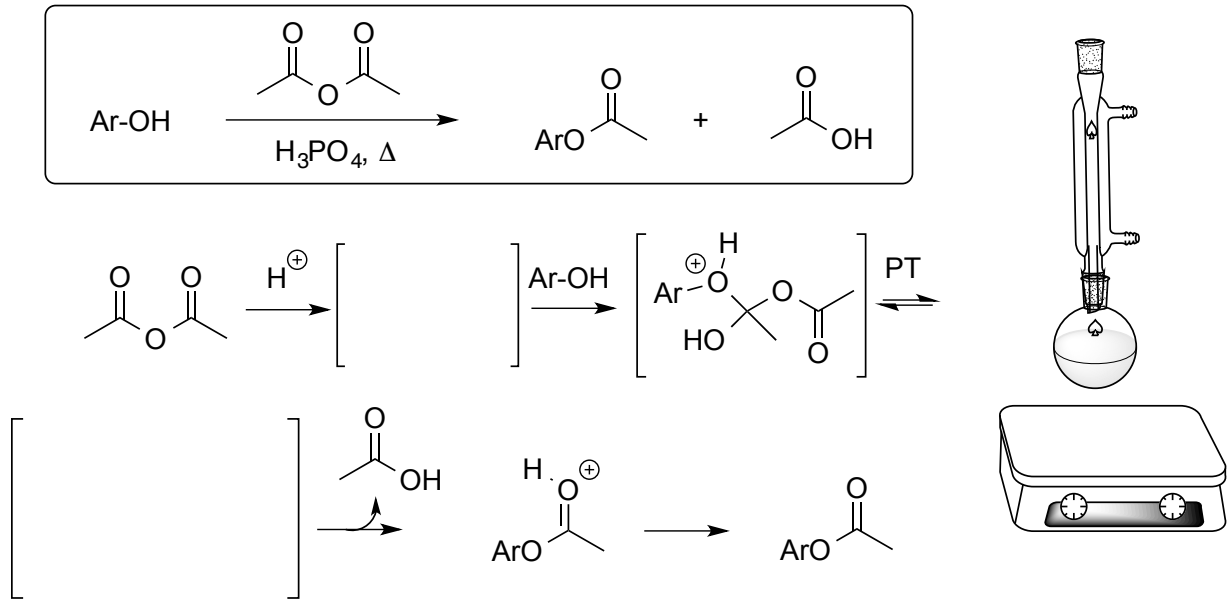
1H NMR Spectrum of Salicylic Acid



^{1}H NMR Spectrum of Aspirin

***11.5 ppm broad singlet** expected by not observed in this particular spectrum

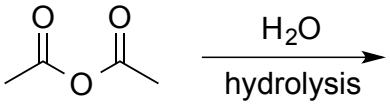
Reaction Mechanism & Set Up



Reaction Work Up

1. Cool for ~1 min

2. Add water to quench in warm water bath, 5 min



3. Crystallize

(a) Cool to RT, transfer to beaker

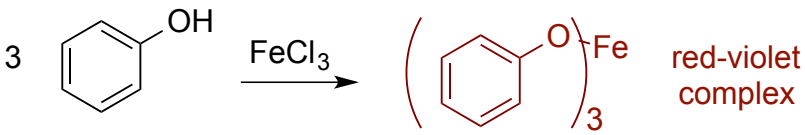
(b) Cool in ice bath, then scratch inside bottom of beaker, then wait!

(c) No crystals after ~5 min? Raise hand, ask TA for seed crystal

- Wait at least 5 min *after* adding seed crystal to filter

4. Vacuum Filtration

Ferric Chloride Test for Phenols



3 test tubes: (1) Salicylic Acid (2) Product (3) H_2O

^{13}C NMR

- Exploring carbon nuclei of ^{13}C isotopes (1.1% abundance)
  - longer experiment, requires more sample
- ^{13}C nuclei resonate at higher chemical shifts (10-220ppm) than ^{1}H nuclei (0-12ppm)
- Similar deshielding effects to ^{1}H NMR

Deshielded **Shielded**

160 - 180 ppm	110 - 160	55 - 80	20 - 35
Carboxylic Acids, Esters O-**C**=O	Aromatic **Ar**	Alcohols, Esters O-**C**	Carboxylic Acids, Esters O=C-**C**

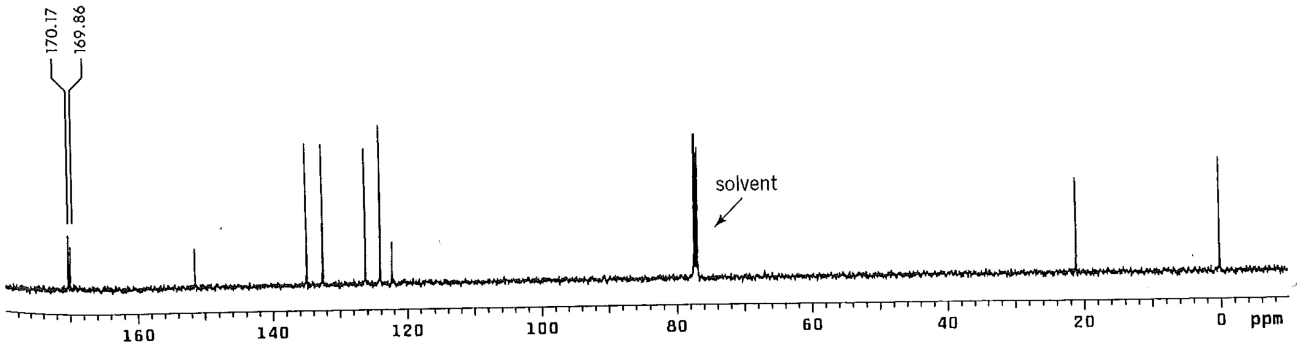
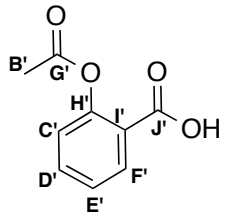


Figure 14.13 125.7-MHz ^{13}C-NMR spectrum of aspirin in $CDCl_3$.

	Chemical Shift (Observed ppm)	Assignment(s) (A' – J')	Expected Chemical Shift Range (ppm)
 **Acetylsalicylic Acid (Aspirin)**	169 & 170		
	152		
	125 – 135 (4 peaks)		
	122		
	20		

IR Spectra of Salicylic Acid & Aspirin available online for comparison

Thanks for a great quarter!

Please fill out separate evals for me and your TA.
- What did you think about these lecture handouts?
- Reflect: what do you remember most about this class?
- How did the instructors play their part in engaging you with the material?
- What did we do well and what could we improve upon?