Santa Barbara Consensus

Thanks: Everyone!

- What we all know
  - I microscopic atomic Physics
  - II Broad Limit
  - III Narrow Limit
- Some nomenclature suggestions
  - IV If Eric ruled the world
- What we don't know, but really wish we did
  - (some of us)
  - (I)
  - V A list of questions
    - some new
    - some from Jason's list

Q: Why Can't We All Just Get Along?
A: We can!! We do!!

I Microscopic, short-range atomic physics

Includes 2 channels (2 "spins")

"Singlet" and "triplet", coupled at short distance

For $r_{atom\text{-}atom} > r_c$,

singlet-triplet coupling, and $U_{int.}^{Phys.}$, vanish

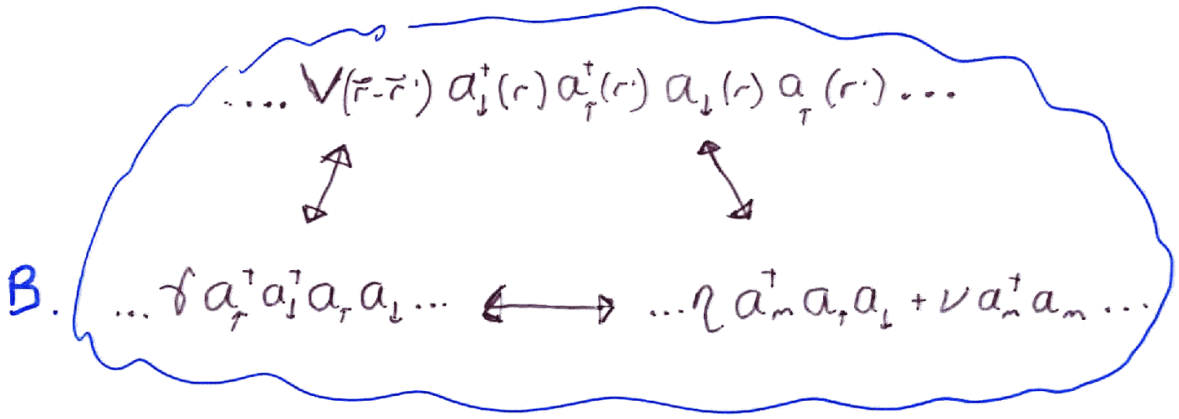
"singlet"
"closed channel"
"molecule"
"bare or fractitious molecule"
"bose field"

"triplet"
"open channel"
"atom"
"fermion field"

II There exists a "Broad F.R. Limit" $\chi^2 \gg \mathcal{E}_f$

A. This is the relevant limit for current ^{6}Li experiments

B.



Various hamiltonian terms...

with various "bare" coefficients, some with B-field dependence

then work Theory magic

In "Broad Limit", get...

II Broad F.R. Limit

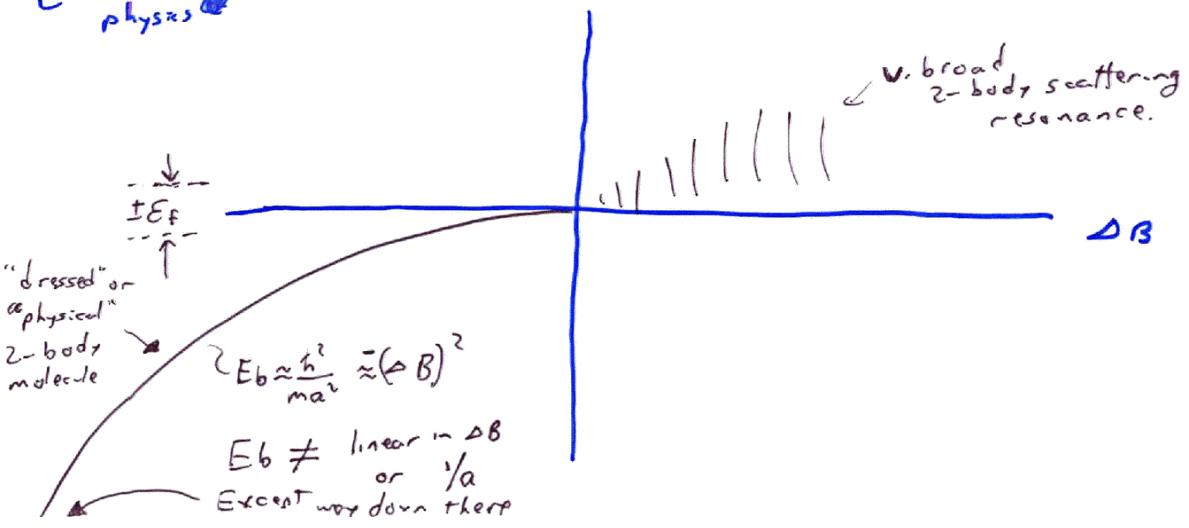
C. Mols, Cooperpairs, crossoverpairs, all have $\} \gg r_e$

D. atoms " " " all in "pure"

"open", "triplet", "atom", "fermion" channel.

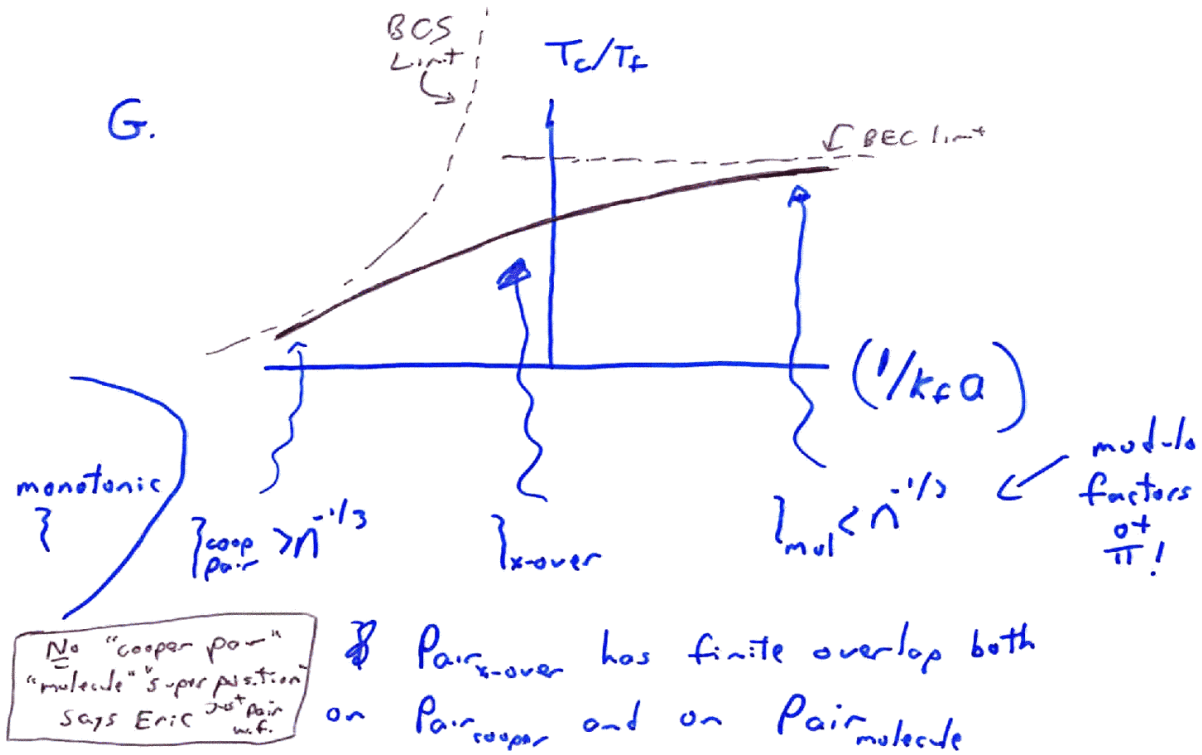
(c.f. magnetic moment)

E 2-body physics



II Broad F.R. Limit

F. 4-body physics $a_{mol\text{-}mol} = 0.6\, a_{at\text{-}at}$ on BEC side

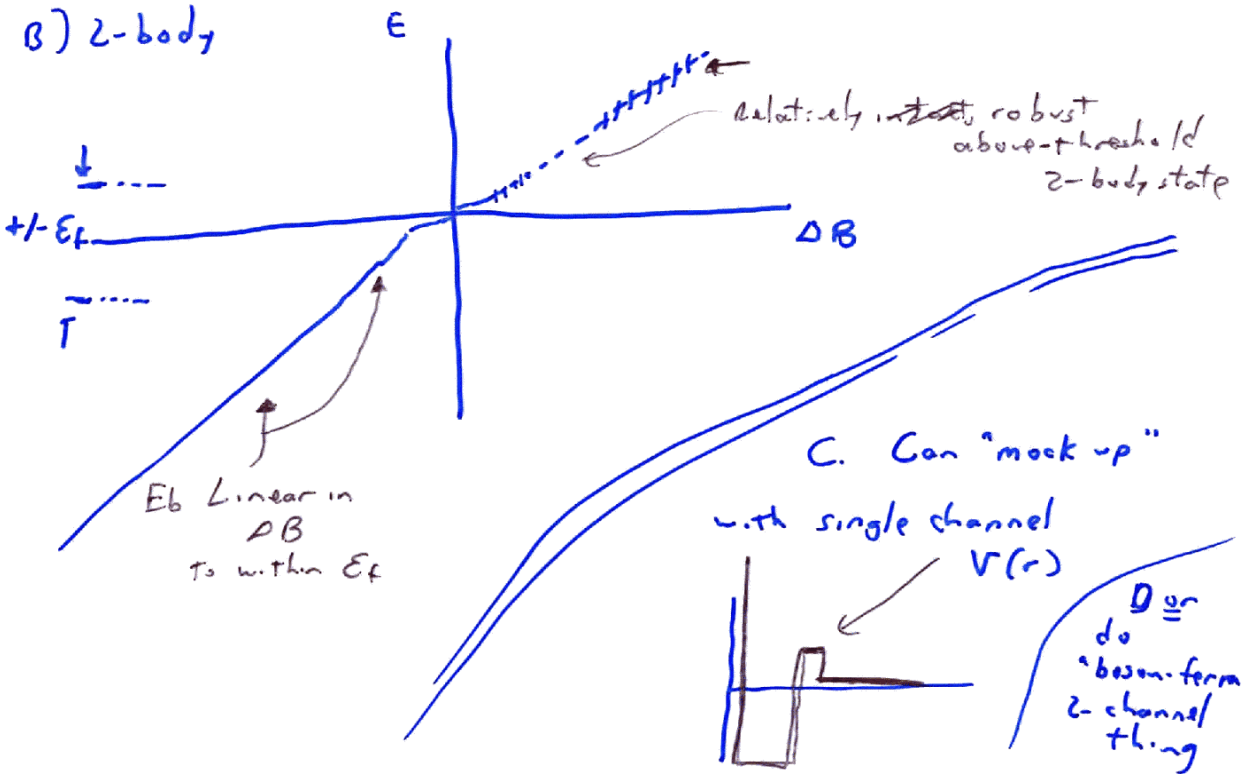


No "cooper pair" "molecule" "superposition" says Eric but pair w.f.

∴ $Pair_{x\text{-}over}$ has finite overlap both on $Pair_{cooper}$ and on $Pair_{molecule}$

III There exists another limit! Narrow(er) F.R.

A. Not yet experimentally relevant, but absolutely experimentally accessible



IV Nomenclature Plea

A. Sometimes we write

$$a = a_{bg}\left(1 + \frac{\Delta}{\delta B}\right)$$

near resances

$$a \approx \frac{a_{bg}\Delta}{\delta B}$$

Say what??

Please write

$$a = a_{bg} + \frac{\Delta}{\delta B}$$

near resonance $a = \frac{\Delta}{\delta B}$

confirming a_{bg} irrelevant

IV B More nomenclature

Theorists! Experimenters!

If you are in broad resonance limit

Theorists: please avoid quoting results, particularly detunings, in "bare hamiltonian" units.

(see 3 Hamiltonian models!)

Experimenters: meet the theorist half way!

I suggest detuning in units of $\frac{1}{k_f a}$

$\frac{1}{k_f a}$ a) Linear in ΔB near resonance.

b) Uncertainty in B_{res} simply an offset in x-axis, near resonance

(yes, raw units are still best, experimenters!)

c) range $\sim 2 < \frac{1}{k_f a} < \sim 2$ clearly most exciting

V Less Resolved (?) but Very Interesting Questions

1) What does pair w.f. look like, more quantitatively (ie, for $\frac{1}{k_s a} = -1$, what is ? vs $n^{-1/3}$?)

2) Dynamical Effects (pace Allan) are cool!
   a) Can one ramp a "big" cooper pair into a molecule?
   b) what else can ramps, jumps tell us about micro- macro-scopic physics?
   c) (cf Bosons) transient, coherent osc.llations in Δ ?

3) How do we understand rf spectroscopy? Obviously powerful! Δ_{sc}, Δ_{pair}, β, pair structure?

4) Collective modes
   a) $\Delta \lesssim \omega_{trap}$?
   b) Finite T [lessons from Bosons $\delta\nu(a,T)$ can be large compared to $\delta\nu(na^3)$]
   c) Do we need a "3-fluid model" for sound, collective oscillations? [cf second sound, and finite-T oscillation studies in BEC] a signature for preformed pairs?

5) β (?!?)
   a) what do different measurements actually probe?
   b) what is the Boltzmann limit? ?? (Surely not $T \gg E_F$, for which $\beta \to 0$?) ??
   c) $T \to 0$??

6. T_c/T_f, and a trap

Lesson from Bosons

For dilute B.E.C.

$T_c(N)$

depends on trap, mean field.

$T_c(n(r=0))$ does not.

For fermions

$\frac{T_c(\Delta B=0)}{T_f} = 0.25$ free-space

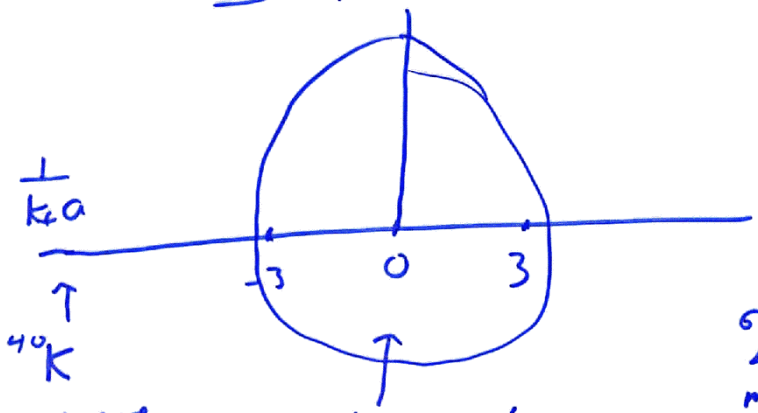
0.50 trap

Is this the same story?

i.e. is $\frac{T_c(\Delta B=0,\ n(r=0))}{T_f(n(r=0))}$

independent of the trap?

7. Can theorists do calculations to help experimentors with their thermometry problems? Could do ~~real~~ quantitative comparisons!!



ramp isoentropically to $1/k_f a \approx 0$

$\therefore$ S/N is known. T, and T_f, not known!!

Theorists, calculate e.g. not T_c/T_f

but $(S/N)_0/T_f$!!