Inflation

First - preview of where this headed
- Earliest we know: universe = hot bath (possibly)
- chaotic motion slows
- false vacuum - achieved at at least some spot
  - bubble of expanding false vacuum
    - inside that bubble: a bubble of real vacuum

So - how did we get to that view?

What are modern/popular science views? - Ask for input
big bang = fire ball from a point

(Other input)

Issues with that

Isotropy
If it exploded "from a point" we'd see directionality of the debris
- instead: "big bang" was everywhere (no directionality)

Horizons
It appears that information exploded faster than light
- if we trace back the information about uniformity to the time of the big bang

Flatness - How come the information that was transmitted was so perfect?

Return: "classical" Big Bang Theory

~~maybe a spec~~

what caused it to "bang"

Maybe equilibrium was achieved before the big bang

Maybe some drove it to a "special" equilibrium

Is our "special" equilibrium a preferred equilibrium?

One solution — "special" equilibrium was stable with growth

any deviations from "perfect" diluted by growth

expansion

Growth

Typically we talk about collapse due to gravity.

But earlier we saw a cosmological constant

- repulsive, constant valued spatially
- caused growth which helped keep universe at

a ~~special~~ special flatness $\Omega \approx 1$

That constant was from dark energy / vacuum energy

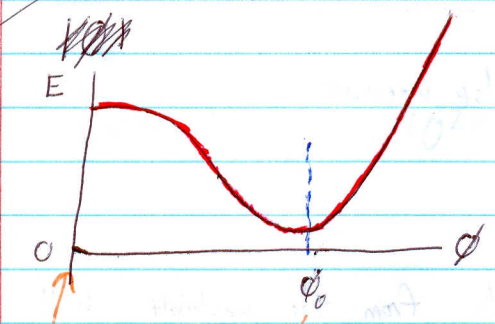
- Can we use the same for pre-big bang expansion?

but we need a stronger drive to perfection

stronger vacuum energy?

higher energy?

Scalar field vs. Potential



false vacuum — real vacuum

There exists a "vacuum" with a higher energy than "our vacuum"
- both energies are $\neq 0$
- false vacuum is psendo-stable

So we have an expanding vacuum?

vacuum ≡ no particles no "stuff"

It has an inherent energy density

Conservation of energy?

balanced by gravitational potential energy — always negative

so a constant energy density

Energy ~ mass

constant mass density

So what? - why not more attractive gravity

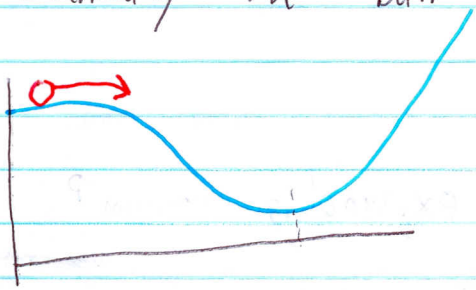
Math says: $\left(\frac{\dot{a}}{a}\right)^2 = \frac{8\pi G}{3}\rho - \frac{kc^2}{a^2}$

If mass-density does not change with scale, then scale increases exponentially, indefinitely

Exit, Stage Left

But it didn't go forever
we are not in a false vacuum
we are real

Eventually the "ball" rolls from the unstable hill



falls to "real vacuum"

Once one spot falls, it pulls around surrounding areas

a localized bubble forms

(outside the bubble expands faster)

our "universe"
everything we can see

At that "decay" to
real vacuum started
the hot dense "big bang"

and all the while
the false vacuum was
driving it towards a
flat universe