# Model-independent constraints on the evolution of the dark energy using WMAP and SN-Ia data

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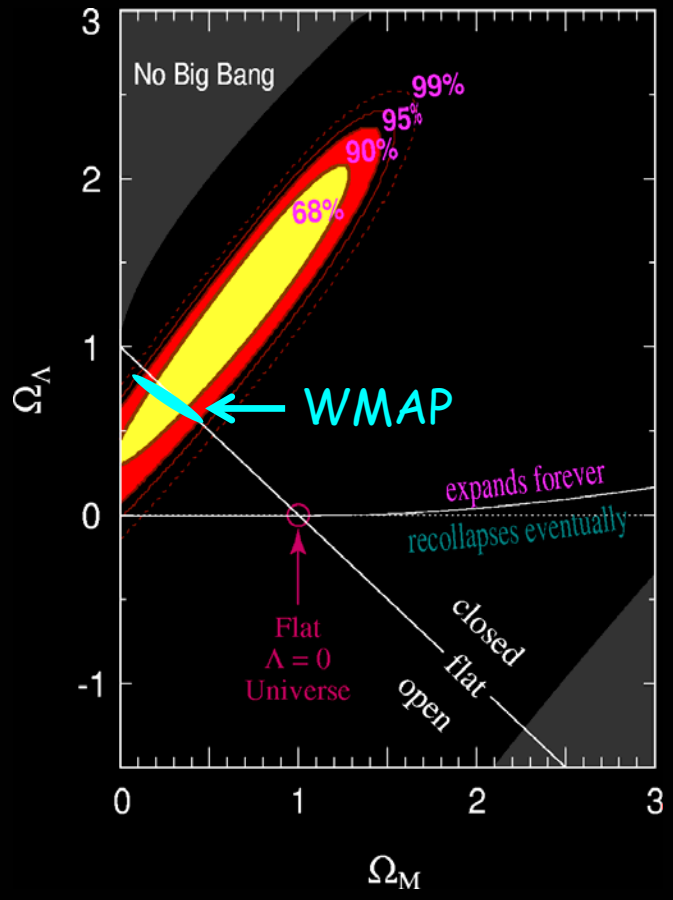
# Outline

- Why Dark Energy?
- What is it?
- How do we investigate it?
- What did we learn?
- The End

# Why do we need Dark Energy?

- Is the Universe low density?
  - Matter + radiation only 30% of critical density
- SN-Ia suggests not the case
- WMAP: $\Omega \approx 1$
- Extra component ($\Lambda$) with negative pressure



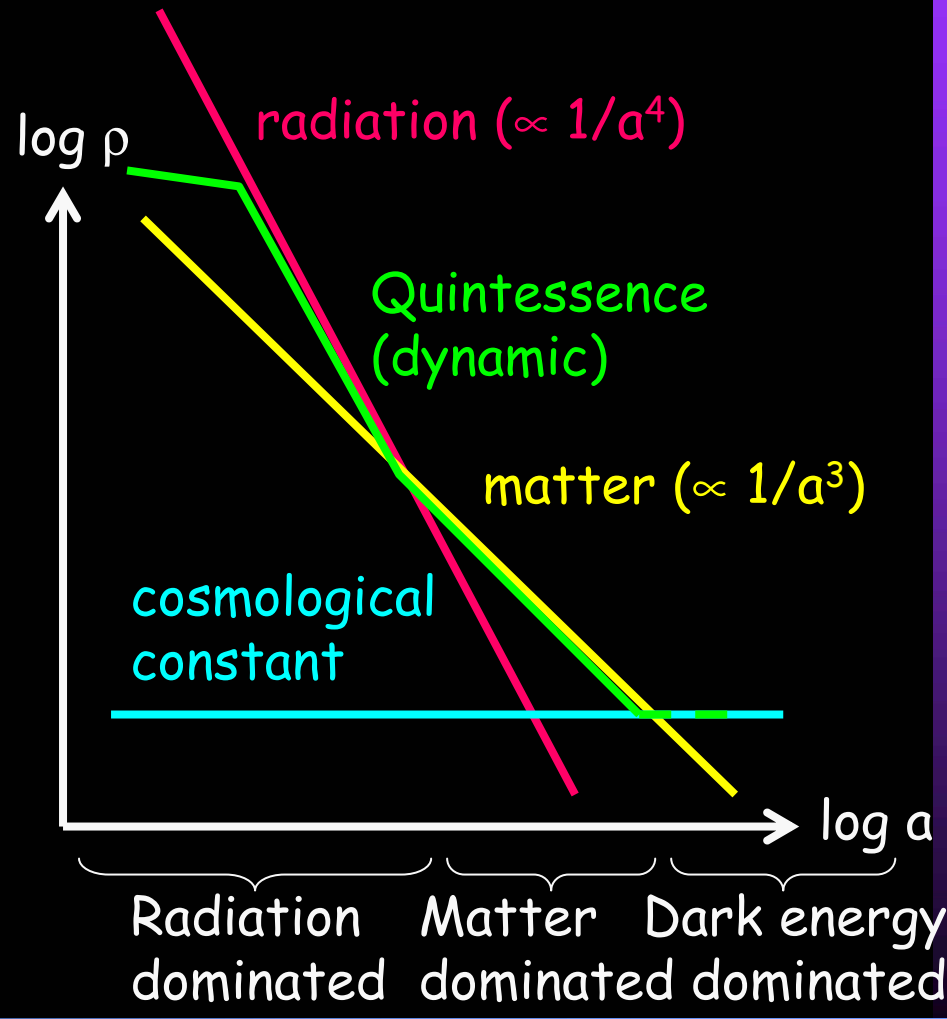
# What is it?

## Cosmological Constant

- estimate of energy of vacuum using QM gives wrong answer

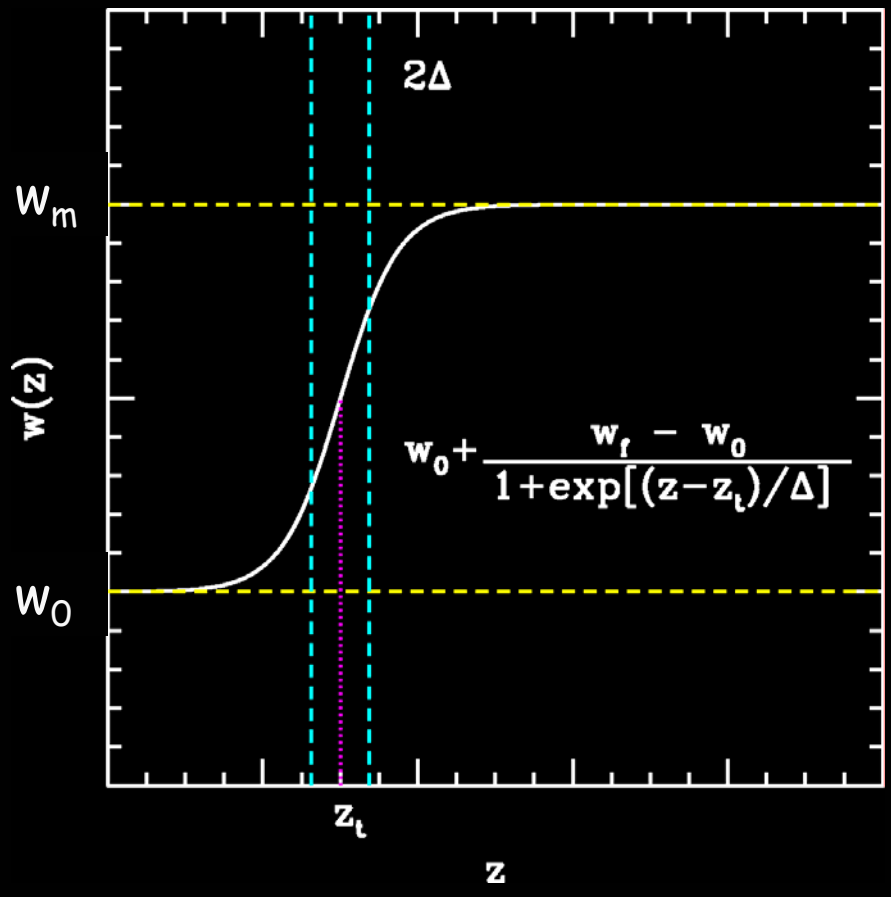
## Quintessence

- Can be dynamically linked to background evolution
- Tracker models make i.c.s less important
- Typical potentials include exponentials, inverse power law, exponentials with polynomials, etc



# How do we investigate it?

- Impose some formulation for the equation of state
- Transition at given redshift $z_t$ with width $\Delta$
- Expect equation of state today, $w_0 < -1/3$ (recent acceleration)
- To avoid fine-tuning i.c.s, $w_m > -1/3$

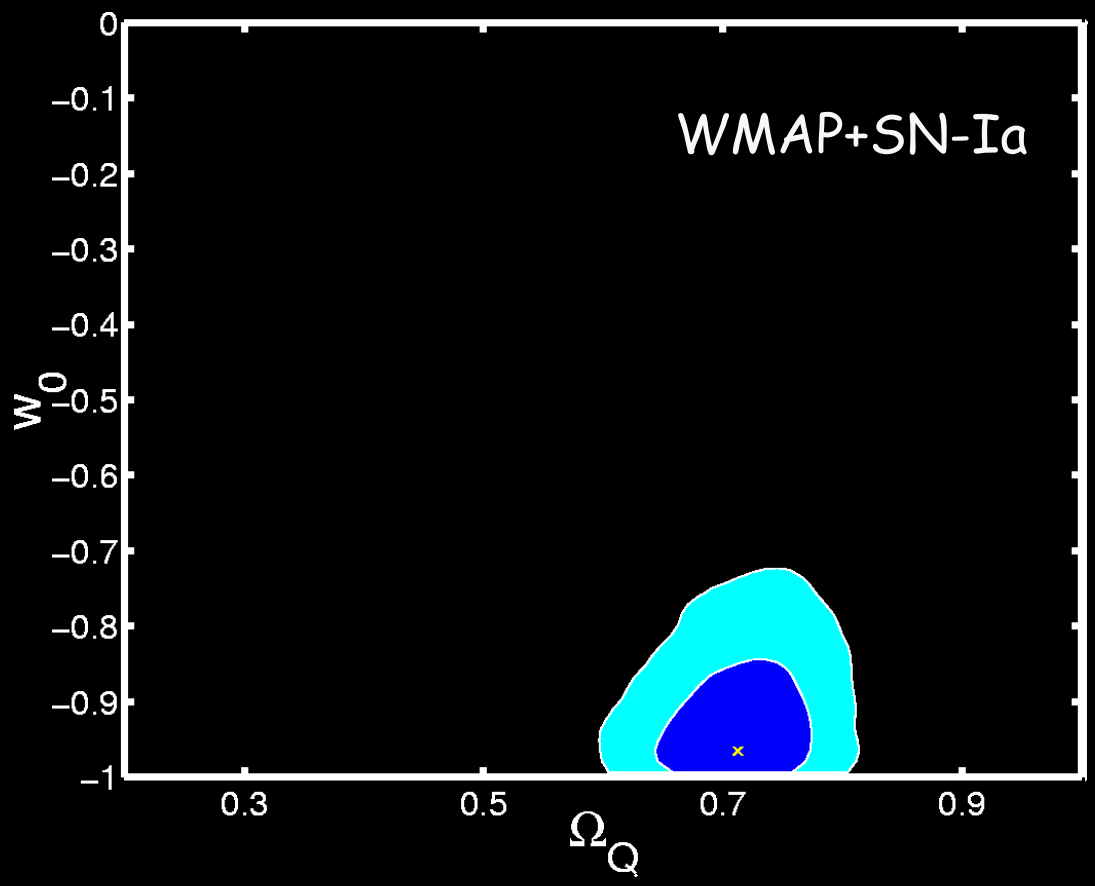


# Outline of analysis

- Compute model predictions for different parameters (we vary $H_0$, $\Omega_Q$, $\Omega_b$, $a_t$, $w_0$, $w_m$, $\Delta$, $n_s$, $\tau$ and the overall normalisation)
- Compare predictions with WMAP + SN-Ia data sets
- Use Markov-Chain Monte Carlo code with modified cmbfast to calculate likelihood surfaces
- Use likelihood data to constrain parameters

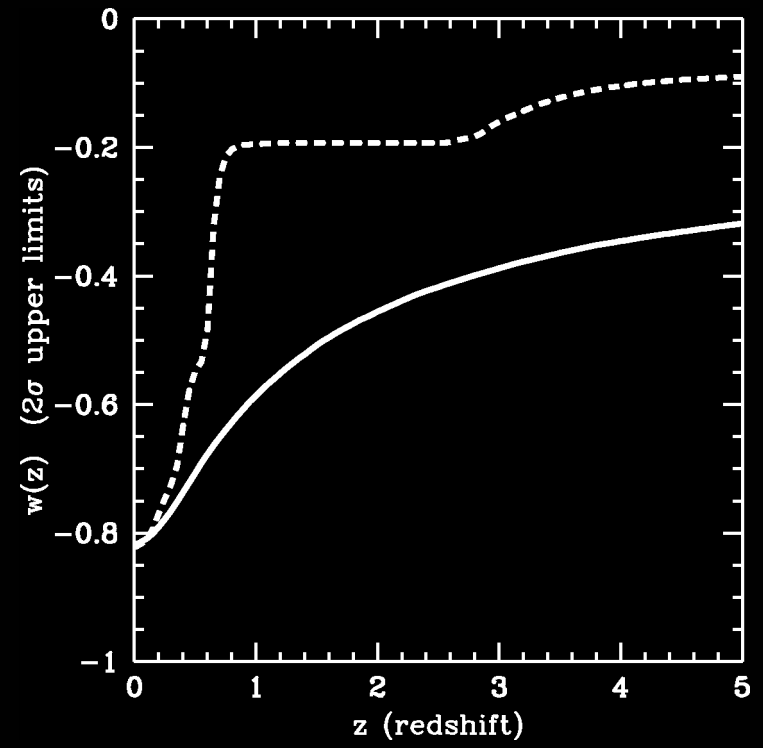
# Degeneracies

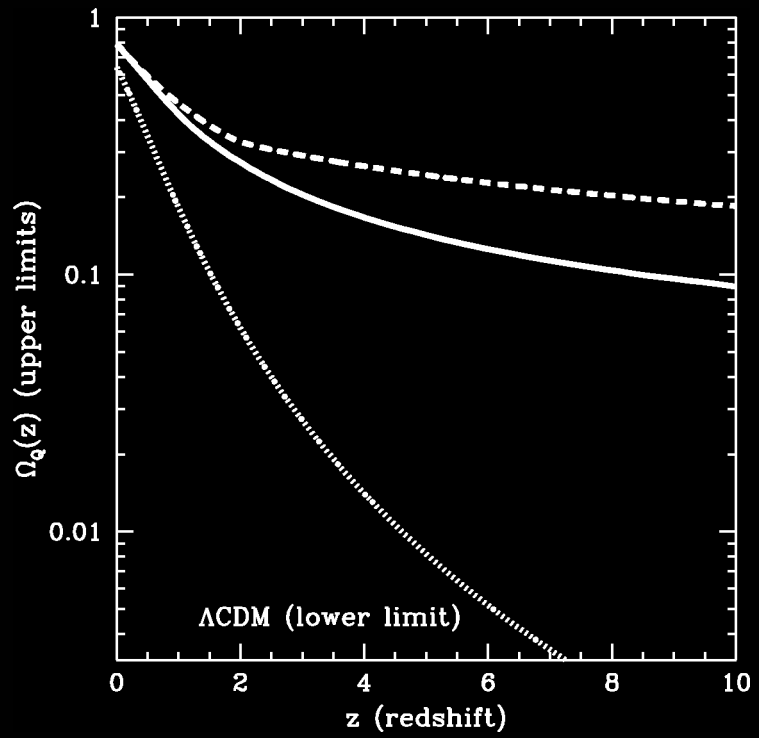
- Degeneracy in CMB
- Similar in SN-Ia, but runs in other direction
- Combine for tighter constraints.



# What did we learn?

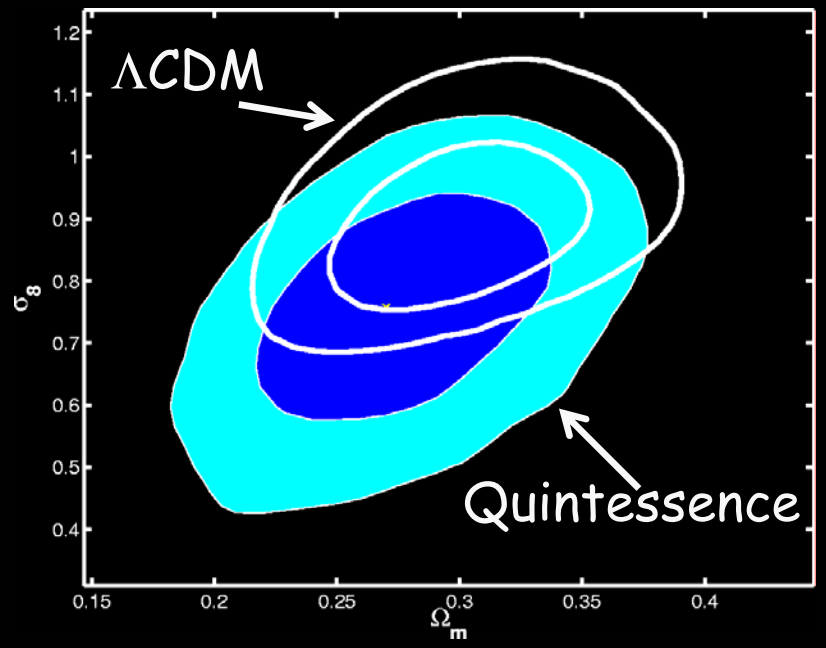
- Strong constraints only for z < 1
- Equation of state w always less than zero

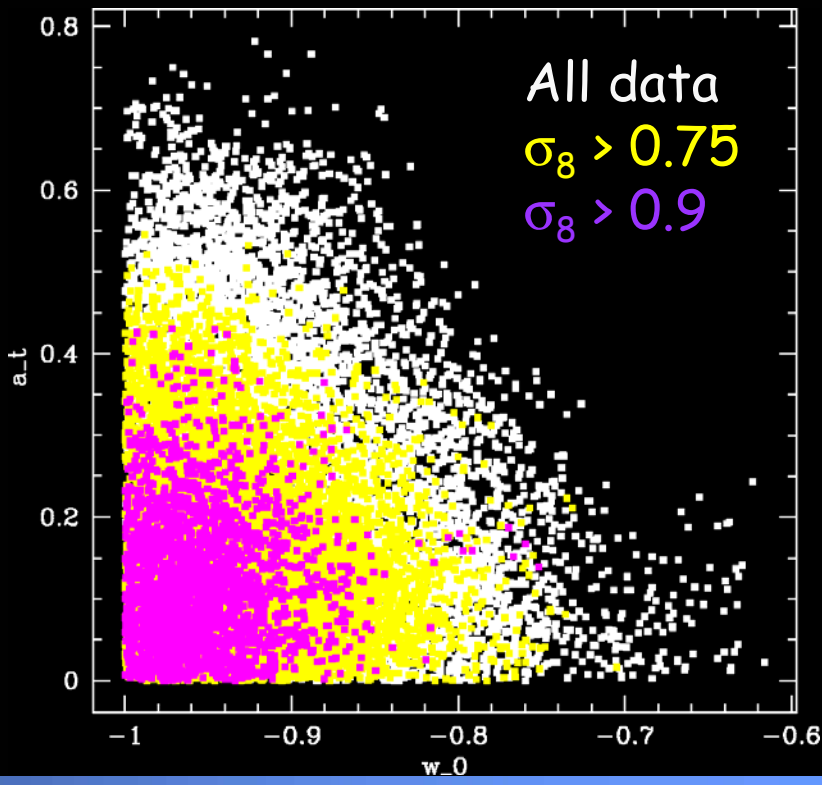


# Results (II)

- ISW changes CMB normalisation
- This in turn changes P(k) amplitude and $\sigma_8$ (possible to distinguish between Q and $\Lambda$)
- But measuring $\sigma_8$ is difficult.

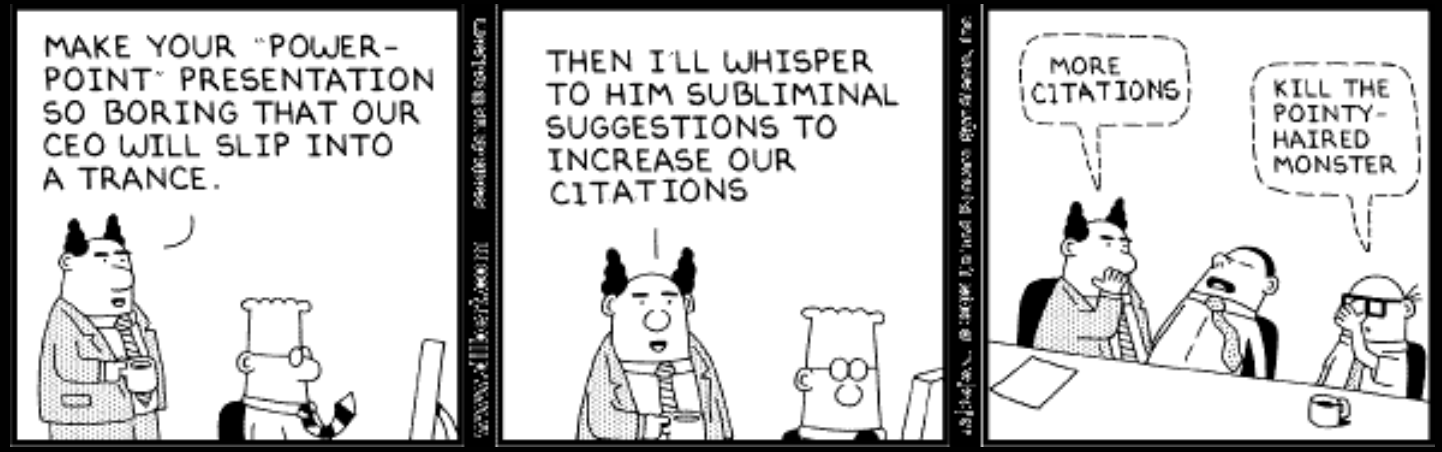


# Conclusions

- Equation of state today, $w_0 < -0.82$.
- No strong change in w for z<1.
- Can use clustering to distinguish QCDM and $\Lambda$CDM
- No significant improvement over $\Lambda$CDM

# The End


MAKE YOUR "POWER-POINT" PRESENTATION SO BORING THAT OUR CEO WILL SLIP INTO A TRANCE.
THEN I'LL WHISPER TO HIM SUBLIMINAL SUGGESTIONS TO INCREASE OUR CITATIONS
MORE CITATIONS
KILL THE POINTY-HAIRED MONSTER