

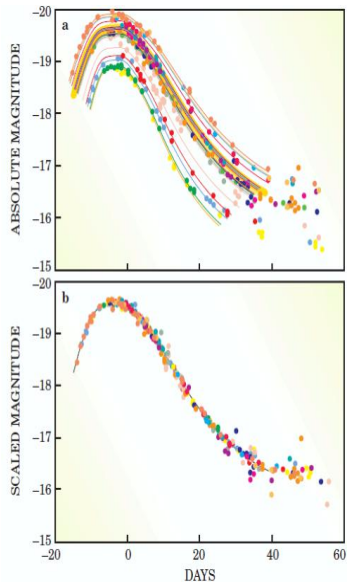
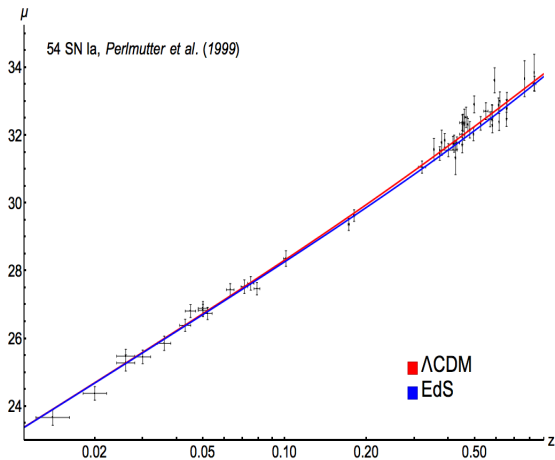
Dark energy

Vladimir Luković
Supervisor: Nicola Vittorio

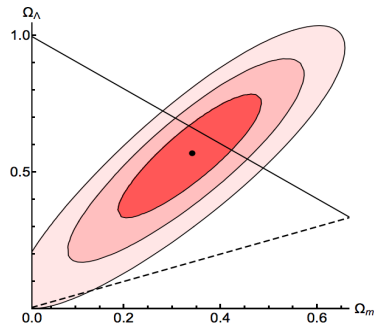
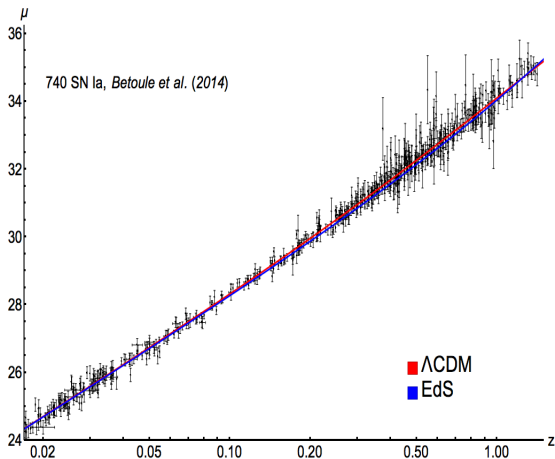
20. January 2017.



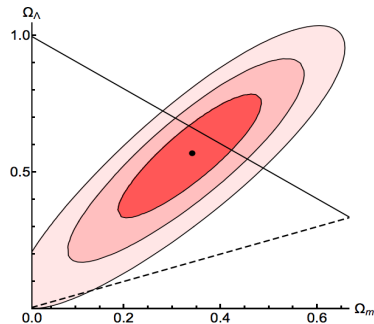
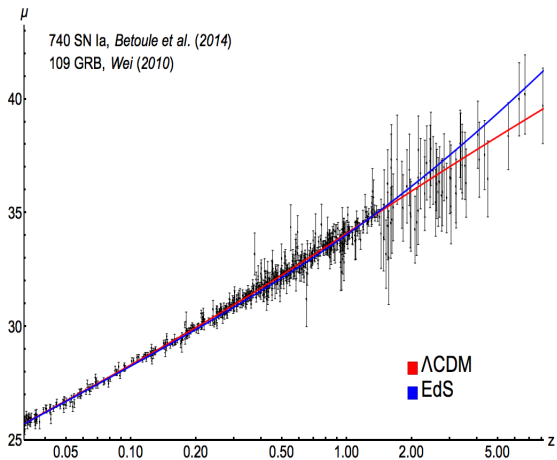
Standardisable candles



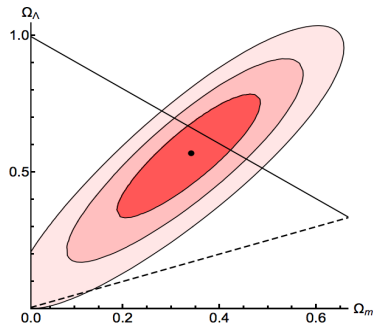
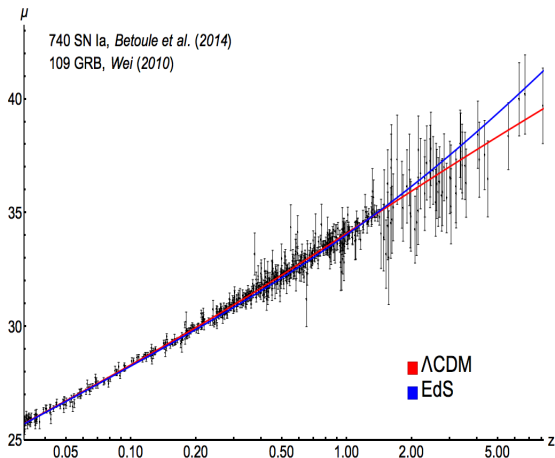
Standardisable candles



Standardisable candles

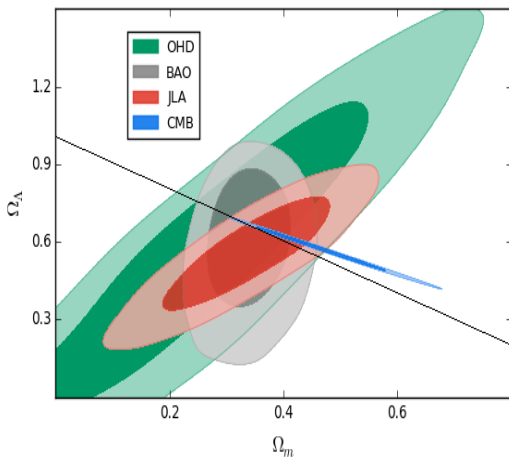


Standardisable candles



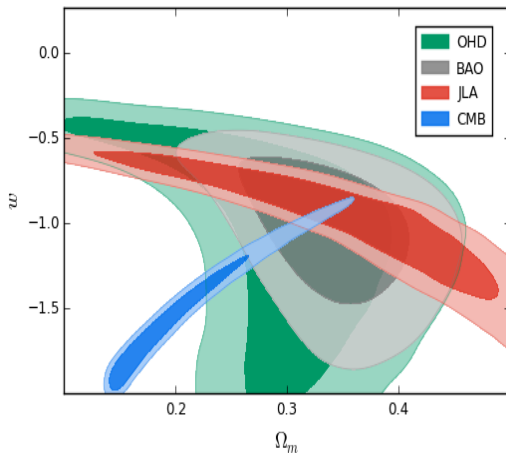
Proper treatment of astrophysical observables

Cosmological observables



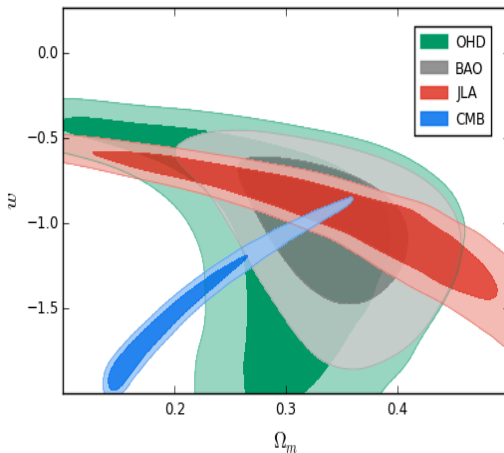
- CMB temperature anisotropies
- SNe Ia, GRB - $d_L(z)$
- Cosmic chronometers - $H(z)$
- BAO - $H(z)$, $d_A(z)$
- Secondary CMB & WL - σ_8
- H_0 measurements

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Combined analysis

Alternative models

- Dynamic dark energy

Linear: $w(z) = w_0 + w_1 z$, CPL: $w(a) = w_0 + w_a a$, ...

- Modified gravity - $f(R)$

- Inhomogeneous cosmology - $\Omega_m(r)$

- Linear and Power-law expansion - $a(t) \propto t^n$

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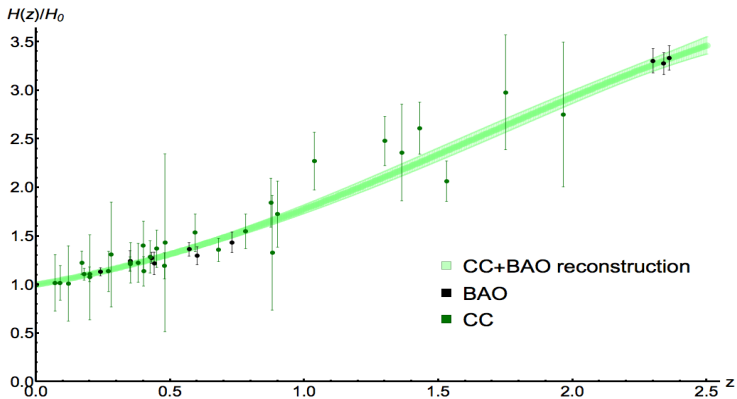
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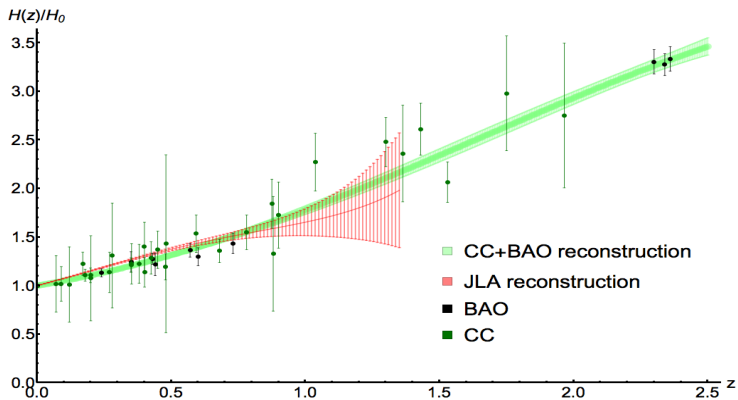
The number of possibilities is large,
but parametrised descriptions are difficult.

Model-independent analysis

Model-independent analysis

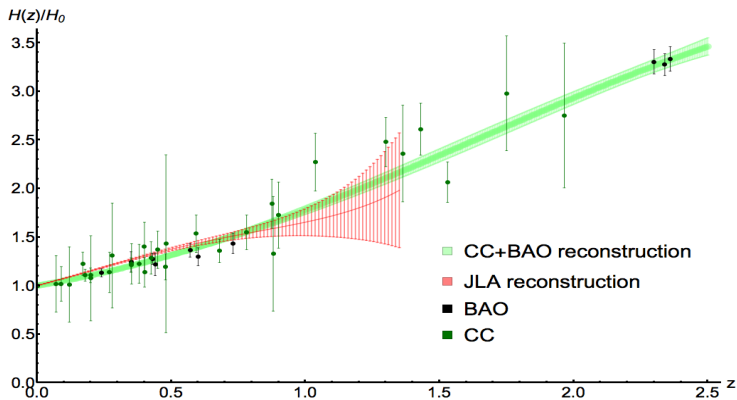


Model-independent analysis



$$d_L(z) \implies H(z)$$

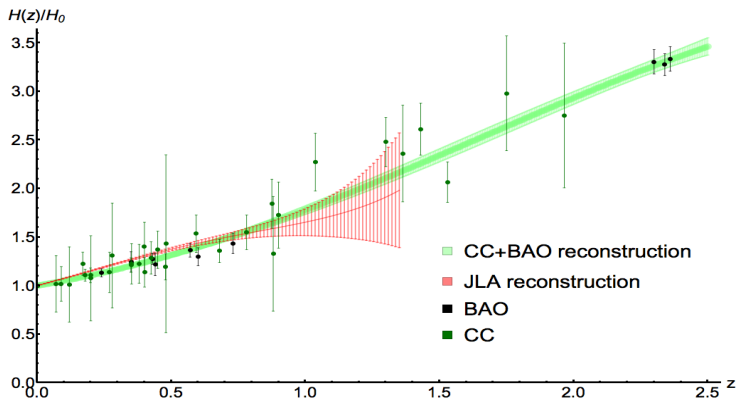
Model-independent analysis



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$$\frac{H(z)^2}{H_0^2} = \Omega_m(1+z)^3 + (1-\Omega_m) \exp\left[3 \int_0^z \frac{1+w(z)}{1+z} dz\right]$$

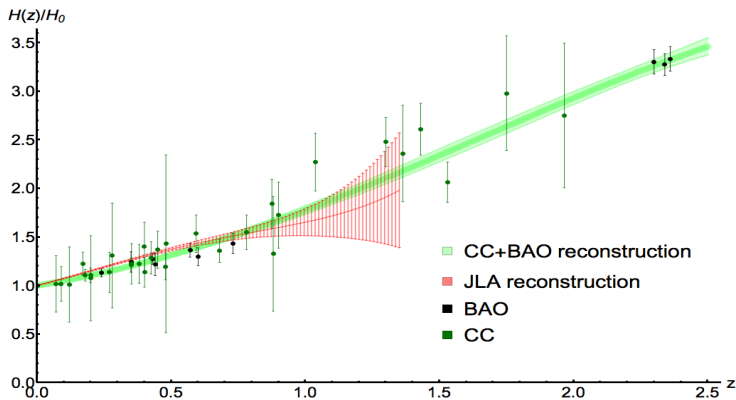
Model-independent analysis



$$d_L(z) \implies H(z)$$

$$H(z) \implies w(z)$$

Model-independent analysis



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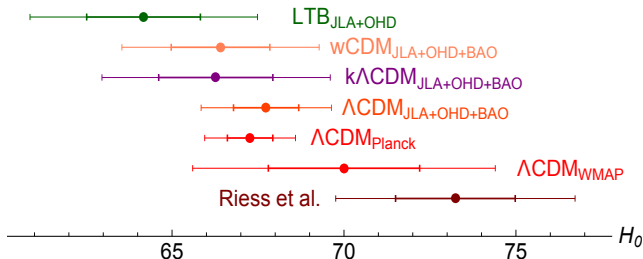
$$H(z) \implies w(z)$$

Model-independent study of Dynamic DE

The H_0 problem

Not many observables are directly sensitive to H_0 :

- CMB
- Cepheids + SN Ia
- Cosmic chronometers



Conclusions

- Importance of astrophysics of cosmological observables
- Combined data analysis
- Model-independent analysis
- Disagreements in H_0 estimates

Thank
you

