Constraining Dark Energy and Gravity with large-scale structures

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Constraining Dark Energy & Modified Gravity

Higher dimensions
- Einstein-Dilaton-Gauss-Bonnet
- Cascading gravity
- DGP
- 2T gravity
- Generalisations of $S_{EH}$
- Gauss-Bonnet
- Lovelock gravity

Non-local
- TeVeS
- Scalar-tensor & Brans-Dicke
- Ghost condensates
- Galileons
- the Fab Four
- KGB
- Coupled Quintessence
- Horndeski theories

Emergent Approaches
- CDT
- Padmahabhan thermo.

Higher-order
- Vector
- Massive gravity
- Bigravity
- Tensor
- Massive gravity
- EBI
- Bimetric MOND
- f(T)
- Einstein-Cartan-Sciama-Kibble
- Torsion theories

Lorentz violation
- Hořava-Lifschitz
- Conformal gravity

Add new field content
- Chern-Simons
- Cuscuton
- Chaplygin gases
- f(R)
- General $R_{\mu\nu}R^{\mu\nu}$, $\Box R$, etc.
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My exploration of models:

- **Phenomenological approach** (e.g. “w” and “γ” parameterizations)
- **Effective approach**: EFT (Gubitosi et al. 2013, universal description of DE & MG)
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DE/MG affects the Universe in two ways:

- Background evolution (i.e. \(H(z)\)) => very well constrained by Planck + BAO + SN
- **Growth of structures** => future large scale galaxy surveys (LSST, **Euclid**)

**DE/MG with Euclid:**

- Galaxy clustering & Weak lensing
- **Combination/cross-correlation with CMB** : ISW effect
- **Individual structures** : (super-)clusters, (super-)voids
The integrated Sachs-Wolfe effect

- Impact of evolving Φ on CMB photons, caused by DE/MG
- Theoretical predictions for models + constraints forecasts + optimization for surveys

- Stacking in CMB at superstructures positions

- In Euclid: combination & correlations with other probes (IST, CMB-X working group)
The integrated Sachs-Wolfe effect

- Impact of evolving \( \Phi \) on CMB photons, caused by DE/MG
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- Stacking in CMB at **superstructures** positions

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Clusters of galaxies

- Abundance very sensitive to cosmology
- Planck SZ clusters in tension with LCDM
- Derive constraints on DE/MG

(Ilic et al. in prep)