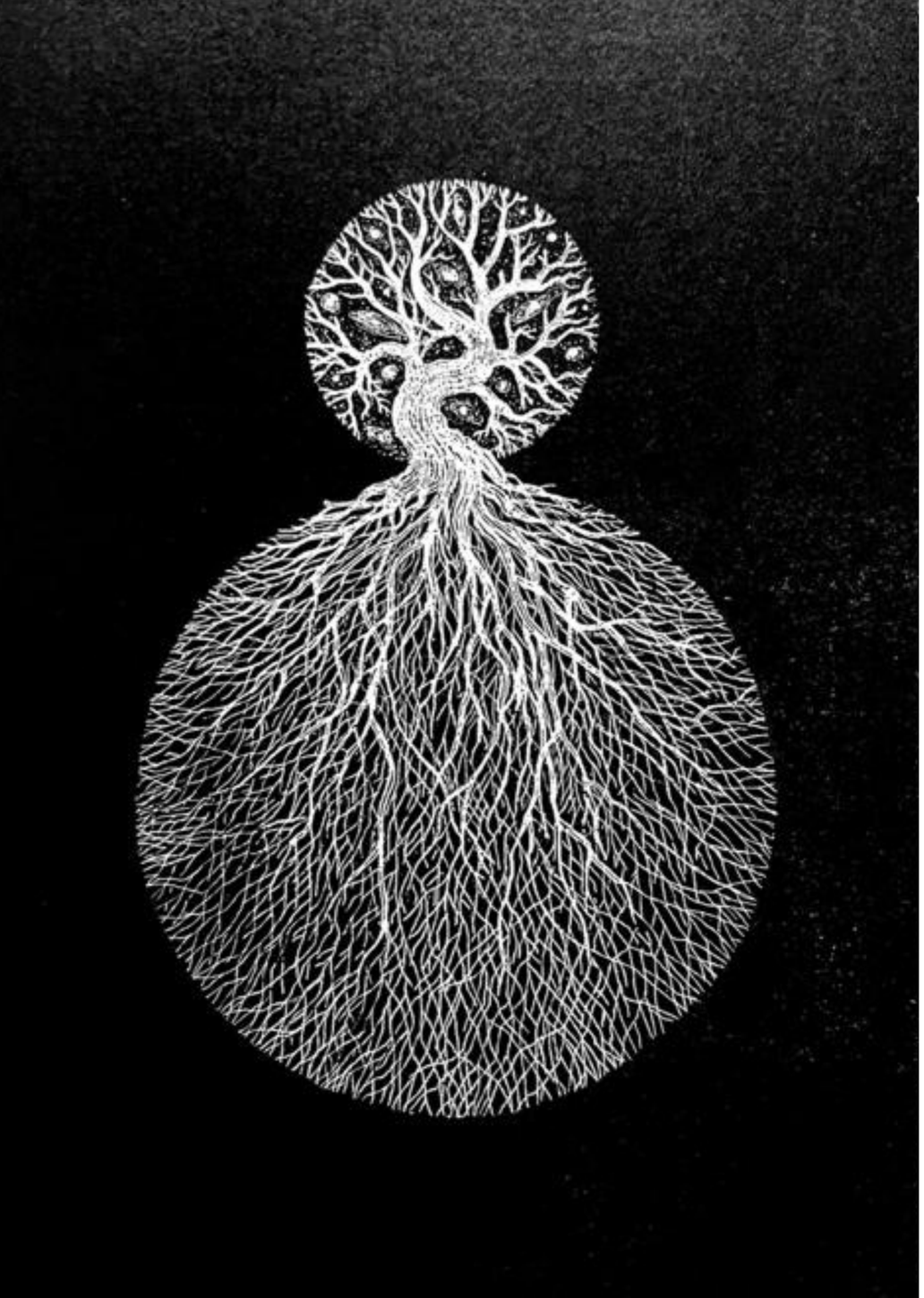

Tesi in cosmologia

Attraverso lo studio della struttura su grande scala dell'Universo

Stefano Camera & Francesco Pace

Physics Torino Department of Excellence

INFN TORINO Istituto Nazionale di Fisica Nucleare Sezione di Torino

Osservatorio Astrofisico di Torino INAF Istituto Nazionale di Astrofisica

University of the Western Cape

Universitas Studii Taurinensis 1404

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The concordance cosmological model

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Definition of **cosmology noun** from the Oxford Advanced Learner's Dictionary

cosmology *noun*

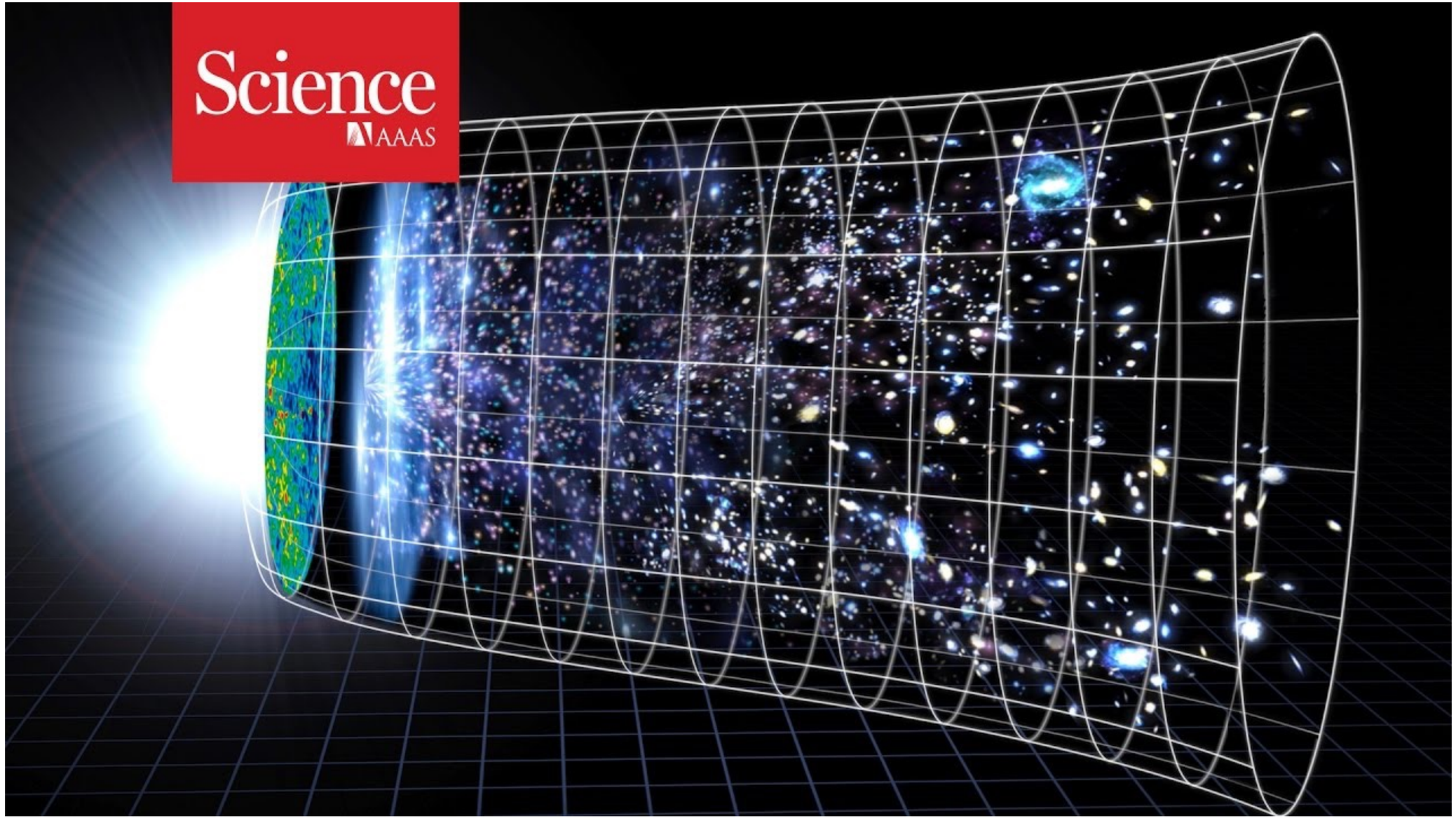
/kɒzˈmɒlədʒi/

/kɑːzˈmɑːlədʒi/

[uncountable]

- the scientific study of the universe and its origin and development

The concordance cosmological model



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The concordance cosmological model

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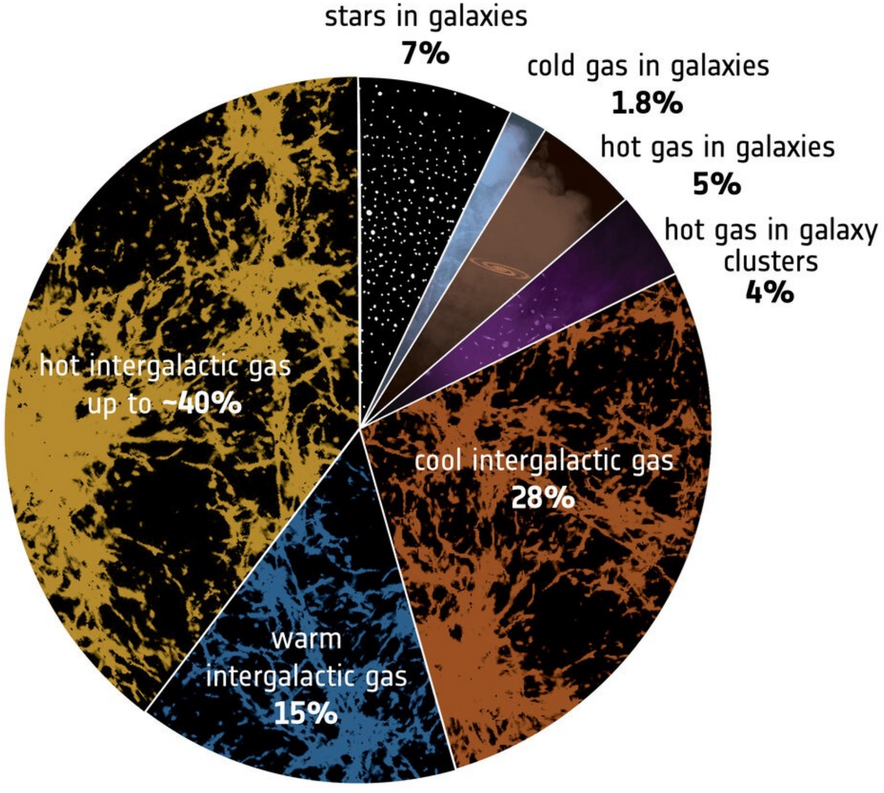
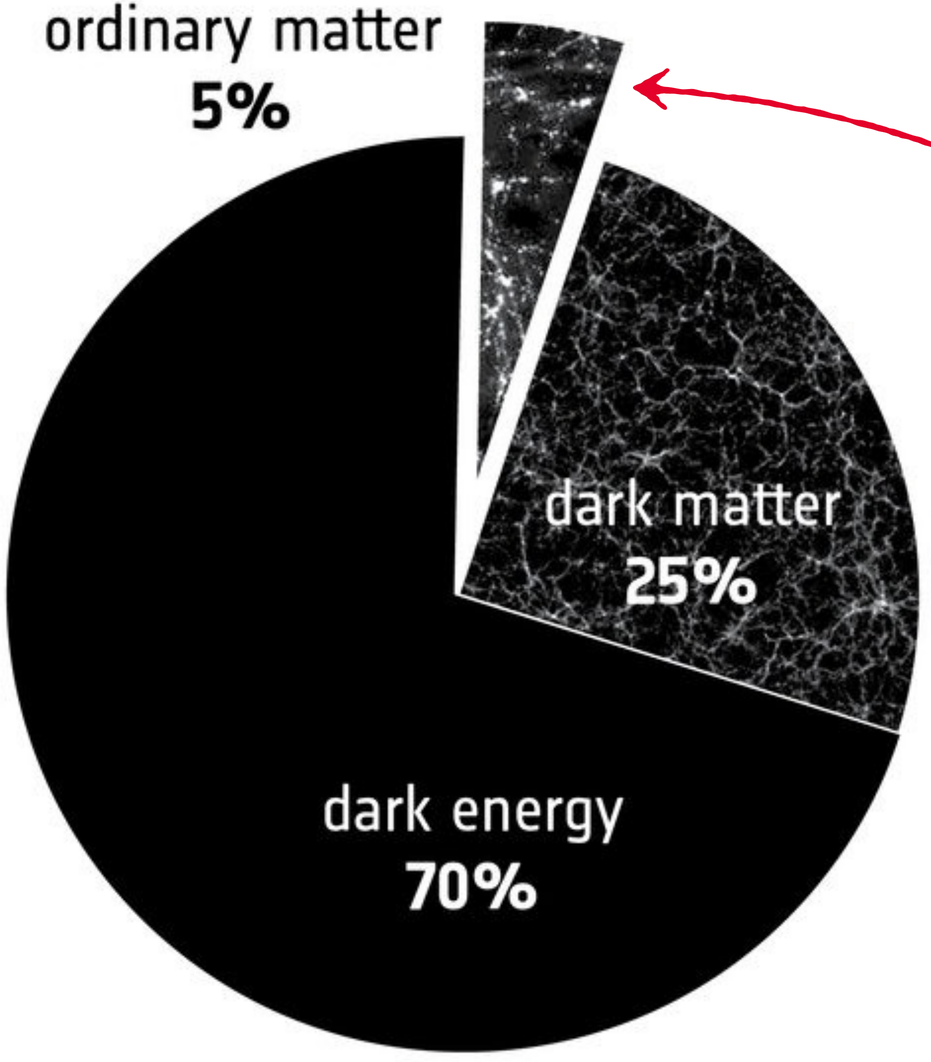
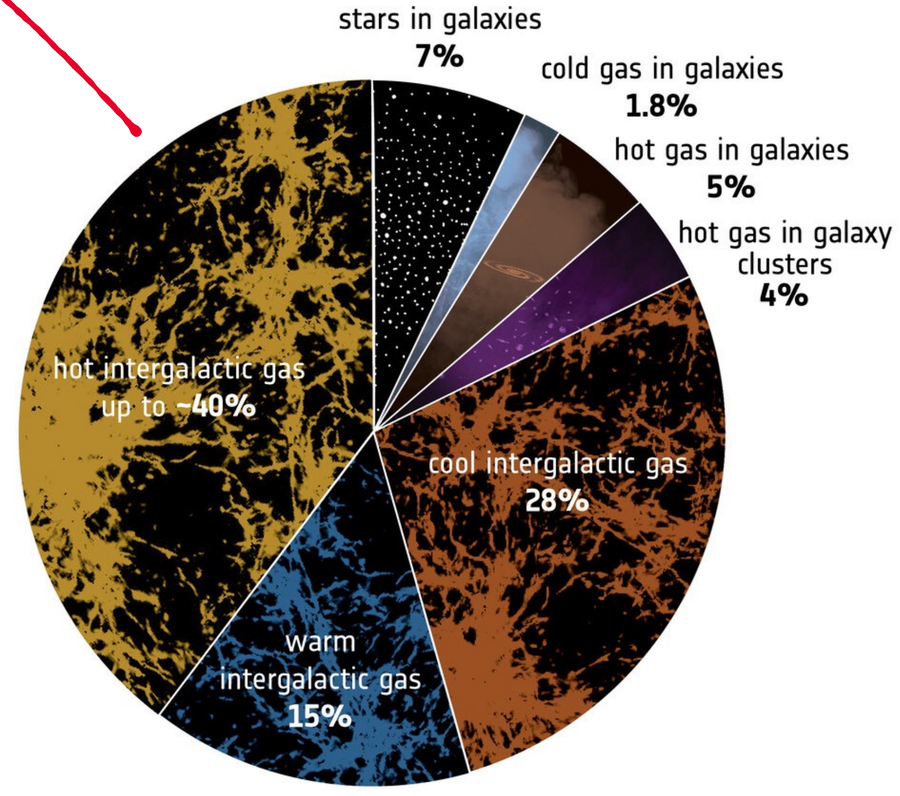
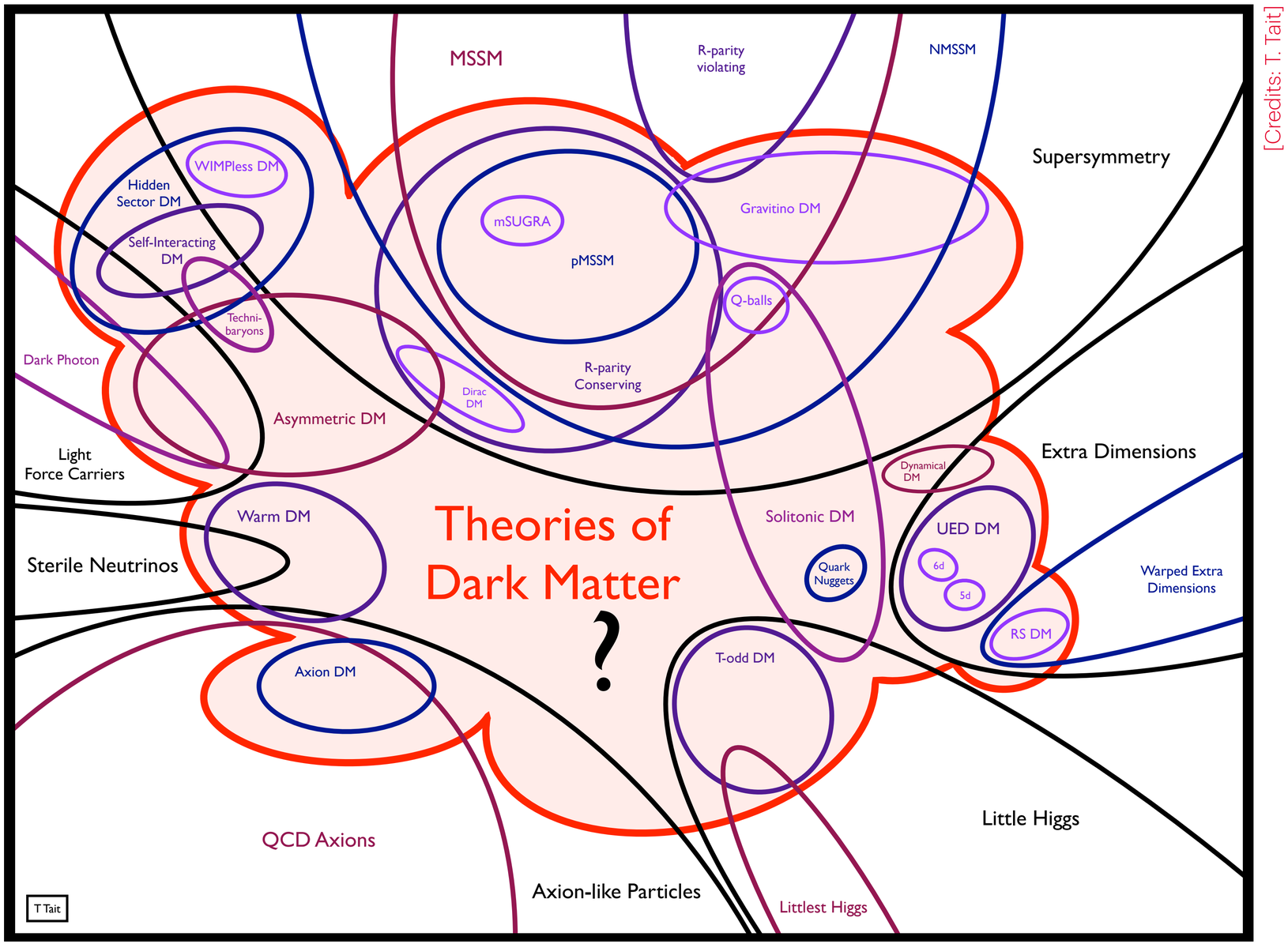


The concordance cosmological model



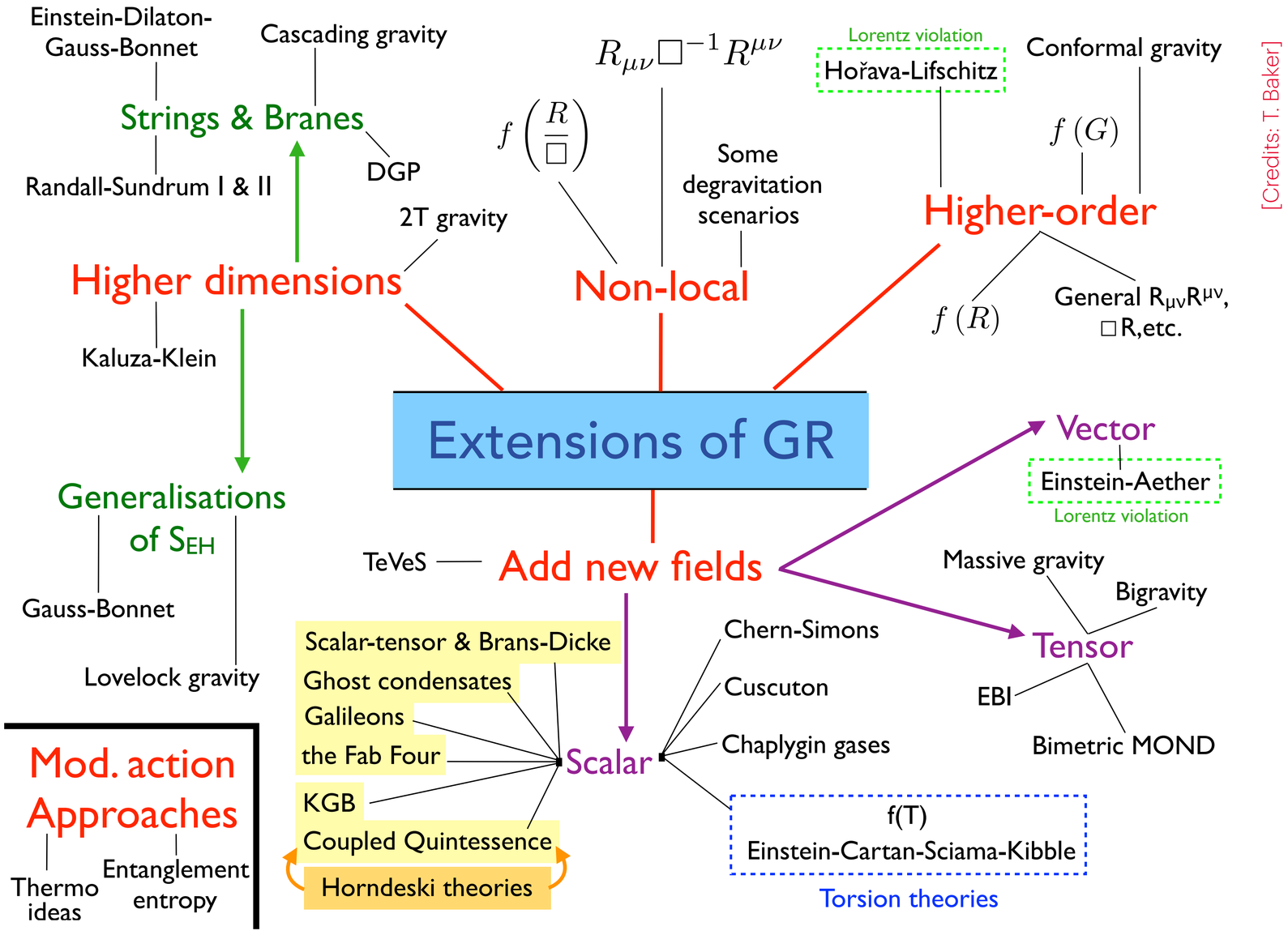


Dark matter

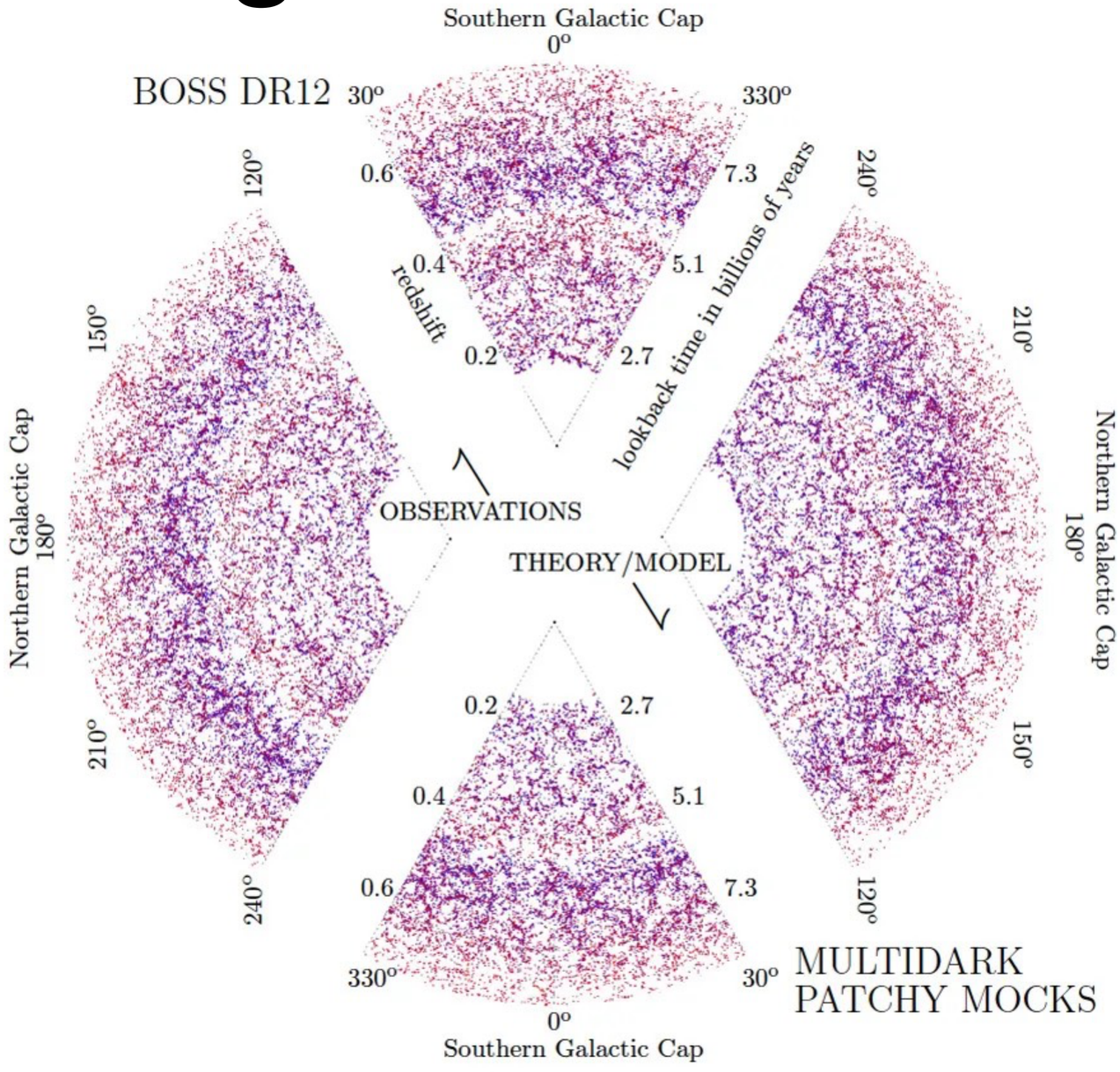


[Credits: T. Tait]

Dark energy


Einstein-Dilaton-Gauss-Bonnet
Cascading gravity
Strings & Branes
Randall-Sundrum I & II
DGP
2T gravity
Higher dimensions
Kaluza-Klein
$f\left(\frac{R}{\Box}\right)$
$R_{\mu\nu}\Box^{-1}R^{\mu\nu}$
Some degravitation scenarios
Non-local
Lorentz violation
Hořava-Lifschitz
Conformal gravity
$f(G)$
Higher-order
$f(R)$
General $R_{\mu\nu}R^{\mu\nu}$, $\Box R$,etc.
[Credits: T. Baker]
Extensions of GR
Generalisations of S_{EH}
Gauss-Bonnet
Lovelock gravity
TeVeS
Add new fields
Vector
Einstein-Aether
Lorentz violation
Massive gravity
Bigravity
Tensor
EBI
Bimetric MOND
Scalar-tensor & Brans-Dicke
Ghost condensates
Galileons
the Fab Four
KGB
Coupled Quintessence
Horndeski theories
Scalar
Chern-Simons
Cuscuton
Chaplygin gases
f(T)
Einstein-Cartan-Sciama-Kibble
Torsion theories
Mod. action Approaches
Thermo ideas
Entanglement entropy

The cosmic large-scale structure



The cosmic large-scale structure

Approaches to cosmology

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Theoretical	Models of dark energy/matter, modified gravity, inflation, relativistic corrections, effective field theory of the large-scale structure, …
Observational	Galaxy properties (clustering, bias, populations, …), weak lensing and intrinsic alignments, clustering of galaxy clusters, …
Computational	Cosmological *N*-body and hydrodinamical simulations, approximate methods, …
Statistical	Data analysis techniques, data weighting and optimisation, Bayesian inference, Markov chain Monte Carlo algorithms, data compression
Machine learning	Big data' handling, neural networks (photometric redshifts, ellipticity measurements, foreground removal, …), emulators, …

Possible thesis titles

- Triennali
  - Optimising redshift binning for galaxy clustering [Camera]
  - Correct derivation of the Fisher information matrix for spectroscopic galaxy surveys [Camera]
  - Comparison of neutrino implementation in the CAMB and CLASS codes [Pace]
  - Different approaches to perturbation theory [Pace]
- Magistrali
  - SKAO forecasts w/ peculiar velocity in the non-linear regime via loop-perturbation theory [Camera]
  - Developing new smoking guns for systematics in HI intensity mapping/galaxy clustering [Camera]
  - Modelling of the cross-correlation of continuum galaxies and the UGRB [Camera]
  - Complexity reduction for next-generation galaxy survey data analysis [Camera]
  - Clustering and lensing analysis (3x2pt) for gravitational waves [Camera]
  - Development of the EoS_class code and QSA_class code [Pace]
  - Improvement of the quasi-static approach [Pace]
  - Structure formation in coupled dark energy models [Pace]
  - Perturbations in Unified Dark Matter models [Pace]
  - Extensions of the spherical collapse model [Pace]
  - Dynamical system analysis [Pace]
  - Refracted gravity [Pace/Diaferio]