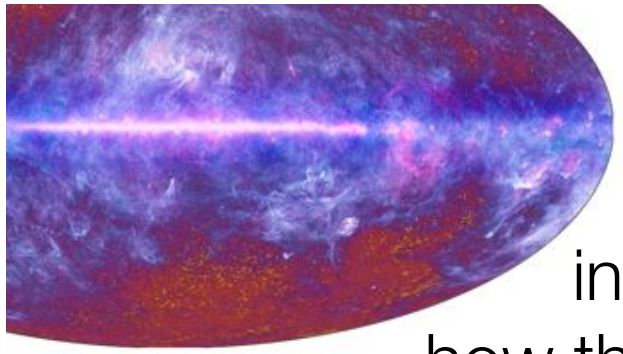


introduction: how the Universe gets structured ?

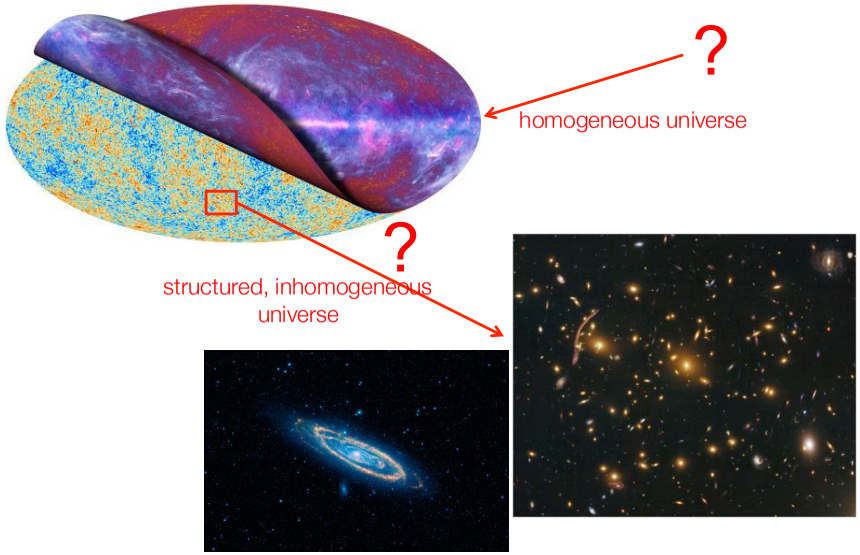
Hervé Dole (IAS), Michael Joyce (LPNHE), Mathieu Langer (IAS)

our scientific ambition

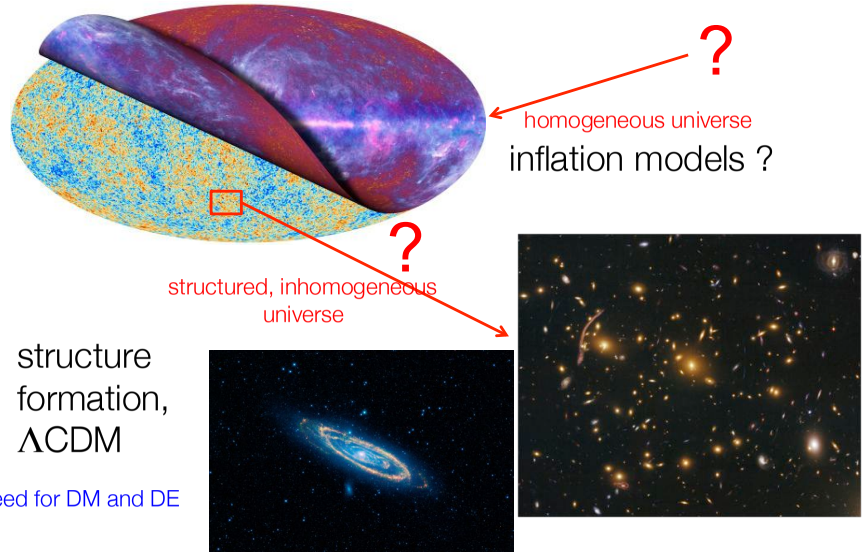
understanding the structure & the evolution of the universe and its constituents, in particular its fundamental physical laws.

- conception, développement, réalisation, tests, étalonnage d'instruments
- opération des instruments
- analyse et interprétation des données
- archivage, diffusion de produits scientifiques à haute valeur ajoutée
- développement de modèles, simulations, avancées théoriques
- confrontation théorie+modèles vs données

the two outstanding questions



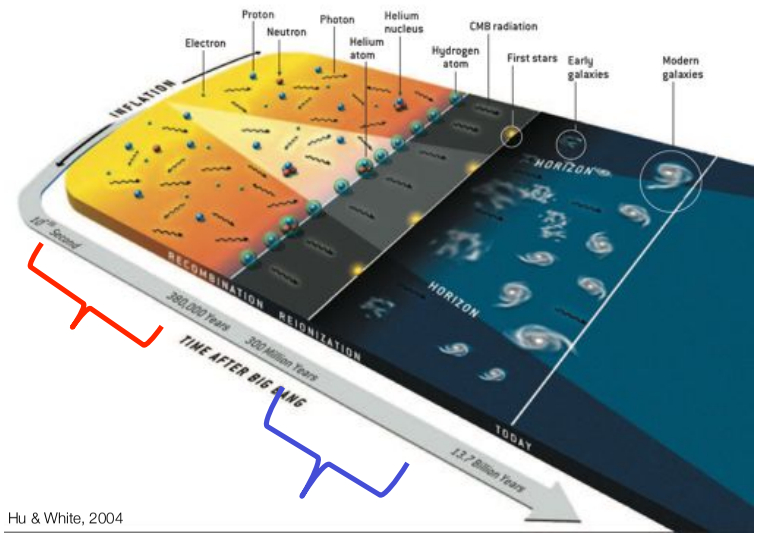
the two outstanding questions



structure formation, ΛCDM

need for DM and DE

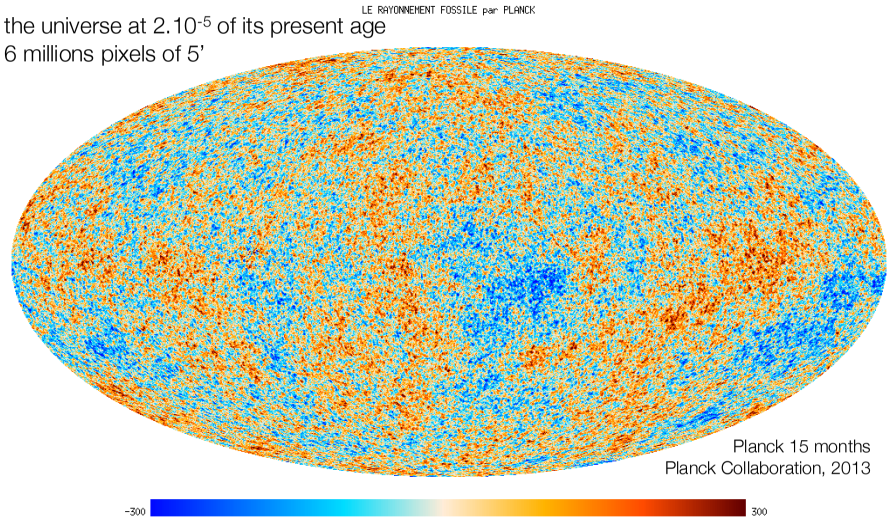
context



Hu & White, 2004

cosmological background

the universe at 2.10^{-5} of its present age
6 millions pixels of 5'

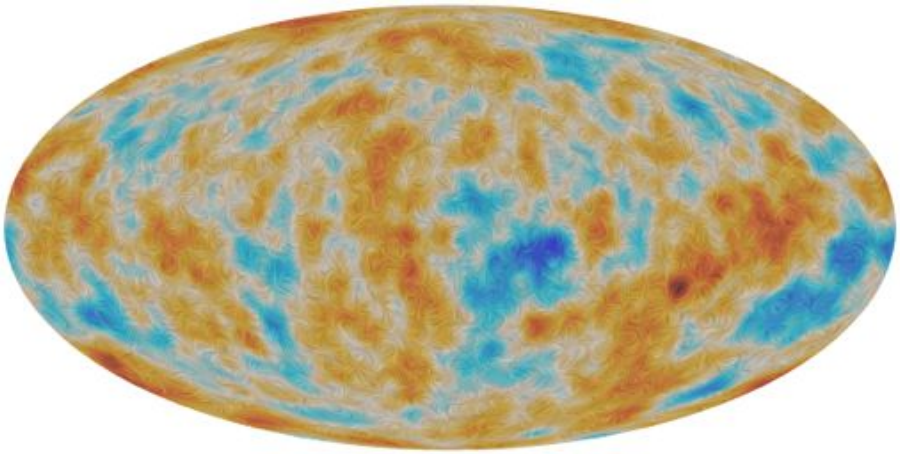


Planck 15 months
Planck Collaboration, 2013

and a fairly wide coverage !

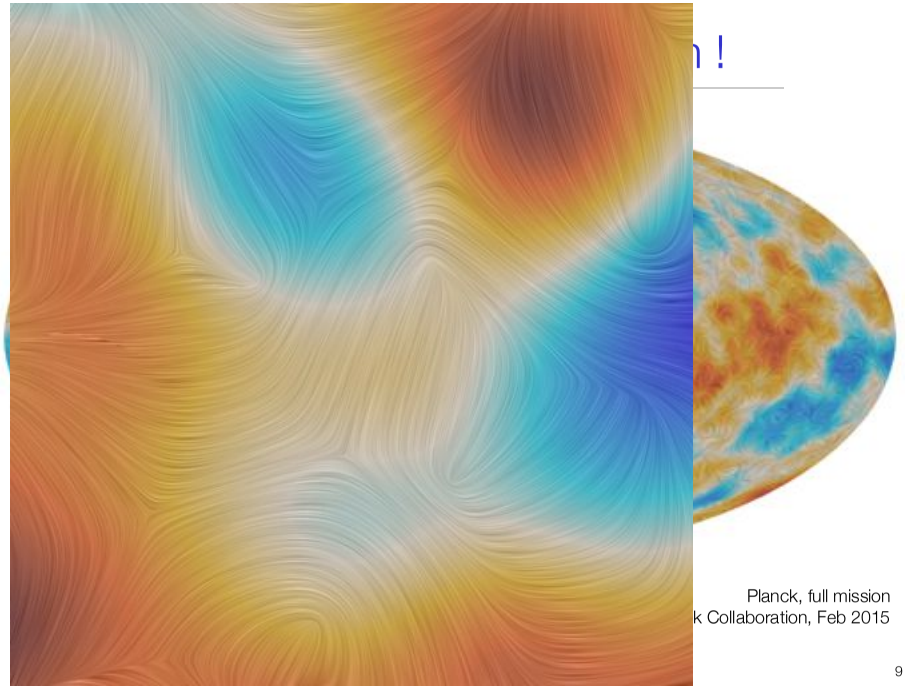
March 21st or 22nd, 2013

and now with polarization !



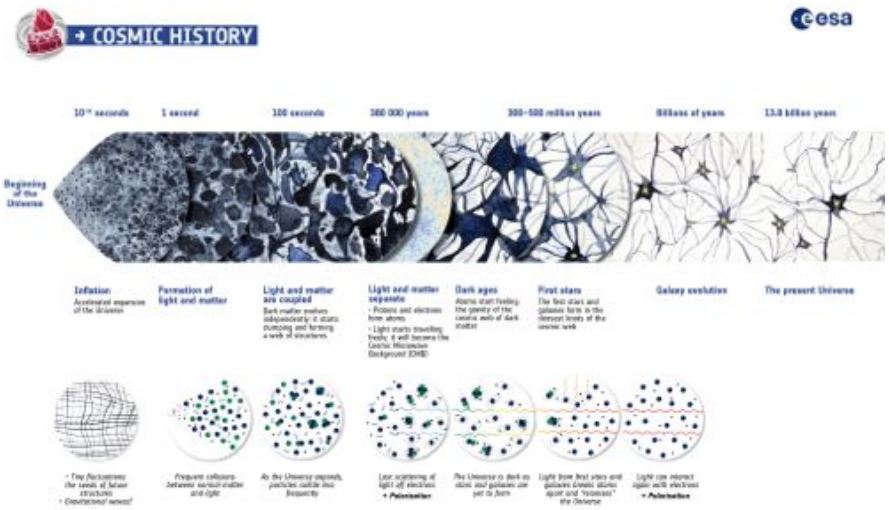
Planck, full mission
Planck Collaboration, Feb 2015

n !

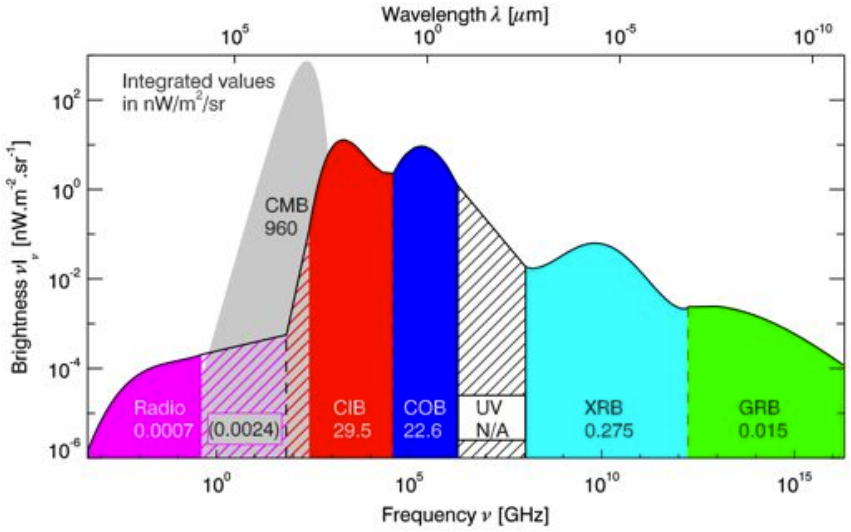


Planck, full mission
k Collaboration, Feb 2015

updated Universe' timeline

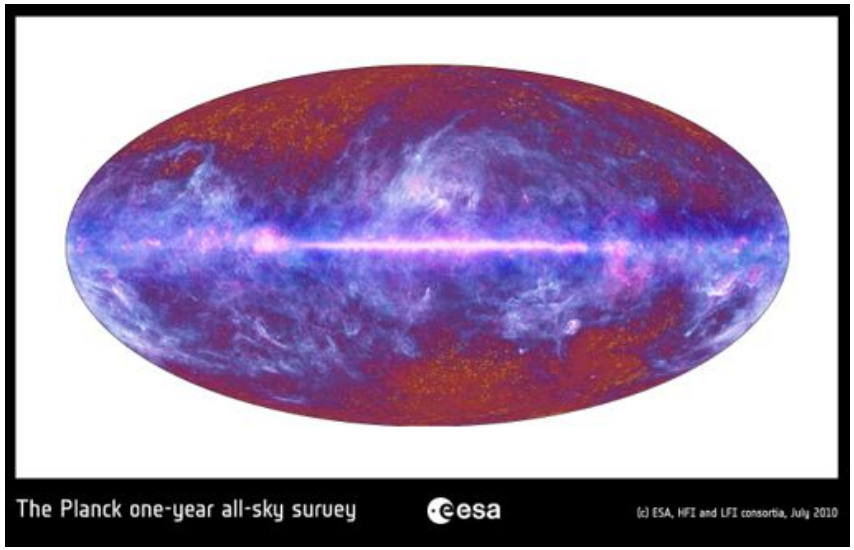


cosmological backgrounds

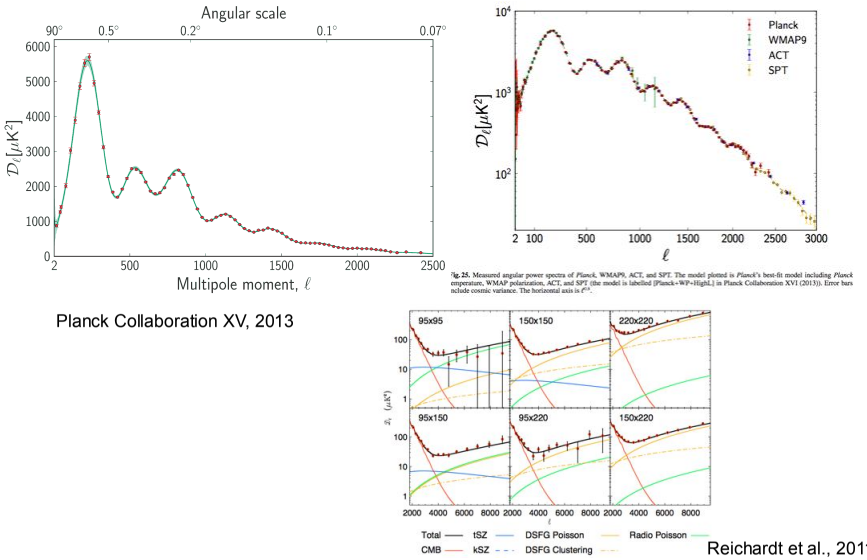


Dole et al., 2006 ; Dole 2010 HDR
Dole & Béthermin in prep

cosmological backgrounds



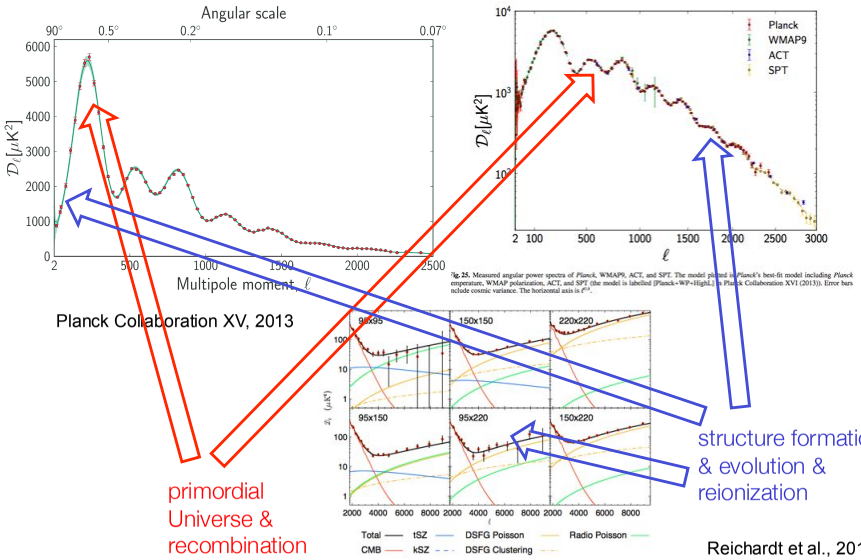
cosmological backgrounds



Planck Collaboration XV, 2013

Reichardt et al., 2011

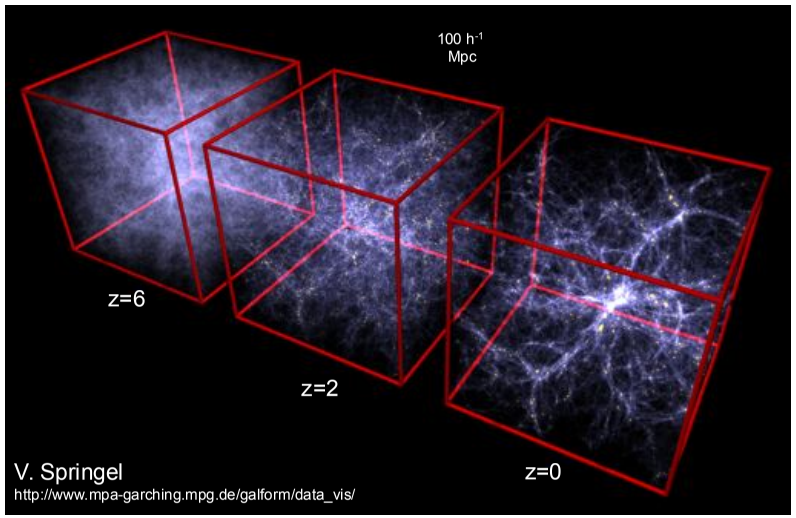
cosmological backgrounds



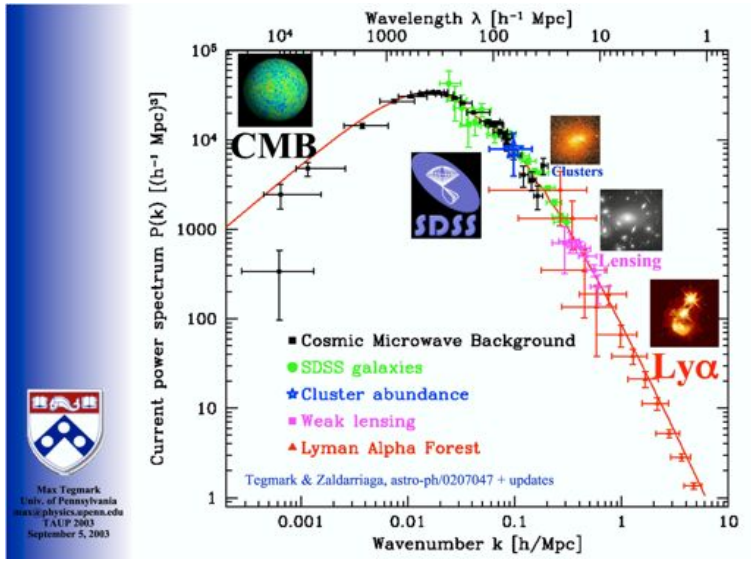
Planck Collaboration XV, 2013

Reichardt et al., 2011

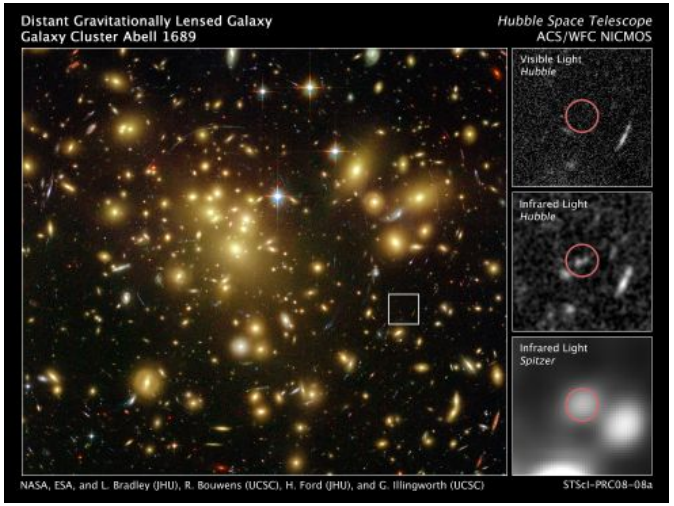
structuration of matter



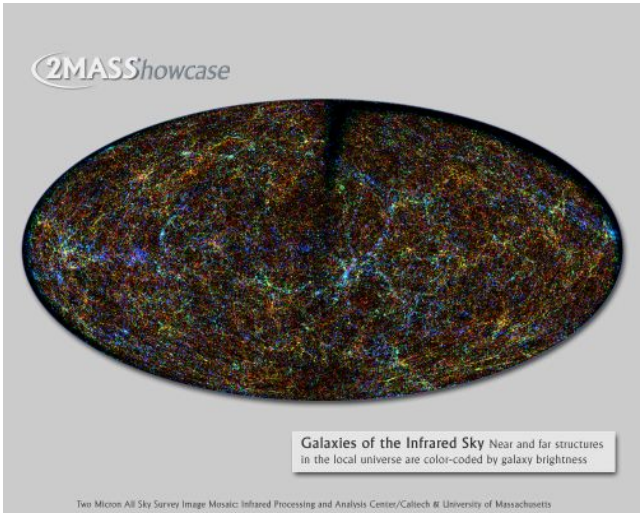
structuration of matter



clusters, galaxies



galaxies



one last word

your professors are working in laboratories at the forefront of research:
take this opportunity for discussions & lab visits !

e.g. Planck HFI – Instrument Operation Room – Institut d'Astrophysique Spatiale

(c) H. Dole

plan of advanced lecture

- lectures 1 – 4 (Hervé)
  - introduction to the structured universe, observables, definitions and statistical tools. CMB, latest Planck results, galaxy formation.
- lectures 5 – 7 (Michael)
  - review of basics of Newtonian self-gravitating system; cold dark matter in an expanding universe, from linear to non-linear regime; hierarchical structure formation; N-body simulation; halo model.
- lectures 8 – 10 (Mathieu)
  - The Dark Ages of the Universe; reionization; magnetic field; cosmic emptiness.

NPAC Advanced Cosmology

- Every morning -> check syllabus
- Textbooks -> check syllabus
- Evaluation -> check syllabus
  - individual 20 min oral exam Friday, March 6th afternoon at IAS (2pm-6pm) (this room):
    - 10min questions about lectures
    - 10min questions about a paper (list provided soon)
- Visit of IAS, LPNHE etc. labs possible whevener