CN-4: Dark Energy

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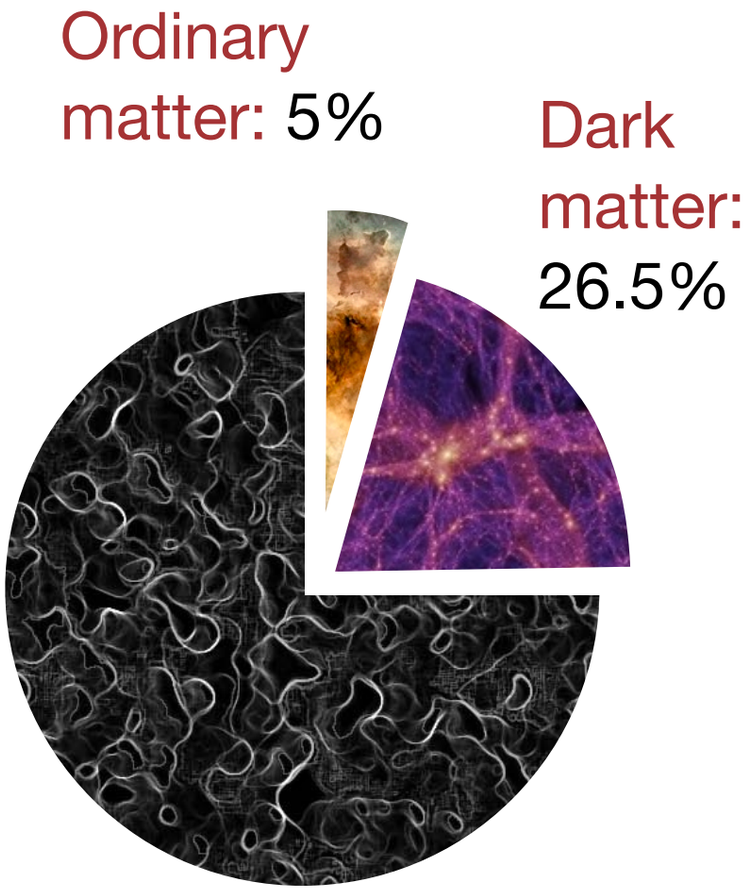
CN-4: *cosmic acceleration*

- Possible explanations of the **accelerated expansion of the Universe** involve:
  - Cosmological constant
  - Slowly rolling scalar field
  - Deviations from GR on large scales
  - More general degrees of freedom

- Wealth of observational probes (Large-scale structure, Galactic structure, Stellar physics, Laboratory and Solar System constraints).

- Exploiting these requires close collaboration between RU A, B, C, & D



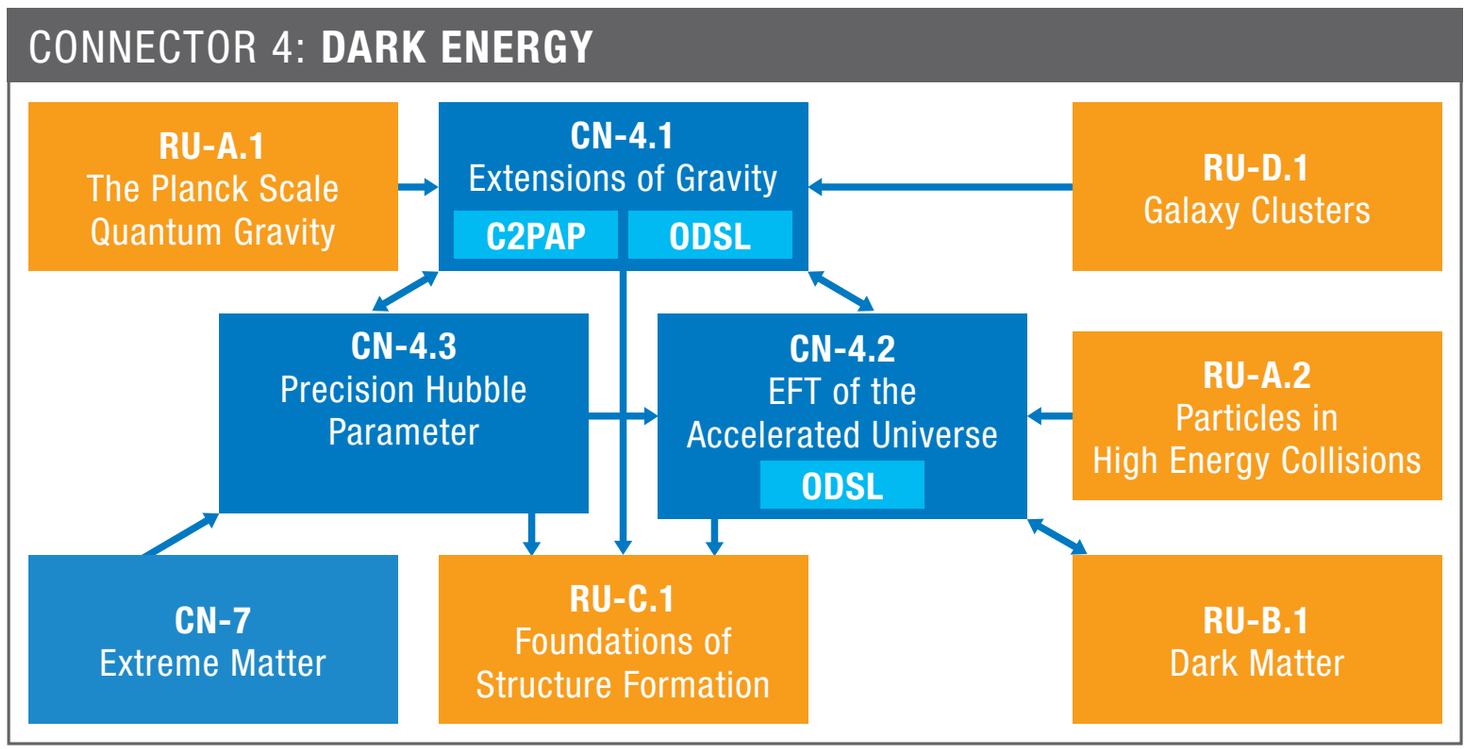
Projects

Three linked projects:

CN-4.1: Extensions of gravity, their phenomenology, and observational constraints.

CN-4.2: Effective field theory of the accelerated Universe.

CN-4.3: High-precision measurements of H_0 as a probe into the physics of the accelerating Universe.



What worked well?

- Good support from Cluster administration, smooth interaction with MPG administration.
- Hired personnel worked very well in all cases.
- CN and RU Science Days foster interaction between groups.
- MIAPbP workshops are highly valued.
- Central initiatives such as Origins Fellows and ODSL bring people together.
- CN-4 succeeded in connecting people with different expertise.
- Interactions enabled new lines of research that would not have been possible otherwise.

What worked well?

- New inter-disciplinary project (CN4.3): measuring H_0 from lensing of Type II supernovae

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HOLISMOKES - V. Microlensing of type II supernovae and time-delay inference through spectroscopic phase retrieval

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What could be improved?

- With the departure of Dr. Schmidt-May to industry we lost vital expertise for the initial phase of project CN-4.1
- This expertise could not be found in the Cluster (or even elsewhere) and we had to redefine the project.
- Funding for PhD students limited to 3 yrs while average time for the PhD is larger.
- Communication with some PIs has been very limited. Pandemic made things much worse.
- Simplify conditions for organising events and spending money on equipment and travel.
- Science week at Kloster Seeon causes family/childcare problems that could be avoided by meeting in Munich/Garching.

New directions or missing expertise?

- We will see an explosion in the amount of survey data (e.g. HETDEX, PFS, Euclid, DESI, eROSITA, Rubin, etc.)

- Dark energy is the main science driver of these surveys.

- Existing and new collaborations within Origins should focus on extracting leading science from these datasets.

- New datasets will revitalise the field and completely overhaul our analysis methods.

- ML tools, simulation-based inference, field-level inference, etc. will become crucial -> build expertise on these topics now.

Projects

Three linked projects, build on each other's scientific results:

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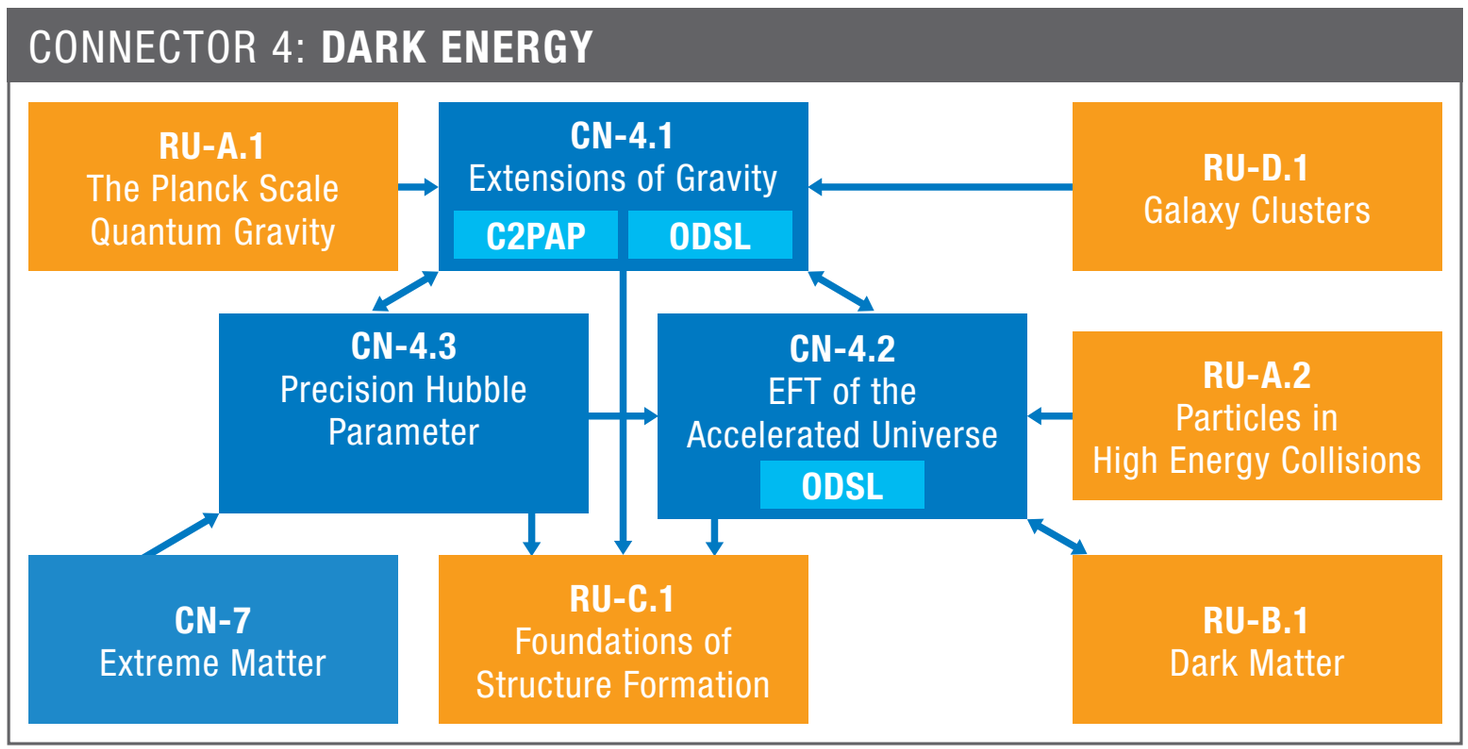
CN-4.3: High-precision measurements of H_0 as a probe into the physics of the accelerating Universe.