GAUSS

Massively Parallel Large Area Spectroscopy from Space

June 21 th, 2021

Motivation : ESA call Voyage 2050

https://www.cosmos.esa.int/web/voyage-2050

“By means of the present Call for White Papers, the Agency is soliciting ideas from the scientific community for the science themes that should be covered during the Voyage 2050 planning cycle.”

https://www.cosmos.esa.int/web/voyage-2050/white-papers

About GAUSS:

https://arxiv.org/abs/2102.03931

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Motivation: Increase the scanned volume of universe

Added comments:

Indeed as emphasized in the GAUSS introduction, improving the volume size of surveys is the key ingredient to improve constraints on the physics of the early universe: neutrinos masses, non-gaussianity of primordial fluctuations (a potential smoking-gun to test inflation), the equation of state of dark energy and of dark matter, including tests of GR at cosmological scales.

ESA answer

New physical probes of the early Universe

How did the Universe begin? How did the first cosmic structures and black holes form and evolve? These are outstanding questions in fundamental physics and astrophysics that could be addressed by missions exploiting new physical probes, such as detecting gravitational waves with high precision or in a new spectral window, or by high-precision spectroscopy of the cosmic microwave background – the relic radiation left over from the Big Bang. This theme follows the breakthrough science from Planck and the expected scientific return from LISA, and would leverage advances made in instrumentation to open a huge discovery space. Additional study and interaction with the scientific community will be needed to converge on a mission addressing this theme.

What is GAUSS ?

Aimed to achieve FOM > 10 000 i.e. an accuracy of > 1% on each w_0 and w_a

Wide field imagery + Spectroscopy

=> need to improve the numbers of objects >~ 10

Forecasts based on Euclid redshift bins => secure forecast.

Type of instrument

4m class

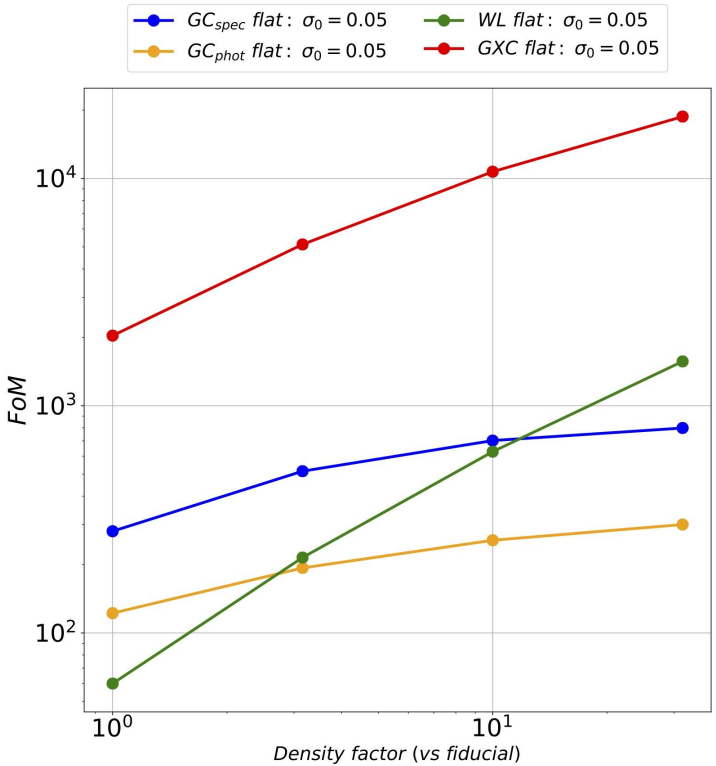
Wide field ⌀ : 2 degree

Pixels size : 5 µm <-> 0.05 arcsec.

DMD for slit spectroscopy

From 0.5 µm to 5 µm

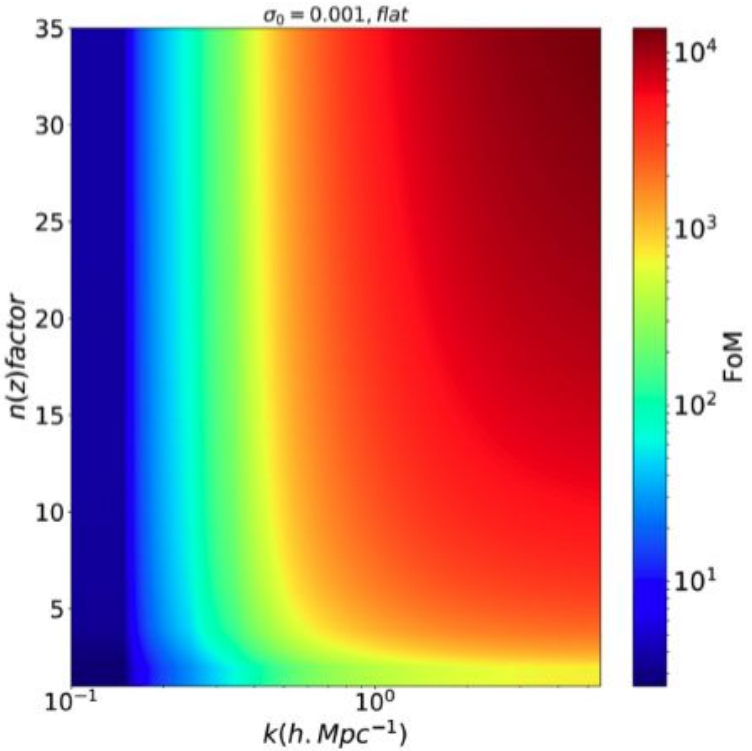
FOM



For FOM including XC is critical.

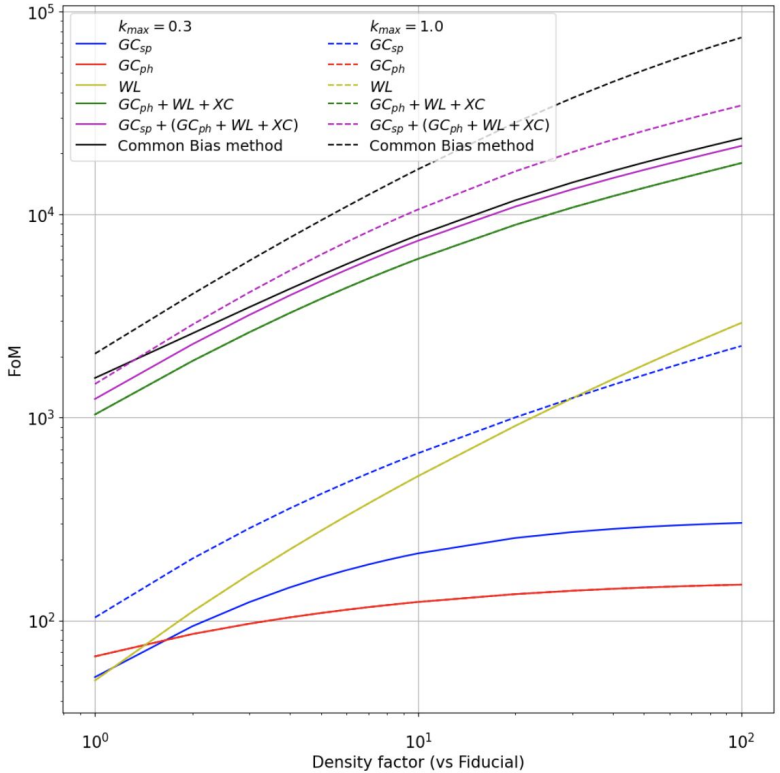
The increase in the number density in spectroscopic seems not to improve the FOM...

FOM boost from spectroscopic surveys



In order to improve the gain from spectroscopic we need to increase the density and the k_{max} !

FOM final figure



Reaching FOM ~ 10 000 needs a factor of 10 in density of objects.

This is a robust conclusion...

Conclusion

Improving the DE FOM ~ 10000 is reacheable.

A 4m with optical-IR imaging and spectroscopy facilities is ambitious but doable.

Large volume is the best way to investigate high energy early universe physics

GAUSS: performances/characteristics have to be refined.

The potential of such a facility is much beyond FOM… -> fundamental road towards fundamêntal physics.