Space-GROND
the first space-application of ALFA by 2025 ??

A 4-channel Near-Infrared Telescope
on a small Satellite

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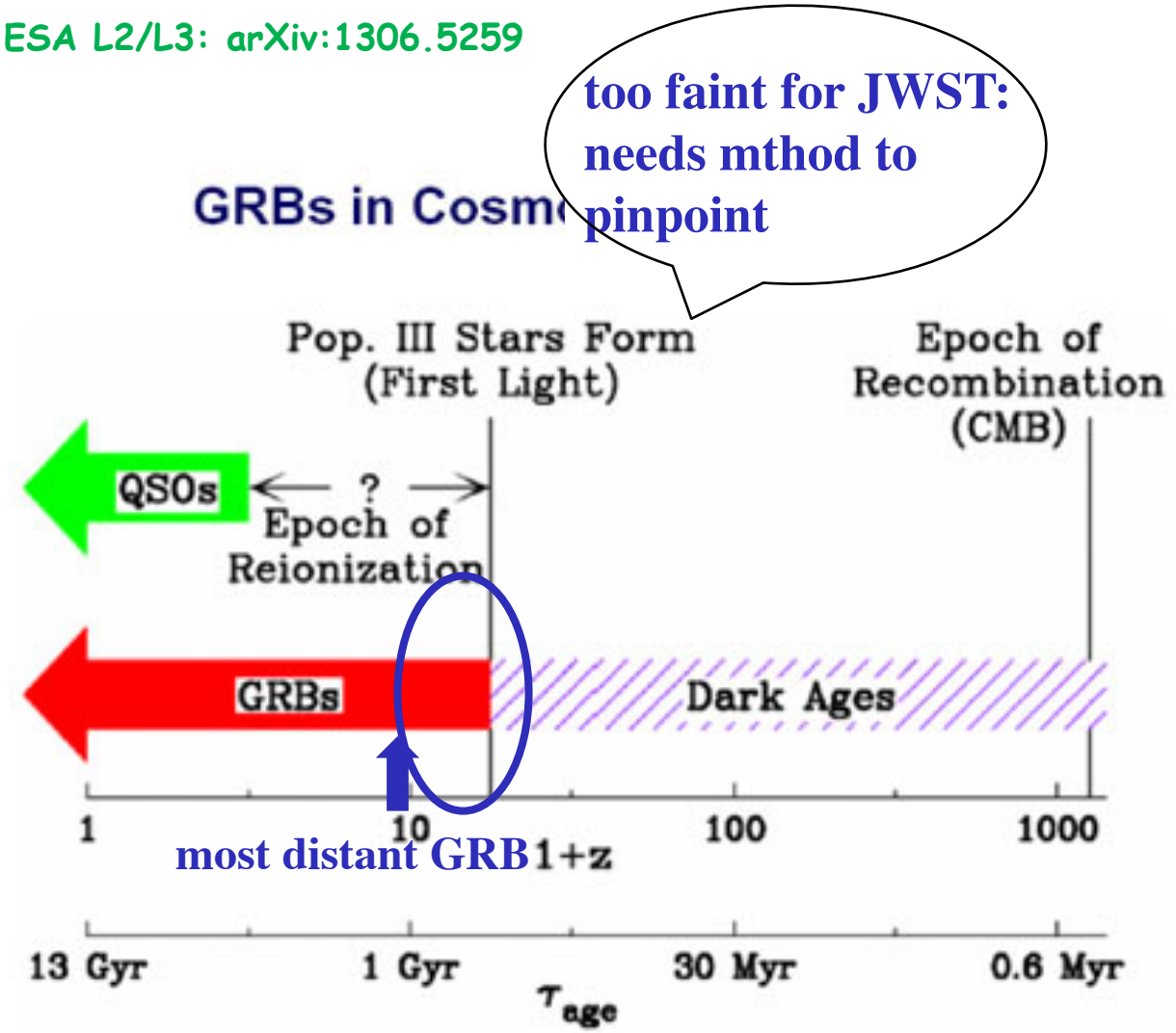
How to find the first star(s)?

See, e.g., White Paper to ESA L2/L3: arXiv:1306.5259

- When did the first stars form?
- When and how fast was the Universe enriched with metals?
- How were the first structures formed which then developed into the first galaxies?
- How did re-ionisation proceed as a function of environment?
- What is the relation between GRB rate and star formation rate, and what is its evolution with time? What is the true redshift distribution and corresponding luminosity function of long GRBs?

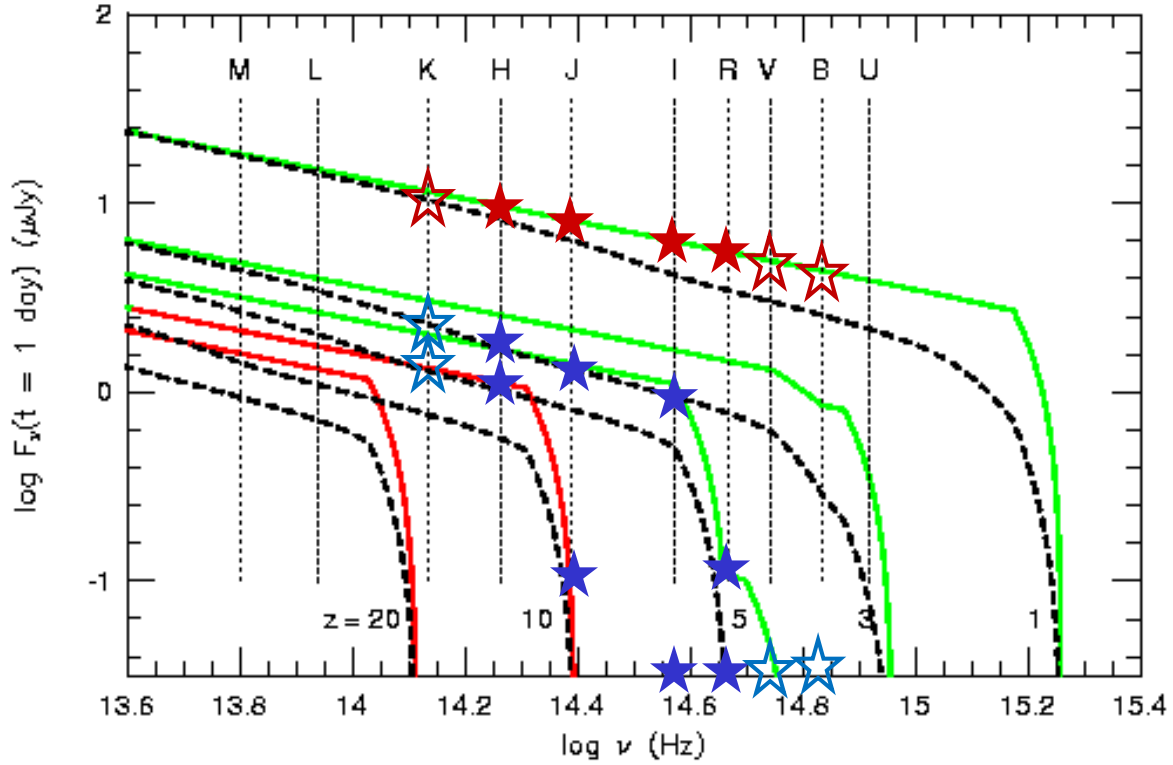


Lamb and Reichart (2000)

Quickly identifying high-redshift GRBs

At high redshift: identification very simple!

➔ Photometry in several filters (simultaneously!) around the Ly break allows to derive the redshift



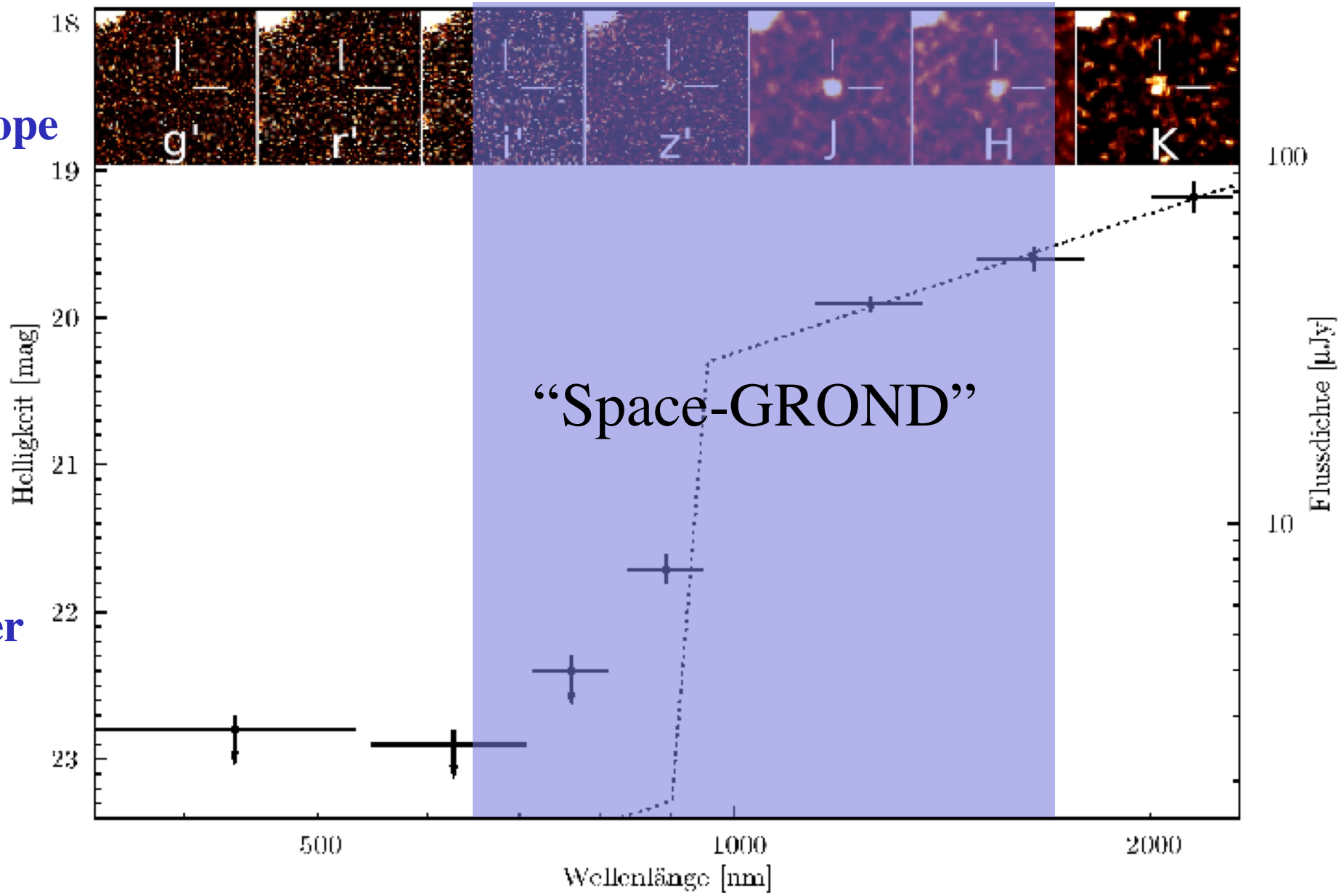
← GRB redshift

Prompt NIR imaging identifies high redshift GRBs

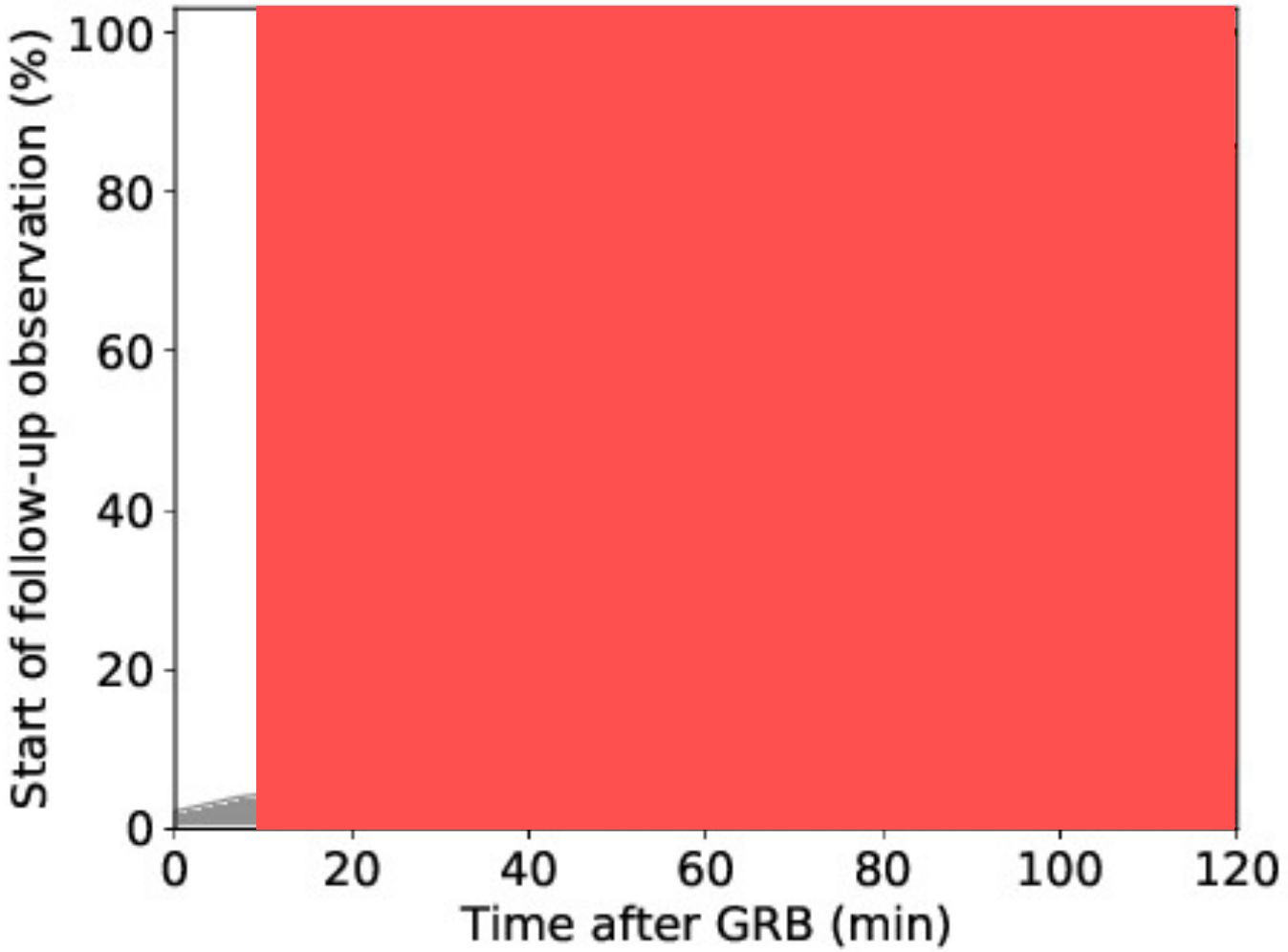
GROND Heritage

GROND @ 2.2 m telescope at La Silla (Chile)

- **GRB 080913**
- **at redshift z=6.9**
- **with 10 min exposure @20 min after GRB**
- **confirmed with VLT spectroscopy 1 hr later**



Why from Space?



Challenge: Compact Beam-splitting

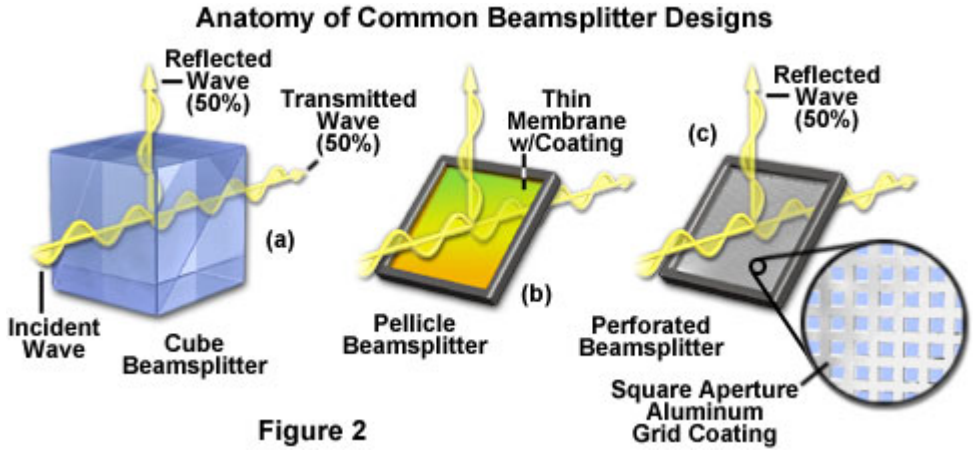
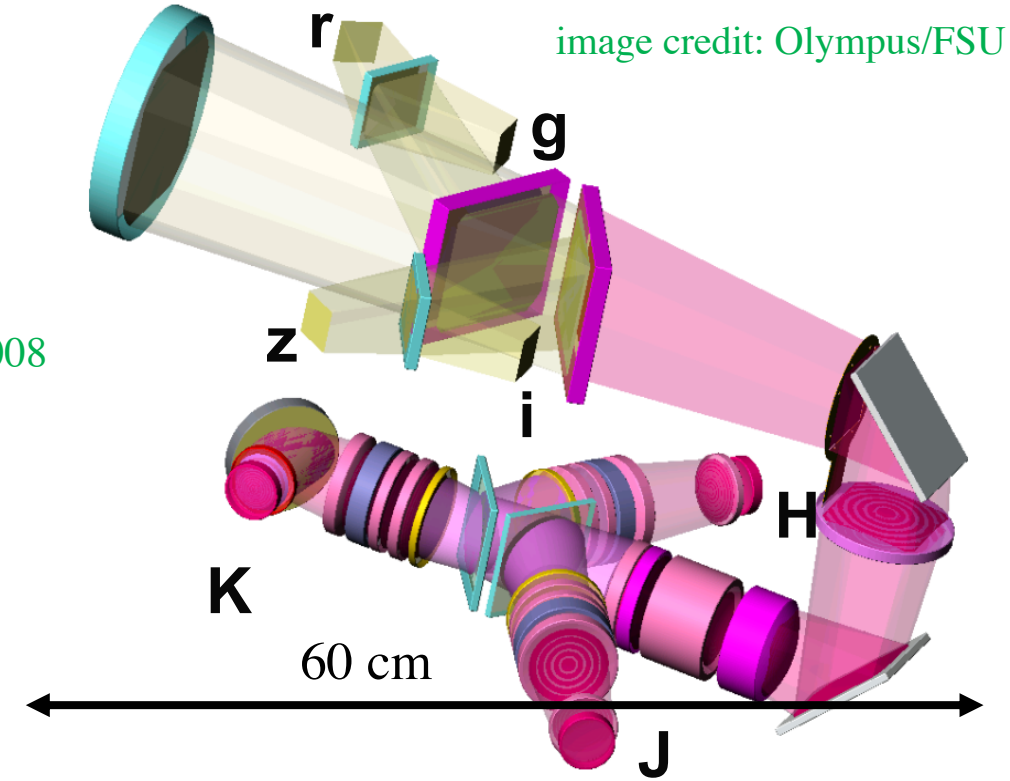


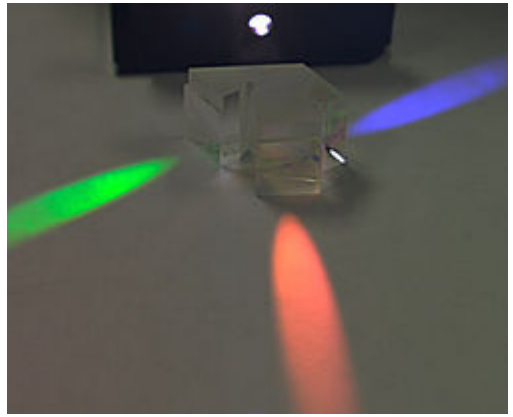
Figure 2

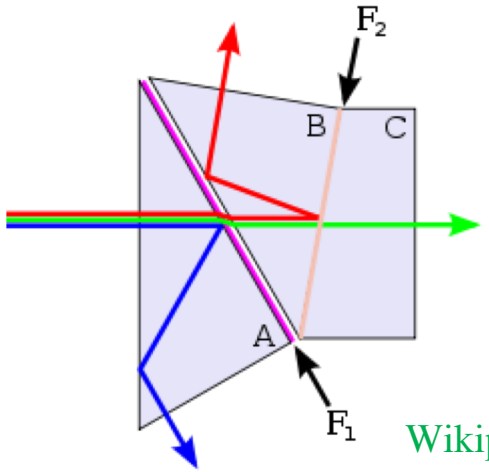
image credit: Olympus/FSU



GROND
Greiner+2008

Standard beam splitters are not suitable, since multiple detectors needed

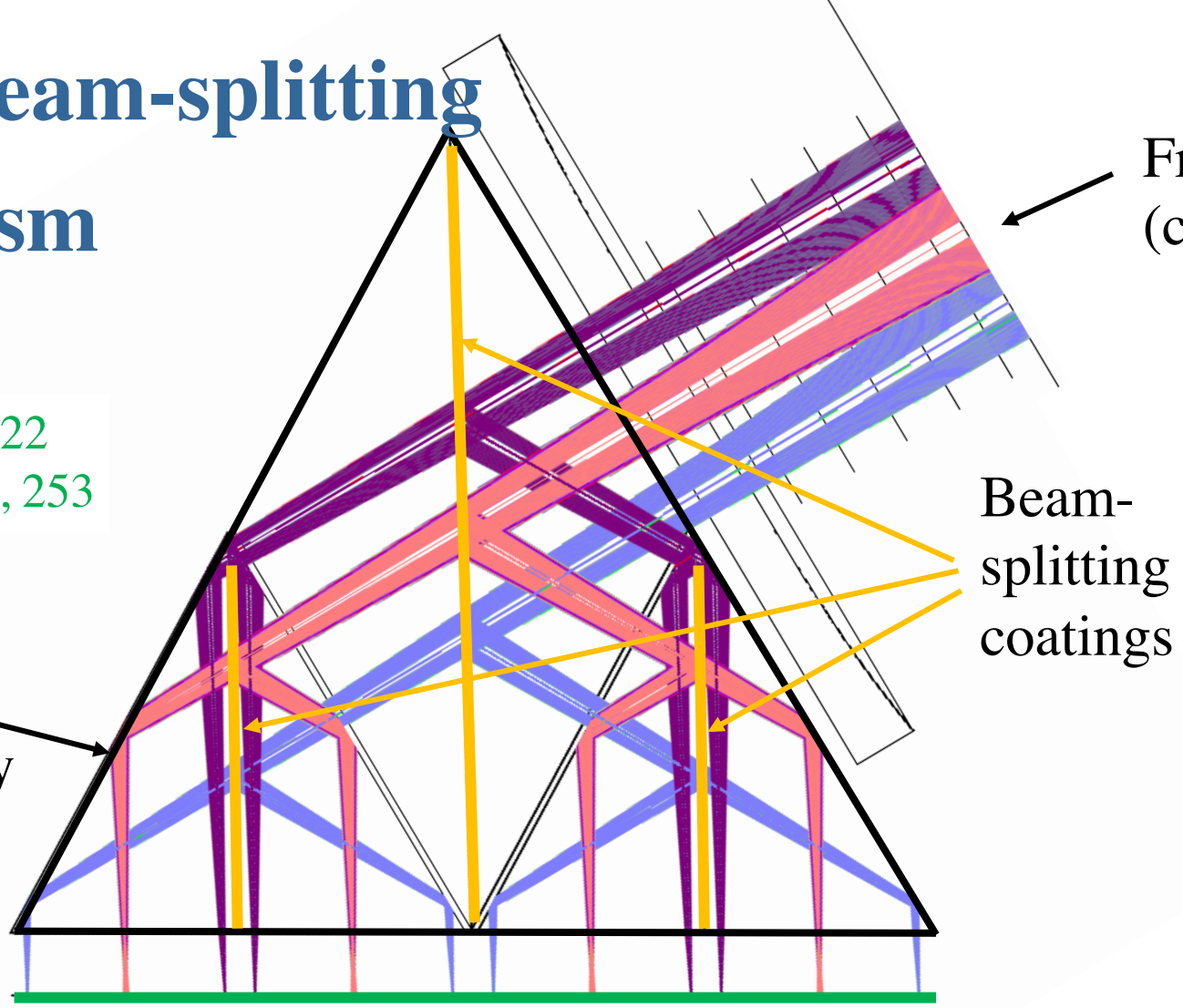




Wikipedia

Compact Beam-splitting Kösters prism

Greiner & Laux 2022
CEAS Space J. 14, 253



From Source/Telescope
(converging beam)

Beam-
splitting
coatings

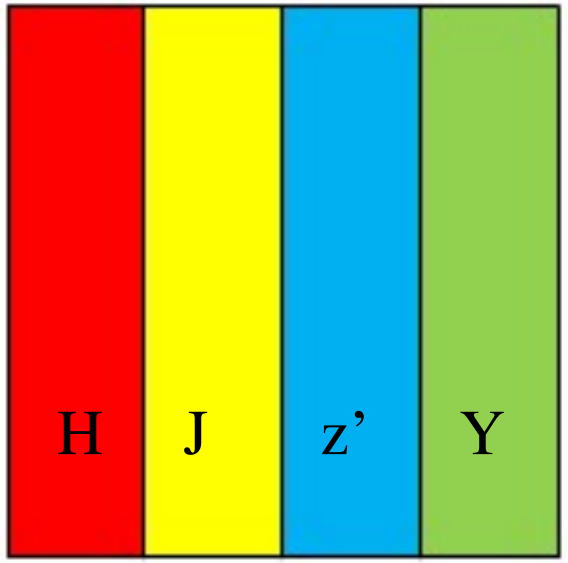
Prism
Boundary

Detector
Plane

Wave
bands

H	J	z’	Y
1.4-1.7 µm	1.1-1.4 µm	0.8-0.95 µm	0.95-1.1 µm

Detector View

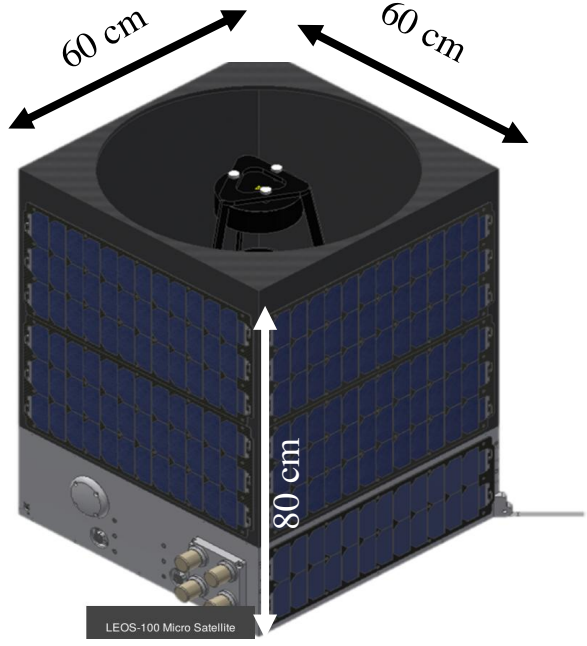


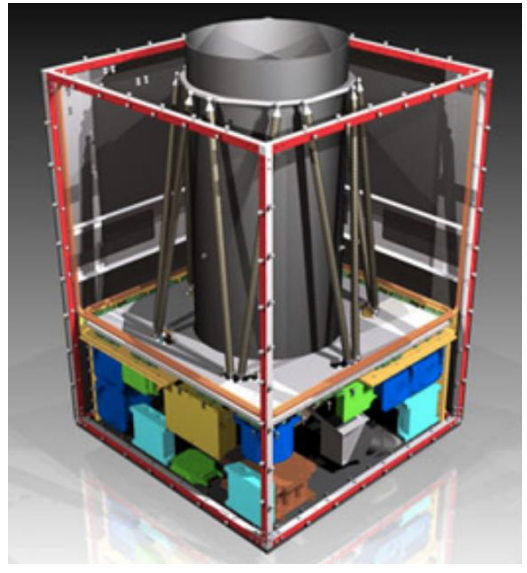
New Deal: shared use on Earth observing satellite

Agreement with satellite company

- Fly on a commercial satellite with standardized bus (was flown already 3x), and with 50 cm telescope
- Share incoming light: 400-800 nm Earth observations
  800-1700 nm Sky observations
- Rapid slewing upon GRB alert upload
- Satellite/mission payed by costumer;
  we only provide the instrument
- Launch possible by 2025/26 – just depends on how quickly we can provide NIR camera

Offer: Turn ALFA detector into a NIR camera (read-out electronics), and fly it within 3 years

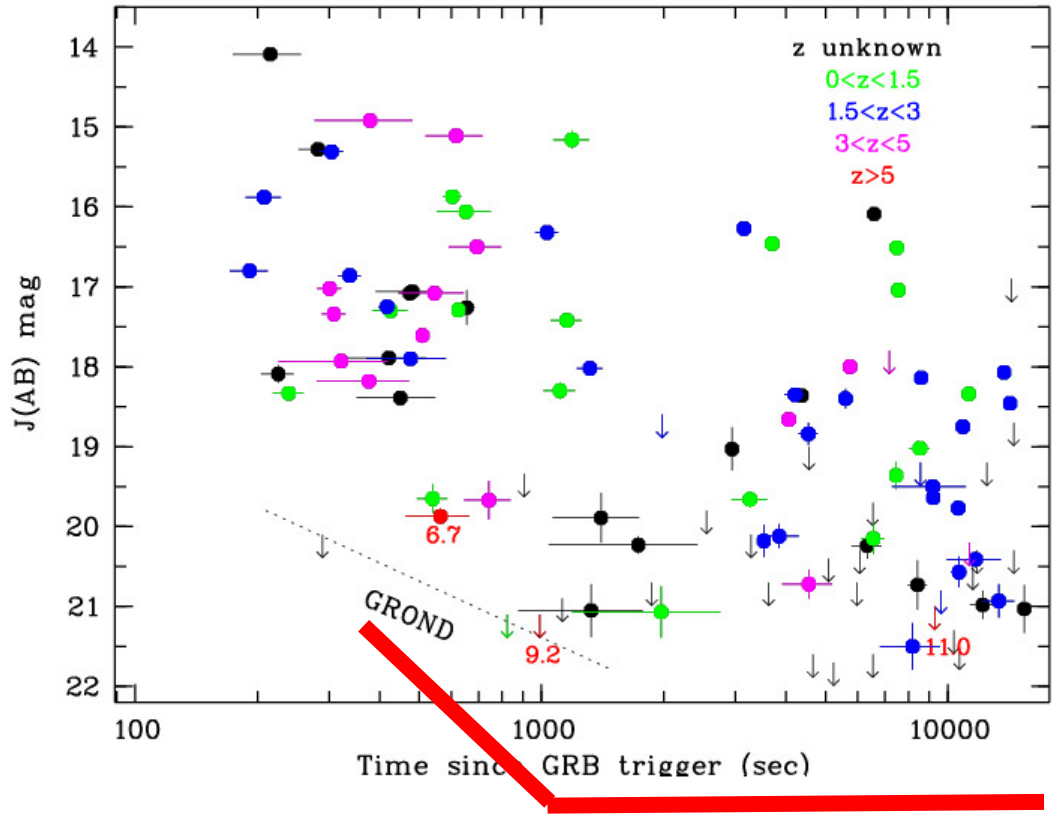




Sensitivity

5σ in 600 s: J(AB) ~ 23.5 mag ➔ in J+H comparable to 4 m telescope on ground

Detect 98% of all long GRB afterglows at z<11
Find 4-6 GRBs/yr at z>5



Detect 80% of all short GRB afterglows
Sample early light curve of >2 KN/yr during O5