Calibration group

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"Mission statement"

- **Define** the **detector parameters** ("calibration constants") that must be determined to operate an undersea km^3 telescope at the desired accuracy.
- **Establish** the **precision** at which this parameters must be/ can be estimated.
- **Propose** the **systems** that may be used to reach this goal.
- **Study** **concrete solutions**, adapted to the selected final design, to implement these systems.

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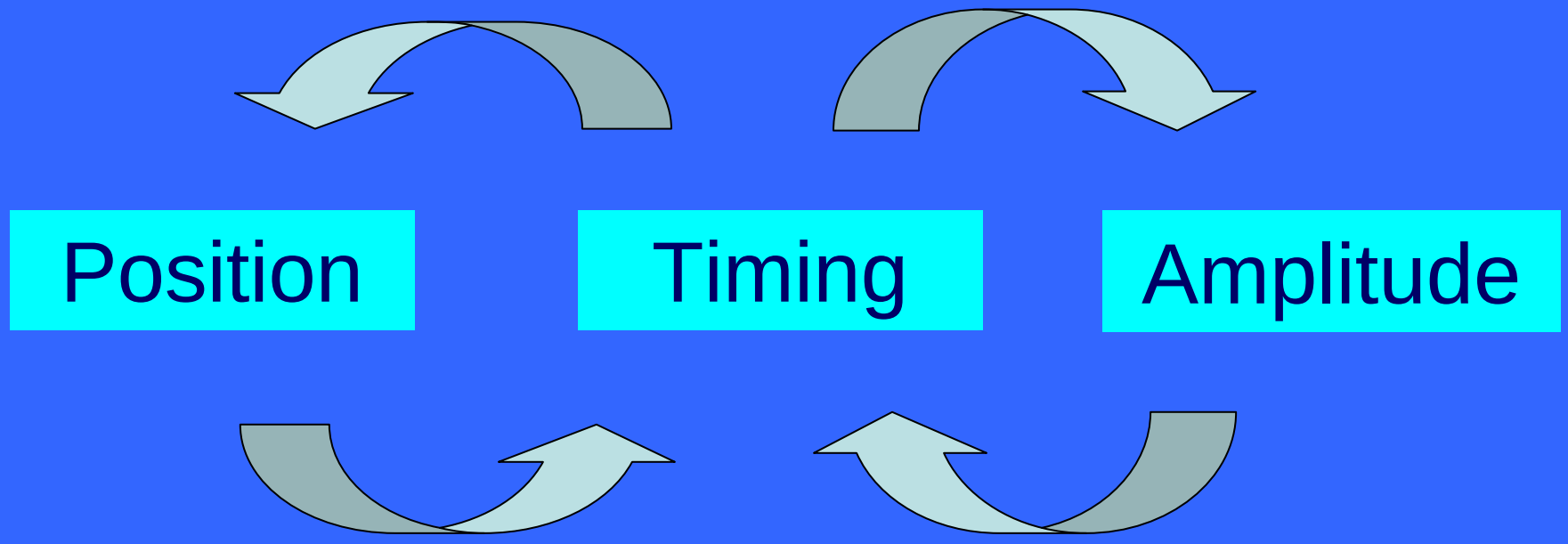
Calibration goals

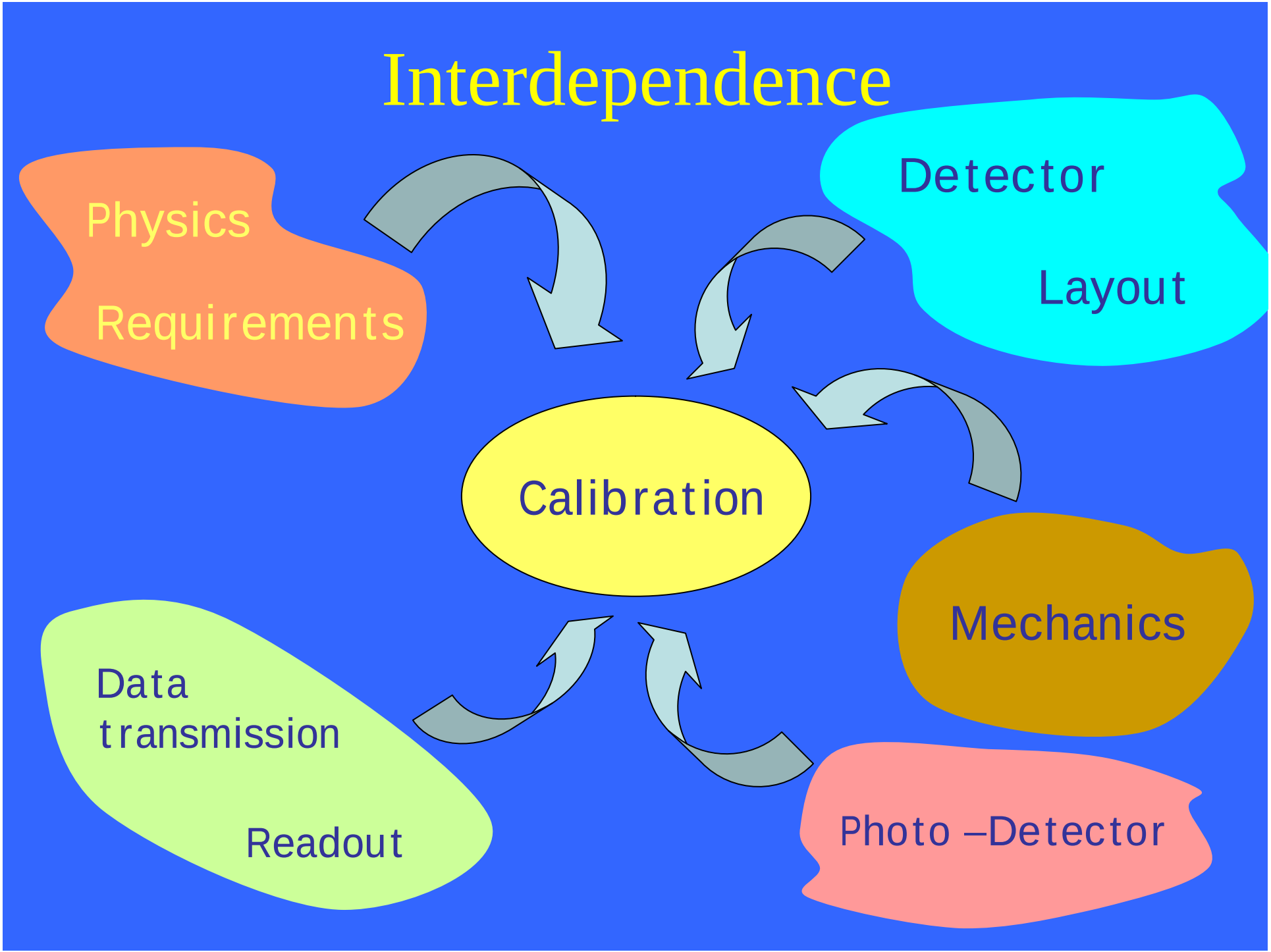
Determine the necessary constants to allow the reconstruction of events in

space **time** **energy**



All other constants (temperature, voltages) are used to determine these parameters

Interdependence



Positioning

Position calibration

Absolute

w.r.t. external objects

depends on site

- **GPS + acoustic transponders**
- **Moon?**
- **Local geological peculiarities?**
- **Other detectors?**

New ideas are most welcome

Relative

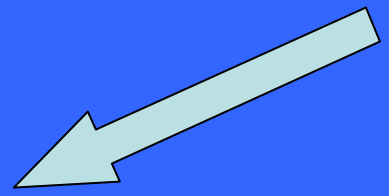
among inner components

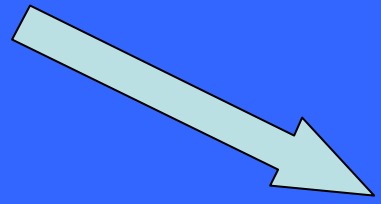
depends on detector design

- **Semi-rigid/fixed parts: tiltmeters, compasses**
- **Moving parts: Non-luminous devices (sonic, other?)**

Time

Timing calibration





Absolute

w.r.t. to UTC

Should not be a major problem (in the msec range)

But several junction points would mean new problems in relative calibration

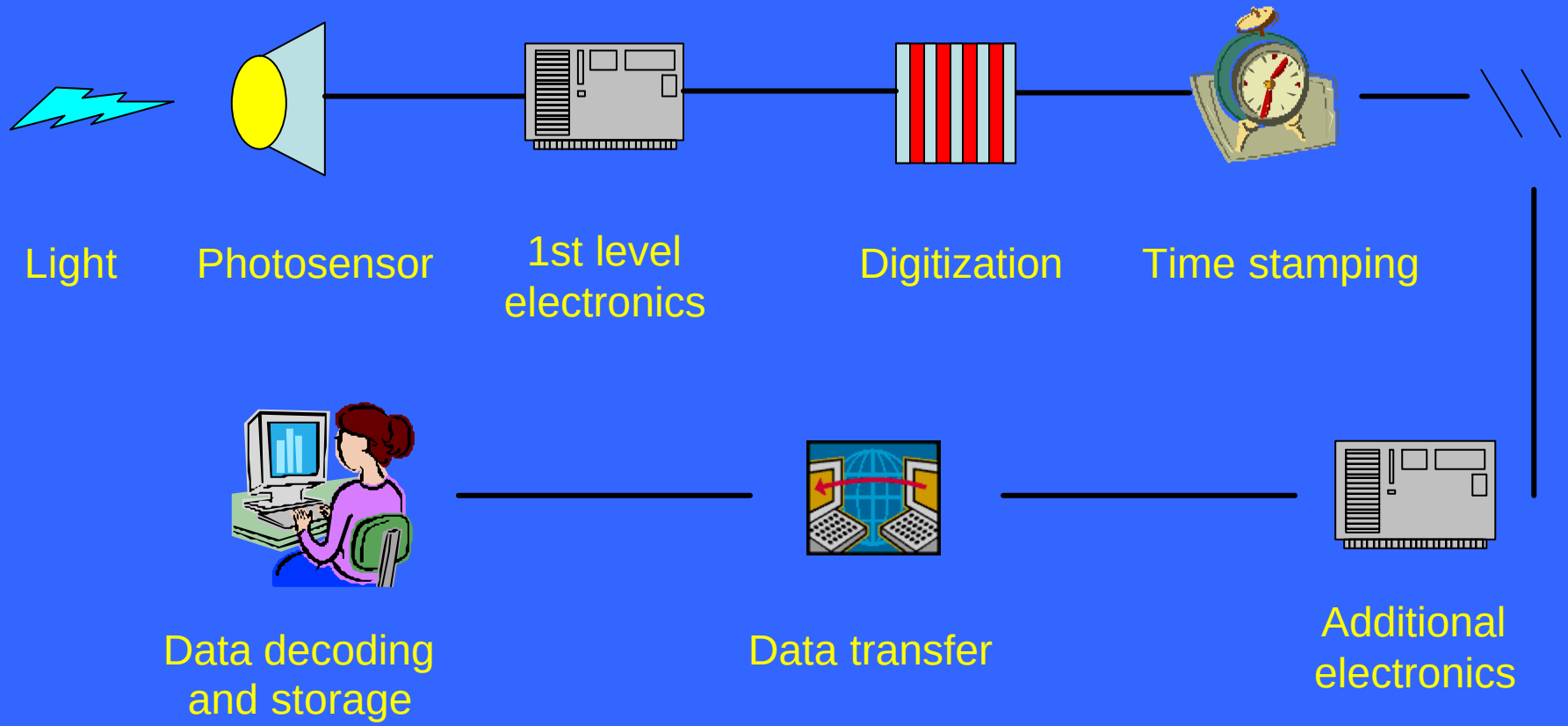
Relative

among inner components

extremely important

- **Affects reconstruction efficiency and angular resolution**
–Limited by intrinsic processes: photosensor time fluctuations, medium time dispersion, electronics.

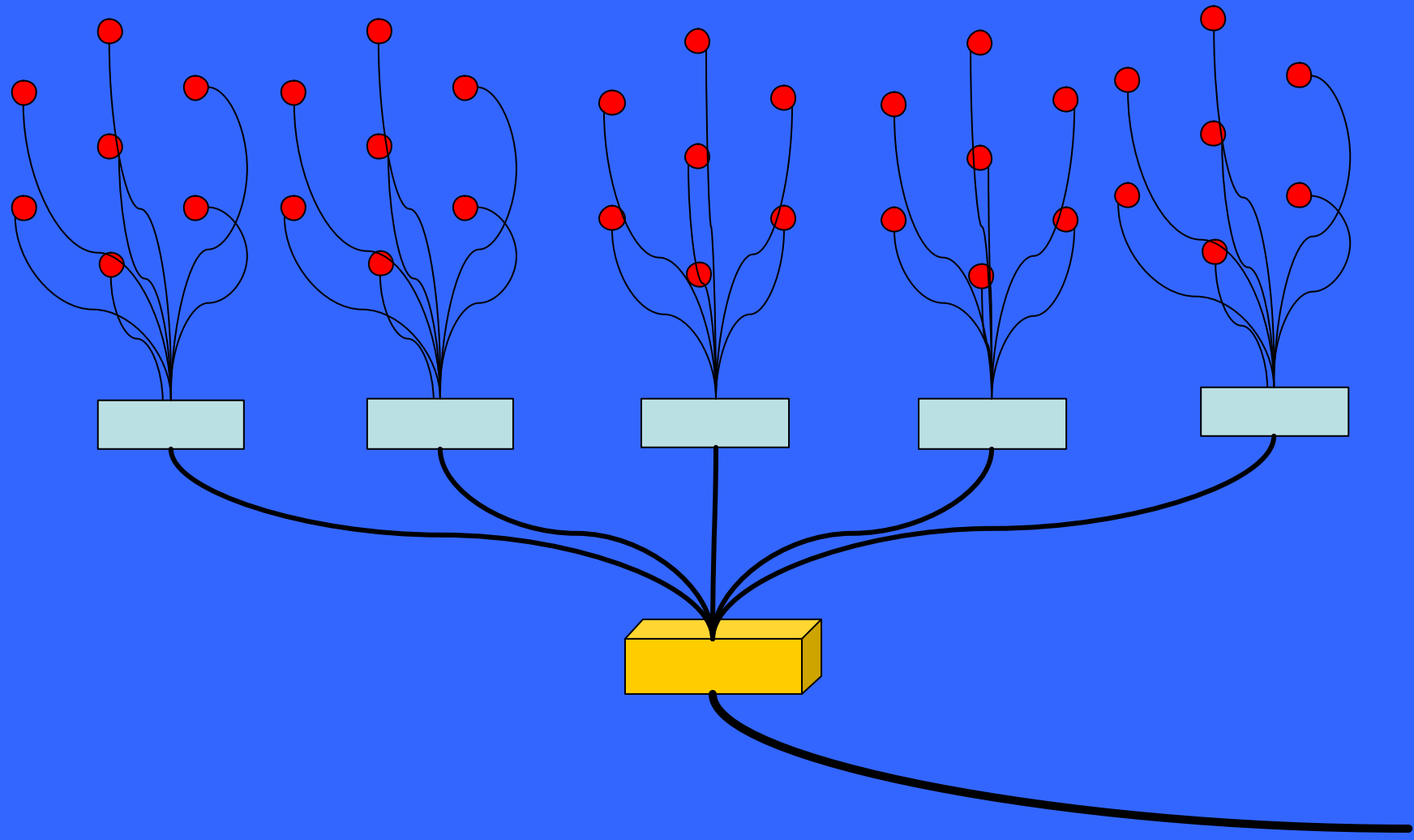
Timing calibration



Each level can introduce **delays**, **jitters** and **shifts** with time

At which levels is convenient to have time calibration? **How?**

Timing calibration



Amplitude

- Photodetectors can be calibrated at the laboratory (the site is a “quiet” place).
- For conventional PMTs, gain can be monitored via ^{40}K (site dependent).
- Transparency losses are more difficult to monitor.
- New devices may need different calibration.

R&D road map

- Study the scalability to km^3 of existing techniques and technologies.
  - Position:
    - Positioning within one detector “unit” (string, tower, etc) and “sub-unit” (storey, floor, star).
    - Relative positioning between “units” Acoustic devices? Systematics @ 1km? Horizontal tracks. How frequently?
    - Absolute positioning (GPS plus several reference points?)
  - Timing:
    - Clock based: echo system, synchronous data.
    - Optical calibration within detector units: through fibers? through the water (shadowing)?
    - Optical calibration among detector units: needed? (redundancy is not a luxury) Feasible? (distance between beacon-OM ~ $?_{abs}$ and $?_{scat}$)
  - Amplitude :
    - Gain calibration via ^{40}K
    - Overall monitoring (transparency loss) more difficult (site dependent)

R&D road map (continued)

- Explore new ideas in all domains:
  - Independent calibration array?
    Far–fetched idea: needs to be studied in detail
  - Synchronous Digital Hierarchy
  - ν beam from CERN??
  - …
- Start studies with some likely designs

Summary

- The review of existing/near future detectors showed common basic approaches to calibration.
- Are these concepts scalable to a km3 detector?
- New ideas are needed and already some appeared and were discussed.
- Calibration is closely related to other topics. Next step requires an interaction with convenors of other task groups.

END OF TALK

Synchronous Digital Hierarchy (SDH)