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LIGO-3 straw man design process: Warm-up telecon

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WELCOME

- Welcome everybody. Thanks for signing up for this activity.
- Looks like we are around 20+ people. Good mix of experienced people and young, highly motivated people.
- Also really good spread of expertise: Thermal noise, interferometry, suspension etc.

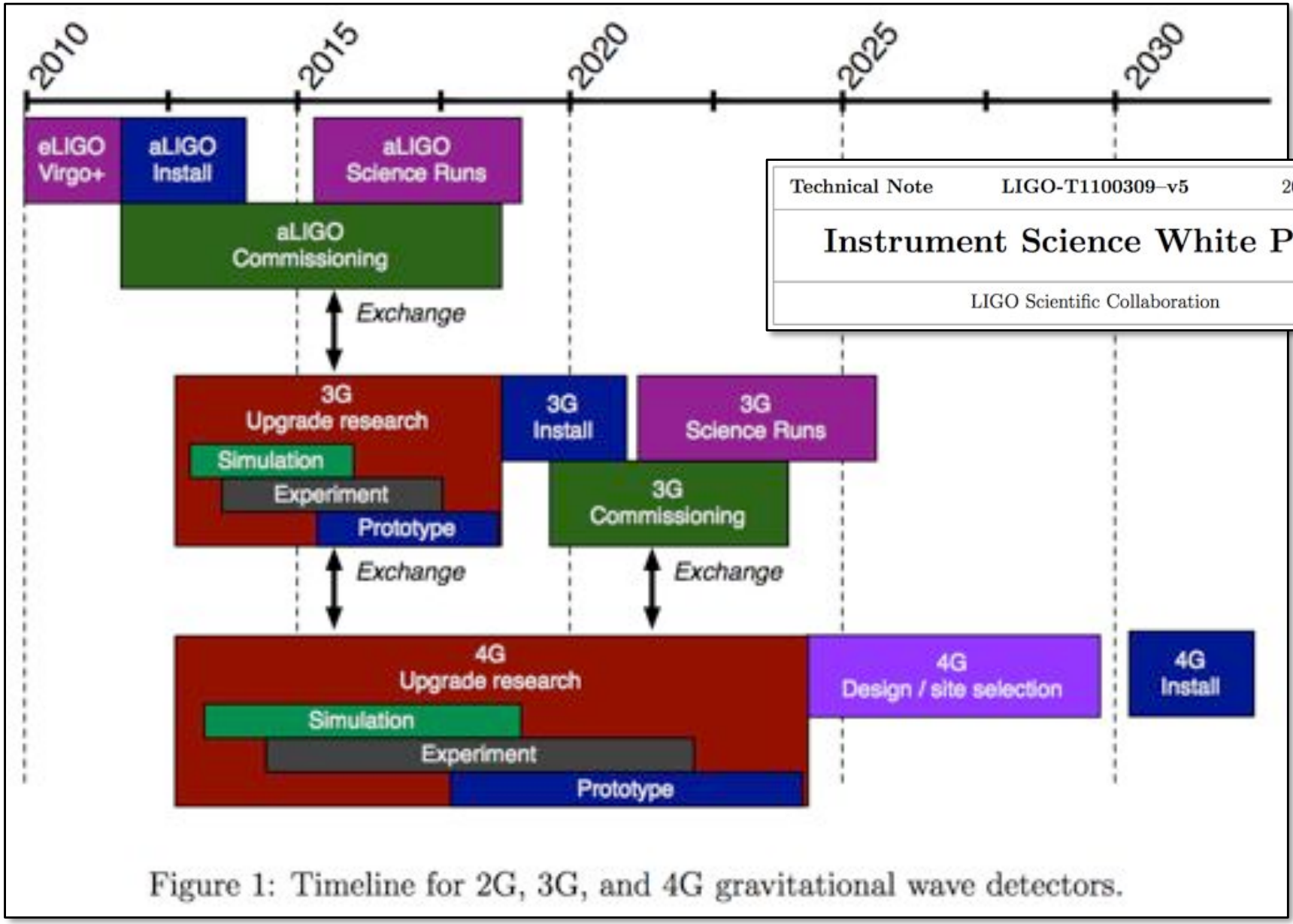
- So we should be well equipped to do some useful work!

What is our task?

- That is a good question. And the answer is not necessarily clear. :(
- Email from Eric to LSC: *"... it was proposed that three teams be created to work through the details of three different "straw man" configurations for possible 3rd generation detectors. This design work would be followed by a competition comparing the different approaches. This is not a "real" competition for funding but instead an exercise to focus our thinking about what research and development we will need to do over the next few years to be in a position to build the next detector."*
- Apart from this there is no official task description giving any details on constraints in terms of money, infrastructure and timelines.
- Please note 1: 'Competition' might not be the best term. Perhaps we should rather think of 'comparison'.
- Please note 2: There are also no constraints on how different or similar the 3 straw man designs shall be. 'Very similar' and 'very different' both have advantages and disadvantages.

So is our task to design a US ET?

- Can't we just 'copy' our design for the European third generation detector ET?
- NO, as the term third generation is used differently in the ET community and the LSC.
- ET community: Third generation is at underground location therefore requires new infrastructure.
- LSC whitepaper 2011: Third generation are all upgrades to Advanced LIGO and therefore 3G uses the Advanced LIGO facilities (with minor modifications). Any US detector beyond the Advanced LIGO facilities (for instance underground location) is referred to as fourth generation.



Technical Note LIGO-T1100309–v5 2011/10/08

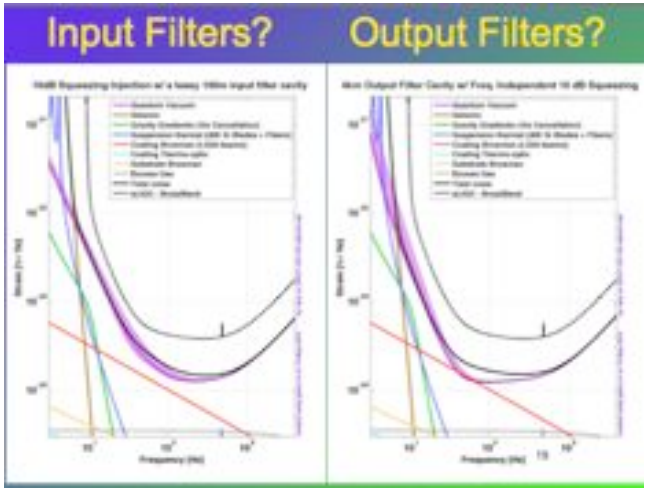
Instrument Science White Paper

LIGO Scientific Collaboration

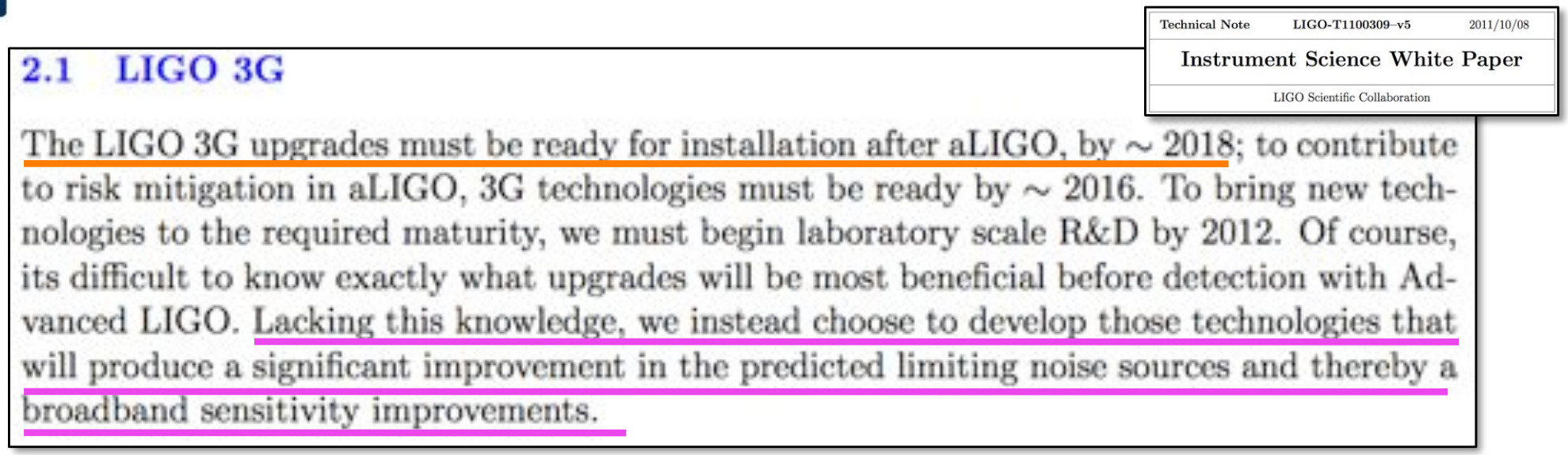
Figure 1: Timeline for 2G, 3G, and 4G gravitational wave detectors.

A bit of background

- Obviously Advanced LIGO upgrades have been discussed already for quite some time.
- The first time they got 'real' attention was in a talk by Rana ('Enhancing the 2nd generation interferometers', G1000524-v1) at the GWADW in Kyoto in May 2010.
- Since then there have been presentations on this topic at all major conferences and at most LSC meetings.



Timeline for LIGO-3



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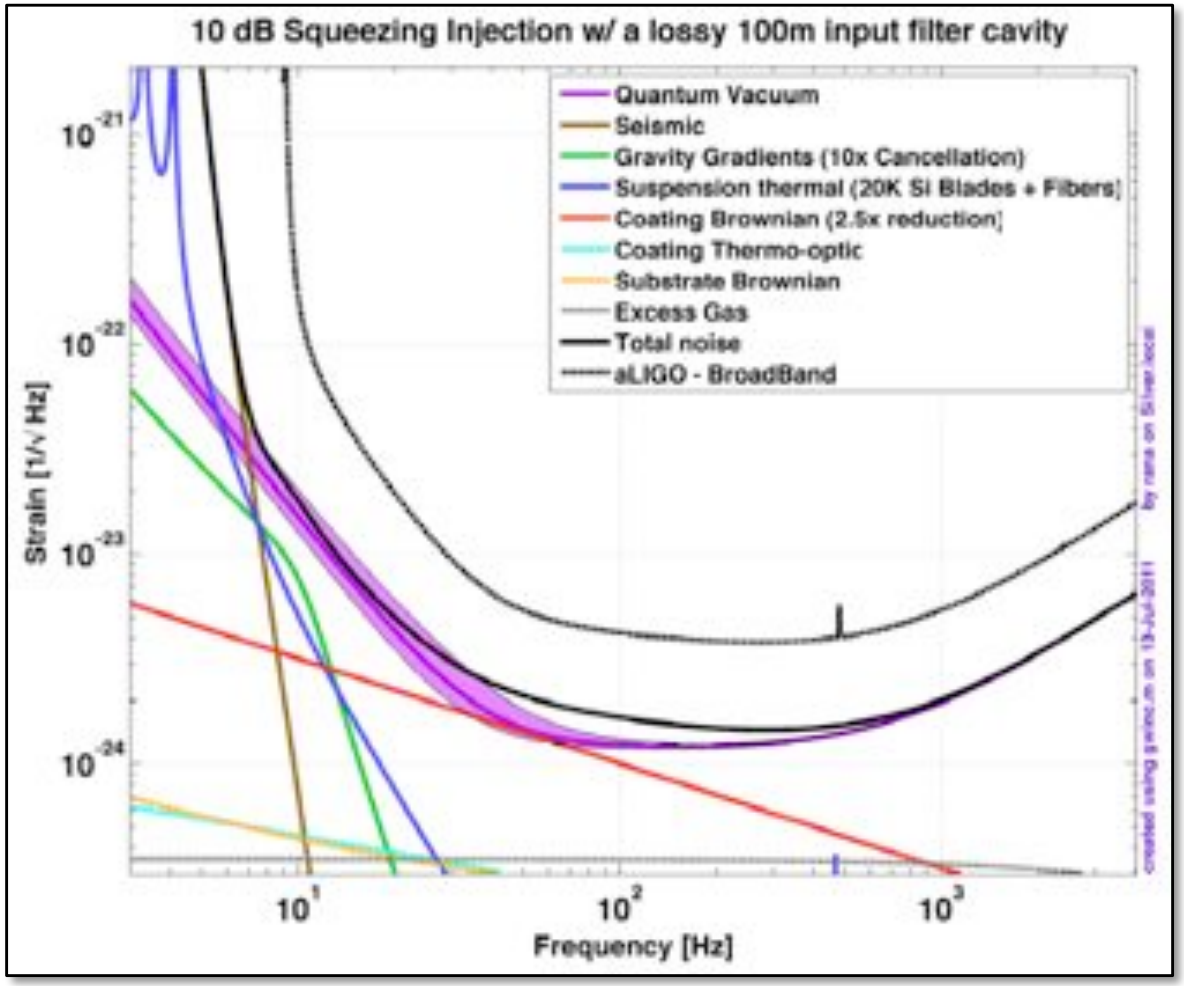
2.1 LIGO 3G

The LIGO 3G upgrades must be ready for installation after aLIGO, by ∼ 2018; to contribute to risk mitigation in aLIGO, 3G technologies must be ready by ∼ 2016. To bring new technologies to the required maturity, we must begin laboratory scale R&D by 2012. Of course, its difficult to know exactly what upgrades will be most beneficial before detection with Advanced LIGO. Lacking this knowledge, we instead choose to develop those technologies that will produce a significant improvement in the predicted limiting noise sources and thereby a broadband sensitivity improvements.

- Want to have plans for upgrades ready in the drawer by end of decade and being able to just pull them out after first detections.
- Counting then backwards from 2018, tells us that we when we have to do what.
- Try to push sensitivity broadband and as much as possible.

From the Gainsville LSC meeting

- Rana's design:
  - Only moderate infra-structure changes (such as adding 100m filter cavity and cryogenics).
  - Cost range 20-100 million dollars.
  - Aiming for sensitivity improvement of factor 3-5.
  - Power limited to 1 MW.
  - Includes some optimistic GGN and coatings.



First question we have to answer for ourselves:

What do we want to do? And what can we realistically achieve over the next few months?

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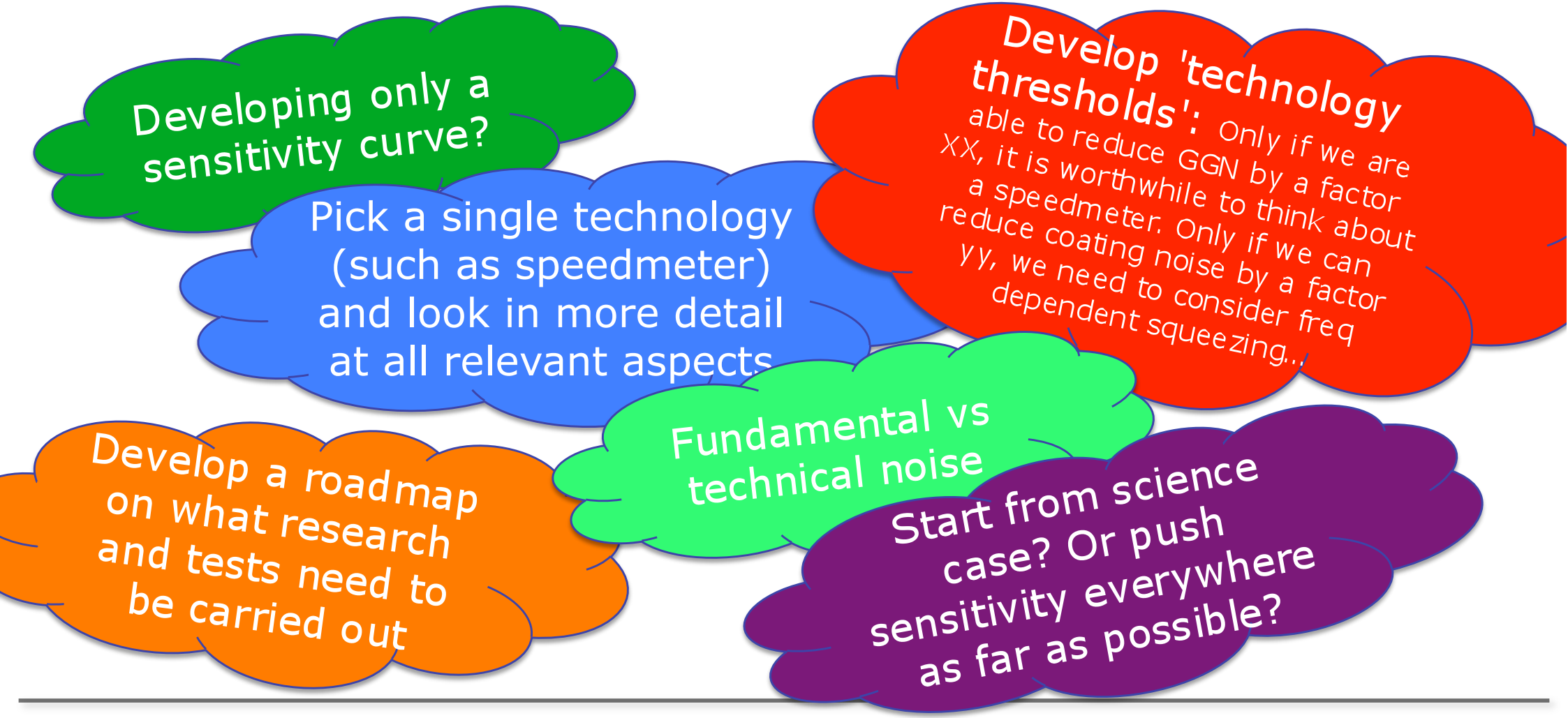
Aims / Targets / Strategies

Obviously we want to come up with a straw man design for LIGO-3. However there might be lots of different approaches:



Aims / Targets / Strategies cont.

- In the end it will probably be a mixture of several of the aspects mentioned on the previous slide.
- However, due to limited man power and even more limited time until the Caltech meeting in January we will have to prioritise, and we should make sure that we are all happy with what we do.

Any Opinions?

Glasgow f2f WORKSHOP

- 3 full (28 Nov 11am – 30 Nov 5pm) days of undisturbed working time in a remote but urban location.
- This will hot phase of our team and we will hopefully get the bulk of the work done.
- How do we want to organise these 3 days?

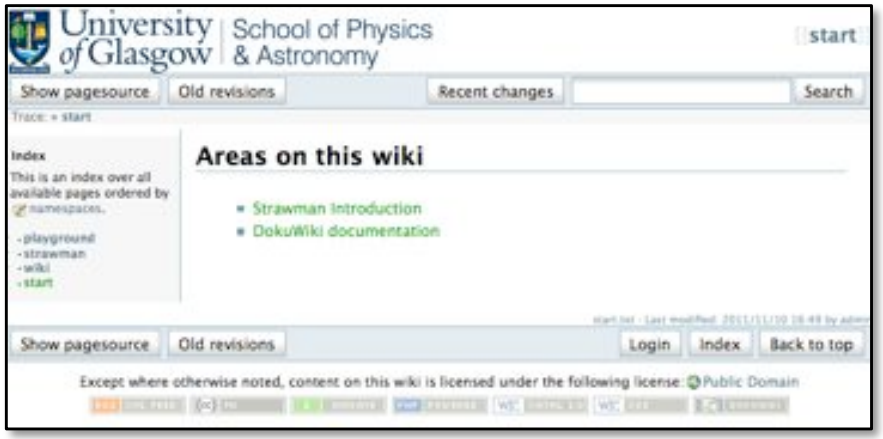
Any ideas or preferences?

Potential dummy schedule for the f2f

- Monday morning: brief intro talks to bring everyone to the same level in terms of what is state of the art and obvious future paths the most important technologies (coatings, quantum noise techniques, suspensions and gravity gradients.
- Monday afternoon: Split into noise related subgroups for exploring crazy 'outside-the-box' approaches. At the end: discussion in plenum.
- Tuesday morning: Each noise group develops 'the best (?)' noise curve.
- Tuesday afternoon: Continue 'best' noise curve + identification of what is need from the other groups for realising this best noise curve. At the end: discussion of cross-compatibility of required technologies.
- Wednesday morning: Split in two groups with experts for each noise. One documents the potential straw man sensitivity. The other group collects open questions and formulates a rough research roadmap.
- Wednesday afternoon: Bringing everything together … access where we are … distributing remaining tasks … pat our backs … etc
- Sounds extremely challenging, close to mad , but perhaps not completely impossible??

Technical Infrastructure

- We will have a wiki and a svn, which are not open to the public and can therefore be used for all crazy ideas we might have and which are not ready for the outside world.
- Everything we want to release to the public we put on the AIC-strawman-wiki or even the DCC.
- Do we need anything else?



http://coll.physics.gla.ac.uk/dokuwiki/doku.php?id=strawman:introduction

https://nodus.ligo.caltech.edu:30889/wiki/doku.php?id=strawman

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'Homework' in preparation for the f2f

- Think of what you want get out of this process? How do want it to be organised? Any suggestions for the f2f meeting? Please share your thoughts, send me wishes or comments etc …
- Have a look at the LSC white paper 2011: https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=62186
- If you have been involved in the ET design study (https://tds.ego-gw.it/itf/tds/file.php?callFile=ET-0106C-10.pdf) try to think which of the technologies in ET could also be applied within the Advanced LIGO facilities.
- Play with the Advanced LIGO GWINC (https://awiki.ligo-wa.caltech.edu/aLIGO/GWINC) and check that you can reproduce the Advanced LIGO broadband curve as shown in trace 1b of Figure 1 in T070247-01. It might be helpful if you check what is inside the code of the functions used to calculate your favourite noise.
- If you then still have free capacity please have a look at the development version of GWINC (https://nodus.ligo.caltech.edu:30889/wiki/lib/exe/fetch.php?media=gwincdev_111109.tar.gz)

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CU at the f2f workshop