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UNIVERSITY

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# milliQan Experiment Kickoff: Goals for the Workshop

***New York University***  
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# Why did Andy and I call this meeting?

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- Its about 1 year since we wrote initial paper with Itay & Eder
  - *Since then, lots of progress in various directions by various people*
  - *Now enough people w. enough different interests that need to organize activity*
    - **Nail some things down to reduce number of options to consider**
      - *Make decisions*
    - **Identify open questions that remain**
      - *Brainstorm*
    - **Focus things on what we need to take project to next level**
      - *Produce outline for EOI/LOI*
      - *Discuss funding strategy*
    - **Divide up effort**
      - *Who does what*
    - **Setup means of communication**
      - *Meetings, e-groups, etc.*



# Long and short-term goals & timeline

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- Have experiment ready for physics before Run 3 (2020)
  - *Construction during LS2*
  - *Take data for Run 3,4,5*
- Install (at least part of) detector by end of Run 2 (late 2018)
  - *Partially commission while beam is present*
  - *YETS 2017 + TS during 2018*
- At least 4 years funding needed for 2017–2020
  - *Commissioning in 2020*
  - *Construction funding for starts in 2018, peaks in 2019*
  - *R&D funding needed for 2017*
  - *Proposal to DOE/NSF in late 2016*
- *Need approval by CMS & LHCC*
  - *EOI to CMS early 2016*
  - *LOI to LHCC in time for June 2016 meeting*



# Goals for this meeting

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- Organize effort so that we can (try to) meet the timeline outlined
  - *Today/tomorrow focus on what needs to be done for EOI/LOI*
- **Before we leave I'd like to divide up work on the necessary topics that we will have to address in such a document:**
  - *Physics Case*
  - *Site Selection*
  - *Detector Modules (scintillators, tubes, etc)*
  - *Backgrounds & Shielding*
  - *Mechanics*
  - *Cooling*
  - *Readout*
  - *Powering*
  - *Cost*
- Organized sessions in this meeting along these lines ...



# Main Question to settle

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- Where will put the experiment? Need to nail this down during the workshop
  - *CMS drainage gallery is leading choice - will hear latest about specific locations today*
  - *Once we choose location, sets longitudinal dimension available for active material which sets sensitivity to  $mCP$  (since  $dE/dx$  low, need  $x$  large)*
  - *Our paper was based on 1.4 m scintillator (x3) and we did account for length of tubes or any other non-active materials*
    - **It seems clear 4.2 m length (which is an underestimate as said above) is not available in drainage gallery**
  - *Since we will have shorter length, recoup sensitivity in other ways*
    - **Do better on background (e.g. cool tubes)**
    - **Do better on efficiency (e.g super biakali tubes)**
    - **Increase acceptance (increase from 1 x 1 m array)**



# Other Open Questions to Discuss

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- What should be the size of the scintillator bar in the transverse dimensions?
  - *In paper we used 5 cm x 10 cm, is this too big? too small?*
  - *Should it be the same as you go along longitudinal dimension, or should bars be tapered?*
- What kind of plastic scintillator? (Assume we can dismiss more complicated things like liquid ...)
  - *Questions of light yield, wavelength, self-radioactivity etc.*
- What kind of tubes? What size?
  - *bi-alkali, super bi-alkali, ultra bi-alkali*
- Where do you put tubes?
  - *In paper, naively place tubes on one end. What about on both ends?*
  - *Both of these eat into active material available. What about between bars?*
- How do you get light out with maximal efficiency?
  - *Mate transverse size of bar to PMT size?*
  - *Something else?*
- What is right balance between efficiency vs. cost?
  - *My feeling is not too skimp here, efficiency will be the name of the game*
- What temperature do we want to cool tubes to?
  - *Do they need to be directly cooled or is indirect cooling (e.g. Cu) sufficient?*
- What materials/thickness (e.g. Cu) use to shield EM noise?
- What materials/thickness use to shield radioactivity and/or cavern backgrounds?



# Other open Questions to Discuss (cont.)

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- After mitigating thermal noise with triple-incidence and cooling, what will dominant background be? What about sub-dominant backgrounds?
  - *What additional in situ measurements are needed to confirm this?*
  - *How can we estimate rare signal like background events?*
- Effects of CMS magnetic field?
  - *Deflection of  $Q=1e$  pls*
  - *Deflection of  $mCP$*
  - *Residual field in drainage gallery*
- What are mechanical requirements?
  - *Needs to be able to support  $> 5000$  kg*
  - *Needs to be able to align to  $IP$*
  - *Needs to be retract to allow passage?*
- What are readout requirements?
  - *What will we readout? How often?*
  - *Is deadtime due to  $Q=1e$  negligible as we have assumed?*



# Other (less pressing) Questions to Discuss

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- How will we work with CMS?
  - *Formally associated but independent experiment (a la TOTEM) or something else?*
- How many institutes/people do we think we need?
  - *What resources do we have now in our groups? Should tally FTE*
    - **UG, grads, postdocs, engineers**
- Should we seek funding from DOE or NSF? Or Europe? Or somewhere else? Or all of the above?
- How do we fund R&D activities until we get formal funding?
- How should we meet? How often?
  - *Vidyo, once a month? more or less?*
  - *e-groups for mail?*
  - *common e-log for work?*
  - *When have next “collaboration” meeting? Where?*

# Summary

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- Things I want to have before we leave (or by email shortly thereafter):
  - *Informal commitment from those who will sign EOI*
    - **No hard feelings for those who don't want to, or can't**
  - *Decision of site location and relevant dimensions of position*
  - *Outline of EOI/LOI with (interested) people in charge of chapters*
  - *Matrix of who will do what R&D*
  - *List of resources available at each (interested) institute*
  - *Tentative plan for next meeting*
- I am glad so many of you could make it, I hope and think it will be a productive meeting
  - *Thanks a lot to Andy for hosting!*