

Scott Gaudi:Greetings. We will get started in a few minutes.

Scott Gaudi:The audio for the webex is not working, so please call in to the regular phone line. Please mute unless you are called on.

Shawn Domagal-Goldman:We can hear you!

Steve Unwin:24 participants !

Eric Agol:What is the phone number/passcode?

Howard MacEwen:What is the phone number?

Gabriel Rangel:818-354-4044 ID 15154700

Shawn Domagal-Goldman:Apparently some people are getting a plumber when calling that number

Shawn Domagal-Goldman:I think they need the toll-free number:

Shawn Domagal-Goldman:TOLL FREE: 844-575-9329

Ravi Kopparapu:what is the band range for Far IR?

Shawn Domagal-Goldman:Scott, will these slides be posted?

Avi Mandell:These slides about the missions are posted on the COPAG website, under the heading for the Joint EC meeting

Shawn Domagal-Goldman:Thanks, Avi!

Aki Roberge:Scott, can you reiterate the questions we actually need to answer, and when?

Aki Roberge:OK, never mind.

Shawn Domagal-Goldman:Scott, you may want to expand the attendee list window now that you're not sharing things. It will help you find the people with "hands raised."

Aki Roberge:\$627M

Avi Mandell:Is there any 'minimum' cost for flagships versus probes?

Aki Roberge:Approximately \$1B boundary between probes and flagships.

Aki Roberge:I think

Avi Mandell:Just want to weigh in on Joint reports

Shawn Domagal-Goldman:Scott, if I remember right everyone had WFIRST-starshade in their "matrix" of suggestions at some level at the in-person SIG meeting at JPL.

Scott Gaudi:Shawn: agreed

David Bennett:If we are going to make any change in the WFIRST instrumentation, we should get some sort of peer review report telling NASA that this is a priority.

Aki Roberge:Paul Hertz seemed unenthusiastic about taking much action on WFIRST-S before the official decadal process.

Shawn Domagal-Goldman:Also, it should be noted that the Exo-S Final Report examined the science that could be achieved without any changes to the WFIRST instrumentation.

Avi Mandell:Agreed

David Bennett:Aki, it definitely complicates things for Paul, but if it is important for the starshade, we should speak up anyway.

Shawn Domagal-Goldman:I agree with Nick entirely. I'm a HUGE fan of TPF-I, but it's not ready for this decade and I wouldn't be in favor of studying it now.

Shawn Domagal-Goldman:However, this is one of the ways a Far-IR surveyor would be beneficial to our community, depending on what architecture they select.

Amy Lo:just FYI I'm taking notes, and am capturing the contents of

chat window. Hope no one minds.

Natalie Batalha:I agree, Shawn, with regards to the Far-IR surveyor. I'm anxious to see progress with interferometry missions leading up to the exoplanet mission we want some 20-30 years down the road.

Aki Roberge: We're also thinking about pushing LUV0IR to as long wavelengths as possible.

David Bennett:That's great, Amy. Thanks!

Aki Roberge:No

Aki Roberge:One more thing, Scott

Shawn Domagal-Goldman:The point David is making for probes vs. flagships is critical, IMO.

Joshua Pepper:Have there been any advocates within the ExoPAG for the X-ray mission? Would it be in our interest to recommend subtracting it as not significantly contributing to exoplanet science?

Avi Mandell:The key is that you want a "apples-to-apples" comparison. This will be critical to avoid dissension and fragmentation in the overall Exoplanet community

Daniel Apai / UA:I agree with Avi, that is important.

Shawn Domagal-Goldman:It should be the minimum increase in our science knowledge compared to the next "bin" down.

Shawn Domagal-Goldman:There may be science questions worth asking/ answering that could also be accomplished for less, for example.

David Ciardi:@Shawn - I agree ...

Sally Heap:Is there a case to be made that a LUV0IR extended into the IR could be used to characterize transiting planets?

Aki Roberge:Sally, yes, we think so. But not too far into the IR.

Avi Mandell:Simulations suggest a 5-micron cut-off will give good transit science even for a room-temperature telescope

Sally Heap:I was thinking about extending the max wavelength to 5 microns

Eric Agol:How long, Aki?

Aki Roberge:What Avi said. ~ 5 microns.

Aki Roberge:But only for transit spectroscopy, not direct spectroscopy. The latter probably will cut off at ~ 2 - 3 um.

Avi Mandell:(probably more like 2, or 1.8)

Aki Roberge:TBD

Shawn Domagal-Goldman:I agree with your assessment of what I said :)

Avi Mandell:One science team and 2 engineering teams!

Eric Agol:So the coronagraph would not operate out to 5 micron?

Aki Roberge:Eric, no the IWA blows up. And also the thermal background is intolarable.

Natalie Batalha:Seems there is consensus on the science goals. If the STDT is split into two, I wonder if we set up a dynamic whereby each group falls into the trap of advocating for their particular project instead of looking for the most effective way of accomplishing the science objectives that we all agree on.

Alan Boss:According to Paul Hertz: "A Science and Technology Definition Team (STDT) will be appointed for each mission concept study selected by the Astrophysics Division Director. "

Sally Heap:Since the inner working angle tends to scale with

wavelength, a coronagraph operating at 5 microns would not be attractive.

Natalie Batalha:Yes, Avi: subcommittees of one team working, each working on different technology aspects.

Avi Mandell:But you could make an argument for longer-wavelength coronagraphy for non-exoplanet work, such as disks...

Daniel Apai / UA:I suggest two STDT teams but with a few shared members.

Avi Mandell:Daniel, I see your point, but I think the overlap between HabEx and LUV0IR is so significant that you'd have a huge overlap, in both exoplanets and astrophysics

Aki Roberge:What Rus said!

Aki Roberge:HabEx is a small LUV0IR

Avi Mandell:I disagree! Engineering is completely different for monolith vs segmented

Avi Mandell:So engineering effort should be separate

Gabriel Rangel:(Bertrand): 2 design teams required for sure. Possibly 1 science team.

Aki Roberge:The LUV0IR in the Roadmap was monolith OR segmented.

David Ciardi:@Aki ... I think HabEx \*could be\* a small LUV0IR if designed in the right way

Shawn Domagal-Goldman:That was one thing that there seemed to be consensus on at the last meeting - that Hab-Ex is likely less capable than LUV0IR would be, based on their descriptions.

Aki Roberge:But I agree, the technology differences between monolith vs. segmented are significant -> design teams. But the science is more of a continuum.

Avi Mandell:Exactly!

Aki Roberge:-> 2 design teams

Avi Mandell:Rus and Aki - you have hands up. Is that current, or do you want to "un-raise" your hands?

Aki Roberge:I want to say something.

Avi Mandell:K

Sally Heap:I'd like to raise my hand, but I don't seem to be able to do it.

Gabriel Rangel:(Bertrand) common Exoanets + general astro science team, and 2 design teams generating input for mission instrumental parameters to be folded in a common science yield estimation

Avi Mandell:Yes!

Natalie Batalha:What Jim said! That was my earlier point as well.

Amy Lo:is this Jim talking?

Avi Mandell:Jim Kasting

Shawn Domagal-Goldman:This is Jim Kasting

Amy Lo:thankz

Shawn Domagal-Goldman:So far, I've heard a LOT of agreement that we need two design teams. (And I meant to indicate that when I spoke, as well.)

Sally Heap:I'd like to suggest a different tack: to summarize the science we want to accomplish, and then summarize the technology that needs to be developed before committing to a specific type of

telescope.

Shawn Domagal-Goldman:But there also seems to be a significant amount of agreement (although not unanimity) of having one science team.

Joshua Pepper:Sally, you can raise your hand using the small drop-down box at the top

Avi Mandell:Aki first

Avi Mandell:i mean, before me

Aki Roberge:Sally, there's a little icon of a person with their hand up. You can raise your hand with that drop down menu there.

Shawn Domagal-Goldman:I also have noted that everyone (I think) agrees there should be at least some small amount of overlap in team composition. The question is how much over lap.

Gabriel Rangel:(Bertrand): agreed

Sally Heap:Aki, my icon is frozen

Shawn Domagal-Goldman:As a fellow Exo-S team member, I agree with Aki's assessment.

Avi Mandell:I agree as well (even though i wasn't on the teams)

Natalie Batalha:I agree with Aki: one science team, two design subcommittees.

Avi Mandell:I don't agree with referee team!!

Avi Mandell:Will lead to arguments, not negotioations

William Sparks:can someone clarify if there is a consensus that LUVOIR can do HABEX but not vice versa?

Natalie Batalha:Seems we're discussing implementation before science goals.

Sally Heap:no

Amy Lo:Sally call the telecon line

Bill Purcell:Is there some way to develop a "figure of merit" for the scientific objectives which could be used to evaluate various design options (including HabEx vs LUVOIR)?

Aki Roberge:Bill, that's harder than you think to actually achieve. Lots of assumptions, different possible methodologies.

Aki Roberge:We tried for Exo-S and Exo-C.

Rus Belikov:Bill, I think the choice between HabEx vs. LUVOIR would (to first order) come down to available budget and not science figures of merit

Sally Heap:My suggestion is to have two science teams, as the COPAG science objectives are different from a those of the ExoPAG. Each science team needs to identify the technologies that need to be developed before we can credibly present the case to Astro-2020. Our recommendation to Paul Hertz might be to put a lot more money into technology development in FY16-FY19.

Avi Mandell:Agree with Chaz on that -- fragmentation between exoplanets & astrophysics is a big risk

Alan Boss:I agree with Sally, though with some overlap of the two science teams.

Shawn Domagal-Goldman:My hand is now lowered, but I want to say I wholeheartedly agree with Chas on the risk for community fracturing being much lower than it was last decade.

Aki Roberge:What Avi just said!

Jim Kasting:Yes, I'm with Shawn and Chas. I think we'll end up with a direct imaging mission no matter what.

Jim Kasting:Note that the minimum science requirements for a Habex mission have already been fairly well laid out. We did this on TPF-C ten years ago.

Avi Mandell:Where did the cost cap come from??

Shawn Domagal-Goldman:But again, this argument presumes we already know the best way to get under the cost cap. We do NOT know that yet.

Avi Mandell:Or at least a ranked list...

Sally Heap:The COPAG and ExoPAG have different scientific objects, but both groups long for a large telescope because the interesting targets are faint. Couldn't both groups get help from a single telescope technology team?

Alan Boss:As someone who was a part of the crucial votes for Astro2010 EOS, the real battle was between WFIRST, SIMLite, and IXO. Only the rank ordering of the top three mattered. In the end, only the top ranking mattered, i.e., WFIRST.

Shawn Domagal-Goldman:Good point, Amy.

Avi Mandell:Can people "un-raise" their hands if they are done talking?

Amy Lo:Current summary of options:Agreement on design team: 2 engineering/design teams for HabEx and LUV0IRScience team options: 1) 1 integrated science team; 2) 2 separate science teams; 3) 2 science team with a referee.

Aki Roberge:Interesting suggestion, Dave.

Shawn Domagal-Goldman:Amy, it's also worth pointing out that everyone seemed to agree that there should be \*some\* overlap if there are two science teams.

Aki Roberge:Steve, U. didn't just we do that with Exo-C and Exo-S?

Amy Lo:got it, I'll note that

Natalie Batalha:Amy: I don't think number 2 is an option. There must be some kind of integration either by having an umbrella science team or by having a referee team. Perhaps Shawn was implying the same.

Amy Lo:revised: Science team options: 1) 1 integrated science team; 2) 2 separate science teams with some shared member/overlap; 3) 2 science team with a referee.

Shawn Domagal-Goldman:I guess knowing the X-ray inputs to planetary atmospheres would be useful? (I'm stretching here.)

Shawn Domagal-Goldman:Yes, what Scott is saying.

Shawn Domagal-Goldman:We can state this discussion Aki and Scott are having - the X-ray sureyor would give us data on high-energy inputs to exoplanet atmospheres. However, UV data are likely much more important data for that science case.

Alan Boss:Evgenya Shkolnik studies exoplanet magnetic field interactions with host star field via x-rays. X-rays are also of interest for habitability for M dwarfs.

Amy Lo:is this Avi?

Aki Roberge:That was David Ciardi talking right now.

Amy Lo:ah, thanks

David Ciardi:@Amy ... yes, that was me.

Amy Lo:got it, thanks!

Amy Lo:the very next discovery call eliminated all Exoplanet science...

Shawn Domagal-Goldman:Discovery: \$450M cost cap, proposed mission on any topic

Shawn Domagal-Goldman:New Frontiers: \$1bn cost cap, but you can only proposed on missions on a subset of science goals defined in the decadal survey and mid-decadal review

Alan Boss:In Astro2020, the Exoplanet Mission that was recommended was essentially a probe-class mission. It was bigger than the "medium-class", which is where Explorer-class falls.

Alan Boss:oops, make that Astro2010 -- Freudian-slip!

Bill Purcell:Isn't one of the issues trying to keep the JWST funding wedge within Astrophysics?

Bill Purcell:I've heard Europa has eyes on it...

Natalie Batalha:Perhaps an interferometry pathfinder would also fit within the probe-class or New Frontiers box

Alan Boss:Actually, even Explorers fell in the "large-class" in Astro2010 -- the "medium-class" was limited to \$200M or less, e.g., technology development programs.

Shawn Domagal-Goldman:We have to be careful here.

Shawn Domagal-Goldman:There are implications with how we make this recommendation.

Shawn Domagal-Goldman:Just to put my sentiment into words - we have to specify details with "New Frontiers for Astro" type suggestions. What's the cadence? What's the cost cap? What's the list of science cases people could propose to address? Would there even be such a list? Etc...

Amy Lo:thanks Shawn! you were dropping out and I didn't catch it all

Shawn Domagal-Goldman:I also want to ensure that we keep our discussion here on the exoplanet advantages/disadvantages to such a recommendation.

Natalie Batalha:"The yield is a continuum," says Aki. Yes, but at some point, as we descope other science becomes more compelling.

Aki Roberge:Natalie, yup. I just don't exactly know yet where the break point is.

Gabriel Rangel:(Bertrand): in case of non detection of habitable planets, the question is what upper limit on the true fraction are you ready to live with? 1%, 5%?

Aki Roberge:Bertrand states it well.

Aki Roberge:Or Gabriel, I'm not sure.

Gabriel Rangel:Bertrand using Gabriel's computer

Rus Belikov:I would adjust Bertand's statement to "fraction you are ready to pay for"

Rus Belikov:5% may be more attractive than 1% if significantly cheaper

Alan Boss:Thanks, Scott, for running this today!

Aki Roberge:Yes, thanks very much, Scott.  
David Ciardi:thanks scott