



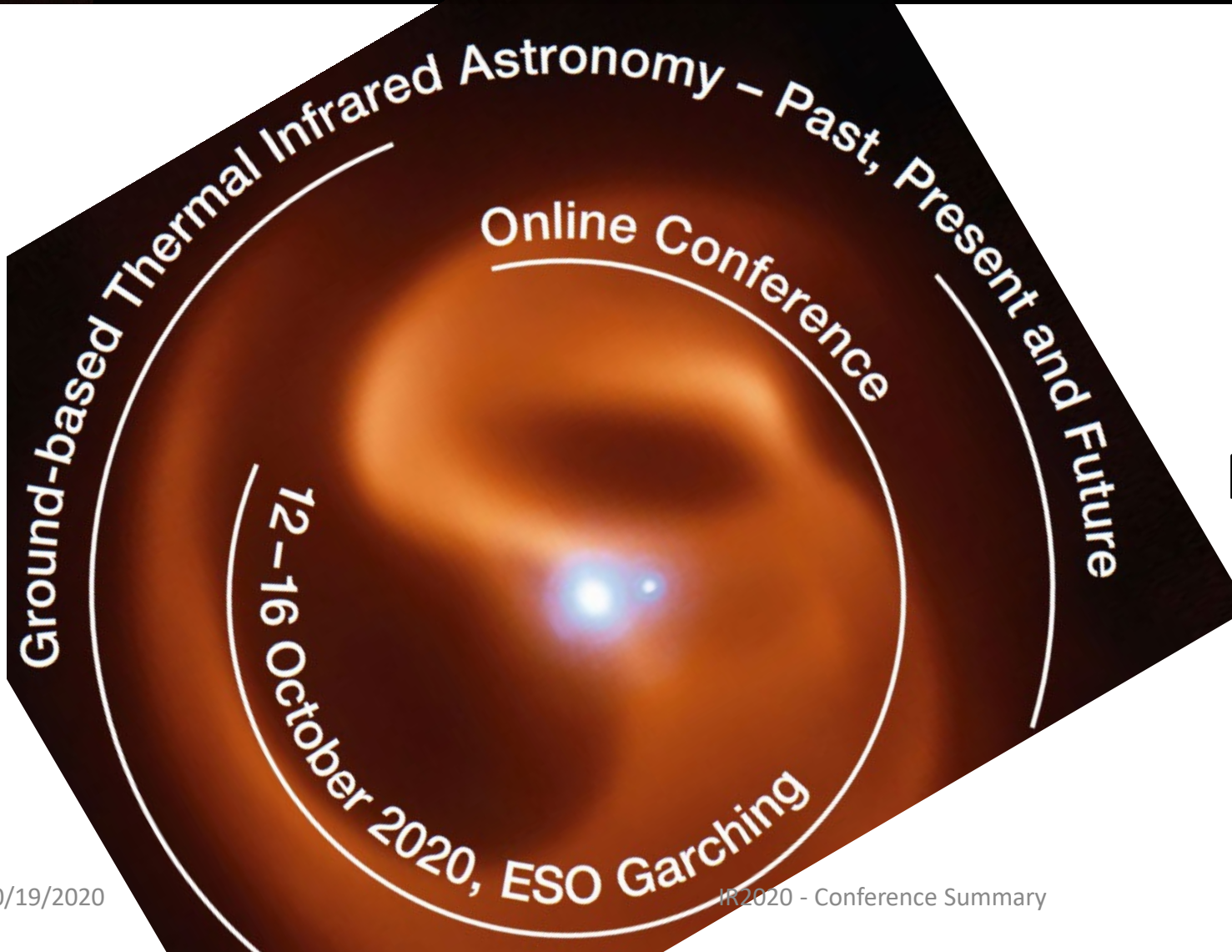
IR2020 Conference Summary

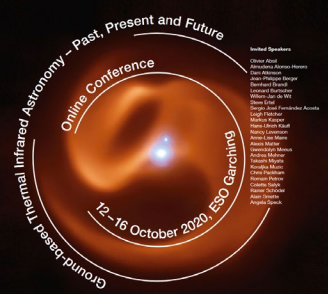
by

Bernhard Brandl (part I)

&

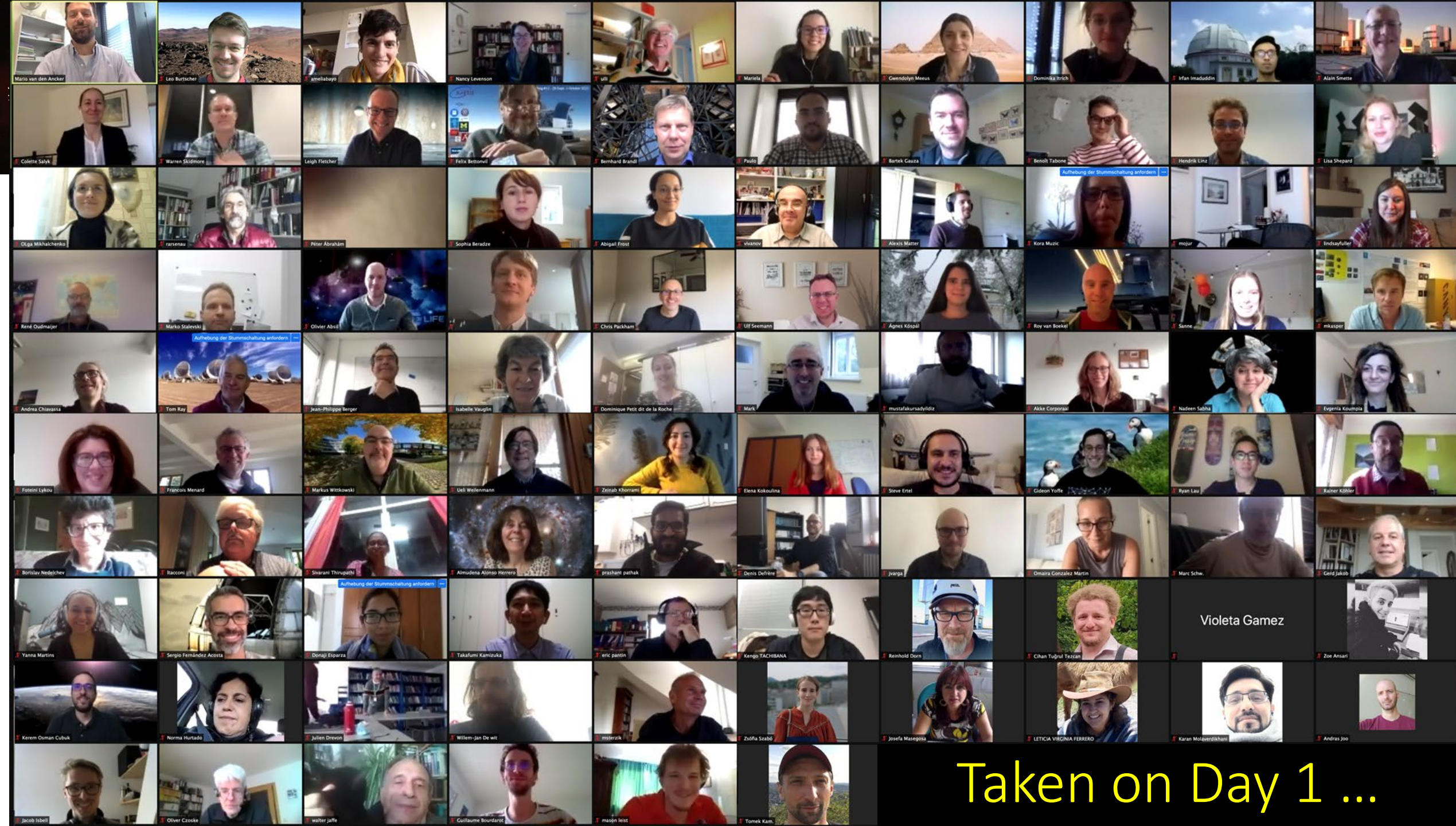
Nancy Levenson (part II)





The Time-Zone Challenge – Special Thanks to all Asian and American Attendees!



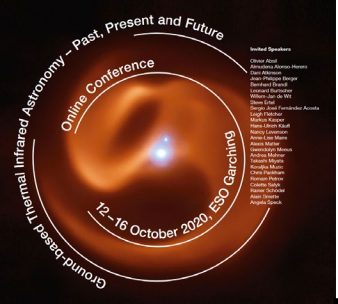


Taken on Day 1 ...



After one week...Have we all become Zoombies?





One Week of great Science and Instruments!

“Ground-based thermal infrared astronomy – past, present and future”

It was *not* evident that we were focusing on “ground-based”

The focus was clearly on science – *as it should be!*



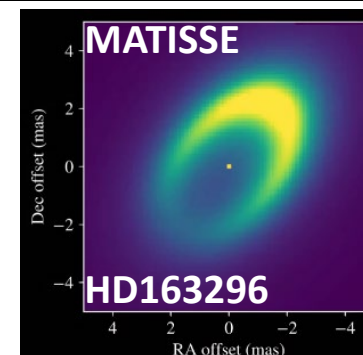
Disclaimer

The following selection has a high personal bias. I have not attempted to be complete or representative. Not being mentioned does not indicate less significant results!

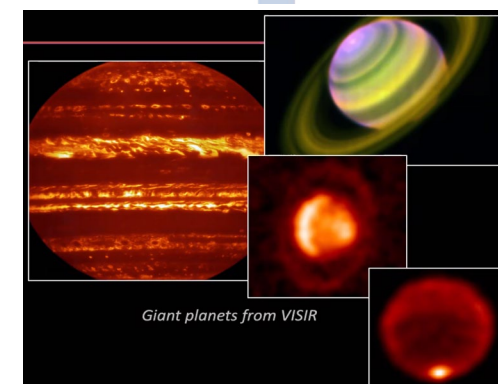
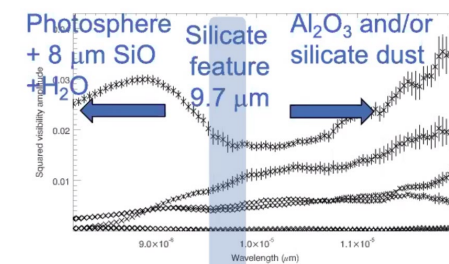


We heard many great Science Talks !!!

- **Proto-planetary disks** (Gwendolyn Meeus, Colette Salyk, **Jozsef Vargas**, Abigail Frost, Kevin Wagner, Julien Drevon, Alexis Matter)
- **Young stars** (Lei Chen, Péter Ábrahám, Ágnes Kóspál, Stefan Kraus, Andrea Mehner, Ian Crossfield, Steph Sallum, Foteini Lykou)
- **Evolved stars** (Ryan Lau, Claudia Agliozzo, **Markus Wittkowski**, Pierre Kervella, Narsireddy Anugu, Lisa Shepard, Kengo Tachibana, Gideon Yoffe)
- **Exoplanets** (Thayne Currie, Dominique Petit dit de la Roche)
- **Solar System objects** (**Leigh Fletcher**)
- **Dust, PAHs, ISM** (Florian Kirchschrager, Elena Kokoulina, Patrick Roche, Benoît Tabone, Angela Speck)
- **Luminous galaxies** (Almudena Alonso-Herrero, Yanna Martins-Franco)
- ...and many great posters!

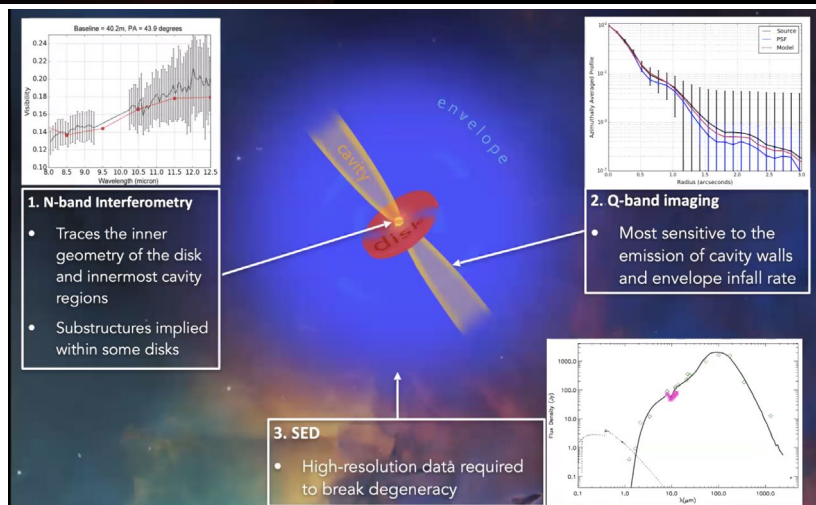


linking molecular layers to dust forming zones by imaging

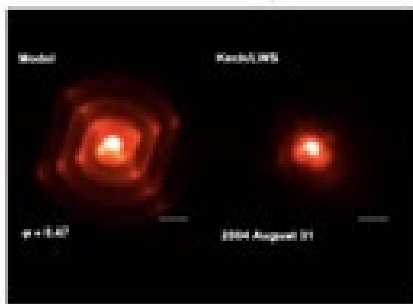


Topics indicate: Ground-based mid-IR Astronomy = “compact Object Astronomy”

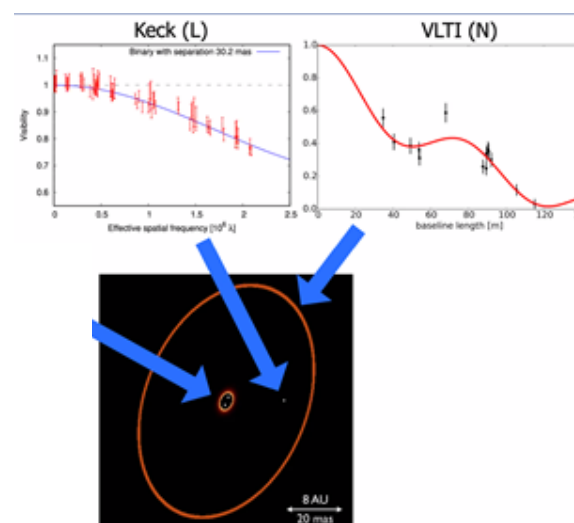
We clearly need ground-based mid-IR!



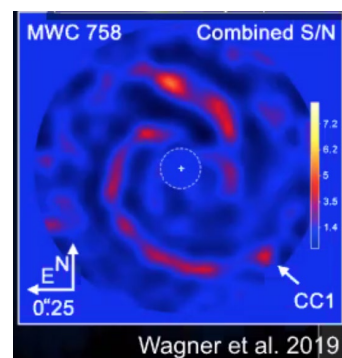
Abigail Frost: Need data at highest angular resolution to distinguish between disk and cavity emission



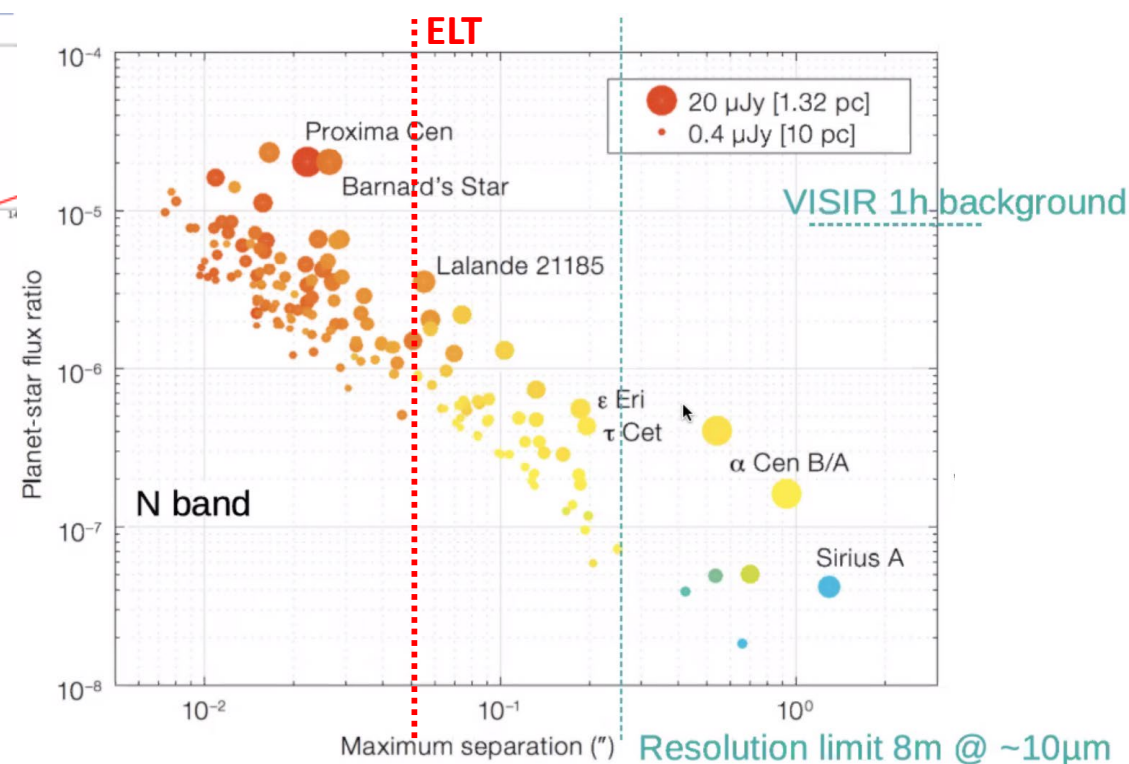
Ryan Lau: Need long-term studies (~20 years) to study dusty streams from WR stars



Stefan Kraus: Need interferometry to study circum-binary/-tertiary/-triple disks



Steve Ertel: Structure and asymmetries in pp-disks



Anne-Lise Maire: Angular resolution is essential to directly image exoplanets



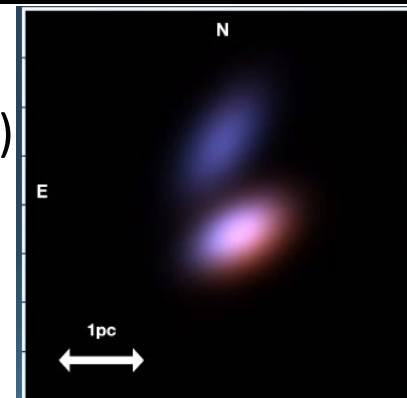
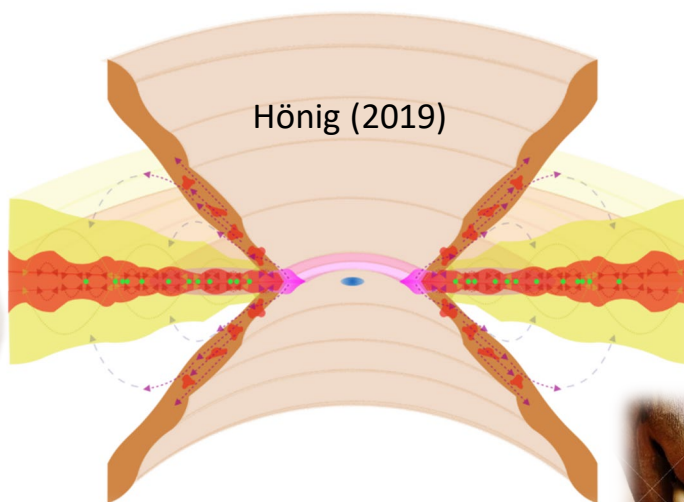
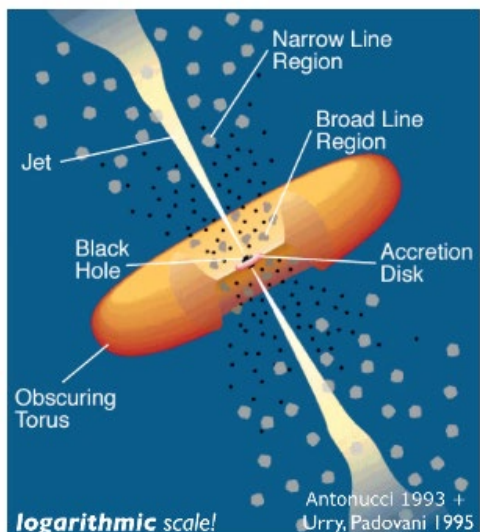
Romain Petrov:
FS CMa



AGNs are *the* Showcase for mid-IR Interferometry!

- **AGNs** (Leo Burtscher, Violeta Gámez Rosas, Jacob Isbell, Marko Stalevski, Omaira González Martín, Mariela Martinez, Donaji Esparza Arredondo, Enrique Lopez Rodriguez, César Victoria)

Leo: “The torus model is dead!” → “Long live ... a more complicated torus-like structure...”

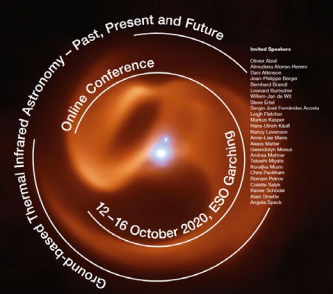


Violeta Gámez Rosas:
MATISSE results on NGC1068 – what is the nature of NC and SC? (dusty winds? Binary BH?)

Does not explain how tori could be oriented along the polar axis → more complex

10/19/2020

IR2020 - Conference Summary



The Future of Polarimetry?!

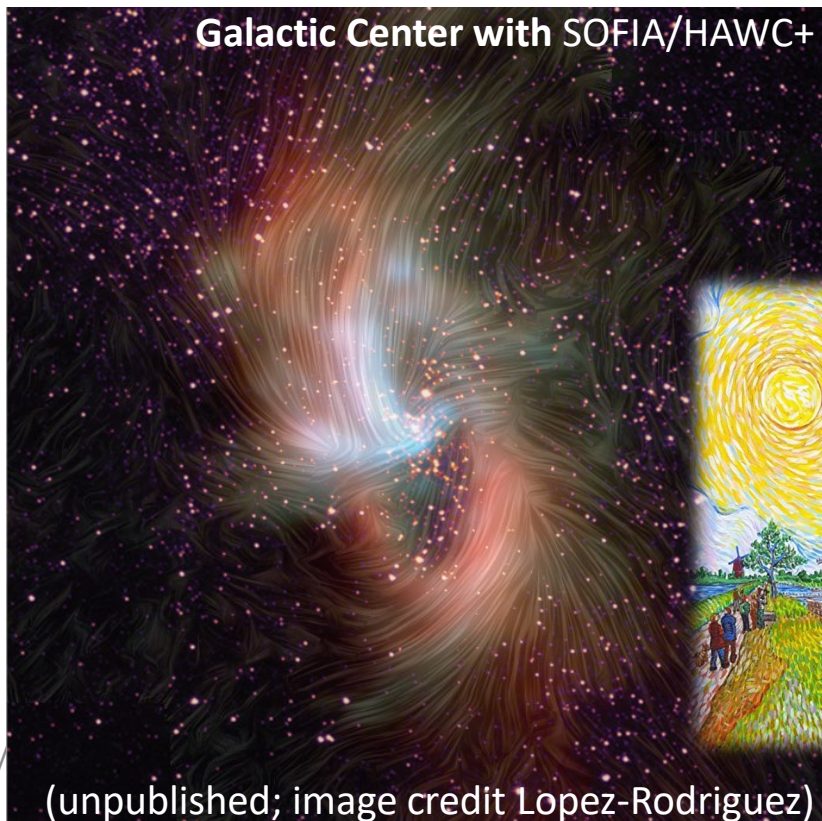
Unique information on

- warm dust grain alignment,
- magnetic field configurations
- Grain properties, material band strength,
- Alignment of icy grains or mantles, carbonaceous grains

Pat Roche

- Note that most published results are from instruments with a wire grid analyser and ambient temperature waveplate rather than an optimised polarimeter

Galactic Center with SOFIA/HAWC+



NGC 1068:
SOFIA/HAWC+ magnetic field lines overlaid on visible (HST, SDSS) and X-ray composite → Supports the "density wave theory" on how the spiral arms are forced into their iconic shape.
Lopez-Rodriguez et al. (2020):

Is SOFIA/HAWC+ the “van Gogh of the 21st century”?


(unpublished; image credit Lopez-Rodriguez)

A provocative Word of Caution on Dust and PAHs

Our community has a lot of expertise on dust! (Silicates are in atmospheric bands)

Summary

- Beware of the letter *k*
- Absorption/Transmission spectra $\sim Q$ (absorption/emission efficiency)
- Mass absorption coefficient \neq absorption coefficient
- Measuring and calculating complex refractive indices is tricky

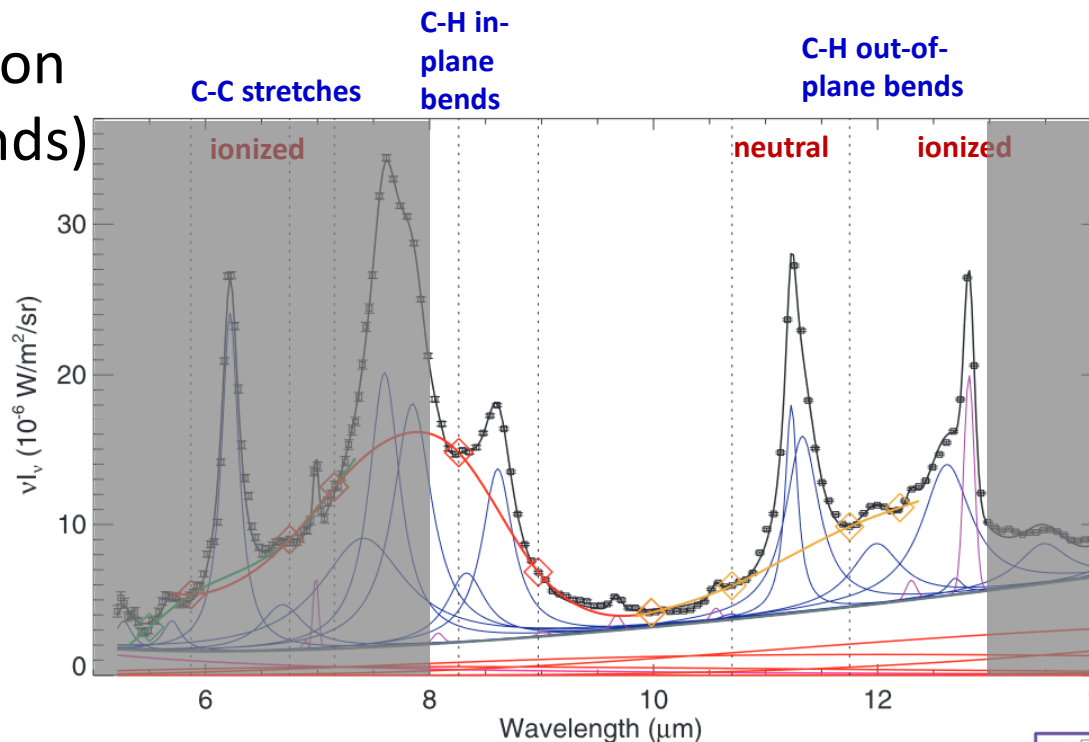


Angela Speck

But does this also apply to PAHs?

- PAHs are molecules, not dust!
- Arise from stochastic, photo-electric heating by UV photons

1. “AGNs destroy PAHs”
2. “AGNs do not destroy PAHs”
3. “AGNs excite PAHs”



λ_r (μm) (1)	γ_r (2)	FWHM (μm) (3)
5.27.....	0.034	0.179
5.70.....	0.035	0.200
6.22.....	0.030	0.187
6.69.....	0.070	0.468
7.42 ^a	0.126	0.935
7.60 ^a	0.044	0.334
7.85 ^a	0.053	0.416
8.33.....	0.050	0.417
8.61.....	0.039	0.336
10.68.....	0.020	0.214
11.23 ^b	0.012	0.135
11.33 ^b	0.032	0.363
11.99.....	0.045	0.540
12.62 ^c	0.042	0.530
12.69 ^c	0.013	0.165
13.48.....	0.040	0.539
14.04.....	0.016	0.225
14.19.....	0.025	0.355
15.90.....	0.020	0.318
16.45 ^d	0.014	0.230
17.04 ^d	0.065	1.108
17.375 ^d	0.012	0.209
17.87 ^d	0.016	0.286
18.92.....	0.019	0.359
33.10.....	0.050	1.655

14 Smith et al. ApJ 656 (2007)

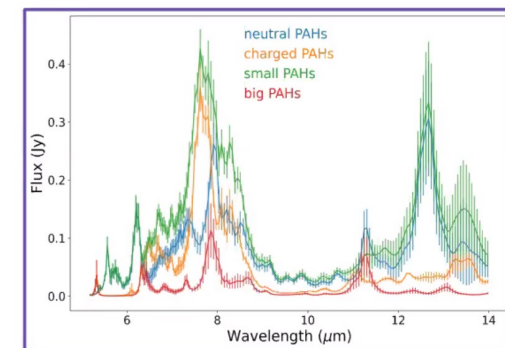
PAHs will survive if rate of reaccretion of carbon onto PAHs higher than evaporation rate due to harsh AGN radiation field

$$\tau \approx 700 \text{ yr} \left(\frac{N_{\text{H}}(\text{tot})}{10^{22} \text{ cm}^{-2}} \right)^{1.5} \left(\frac{D_{\text{agn}}}{\text{kpc}} \right)^2 \left(\frac{10^{44} \text{ erg s}^{-1}}{L_{\text{X}}} \right)$$

Voit 1991, 1992, Miles 1994

Almudena Alonso-Herrero

IR2020 - Conference Summary

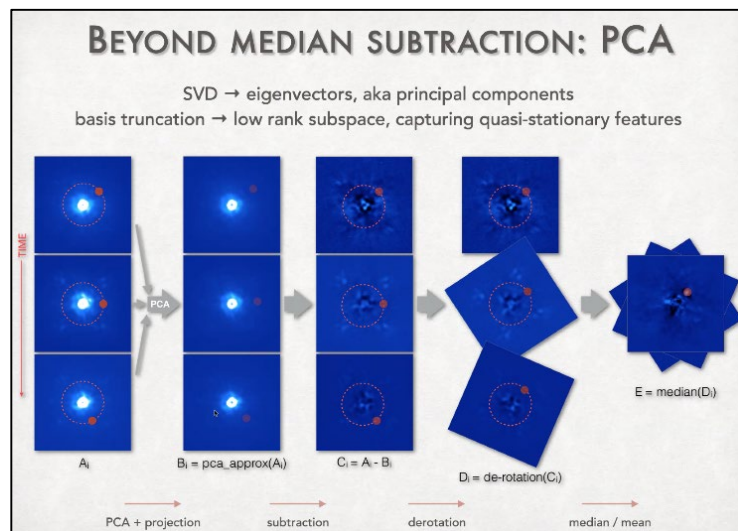


Yanna Martins-Franco

The new Age of advanced Techniques

We need to think open-mindedly about make best use of new data analysis and calibration techniques!

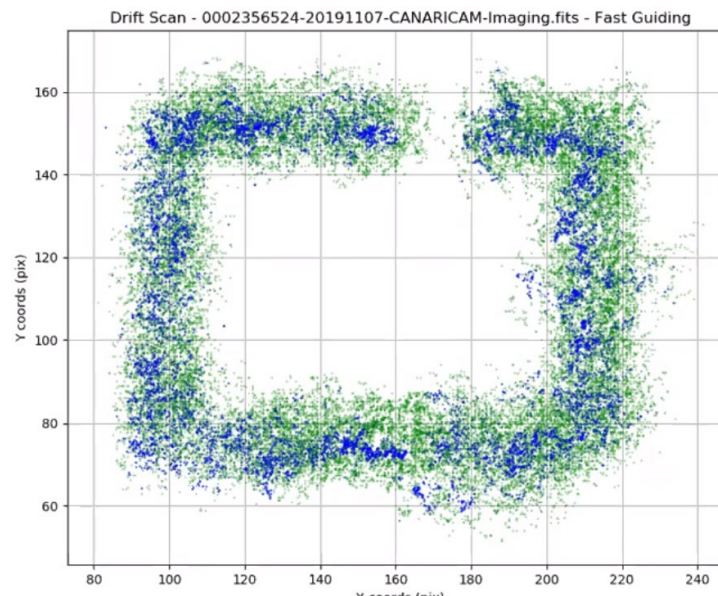
Data reduction



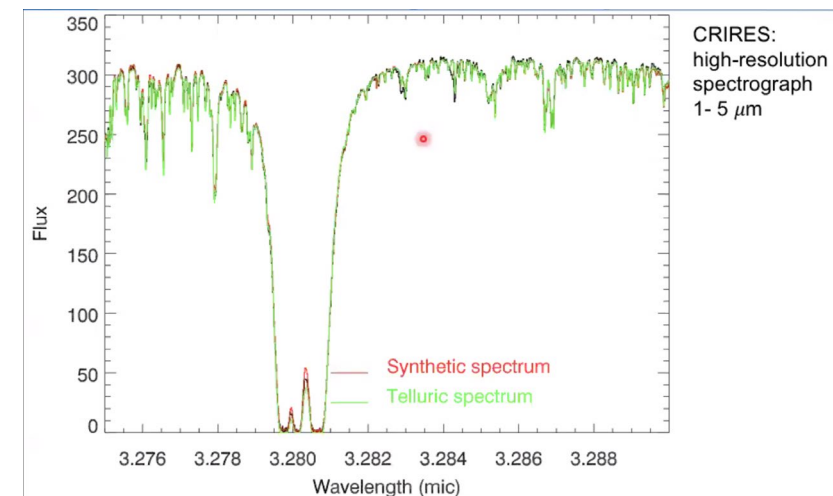
Olivier Absil

Data taking

Sergio Fernandez-Acosta: Drift scanning



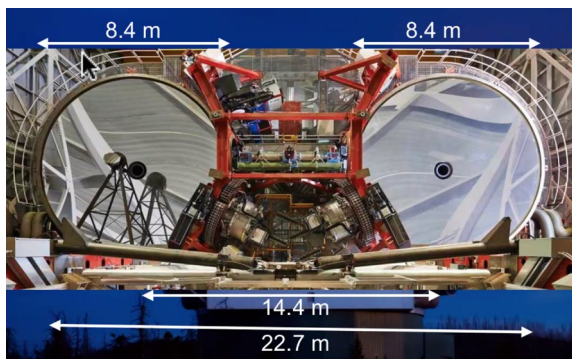
Data calibration



Alain Smette: Molecfit → blind telluric corrections and work by **Aleksandra Solarz** on PCA

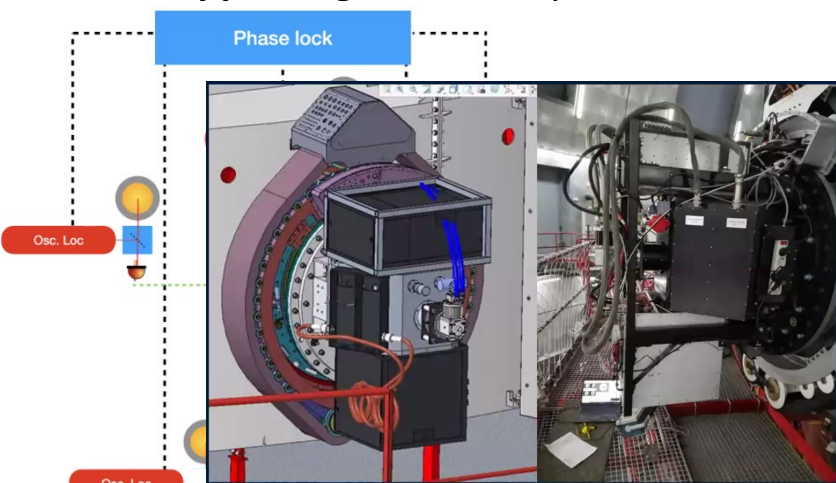
The new Age of advanced Technology

Telescopes



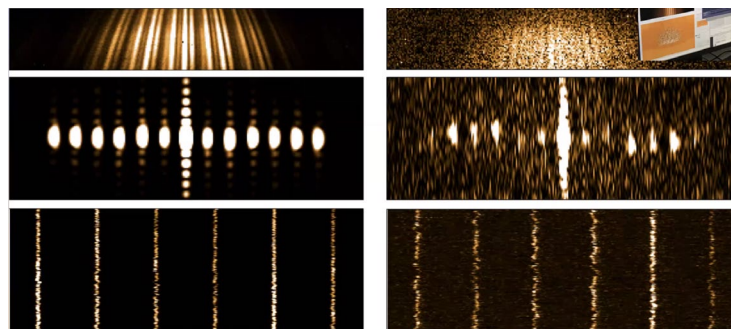
Steve Ertel: LBT

Jean-Philippe Berger: heterodyne interferometry



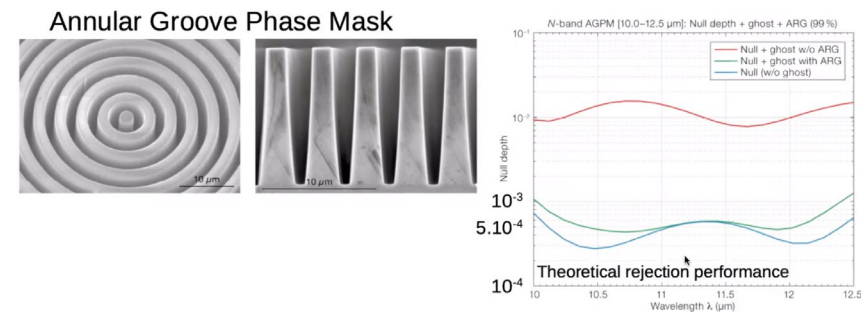
Sergio Fernandez-Acosta: GranteCan

Instruments

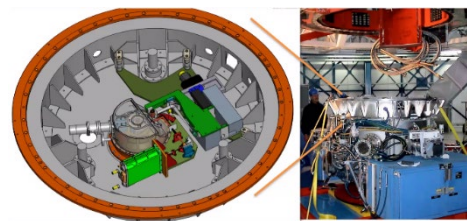


Romain Petrov: MATISSE

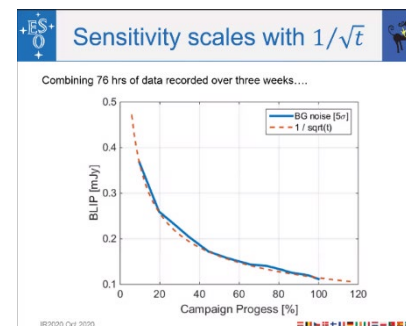
Components



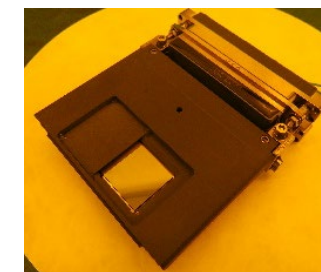
Anne-Lise Maire: AGPM coronagraphy



Markus Kasper: VISIR/NEAR



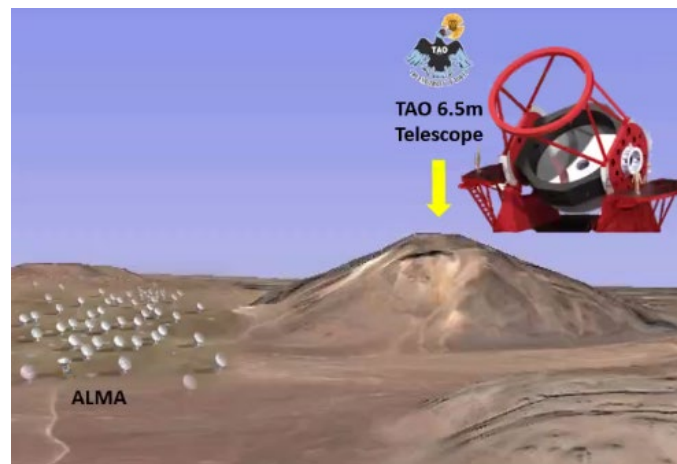
- SNR $\alpha\text{Cen A}$ in 76 hrs (predicted 6ms DIT): $\sim 6.7 \times 10^6$
- SNR $\alpha\text{Cen A}$ in 76 hrs (measured): $\sim 5.9 \times 10^6$



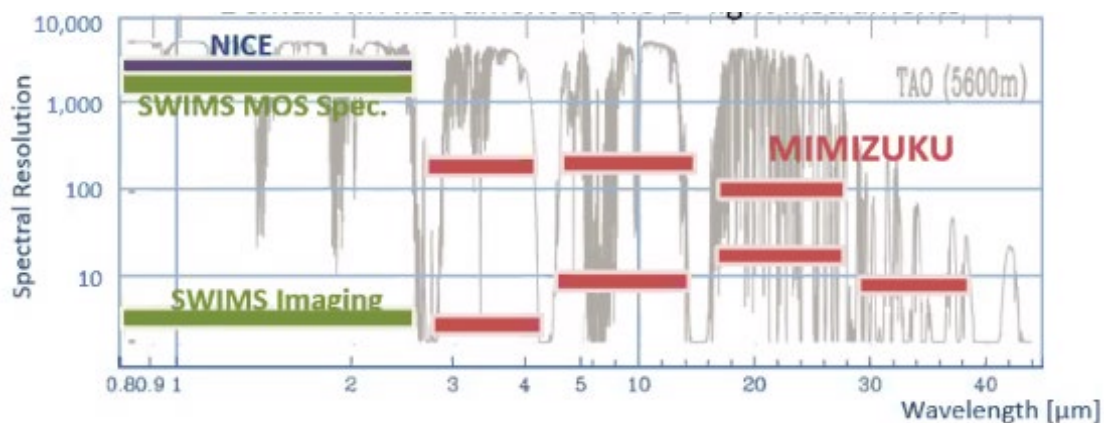
Michael Meyer/Dani Atkinson: GeoSnap
– the next generation mid-IR detector

Alternative Approaches

1. Bigger = better → ELTs
2. Time-domain mid-IR
3. Go to longer wavelengths from the very best sites



Takashi Miyata: TAO



Isabelle Vauglin: Dome C



Alternative Approaches (2)



Leo Burtscher 1 hour ago
And if ESO is supporting it, perhaps they want to give you the AQUARIUS detector that METIS no longer needs (so that your bg per pixel decreases and you can use a broadband filter, too!)...?



Gerd Jakob 1 hour ago
Leo and his wild ideas...



Leo Burtscher 1 hour ago
[@Gerd Jakob](#) And if we also moved the GTC to Dome C... 😊



Gerd Jakob 1 hour ago
Next to the imaginary ELT (as discussed yesterday)...



Leo Burtscher 1 hour ago
And if we move the GMT and TMT as well, then we can do ETLI at Dome C! 😊

→ put the ELT at the South Pole

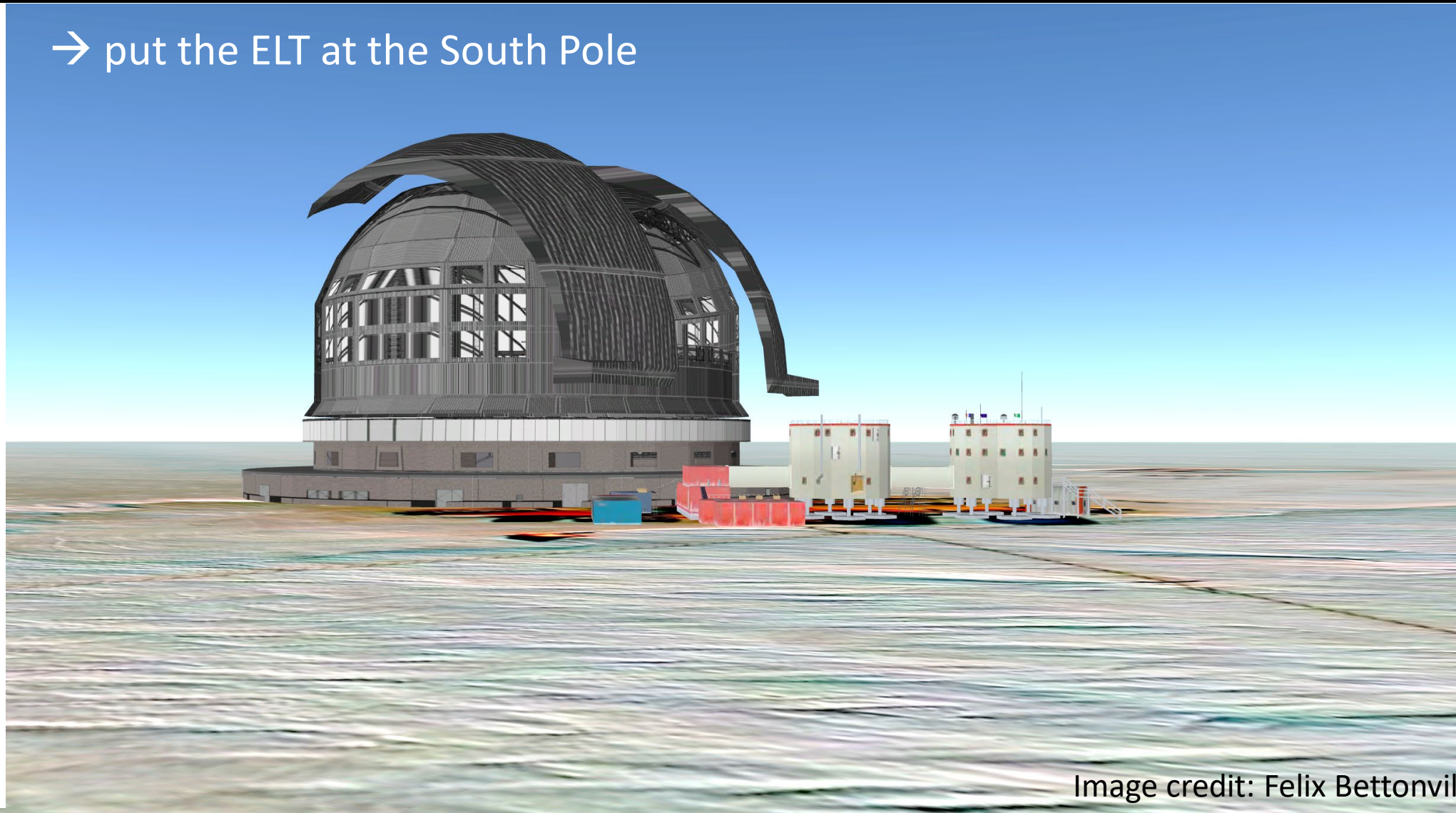
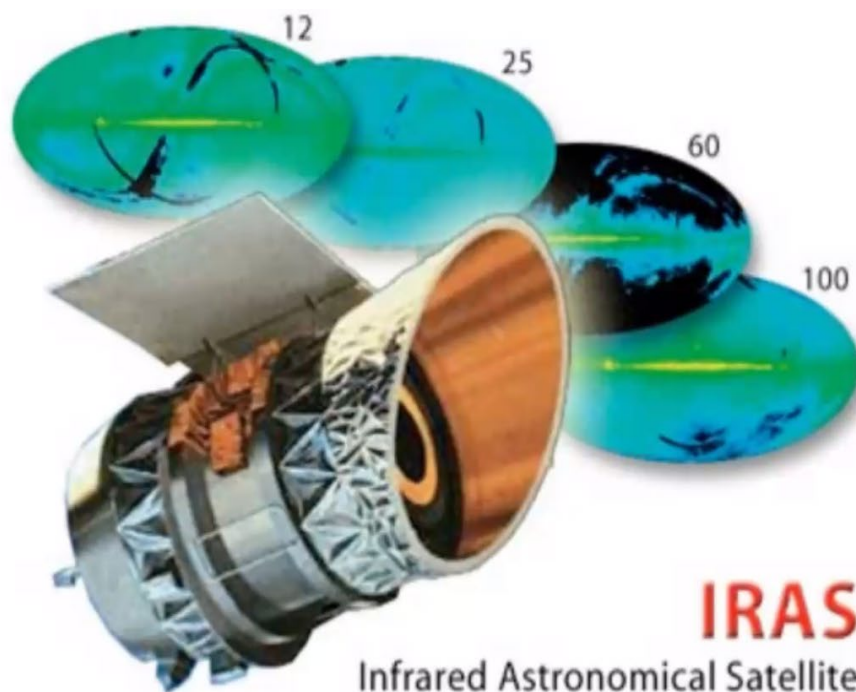


Image credit: Felix Bettonvil

Is the Space Community ignoring us?



Captain Haddock
(Ulli Käufl)

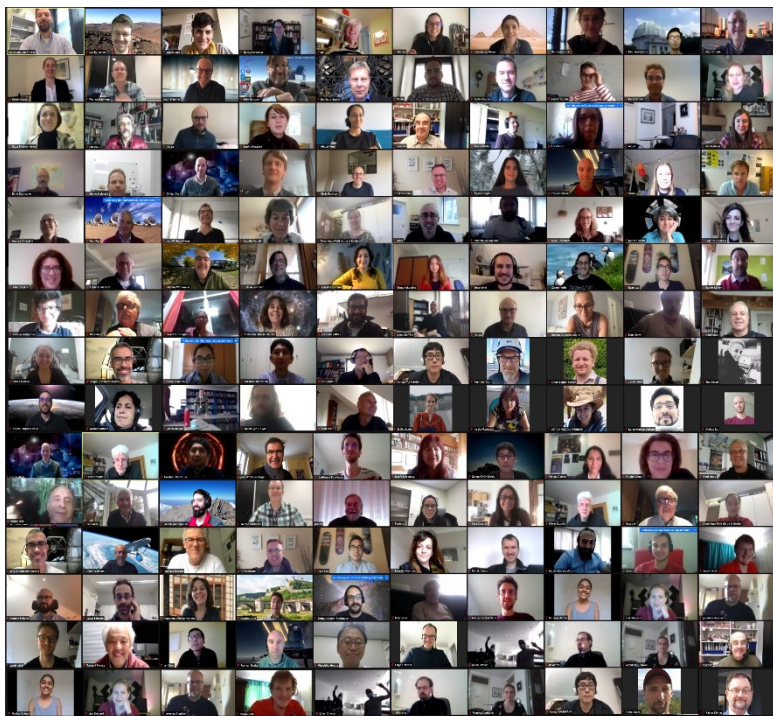


BUT: even though ESO's bolometers at the 1m-telescope were about as sensitive as IRAS the community preferred to ignore them

quote from a colloquium speaker then:
IRAS has not detected this object, so we need to wait for ISO (Europe's Infrared Space Observatory)



Looking toward multiple futures



future of science community

outcomes from this conference

future of instrumentation

zenodo

The Galactic Bulge at the crossroads (GBX2018)

Recent uploads

Search The Galactic Bulge at the crossroads (GBX2018)

April 25, 2019 (v1) [Poster](#) [Open Access](#) [View](#)

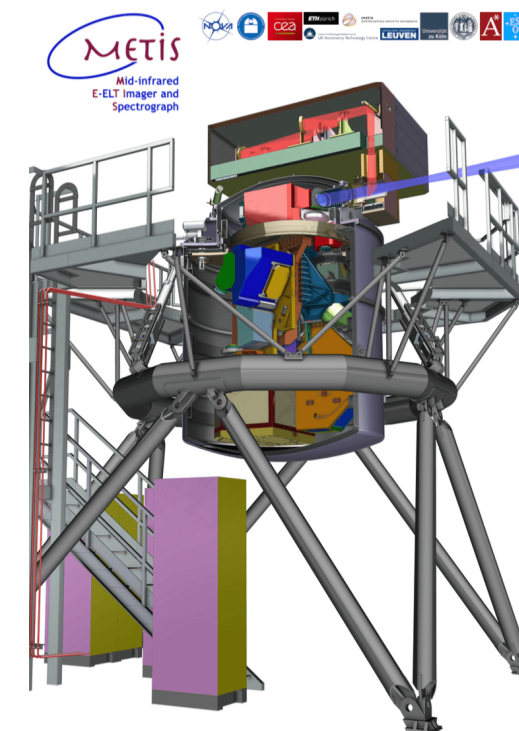
A MUSE study of the inner bulge globular cluster Terzan 9 : a fossil record in the Galaxy
 Ernanandes, H.; Dias, B.; Barbay, B.; Kamann, S.; Ortolani, S.; Rossi, L.; Cantelli, E.; Bica, E.;
 Moderately metal-poor inner bulge globular clusters are relics of a generation of long-lived stars formed in the early Galaxy. Aims. Terzan 9, projected at only 4-12 of the Galactic center, shows an orbit remaining confined in the inner 1 kpc of the Galaxy center, and is among the most central glob
 Uploaded on April 25, 2019

April 25, 2019 (v1) [Presentation](#) [Open Access](#) [View](#)

Yonsei Spectroscopic Survey for Bulge Red Clump Stars
 Lim, Dongwook; Lee, Young-Wook; Chung, Chul; Hong, Seungsoo; Jang, Sohee;
 In order to understand the origin of the double red clump (RC) observed in the color-magnitude diagram of the Milky Way bulge, we are undertaking spectroscopic surveys for the RC stars in different latitude and longitude fields of the bulge. Low-resolution multi-object spectroscopy for CN, CH, and C
 Uploaded on April 25, 2019

April 24, 2019 (v1) [Presentation](#) [Open Access](#) [View](#)

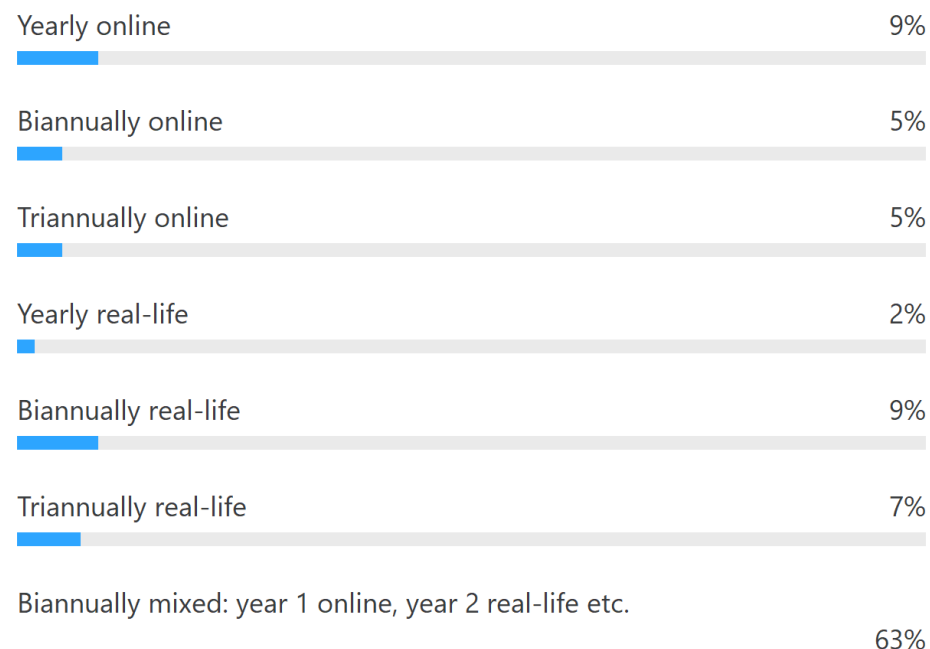
Detailed Abundances of Giants in the Inner Bulge and Galactic Centre
 Ryde, Nils; Forsberg, Rebecca; Fritz, Tobias; Hartman, Henrik; Jonsson, Henrik; Lomaeva, Maria; Matteucci, Francesca;





Outcomes from this conference: meet again

1. How often would you like to have such a meeting and would you prefer in person (possibly with video streaming) or remote or a mix?





Outcomes from this conference: meet again

1. What record of this conference would you personally prefer to use (or share with your students)? (select all that apply)
(Multiple choice)

Recorded talk (YouTube)



Slides (Zenodo)



A handbook containing a selection of talks



An online course (e.g. a MOOC) with the basics



A book (expensive, but beautiful, e.g. Springer)

8%



A self-published book (less expensive, feasibility to be confirmed)

48%



A series of peer-reviewed articles in e.g. New Astronomy Reviews (open access)

50%



21%

Data Pipelines are essential!



**1. Making a 'fancy' pipeline takes a lot of effort, how do you wish to reduce your data for publication?
Choose one option:**

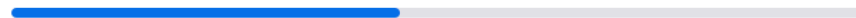
Provide only raw data (do-it-yourself) (2) 4%



Provide data after a basic reduction (instrumental artifacts corrected, i.e., flatfielded, dead pixel corrected, 'mosaicing' for imaging and 'optimal extraction' for



Provide higher level data products (co added, flux calibrated, close to publication quality) (22) 45%

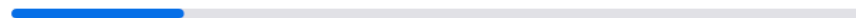


2. Is this true for all modes or just complex modes

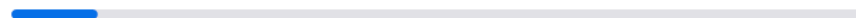
Yes, true for all modes (34) 69%

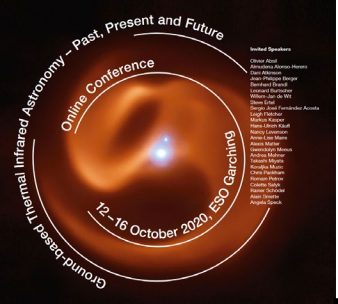


No, only for complex modes (10) 20%



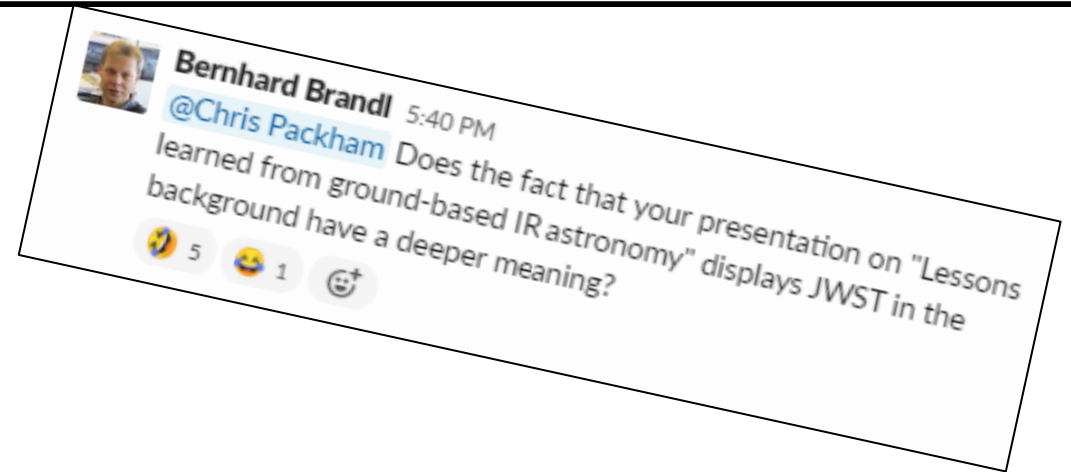
Don't know (5) 10%





(Present and) future instrumentation

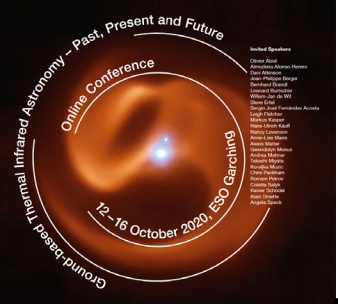
- Some upcoming facilities are in progress
- We will need to use them effectively!
 - Produce important results and make them known



Resolving
stars!

Torus is
dead!

Exoplanet
physics!



Develop the future community

An active community here already...

337 registered

up to 160 participating at once



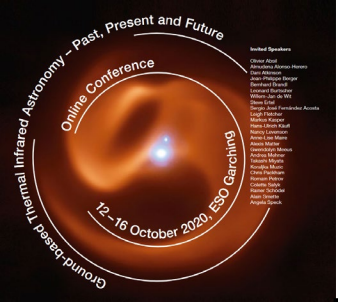
...and joining remotely

~19k "impressions"

8% "engagement"

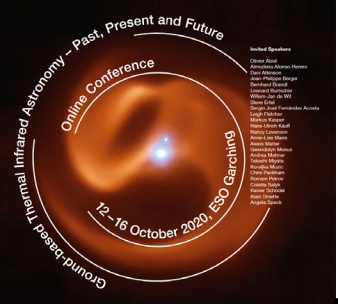


About 1000 messages/day
[#ysos_protoplanetary_disks](#)
[#instruments](#)
[#AGNs_galaxies](#)



Develop the future community

- provide opportunities for people who are already working in this area
 - e.g., develop cohorts, provide training
- expand the community
 - within our current topical areas, or beyond
 - make basic capabilities and results easy to use and obtain
 - be inclusive



Make the science case

A strong science case is a necessary condition for developing or maintaining capabilities

Capabilities:

instruments, modes, observatories

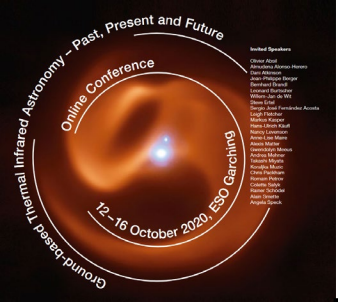
Strong science case:

answers important questions in the field

the field is important to astronomy overall

Maintaining:

needs empirical case, based on results



Action items for us all

- Continue conversations
 - e.g., new plans for observing proposals; connect theory and observations across fields
- Tools: handbook for thermal infrared astronomy; next workshop or school
- Build the community
 - develop people who are already here
 - broaden the community; thermal-IR should not be an isolated niche
- Use current instruments effectively
 - get great science results; make these known
- Make the science case for future capabilities
 - show unique opportunities; connect to important astrophysics overall



Many Thanks to SOC and LOC

Leo (SOC)



Mario (LOC)



Valentin (SOC)

