The structure of the barred galaxy NGC253: target of the VISTA and VST Science Verification extragalactic mini-survey

outline

- details on the SV
- VISTA *vs* VST telescopes and cameras
- structure of NGC253: VISTA NIR *vs* VST Optical data

E. Iodice INAF-OAC

Why a SV?

➡ to test the potentiality of the infrared wide-field camera of VISTA first (2009) and then the optical one of VST (2011), knowing that WFIs are rather problematic instruments and require ad hoc SW

why NGC253?

➡ because it is a wide, dusty, complex, detailed galaxy and it is a *sosia* of the MW

SV science goals

➡ Detecting the Red Giant Brach stars in the faint outer halo

➡ Disk and bulge structure with shallow exposures

The **VISTA** & **VST** SV have been defined by teams of astronomers from ESO and community

ESO - Vitacura: Ahumada Andrea, Pompei Emanuela, Mieske Steffen, Szeifert Thomas, Ivanov Valentin

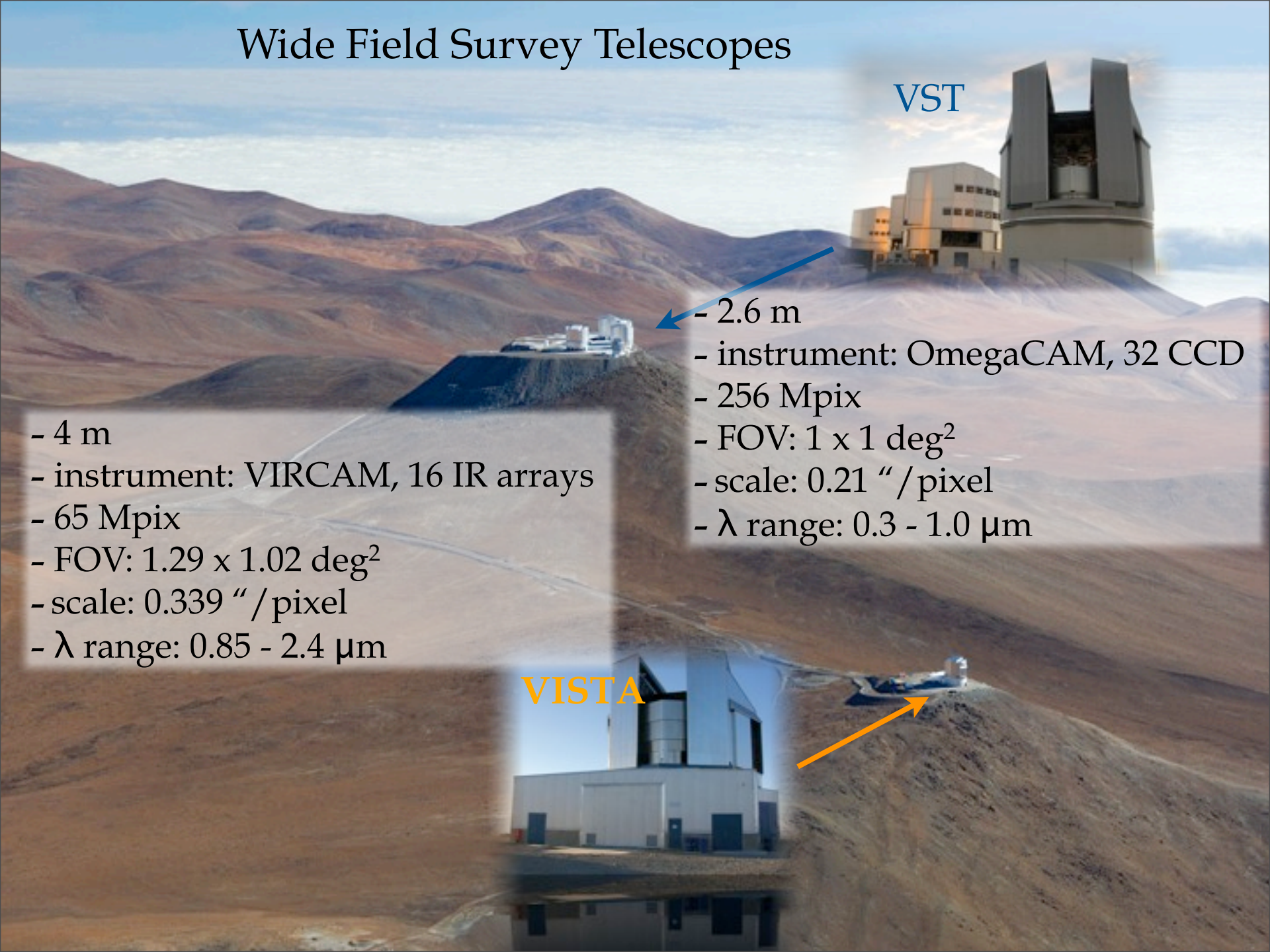
ESO - Garching: **Arnaboldi Magda (P.I.)**, Battaglia Giuseppina, Bilbao Lander, Freudling Wolfram, Hatziminaoglou Eva, Hilker Michael, Hummel Wolfgang, Melnick Jorge, Misgeld Ingo, Moller Palle, Neeser Mark, Nadine Neumayer, Nilsson Kim, Rejkuba Marina, Retzlaff Joerg, Romaniello Martino, Slijkhuis Remco, Venemans Bram, Ziegler Bodo, Harald Kuntschner.

ESO user community : Iodice Enrica (INAF-OAC), Laura Greggio (INAF-OAPd)

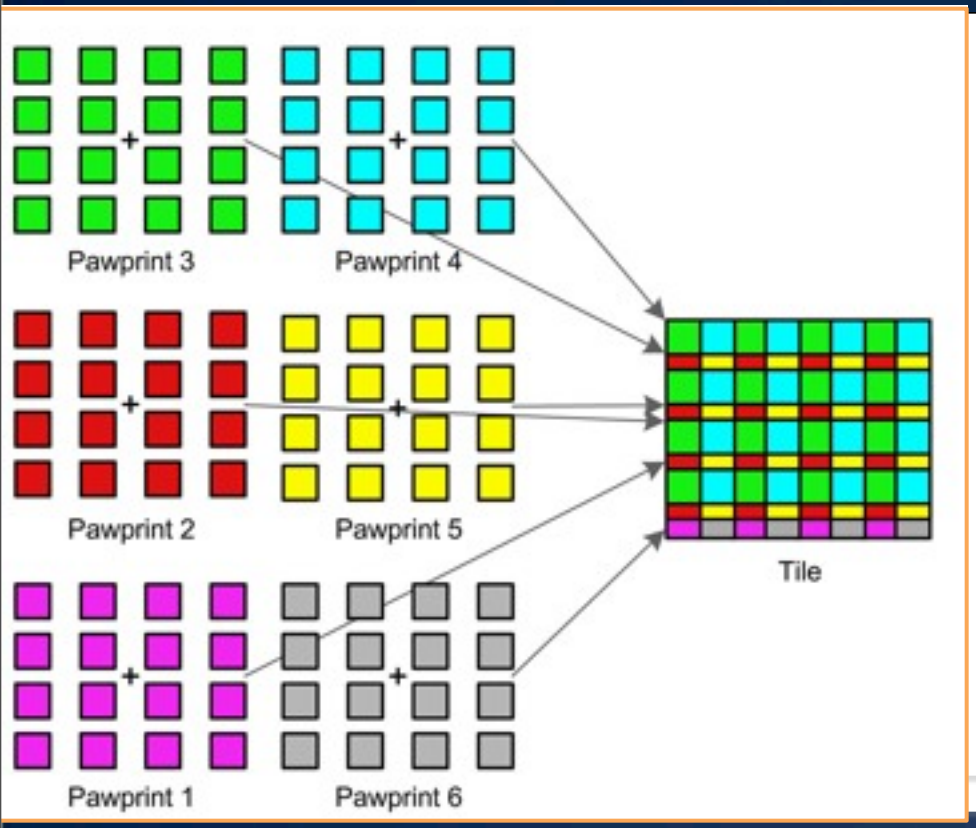
VISTA / CASU: Jim Emerson, William Sutherland, Mike Irwin, Jim Lewis, Simon Hodgkin, Eduardo Gonzalez-Solares

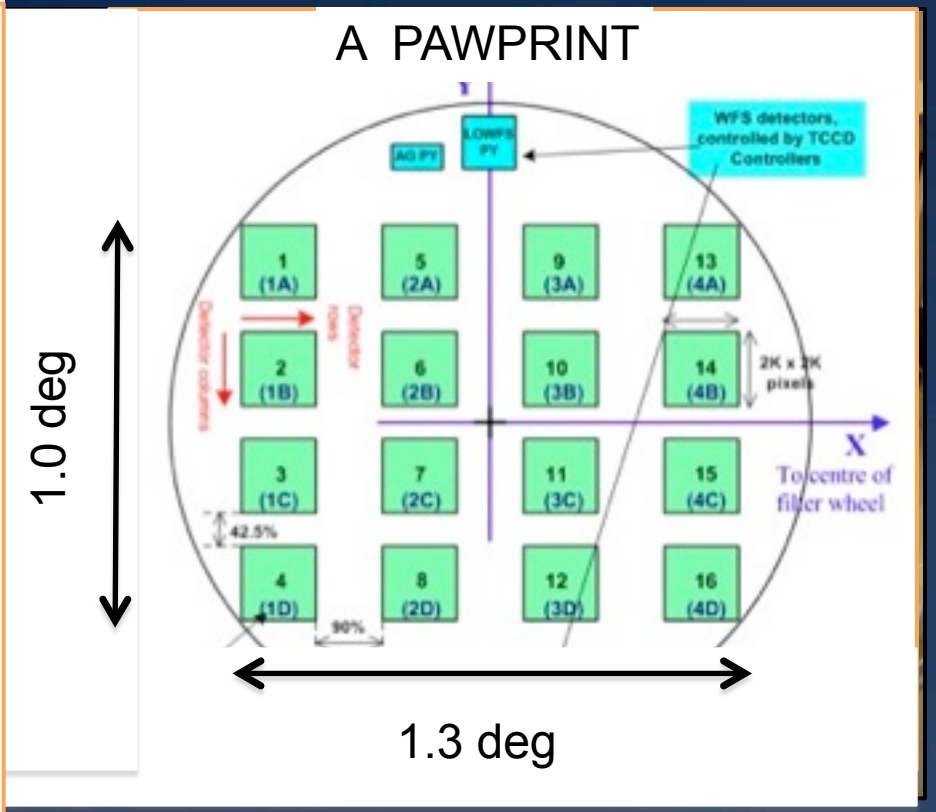
VST / VST-Tube: Massimo Capaccioli, Aniello Grado, Luca Limatola

Wide Field Survey Telescopes



VIRCAM: VISTA Infrared CAMera

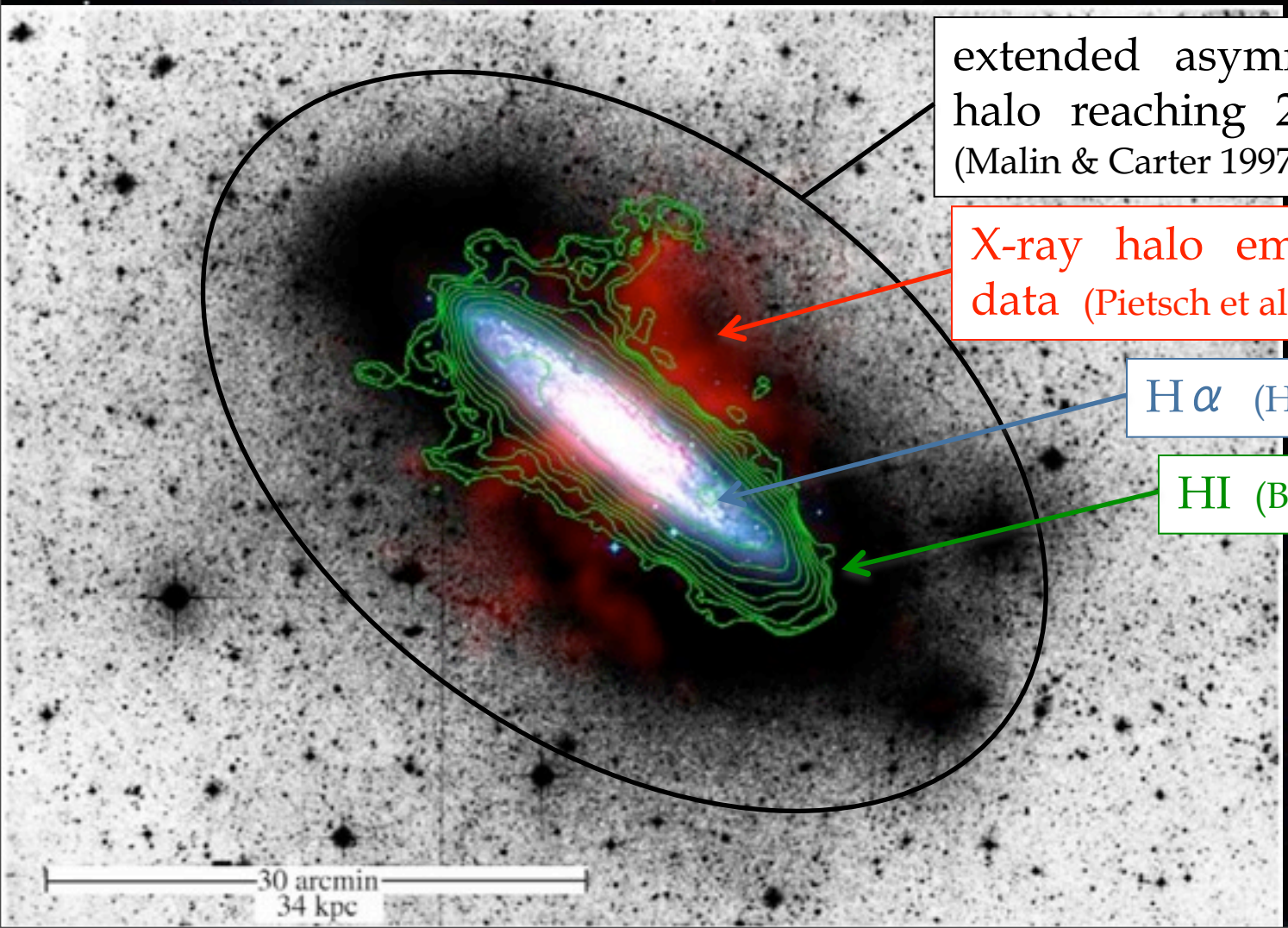




- IR detectors: sixteen, 2048x2048 pixel
- Exposure: the store product is the co-adding of many DITs
- Intradetector gaps: 90% and 42.5% of the detector width
- Pawprint: 16 non-contiguous images, FOV = 0.6 deg^2 with gaps
- Tile: contiguous area obtained by combining multiple offsetted pawprints
- FOV: 1.65 deg^2 with a minimum of 6 appropriately offsetted pawprints

Pre-VISTA - VST anathomy of NGC253

- NGC 253 is a barred Sc galaxy seen nearly edge-on , in the Sculptor group (average distance of ~ 3.2 Mpc)
- it is one of the best nearby examples of nuclear starburst galaxy



extended asymmetrical stellar halo reaching 28 mag arcsec^2 (Malin & Carter 1997)

X-ray halo emission, ROSAT data (Pietsch et al. 2000)

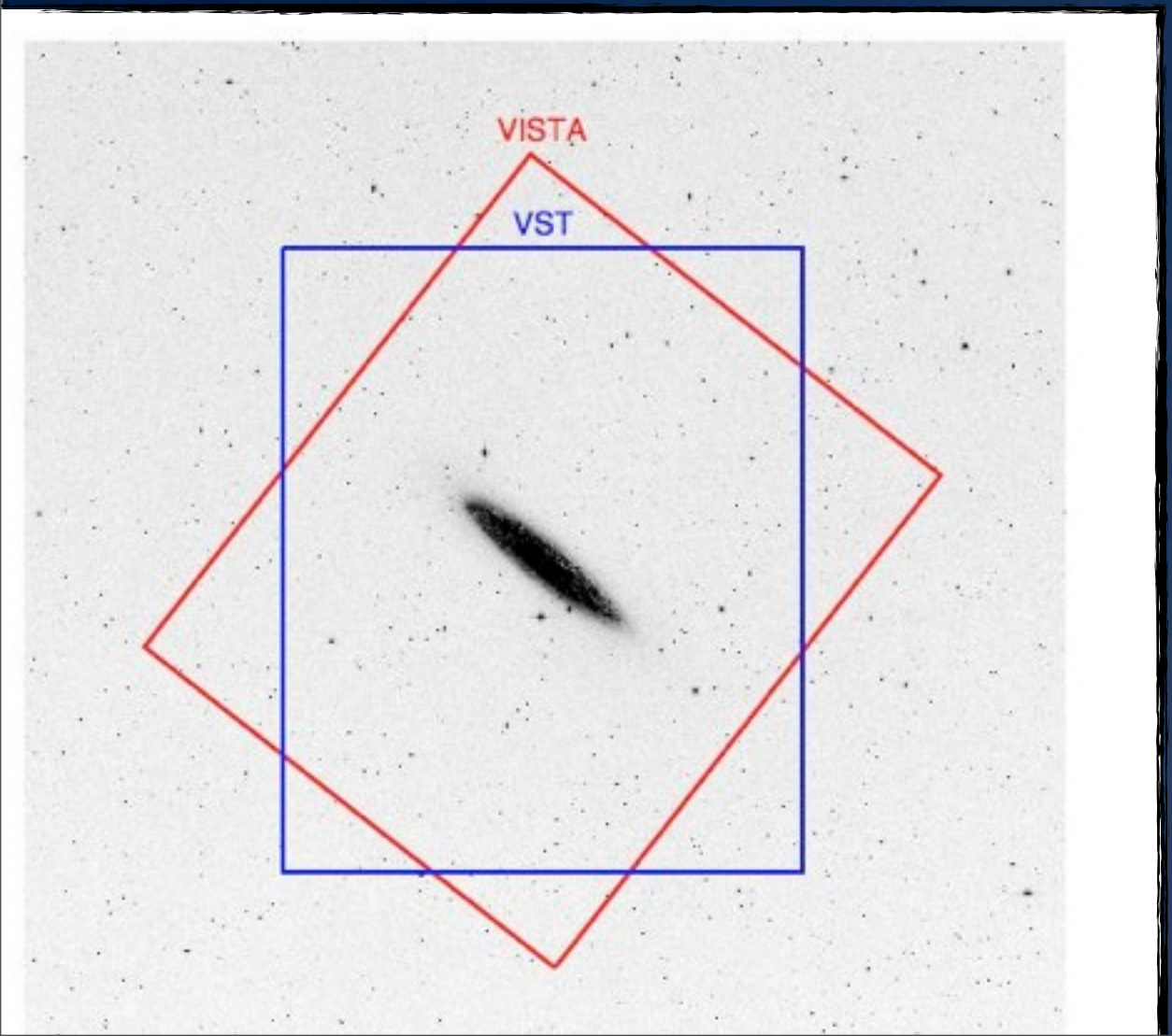
H α (Hoopes et al. 1996)

HI (Boomsa et al. 2005)

VISTA & VST SV observations of NGC 253

Survey area

center RA=00:46:30, Dec=-25:17:40; Width=1.2; Height=1.0;
for VISTA Angle=52



VISTA & VST SV observations of NGC 253

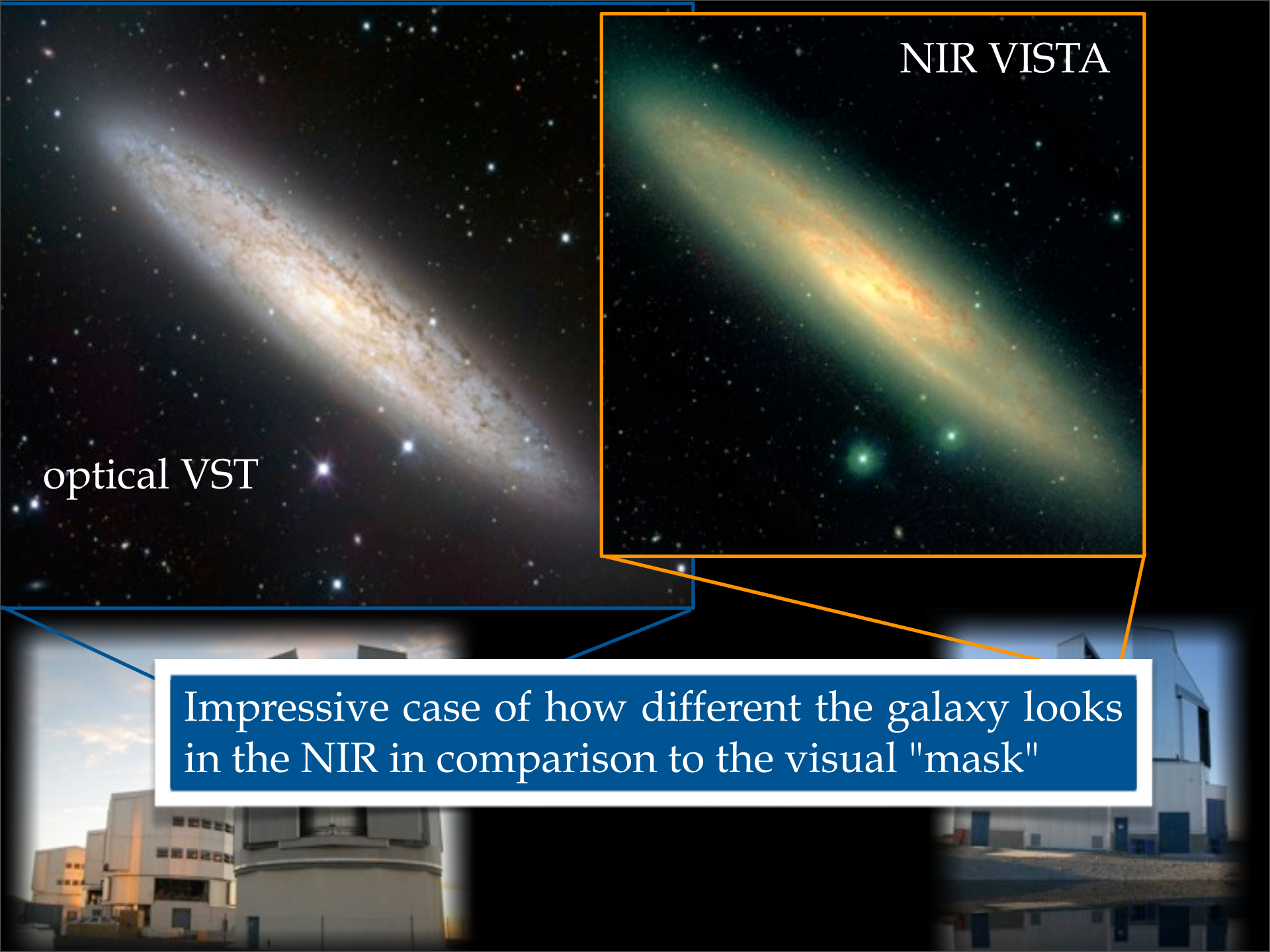
Survey area
center
for VIS

VST

band	u′	g′	r′	i′	NB_659
Tot. Exp. time (hrs)	8.06	0.58	1.03	0.42	1.47
N. Exp.	28	7	21	5	13

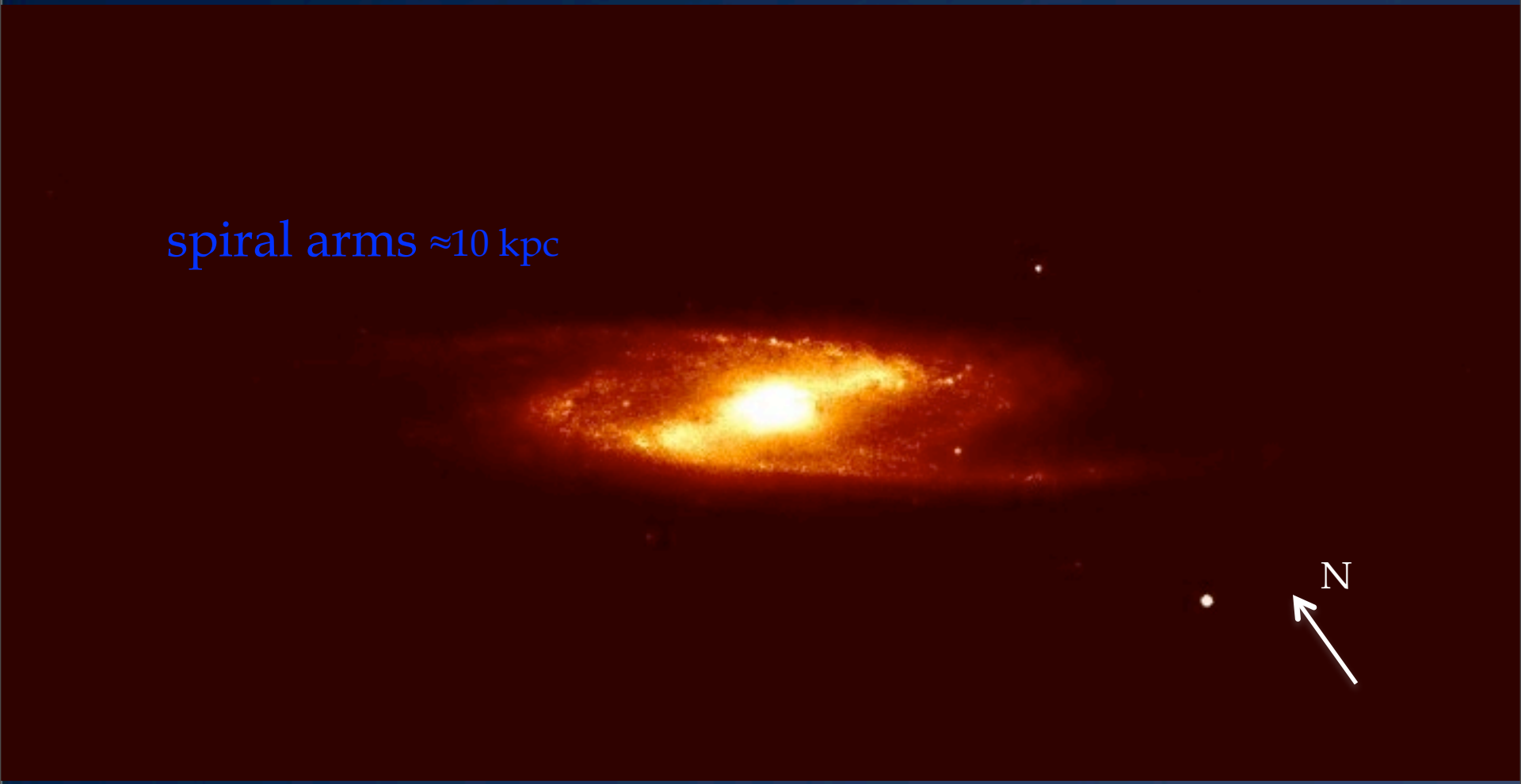
VISTA: deep & shallow

band	Z	Y	J	H	Ks	NB_118
deep (hrs)	9.6		24			6
NDITxDIT(sec)	60 x 3		45 x 5			1 x 300
shallow (hrs)		0.5	0.5	0.5	0.5	
NDITxDIT(sec)			10 x 6	6 x 6	12 x 6	

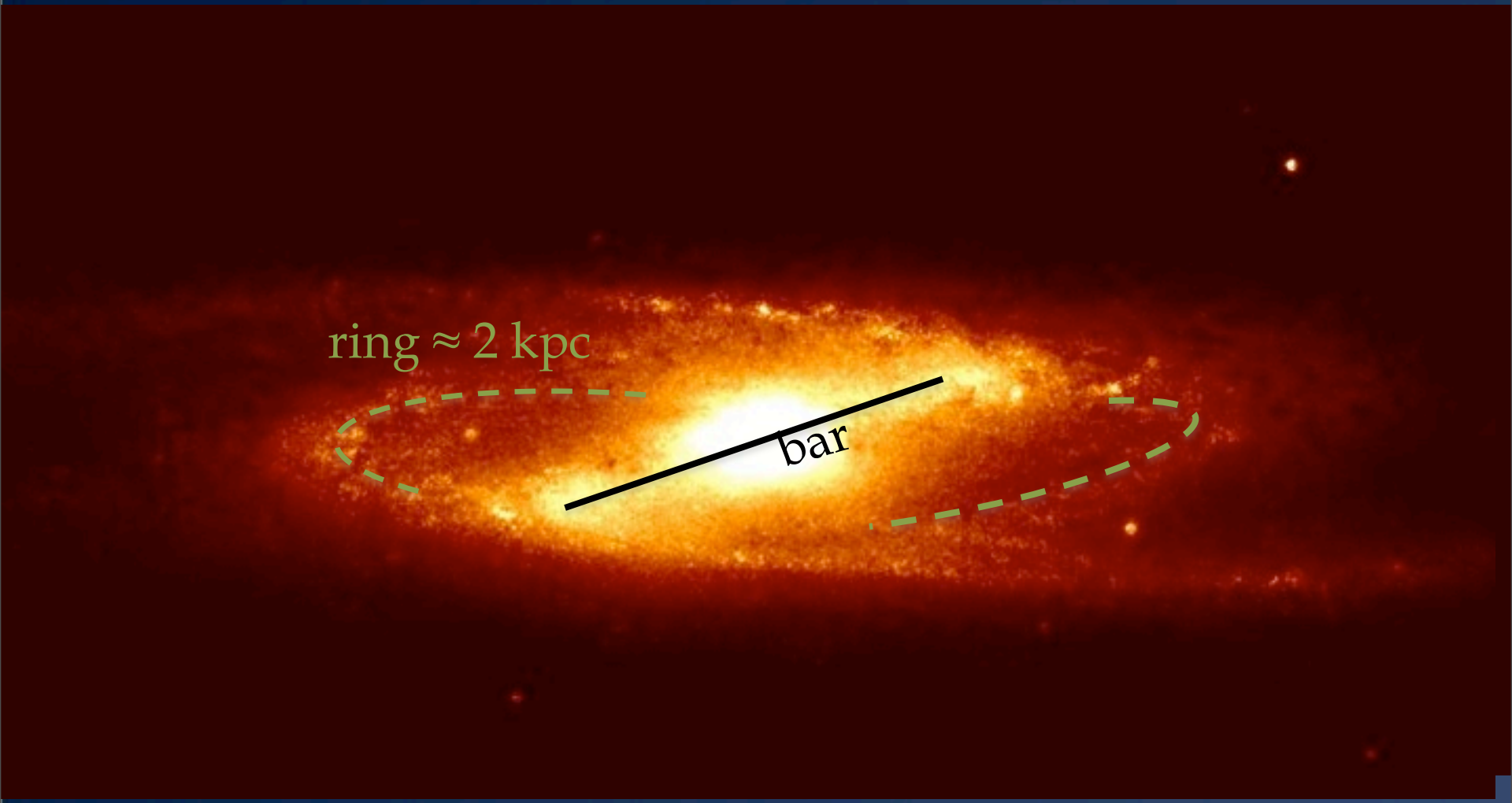


Impressive case of how different the galaxy looks in the NIR in comparison to the visual "mask"

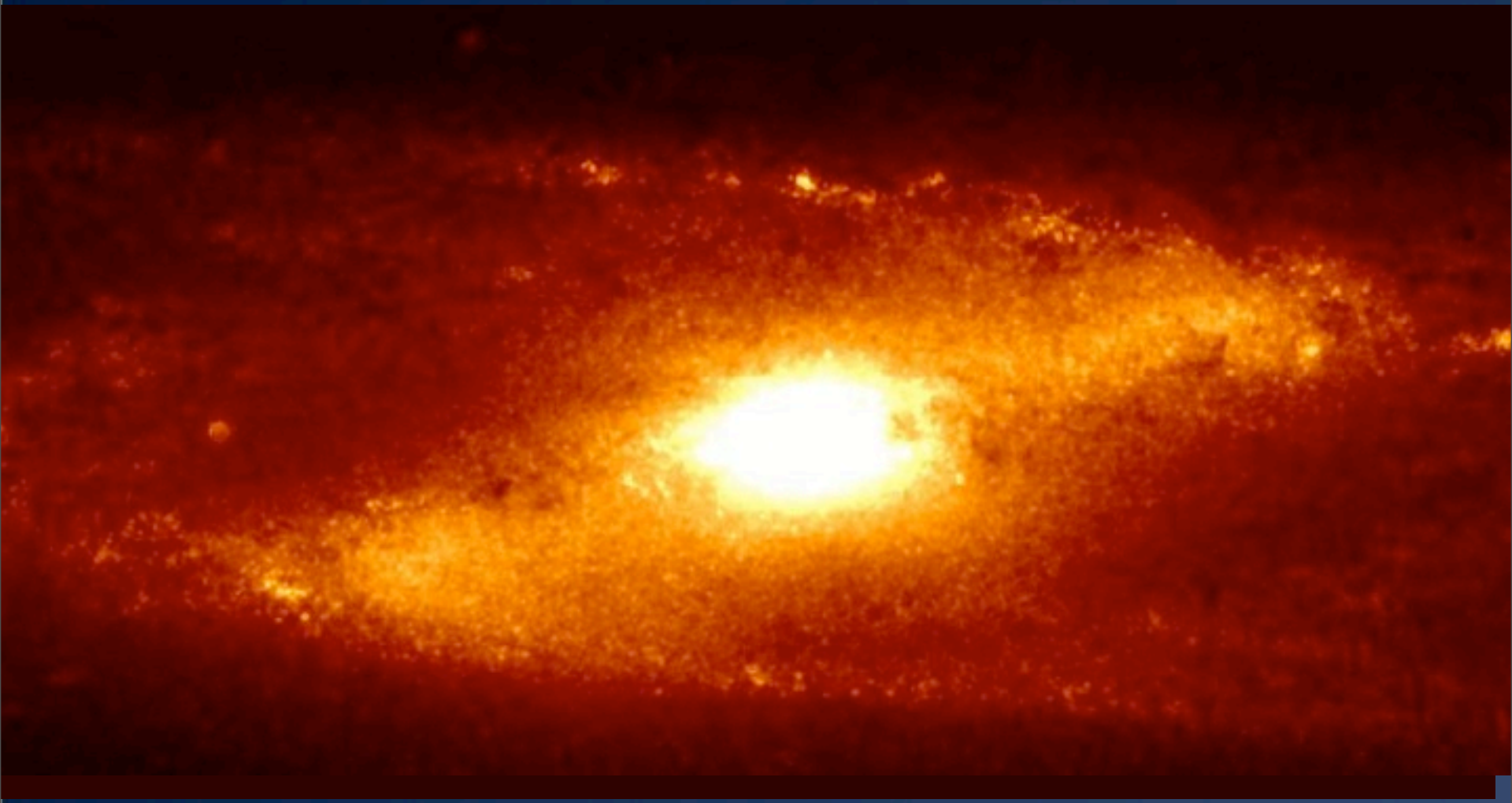
VISTA Ks band image of the NGC 253 disk



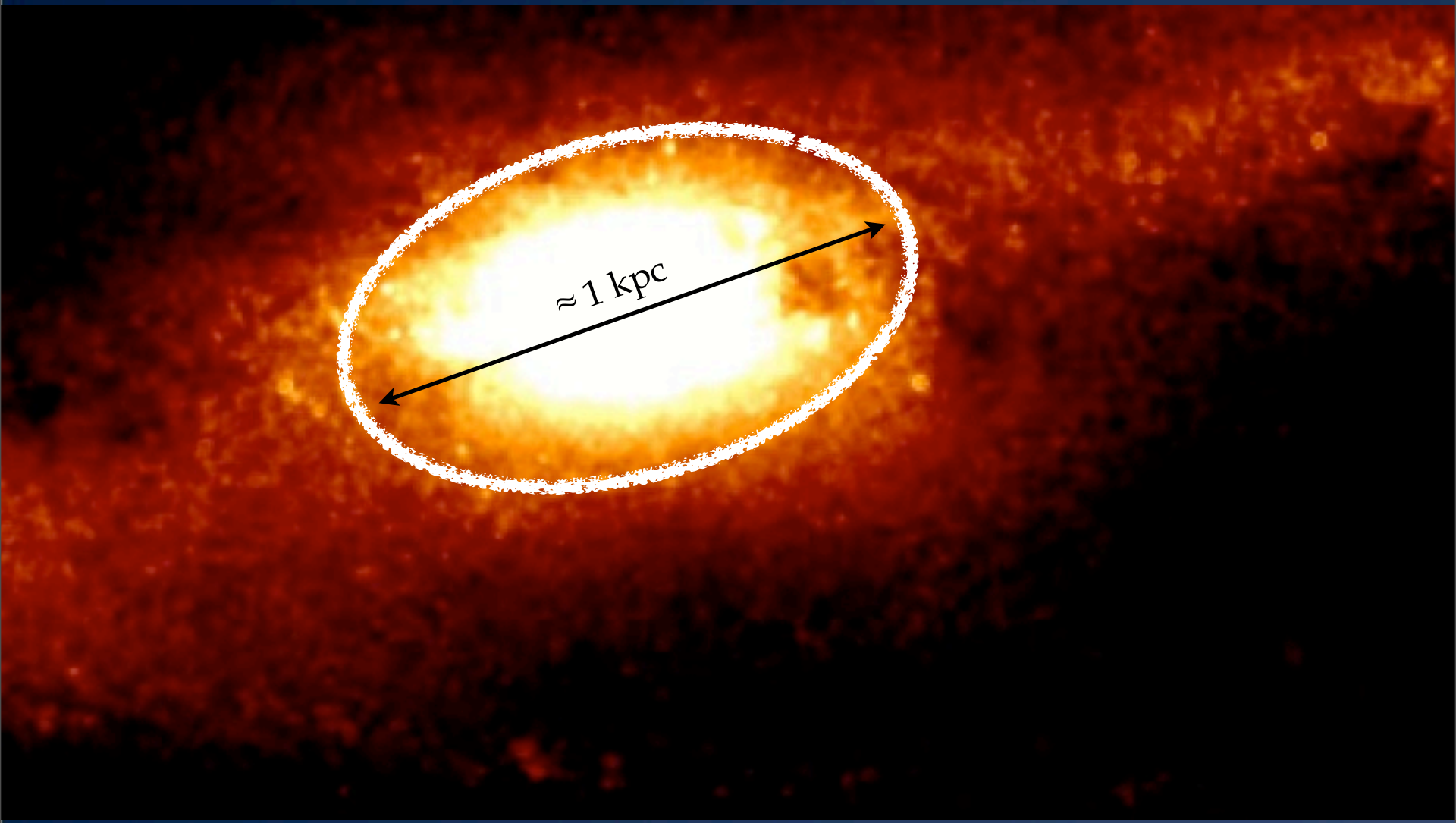
VISTA Ks band image of the NGC 253 disk



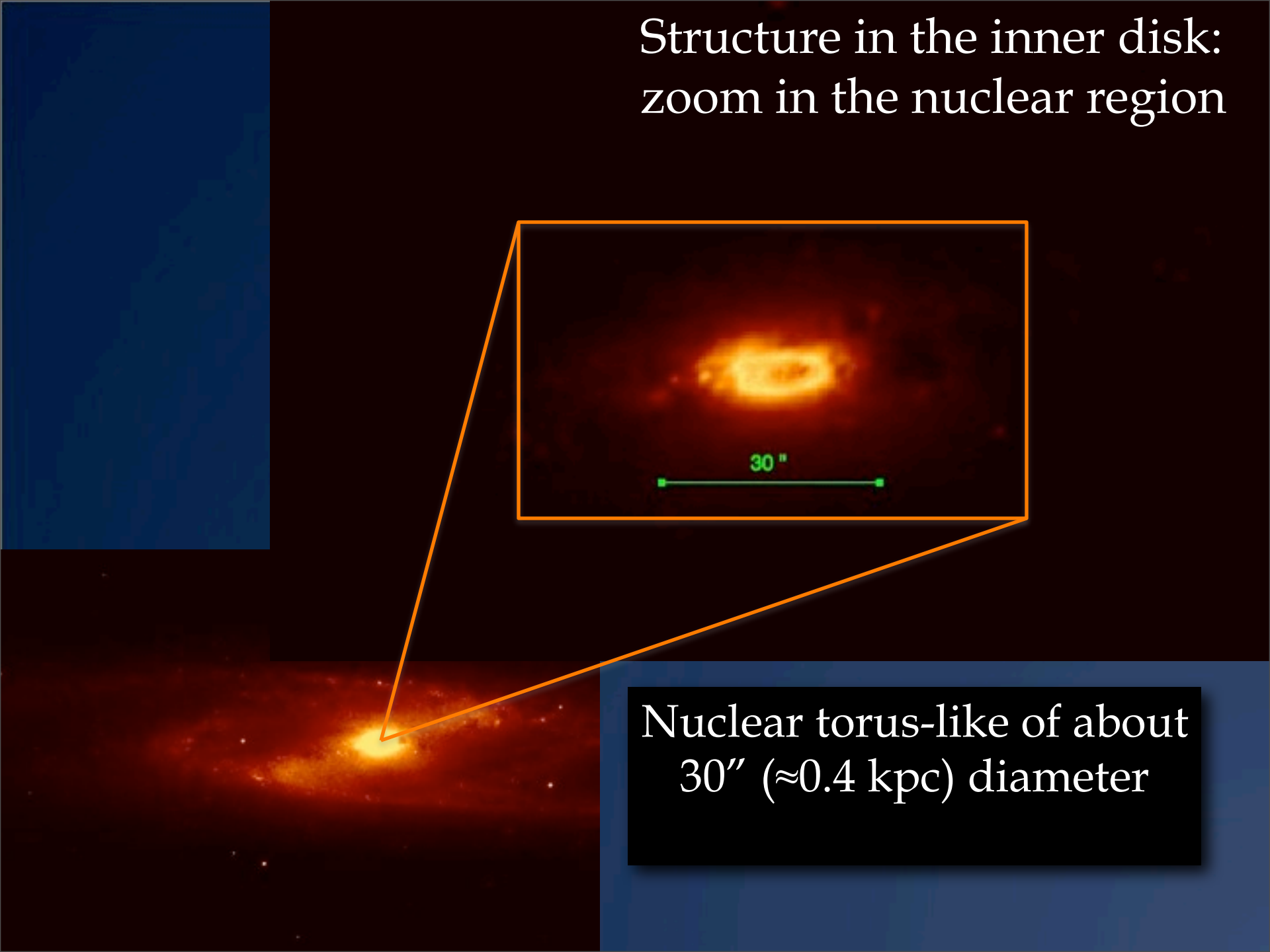
VISTA Ks band image of the NGC 253 disk



VISTA Ks band image of the NGC 253 disk



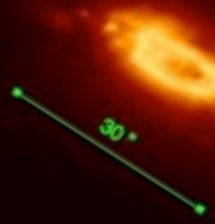
Structure in the inner disk: zoom in the nuclear region



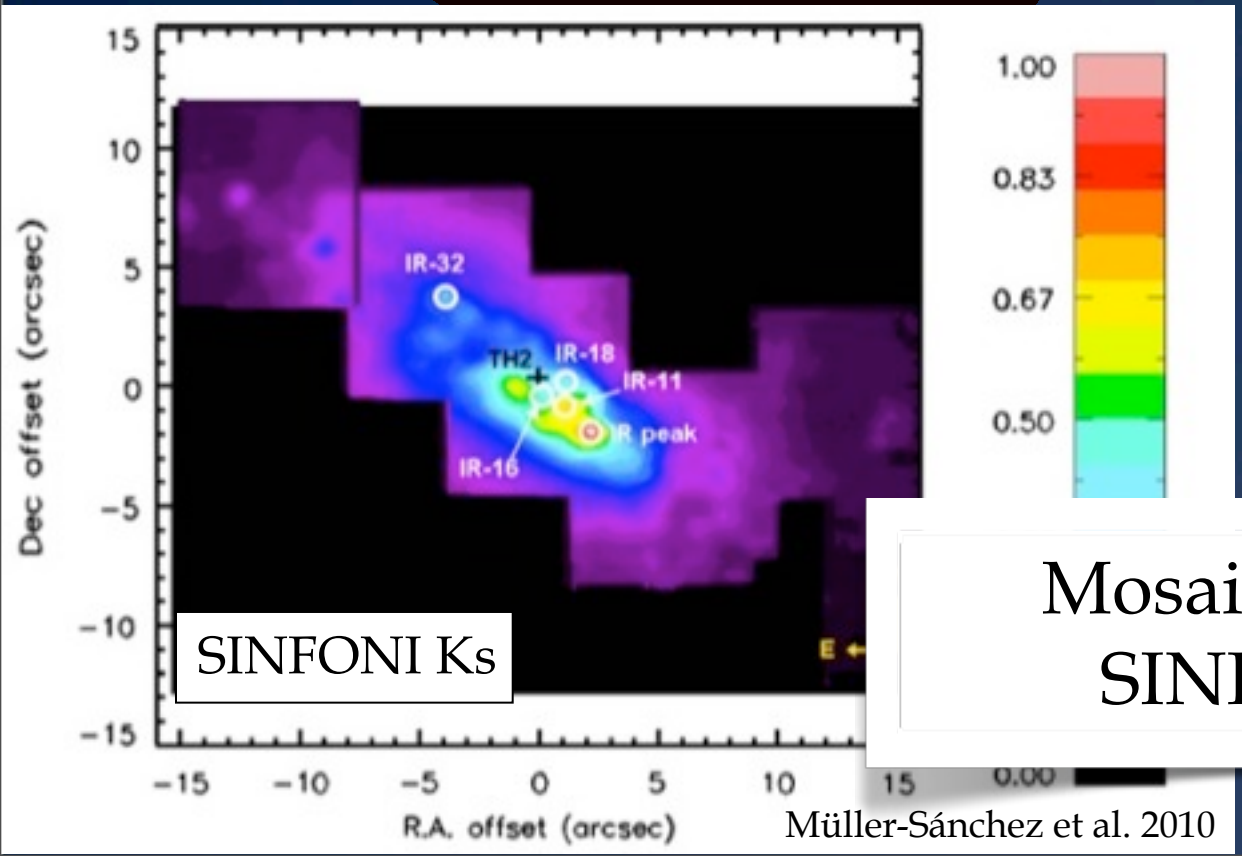
Nuclear torus-like of about 30″ (≈0.4 kpc) diameter

VISTA vs VLT image of the NGC 253

VISTA



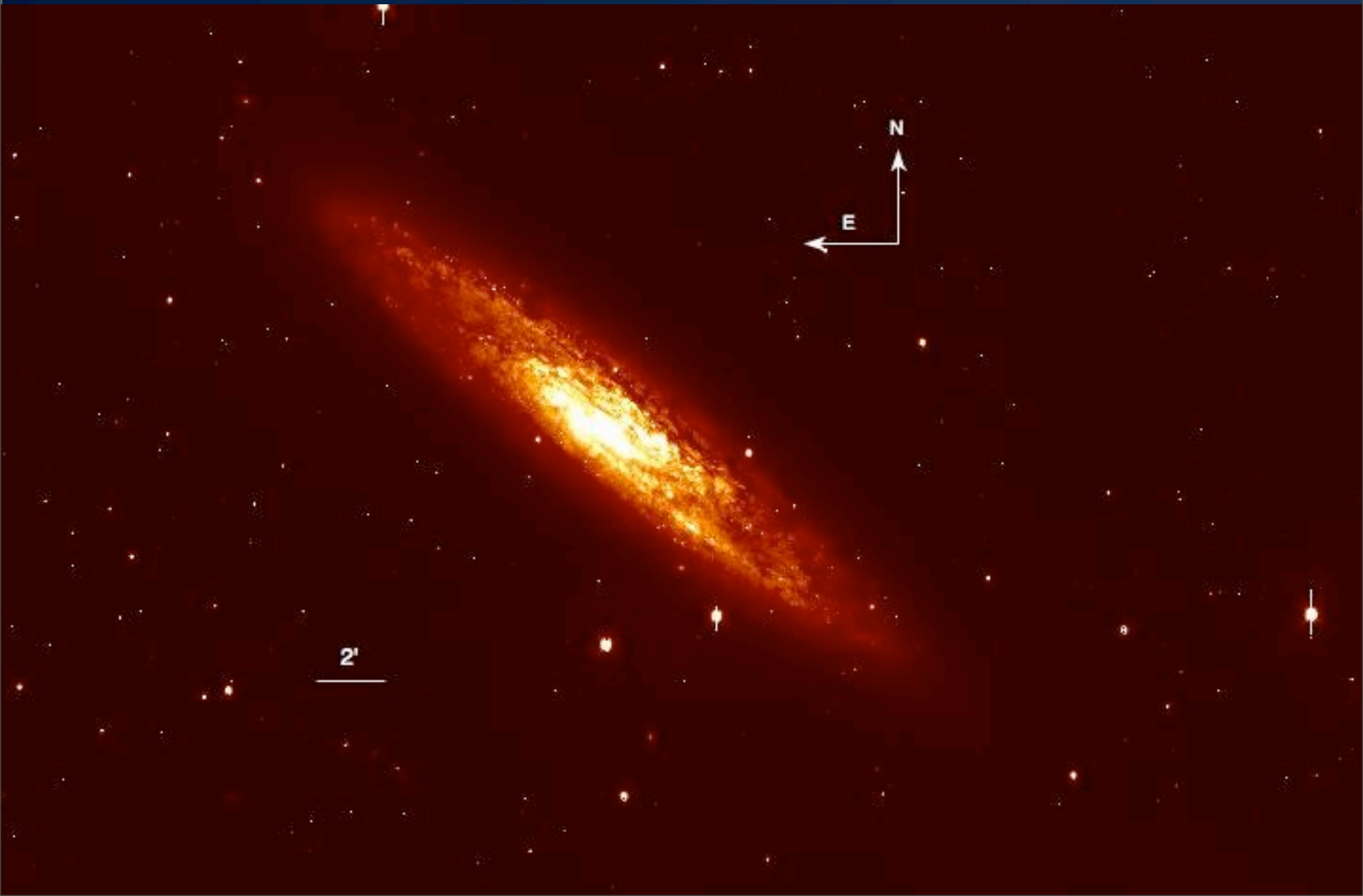
Sub-image of the VISTA Ks



Mosaic of many VLT SINFONI images

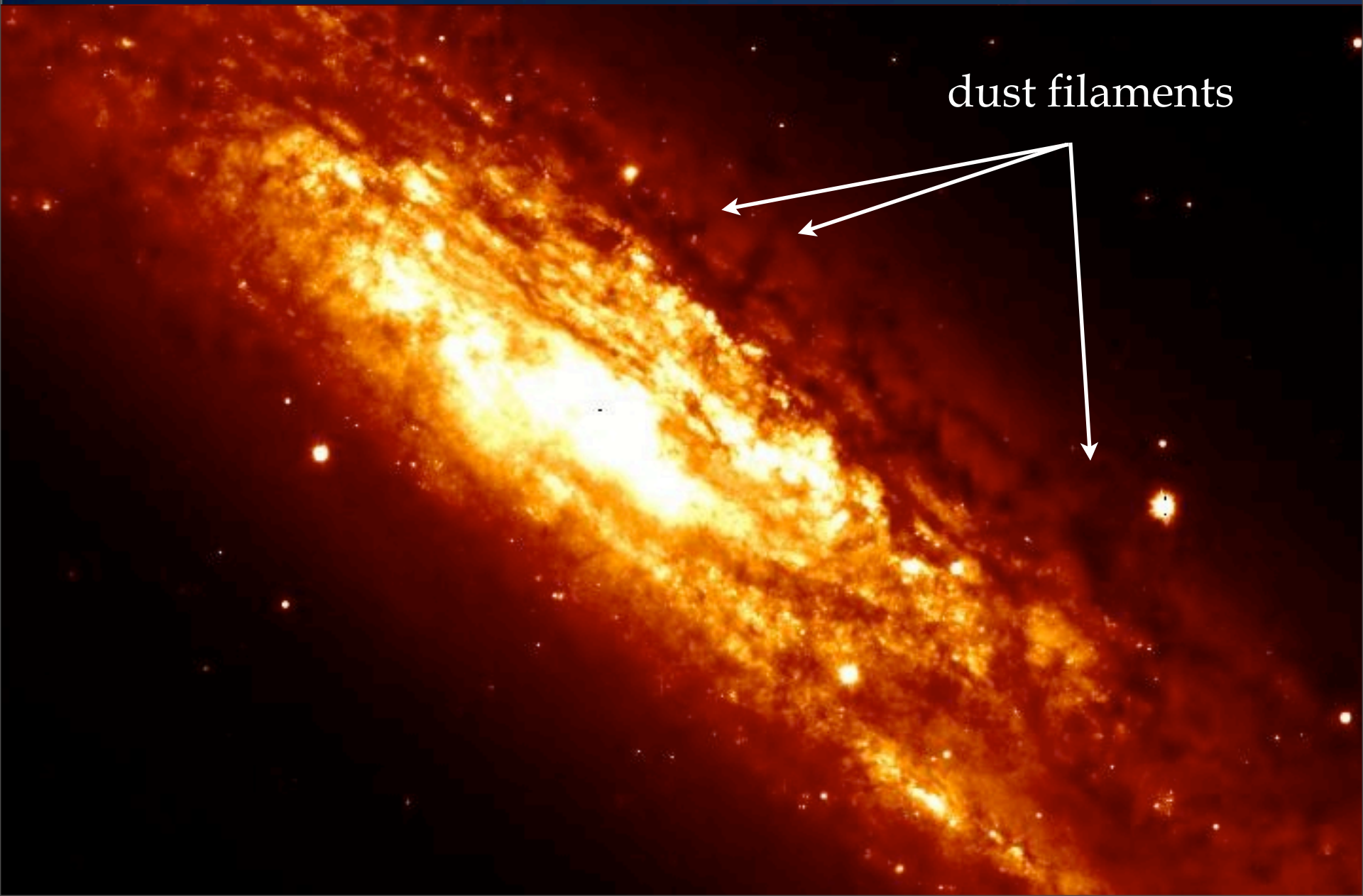
Müller-Sánchez et al. 2010

VST r band image of the NGC 253 disk

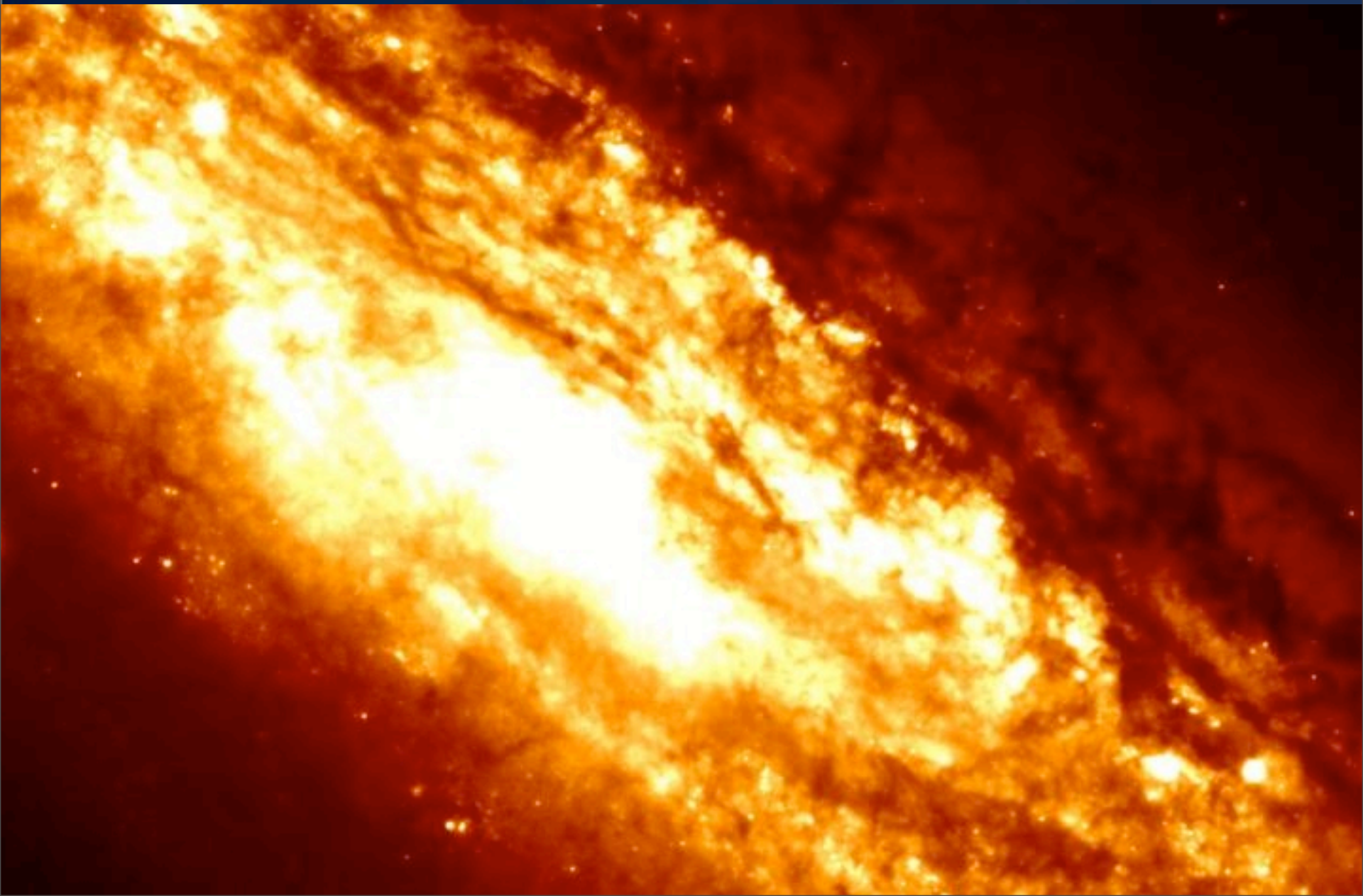


VST r band image of the NGC 253 disk

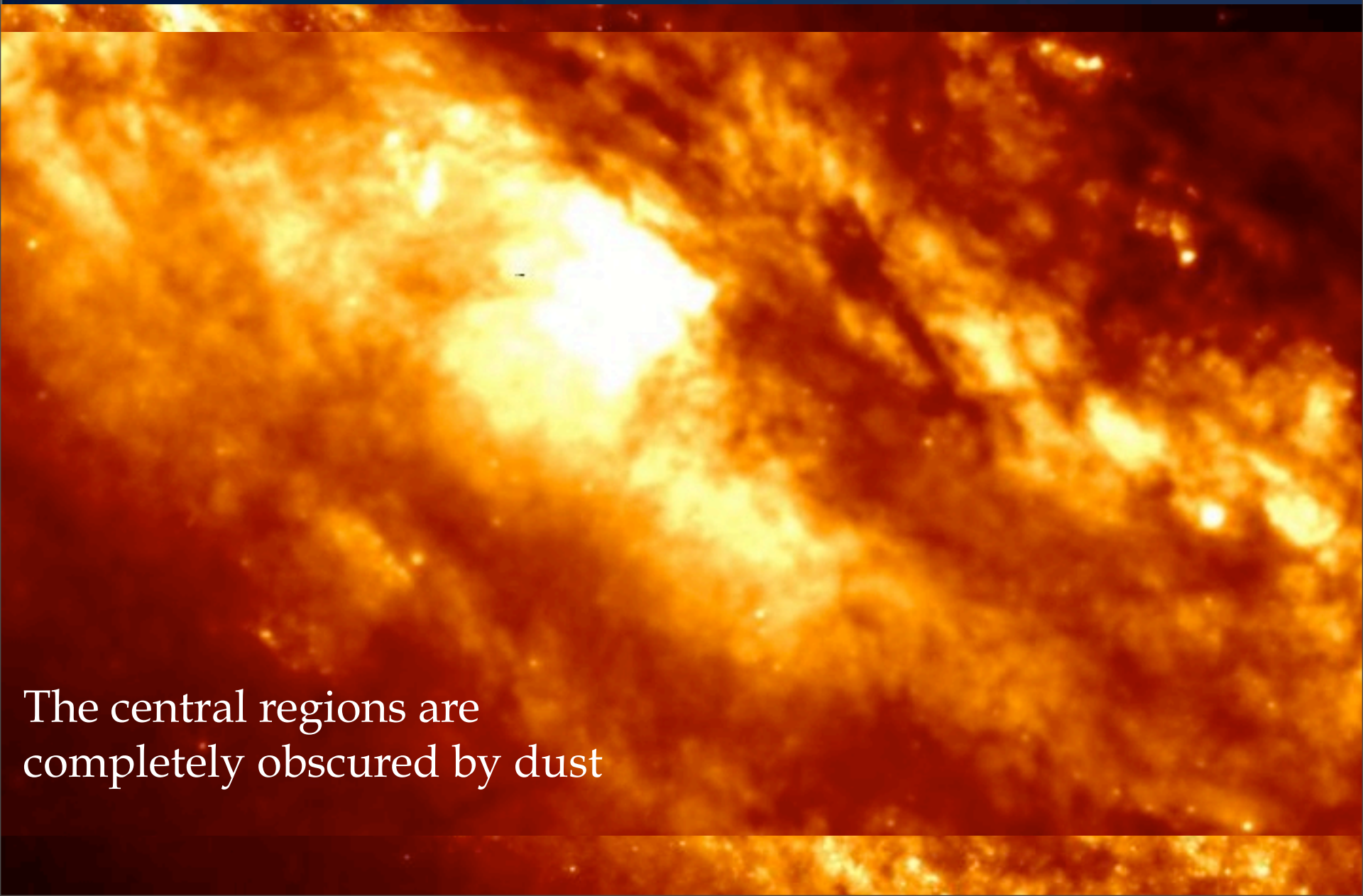
VST r band image of the NGC 253 disk



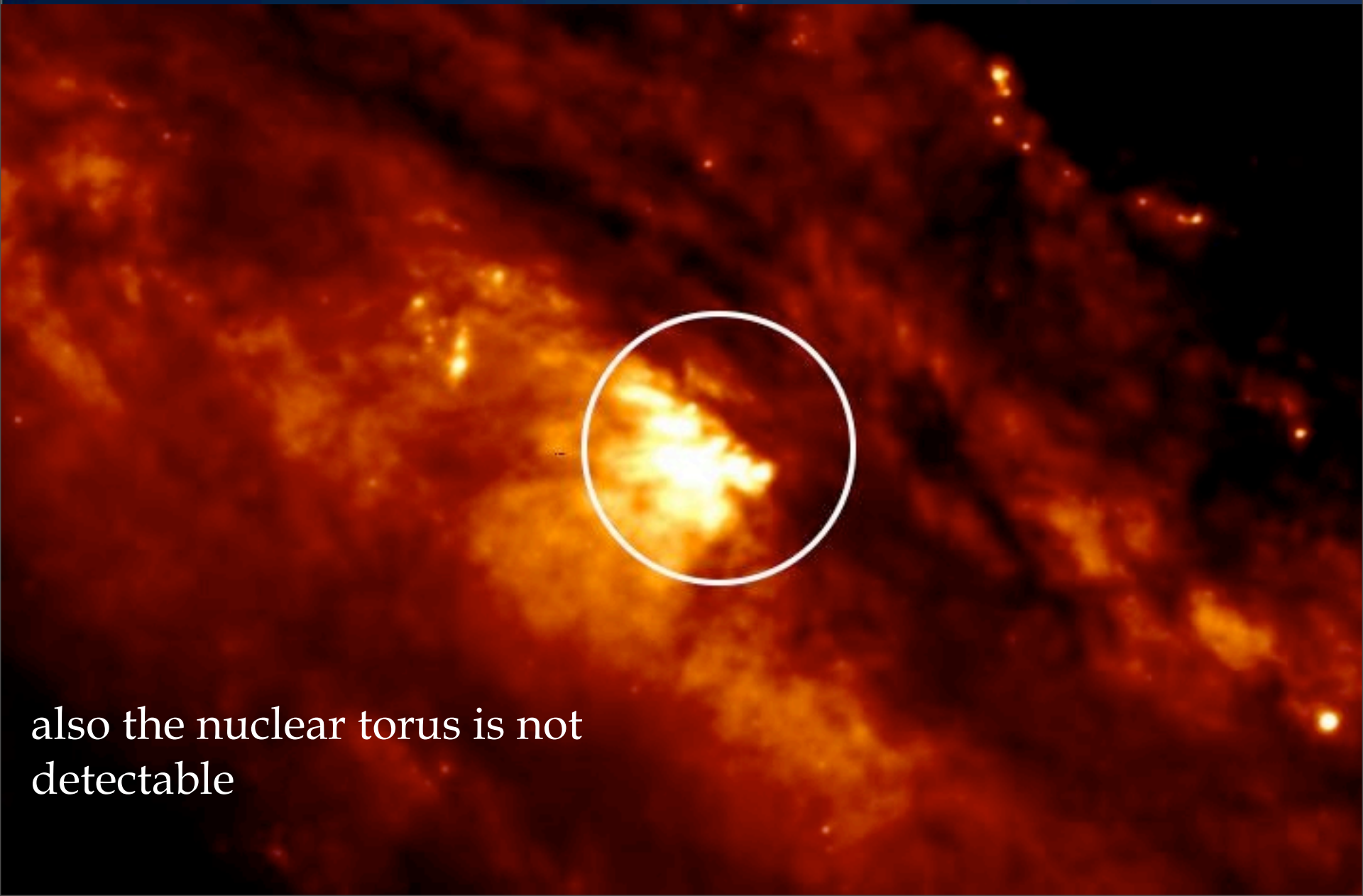
VST r band image of the NGC 253 disk



VST r band image of the NGC 253 disk

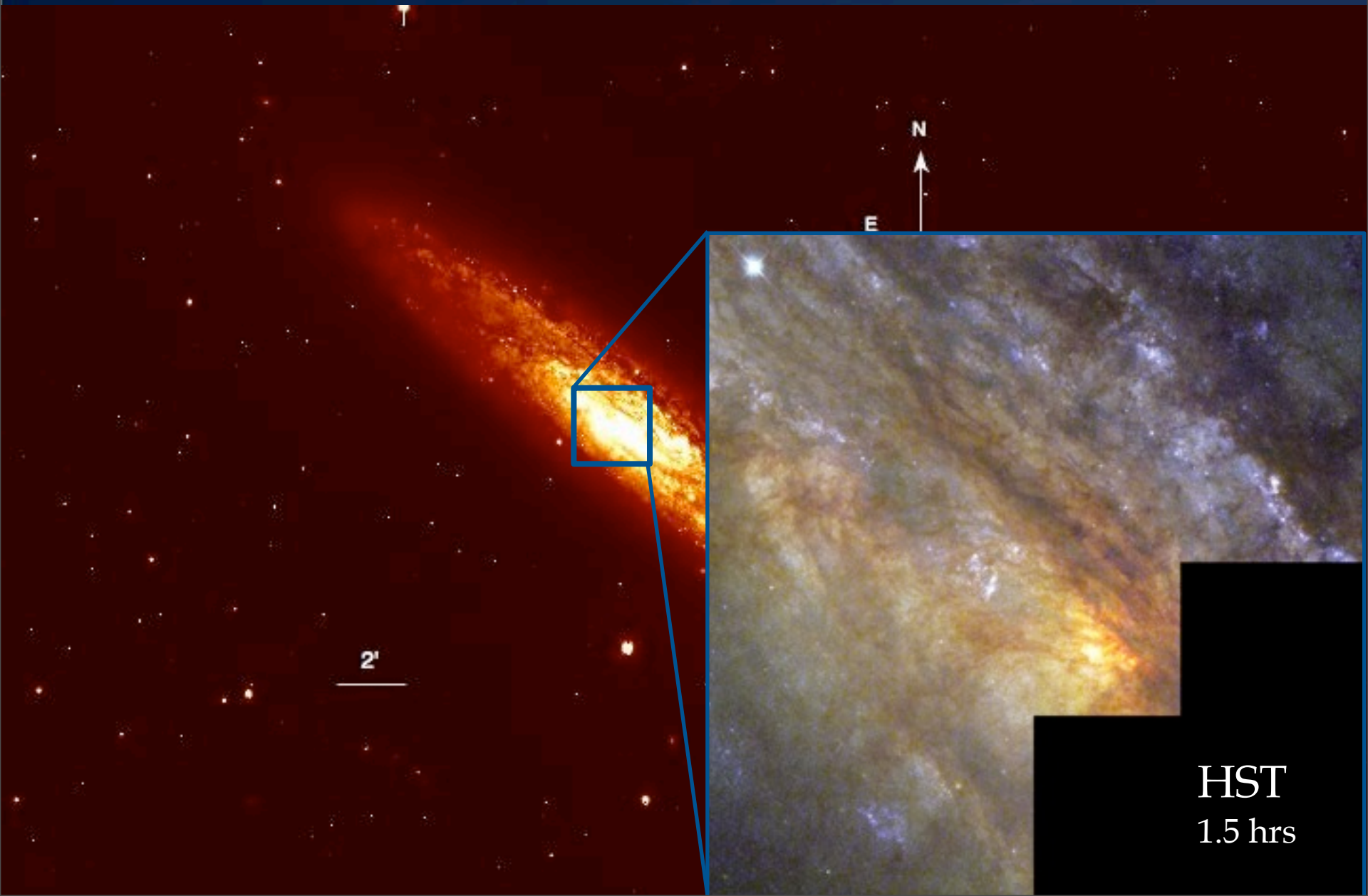


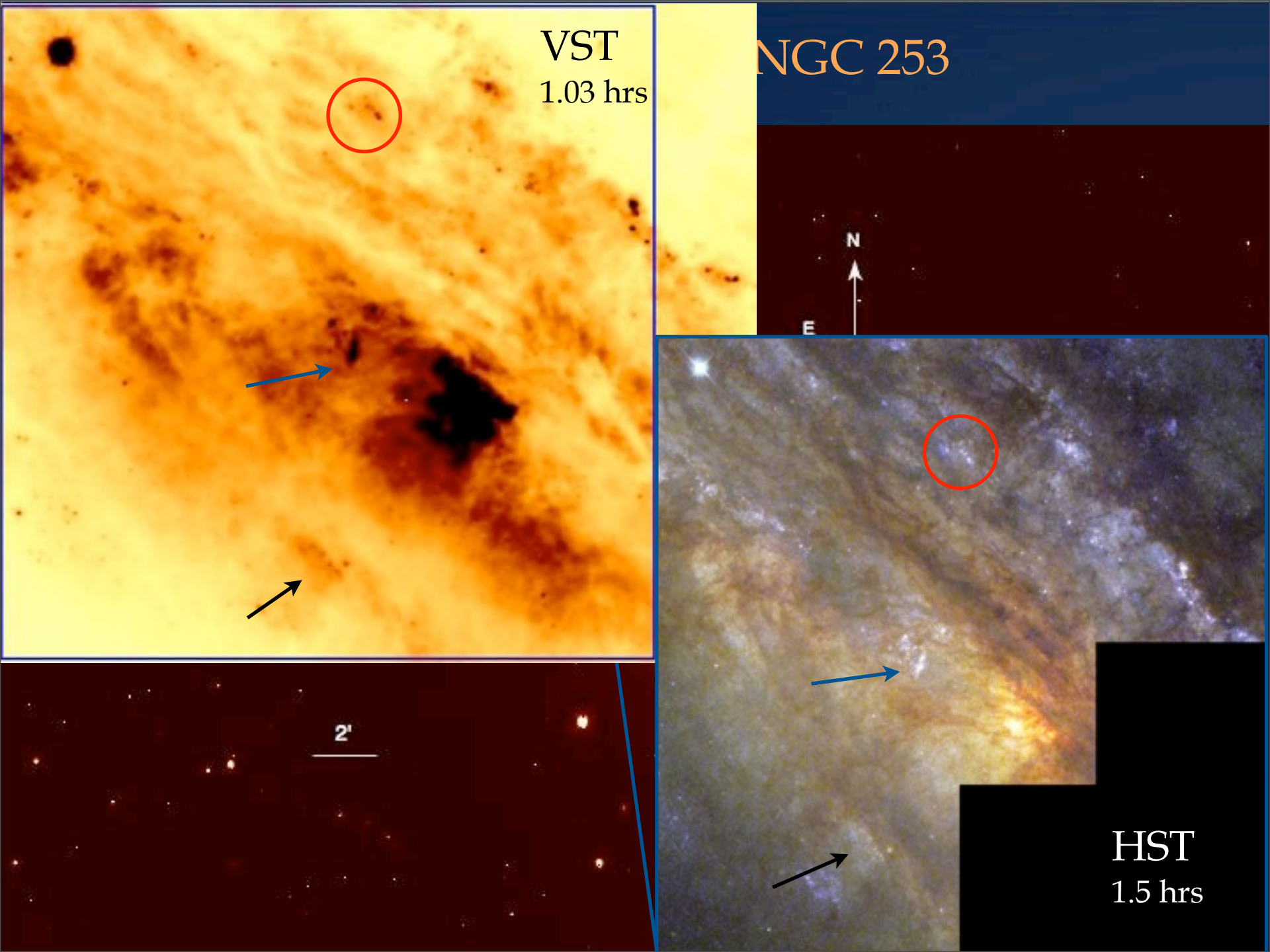
VST r band image of the NGC 253 disk



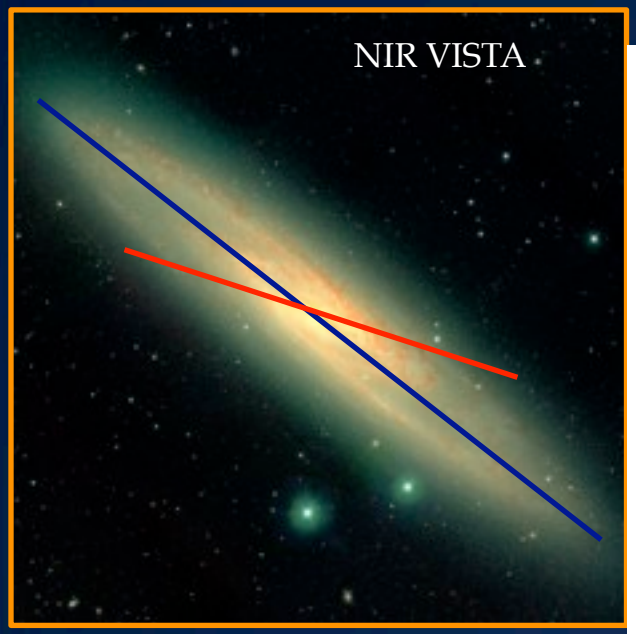
also the nuclear torus is not detectable

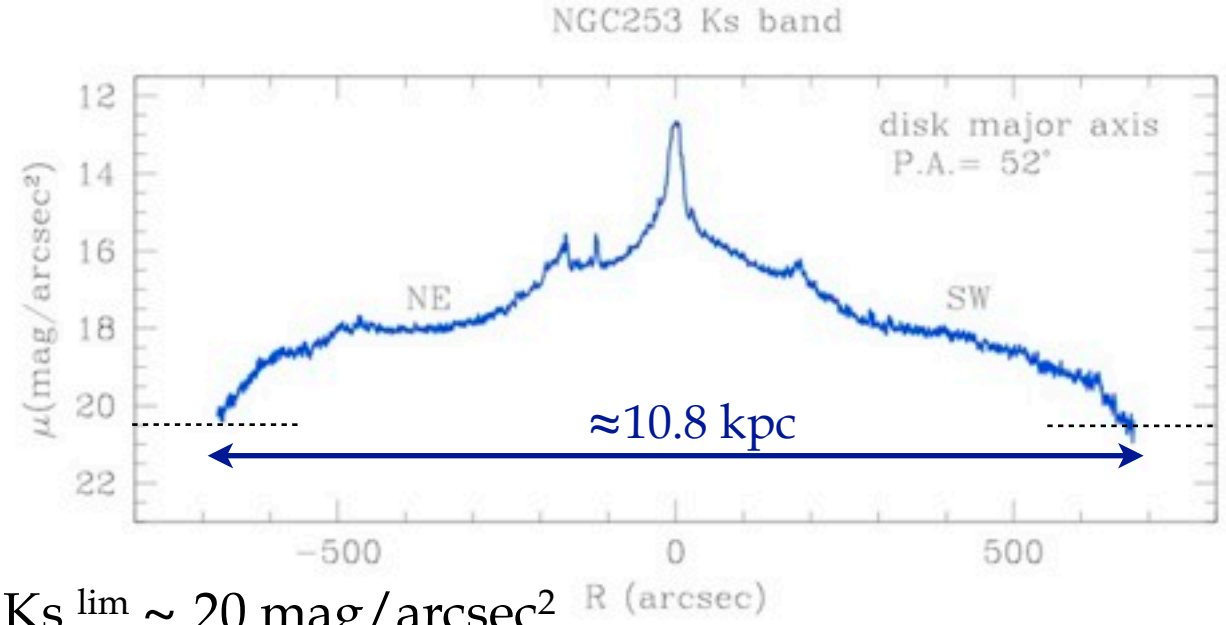
VST vs HST image of the NGC 253



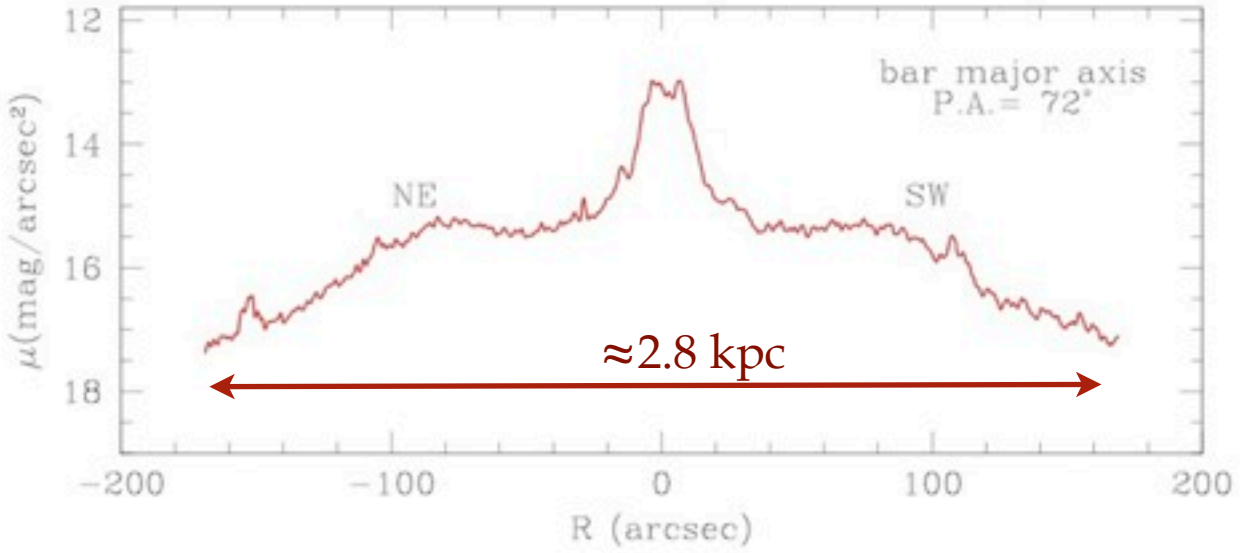

VST
1.03 hrs
NGC 253
N
E
2'
HST
1.5 hrs

Surface brightness profiles

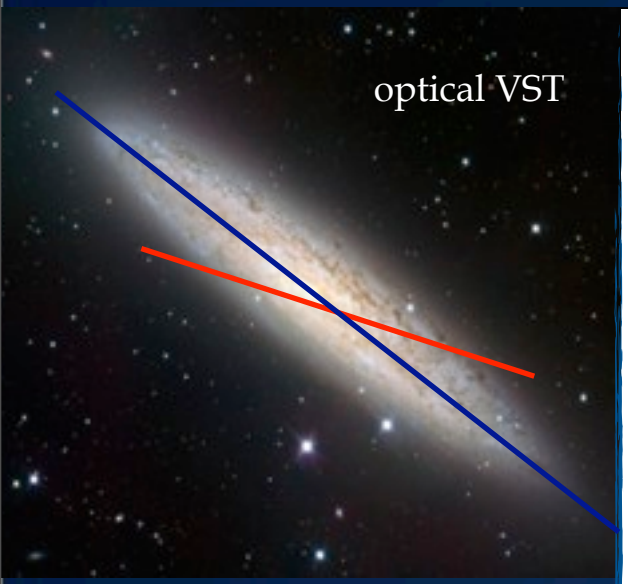


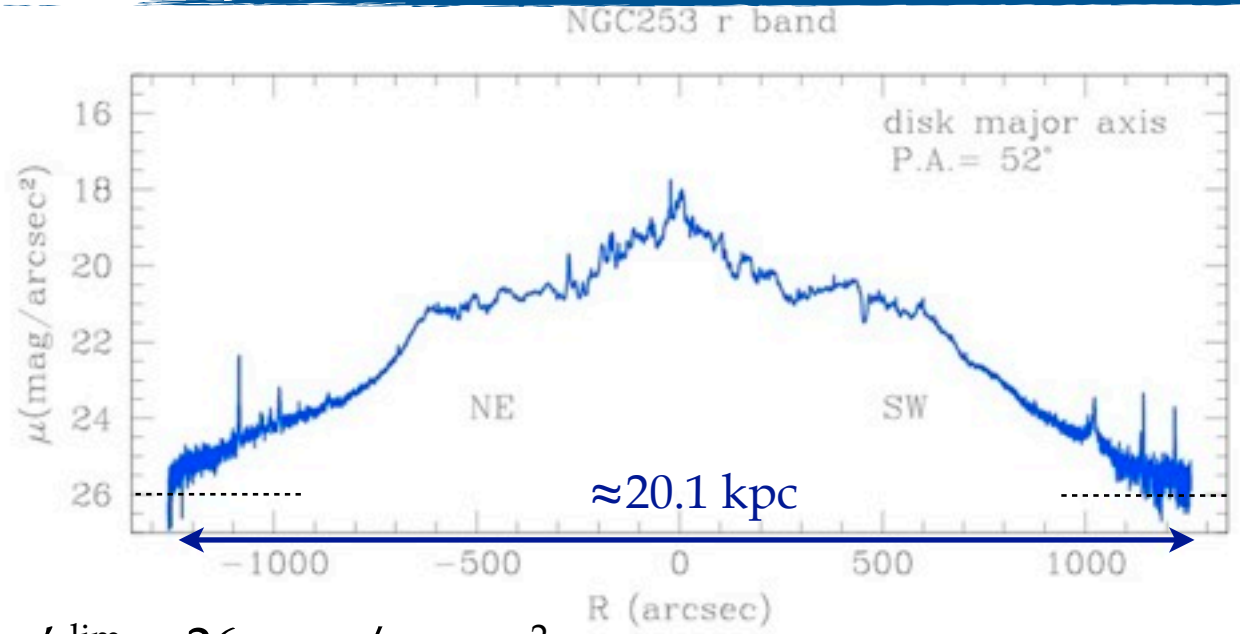


Ks ^{lim} ~ 20 mag/arcsec^2

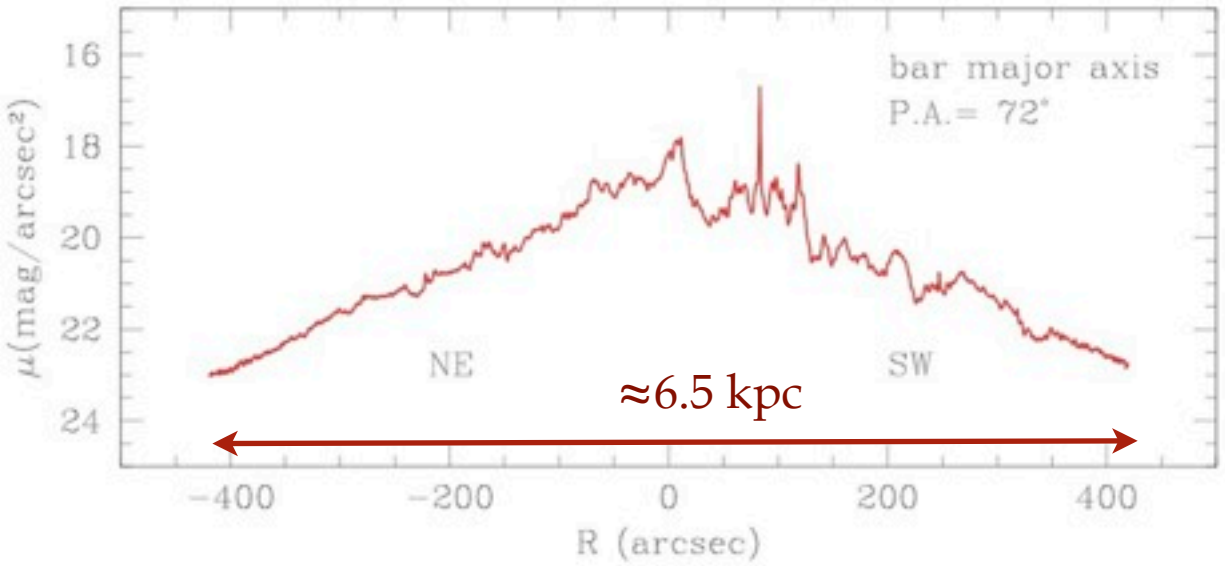


Surface brightness profiles

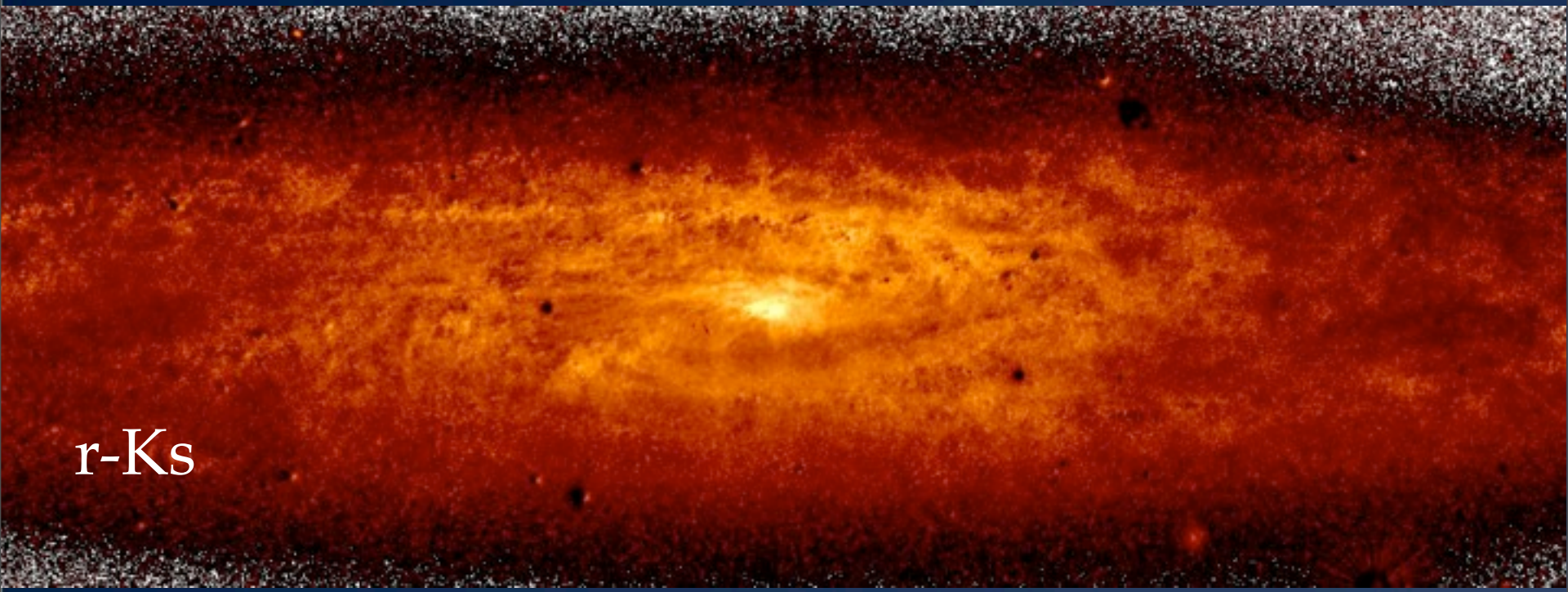




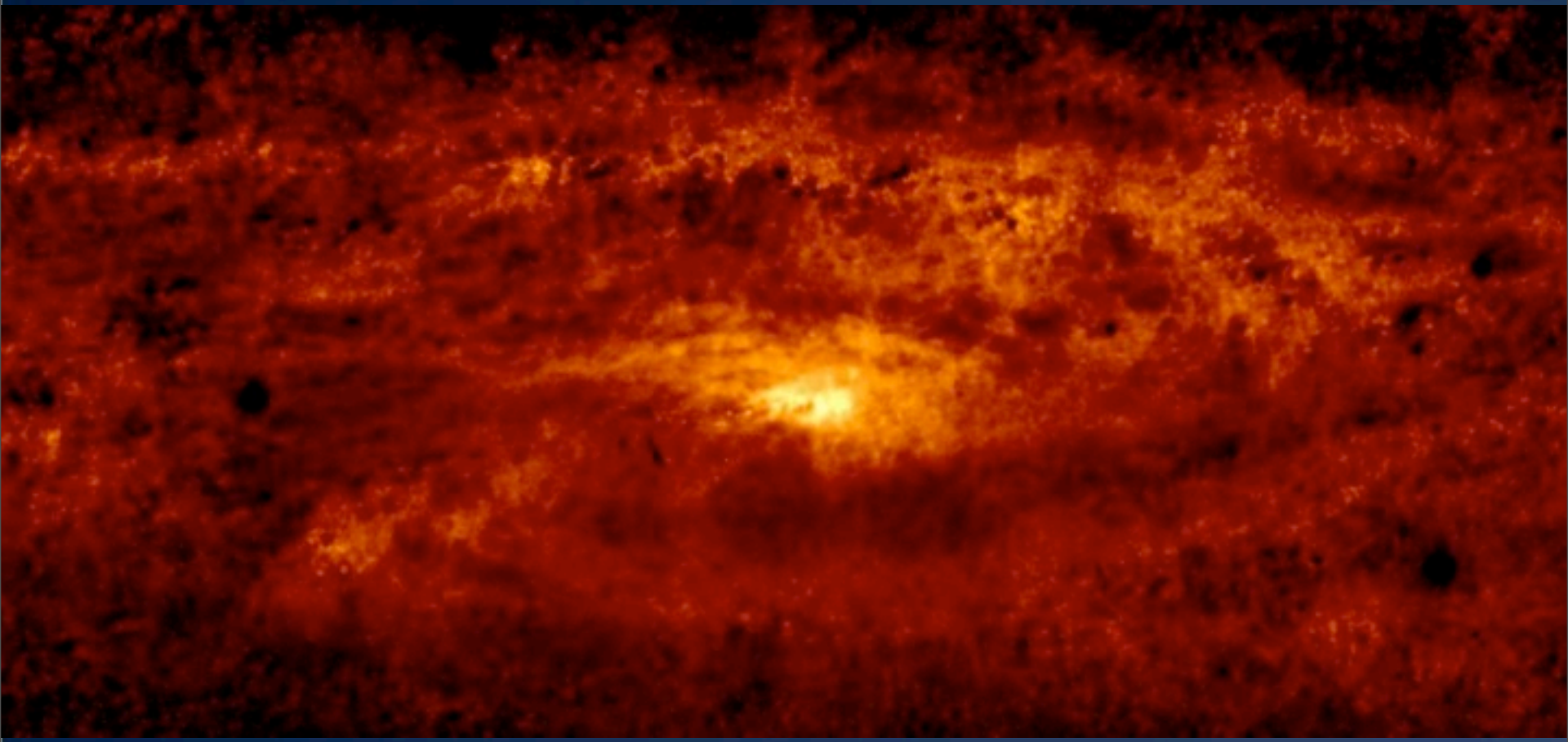
$r'^{\,lim} \sim 26$ mag/arcsec^2



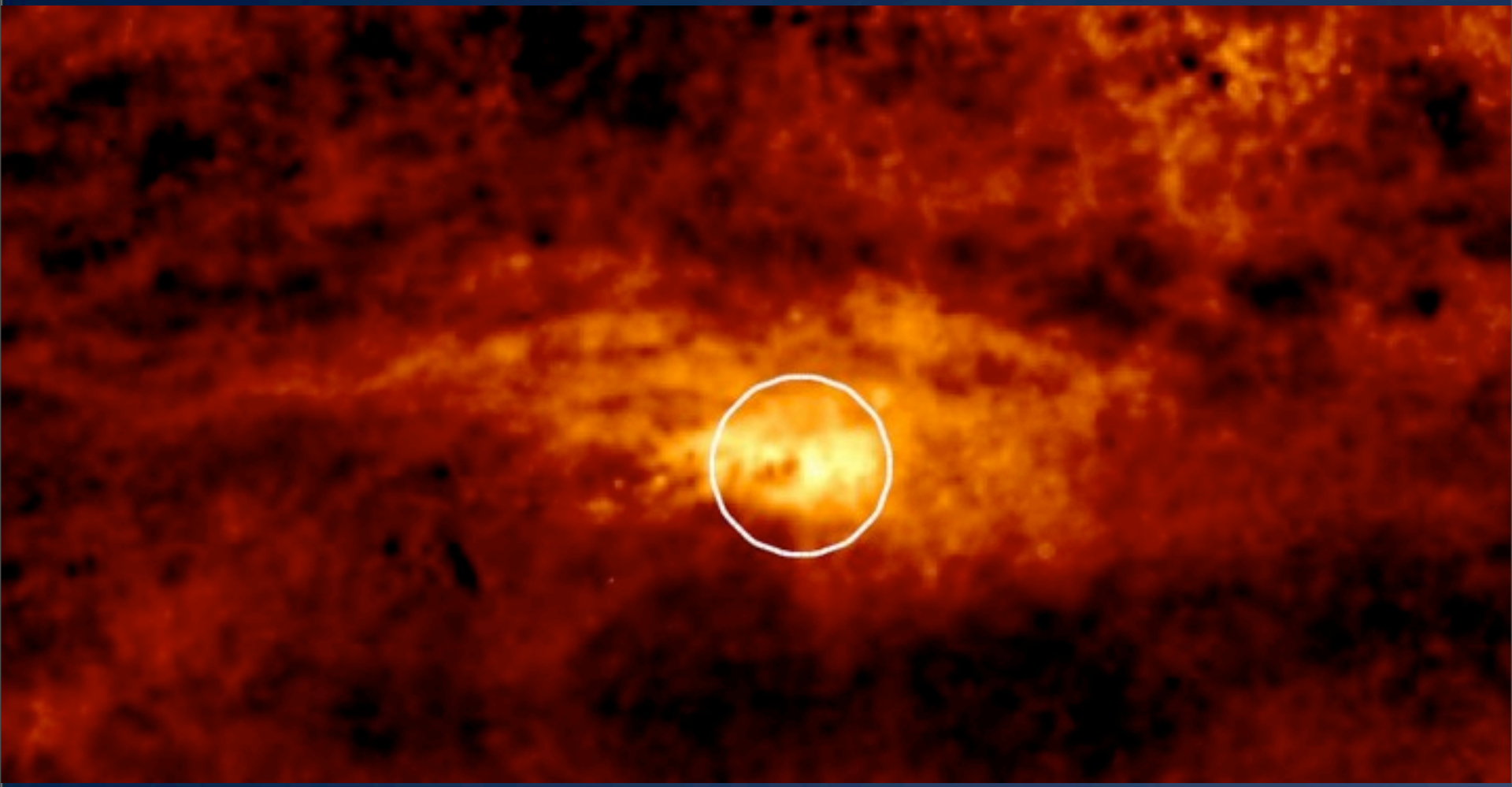
Structure in the inner disk: optical vs NIR colors



Structure in the inner disk: optical vs NIR colors



Structure in the inner disk: optical vs NIR colors



VISTA & VST SV: RESULTS

The new NIR and optical data have emphasized the huge potentiality of the VISTA and VST telescopes for such kind of studies

- both NIR VISTA and optical VST data let to study the structure of NGC253 with a detail comparable to the data of higher class telescopes, i.e. VLT & HST
- the high angular resolution let to detect and study the sub-structures towards the nuclear regions
- the large field of view let to "correlate" the inner features to the structure of the outer galaxy disk

Structure of NGC253 from the VISTA SV:

RESULTS *(Iodice et al. 2012, in preparation)*

- NGC253 has a very complex structure, NIR photometry reveals the coexistence of, at least, 4 components: nuclear torus, inner ring, bar, outer disk;

- the existence of the bright inner torus confirm the previous photometry and kinematics by SINFONI data

- the VISTA Ks data let to a very accurate estimate for the bar intrinsic lenght l_b = 151.5 " ≈ 2.3 kpc and R_{cor} ≈ 2.5 kpc

- taking into account the disk kinematics, the VISTA Ks data predict Ω_B≈ 72 km/s/kpc and the presence of an ILR (at ≈ 0.23 kpc) and OLR (≈ 4.1 kpc)

- the radius of the bright torus detected in the Ks image is consistent with R_{ILR} ; the predicted OLR is consistent with the HI density maximum

- by R = Rcr/lb ≈ 1.10 → fast bar