Workshop *Workflows e Plataformas Científicas — Preparação para o LSST DR1* / LIneA

Exploring the Relationship Between Stellar Population and Nuclear Activity in Hydrodynamical Simulations: An Analysis of the iMaNGA Sample in the Ilustris TNG Simulation

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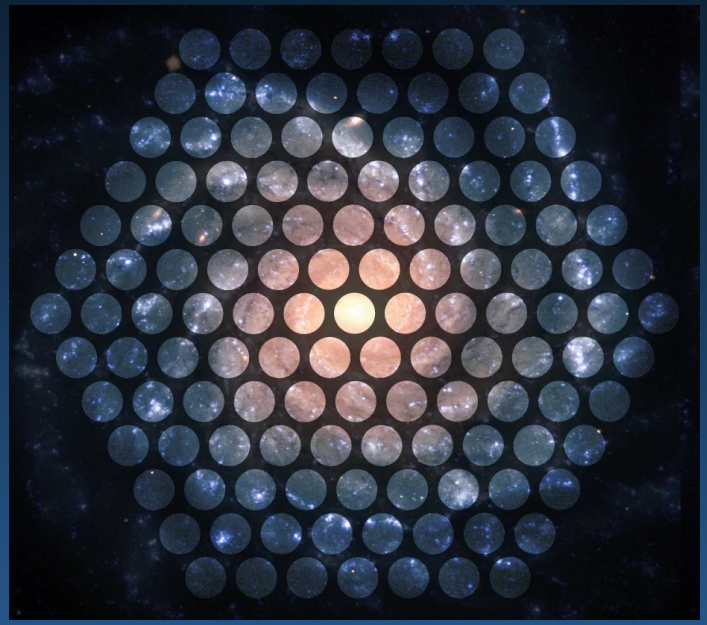
Context

MaNGA survey



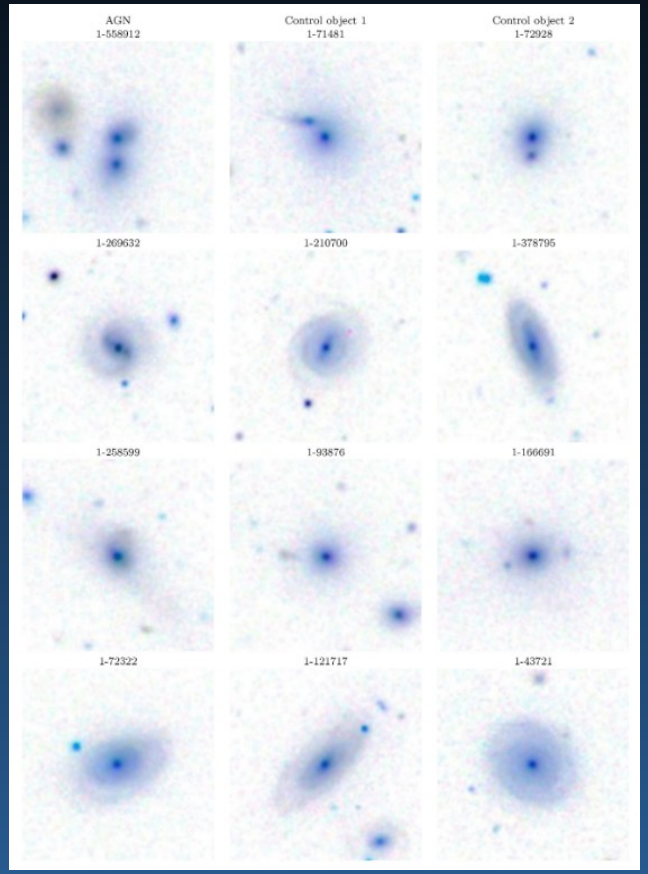
Study the stellar populations and ionized gas properties of a robust sample of AGN hosts

MNRAS **472,** 4382–4403 (2017) doi:10.1093/mnras/stx226
Advance Access publication 2017 September 4

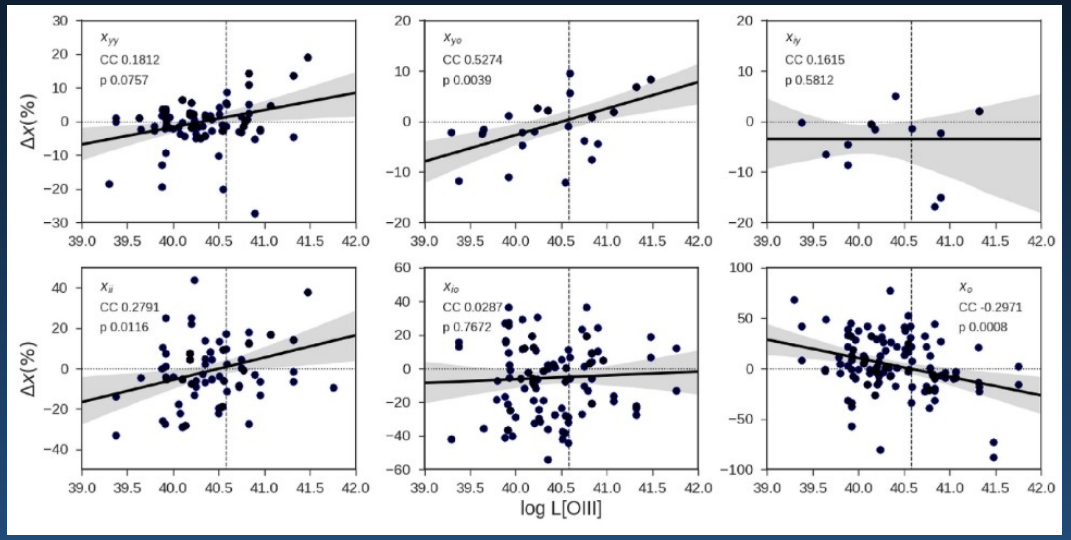
The first 62 AGNs observed with SDSS-IV MaNGA – I. Their characterization and definition of a control sample

Sandro B. Rembold,[1,2]★ Jáderson S. Shimoia,[2,3]★ Thaisa Storchi-Bergmann,[2,3]★ Rogério Riffel,[2,3] Rogemar A. Riffel,[1,2] Nícolas D. Mallmann,[2,3] Janaína C. do Nascimento,[2,3] Thales N. Moreira,[1,2] Gabriele S. Ilha,[1,2] Alice D. Machado,[1,2] Rafael Cirolini,[1,2] Luiz N. da Costa,[2,4] Marcio A. G. Maia,[2,4] Basílio X. Santiago,[2,3] Donald P. Schneider,[5,6] Dominika Wylezalek,[7] Dmitry Bizyaev,[8,9] Kaike Pan[8] and Francisco Müller-Sánchez[10]

Context



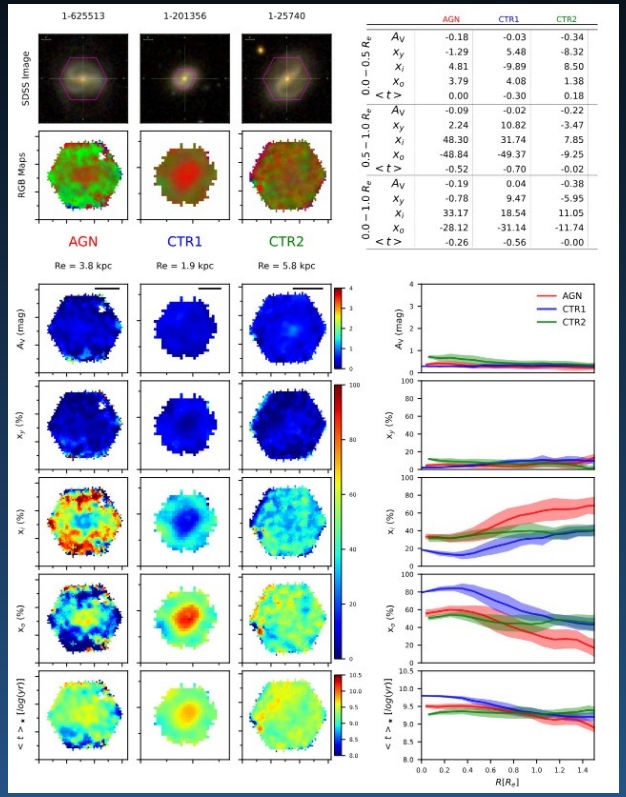
Optically selected AGN hosts + control sample of inactive galaxies



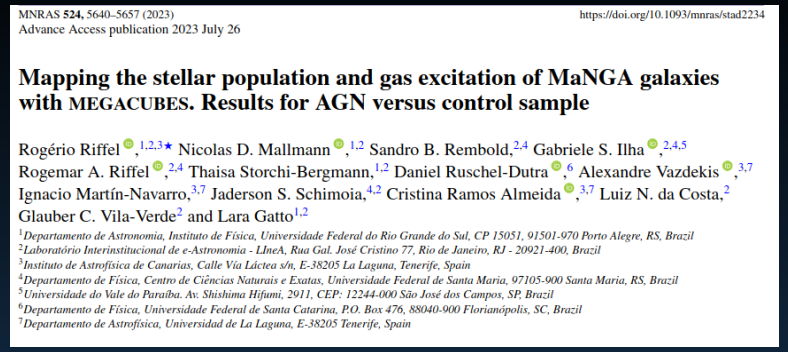
SDSS-III spectroscopy: excess of young & intermediate stellar populations in (luminous) AGN hosts wrt controls

Context

Final sample
& Urutau (Riffel+23)
”MEGACUBES”



		AGN	CTR1	CTR2
0.0 – 0.5 R_e	A_V	-0.18	-0.03	-0.34
	x_y	-1.29	5.48	-8.32
	x_i	4.81	-9.89	8.50
	x_o	3.79	4.08	1.38
	$< t >$	0.00	-0.30	0.18
0.5 – 1.0 R_e	A_V	-0.09	-0.02	-0.22
	x_y	2.24	10.82	-3.47
	x_i	48.30	31.74	7.85
	x_o	-48.84	-49.37	-9.25
	$< t >$	-0.52	-0.70	-0.02
0.0 – 1.0 R_e	A_V	-0.19	0.04	-0.38
	x_y	-0.78	9.47	-5.95
	x_i	33.17	18.54	11.05
	x_o	-28.12	-31.14	-11.74
	$< t >$	-0.26	-0.56	-0.00



MNRAS **524,** 5640–5657 (2023) https://doi.org/10.1093/mnras/stad2234
Advance Access publication 2023 July 26

Mapping the stellar population and gas excitation of MaNGA galaxies with MEGACUBES. Results for AGN versus control sample

Rogério Riffel [1,2,3★] Nicolas D. Mallmann [1,2] Sandro B. Rembold,[2,4] Gabriele S. Ilha [2,4,5] Rogemar A. Riffel [2,4] Thaisa Storchi-Bergmann,[1,2] Daniel Ruschel-Dutra [6] Alexandre Vazdekis [3,7] Ignacio Martín-Navarro,[3,7] Jaderson S. Schimoia,[4,2] Cristina Ramos Almeida [3,7] Luiz N. da Costa,[2] Glauber C. Vila-Verde[2] and Lara Gatto[1,2]

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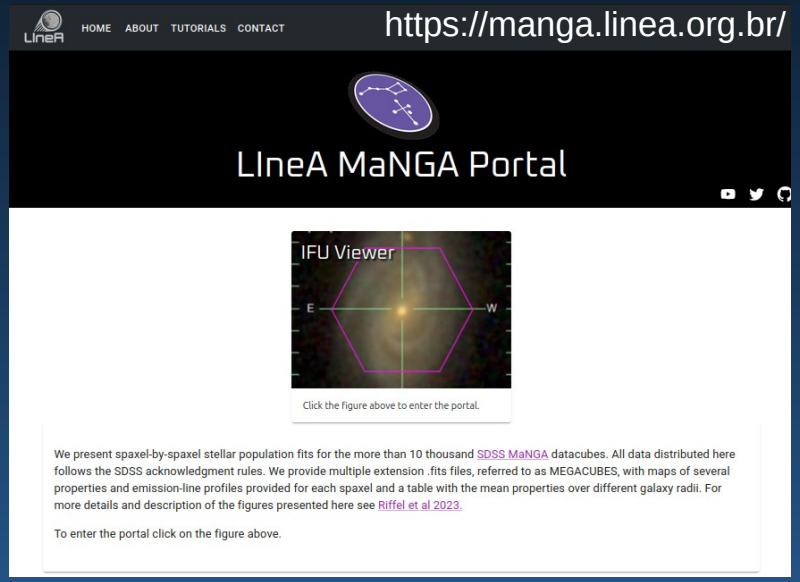
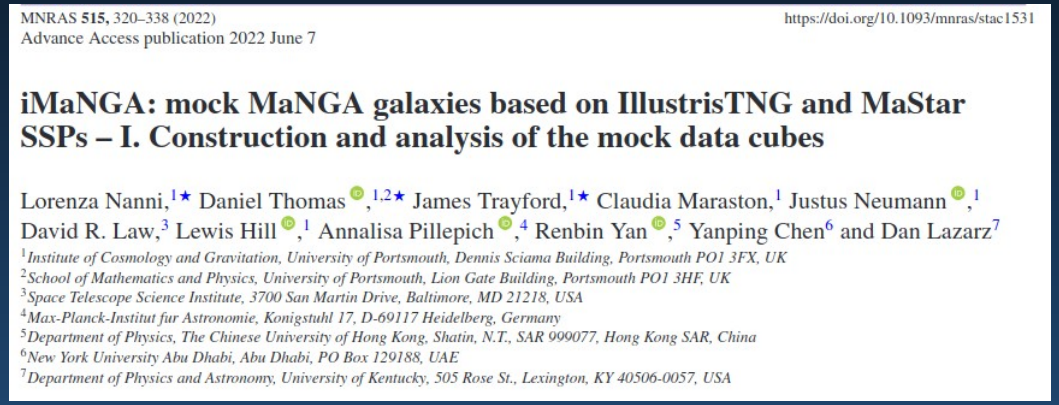


MaNGA data: excess of young & intermediate stellar populations confirmed and quantified

Goals

Are those trends also observed in hydrodynamical simulations?



MNRAS **515,** 320–338 (2022)
Advance Access publication 2022 June 7
https://doi.org/10.1093/mnras/stac1531

iMaNGA: mock MaNGA galaxies based on IllustrisTNG and MaStar SSPs – I. Construction and analysis of the mock data cubes

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- Define AGN & control samples in mock MaNGA datacubes
- Apply Urutau & compare the stellar population properties

Methods

iMaNGA

iMaNGA focuses on generating a catalog of simulated galaxies to improve the understanding of galaxy formation and evolution (Nanni et al. 2022).

- The project aims to strengthen the connection between theoretical simulations and observational data, specifically targeting the testing of galaxy formation theories.
- Advanced cosmological simulations (IllustrisTNG) are used to create simulated observations that resemble real data from the MaNGA survey.

The IllustrisTNG project is a set of state-of-the-art cosmological galaxy formation simulations. Each simulation in IllustrisTNG spans a large portion of a simulated Universe, from shortly after the Big Bang to the present day, while accounting for a wide range of physical processes that drive galaxy formation. The simulations can be used to study a broad range of topics on how the Universe — and the galaxies within it — have evolved over time.

Methods

Our project consists of analyzing the properties of the stellar population in simulated galaxies, reproducing our previous investigations of real galaxies in the MaNGA survey. It can be divided into 4 steps:

1. Download the 1,511 data cubes that constitute the iMaNGA catalog.

The size of the data cubes varies between 2 and 10 GB, totaling approximately 20 TB. With our limited network, it would take days just to download the data.

```
-rw-r--r-- 1 felipe.albanez public 10299971520 Jan  8 22:48 98_741861_ready.fits
-rw-r--r-- 1 felipe.albanez public    96261120 Jan  8 22:47 98_743380_ready.fits
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-rw-r--r-- 1 felipe.albanez public  2540784960 Jan  8 22:47 98_745266_ready.fits
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```

Methods

2. Model the files to ensure compatibility with Urutau's requirements, adopting a structure similar to that used by MaNGA files.

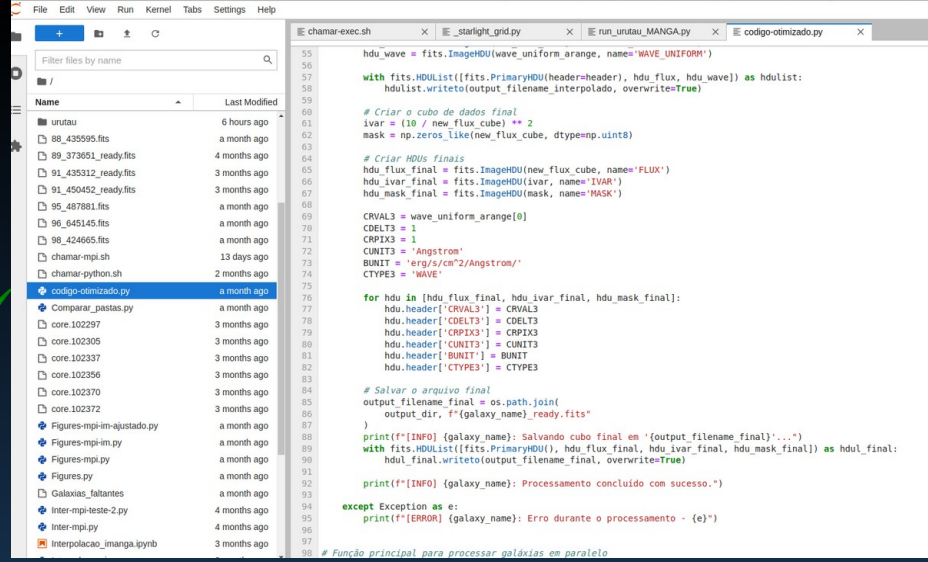
Load parameters (iMaNGA).

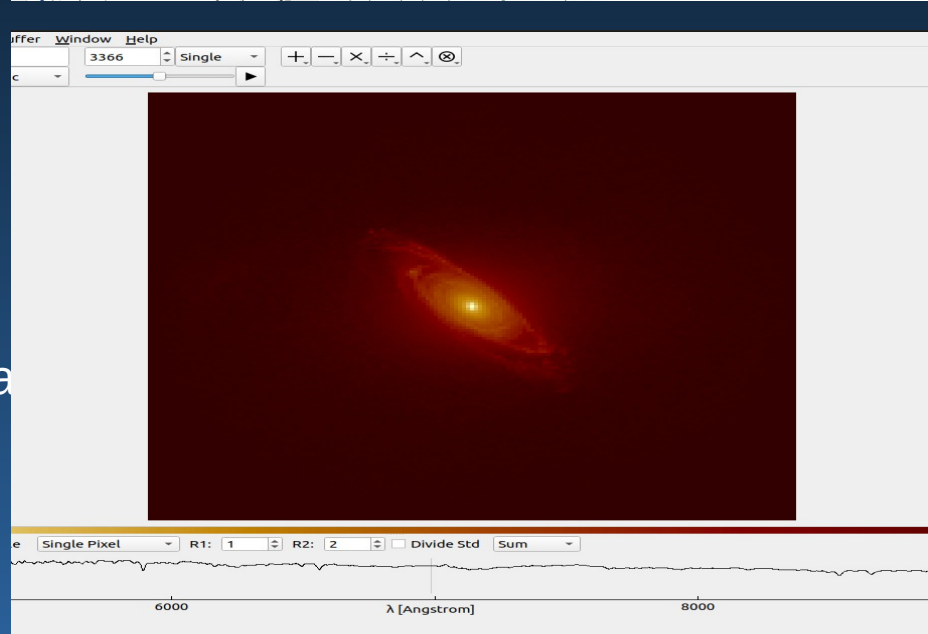
Define a uniform grid between 3621 and 10353 Å.

Flux density interpolation

Calculate inverse variance (IVAR) and mask (MASK) ma

Create the data cube (with final HDUs).





Methods

Configuring a job in LUSTRE

```
#!/bin/sh
#SBATCH -p cpu                                  # Nome da partição
#SBATCH -J Processamento_Urutau              # Nome do job
#SBATCH --nodelist=apl21                      # Número de nós requisitados
#SBATCH --cpus-per-task=104                # Número de tarefas por nó
#-------------------------------------------------------------------------#

# Definir diretório de cache do Matplotlib
#export MPLCONFIGDIR=/scratch/$USER/.matplotlib

# Criar o diretório caso não exista
#mkdir -p $MPLCONFIGDIR


# Exibe os nós alocados
echo $SLURM_JOB_NODELIST
nodeset -e $SLURM_JOB_NODELIST

# Vai para o diretório de envio
cd $SLURM_SUBMIT_DIR

EXEC=/lustre/t0/scratch/users/felipe.albanez/teste-urutau/chamar-exec.sh

# Executa o script
srun $EXEC
```

Para obter uma lista completa da sintaxe, execute o comando man sbatch.

Sintaxe	Significado
#SBATCH -p partition	Define a partição em que o job será executado
#SBATCH -J job_name	Define o nome do Job
#SBATCH -n quantidade	Define o número total de tarefas da CPU.
#SBATCH -N quantidade	Define o número de nós de computação solicitados.

Comandos Básicos do Slurm

Para aprender sobre todas as opções disponíveis para cada comando, insira man enquanto estiver conectado ao ambiente do Cluster.

Comando	Definição
sbatch	Envia scripts de tarefas para a fila de execução
scancel	Cancela um job
scontrol	Usado para exibir o estado Slurm (várias opções disponíveis apenas para root)
sinfo	Exibir estado de partições e nós
squeue	Exibir estado dos jobs
salloc	Envia um job para execução ou inicia um trabalho em tempo real

Search

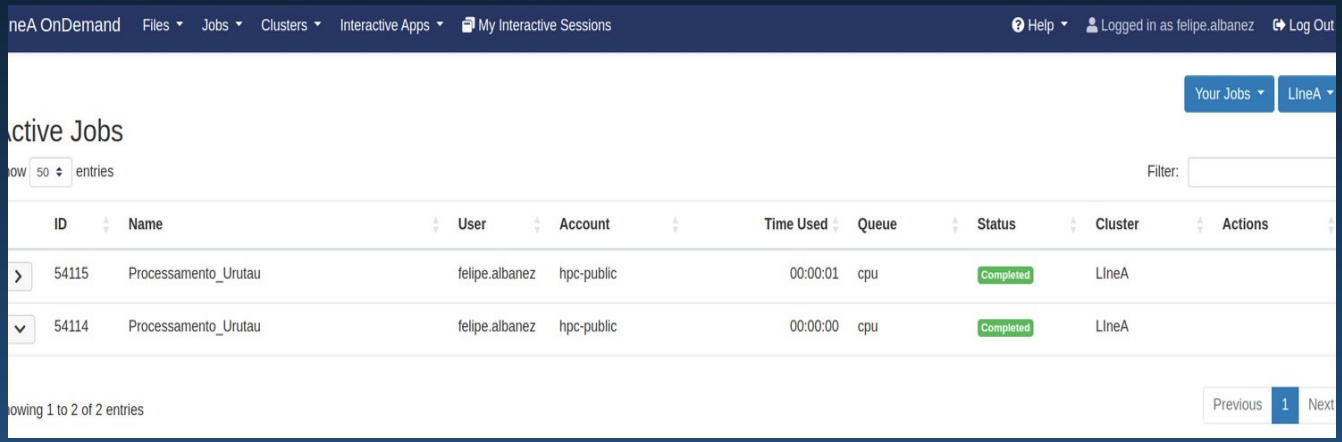
Partições disponíveis

O cluster Apollo é organizado em diferentes partições (subconjunto de máquinas) para atender a diferentes necessidades, por exemplo, a garantia da prioridade máxima dos usuários do projeto LSST na utilização das máquinas dedicadas ao IDAC-Brasil.

PARTITION	TIMELIMIT	NODES	NODELIST
cpu_dev	30:00	26	apl[01-26]
cpu_small	3-00:00:00	26	apl[01-26]
cpu	5-00:00:00	26	apl[01-26]
cpu_long	31-00:00:0	26	apl[01-26]
lsst_cpu_dev	30:00	12	apl[15-26]
lsst_cpu_small	3-00:00:00	12	apl[15-26]
lsst_cpu	5-00:00:00	12	apl[15-26]
lsst_cpu_long	10-00:00:0	12	apl[15-26]

Methods

4. Processing data cubes with Urutau (ongoing)



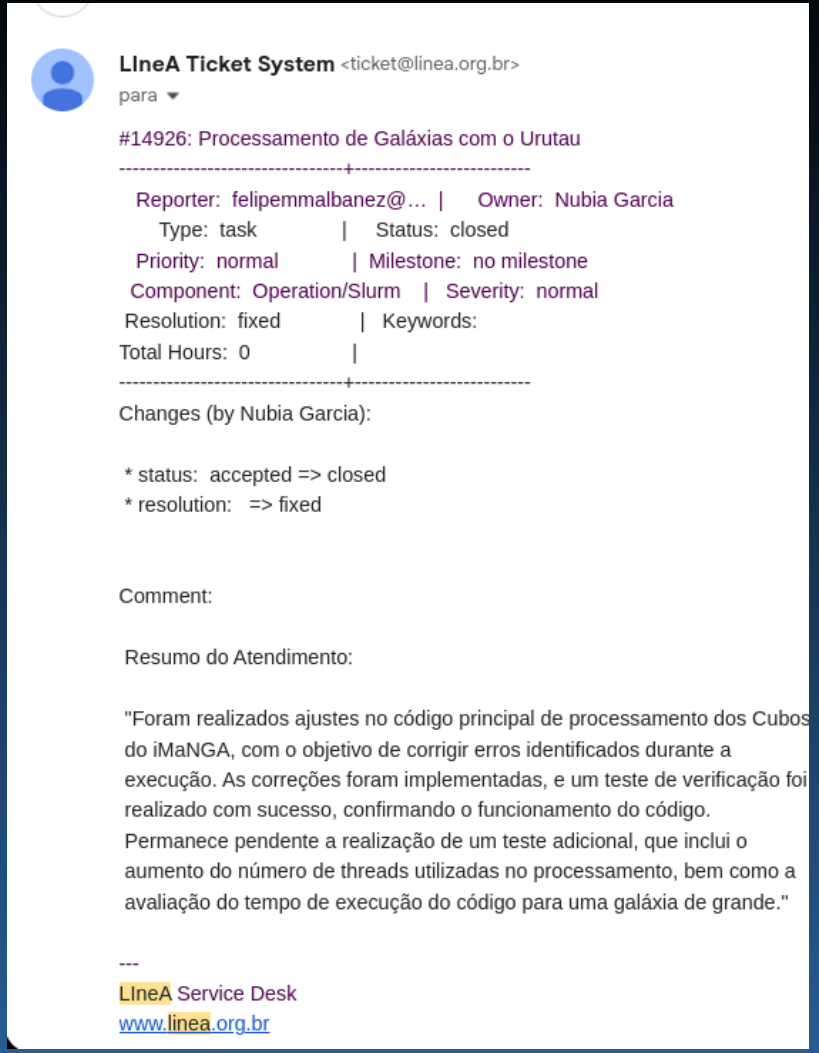
Install Urutau ✓

Testing IN PROGRESS

Create MEGACUBES

Summary

- Local storage solutions unavailable
- Local processing power insufficient for full scale spectra modelling
- LUSTRE & LIneA support (Help Desk and Slack) made the project feasible



LIneA Ticket System <ticket@linea.org.br>
para

#14926: Processamento de Galáxias com o Urutau

Reporter: felipemmalbanez@…	Owner: Nubia Garcia
Type: task	Status: closed
Priority: normal	Milestone: no milestone
Component: Operation/Slurm	Severity: normal
Resolution: fixed	Keywords:
Total Hours: 0	

Changes (by Nubia Garcia):

* status: accepted => closed
* resolution: => fixed

Comment:

Resumo do Atendimento:

"Foram realizados ajustes no código principal de processamento dos Cubos do iMaNGA, com o objetivo de corrigir erros identificados durante a execução. As correções foram implementadas, e um teste de verificação foi realizado com sucesso, confirmando o funcionamento do código. Permanece pendente a realização de um teste adicional, que inclui o aumento do número de threads utilizadas no processamento, bem como a avaliação do tempo de execução do código para uma galáxia de grande."

LIneA Service Desk
www.linea.org.br