30 años del Supercómputo en México

Alfredo J. Santillán
UNAM

¿Qué es una supercomputadora?

¿Qué es una supercomputadora?

¿Qué es una supercomputadora?

#1 Capacidad de procesamiento

#1 Memoria RAM

#1 Almacenamiento

#1 Velocidad de comunicación

1a Supercomputadora

El cómputo en México inicia con la llegada de la IBM 650 a la Universidad Nacional Autónoma de México en junio de 1958.

Antecedentes

Alberto Barajas
Matemático/Físico

Sergio Beltrán
Ingeniero

Nabor Carrillo
Ingeniero

Carlos Graeff
Matemático/Físico

Antecedentes

- En 1958 se crea el Centro de Cálculo Electrónico (CCE), dirigido por el Ing. Sergio Beltrán.

- Durante 3 años, la IBM 650 fue la única computadora en el país.

Antecedentes

Justificación para esa primera computadora.

- Problemas en el campo de las matemáticas aplicadas y de la mecánica de suelos, resolución de sistemas de ecuaciones integrodiferenciales.
- Aplicaciones universitarias y aplicaciones externas.

BOLETÍN DE LOS OBSERVATORIOS DE TONANTZINTLA Y TACUBAYA, VOL. 4, N°28, 1967.

RUN-AWAY STARS AS THE RESULT OF THE GRAVITATIONAL COLLAPSE OF PROTO-STELLAR CLUSTERS.

A. Poveda, J. Ruiz and C. Allen

Abstract

Some of the difficulties in our present understanding of the origin of run-away stars and expanding clusters are briefly discussed; an alternative explanation for these phenomena is proposed here as the result of dynamical interactions during the collapse of small clusters of massive stars. The initial conditions of the collapse are discussed and justified in terms of current ideas on star formation, and the dynamical evolution of 54 cases of collapsing clusters (containing 5 and 6 stars) is followed numerically. Out of these 54 cases a total of 38 run-away stars were formed with velocities larger than 35 km/sec and up to 185 km/sec with percentages of production that go as high as 15% of the stars involved in different clusters. Approximately one half of the run-away stars are produced together with a second star having positive energy and running in opposite direction. Twelve clusters ejected at least one half of their stars with positive energy.

Sumario

Se discuten brevemente algunas de las dificultades que actualmente se tienen para explicar el origen de las estrellas desbocadas y de los cúmulos en expansión. Se propone una explicación alternativa para estos fenómenos, como resultado de las interacciones dinámicas durante el colapso de cúmulos pequeños de estrellas masivas. Las condiciones iniciales para el colapso se discuten y se justifican con base en las ideas actuales acerca de la formación de las estrellas. Se ha calculado numéricamente la evolución dinámica de 54 cúmulos en colapso. De estos 54 cúmulos se formaron un total de 38 estrellas desbocadas con velocidades mayores de 35 km/seg. y hasta de 185 km/seg. El porcentaje de desbocadas respecto al número total de estrellas en los diversos cúmulos llega al 15%. Aproximadamente la mitad de las desbocadas se produjeron acompañadas por otra estrella con energía positiva escapándose en dirección opuesta. En doce cúmulos la mitad (o más) de las estrellas se fugaron con energía positiva.

Tarjetas perforadas

¡Mil horas de cálculos! 8pm a 8 am

18 cases - 5 Stars

36 cases - 6 Stars

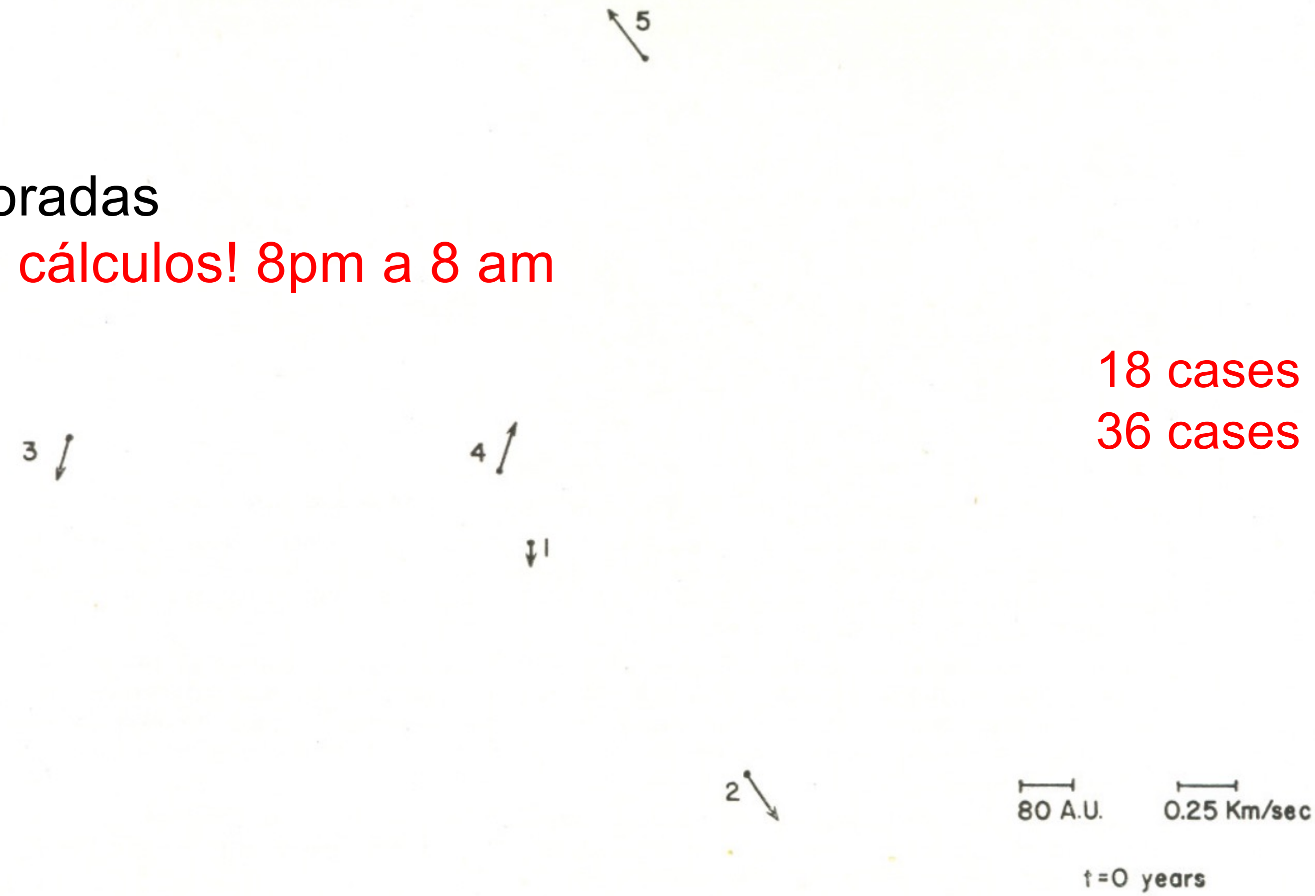
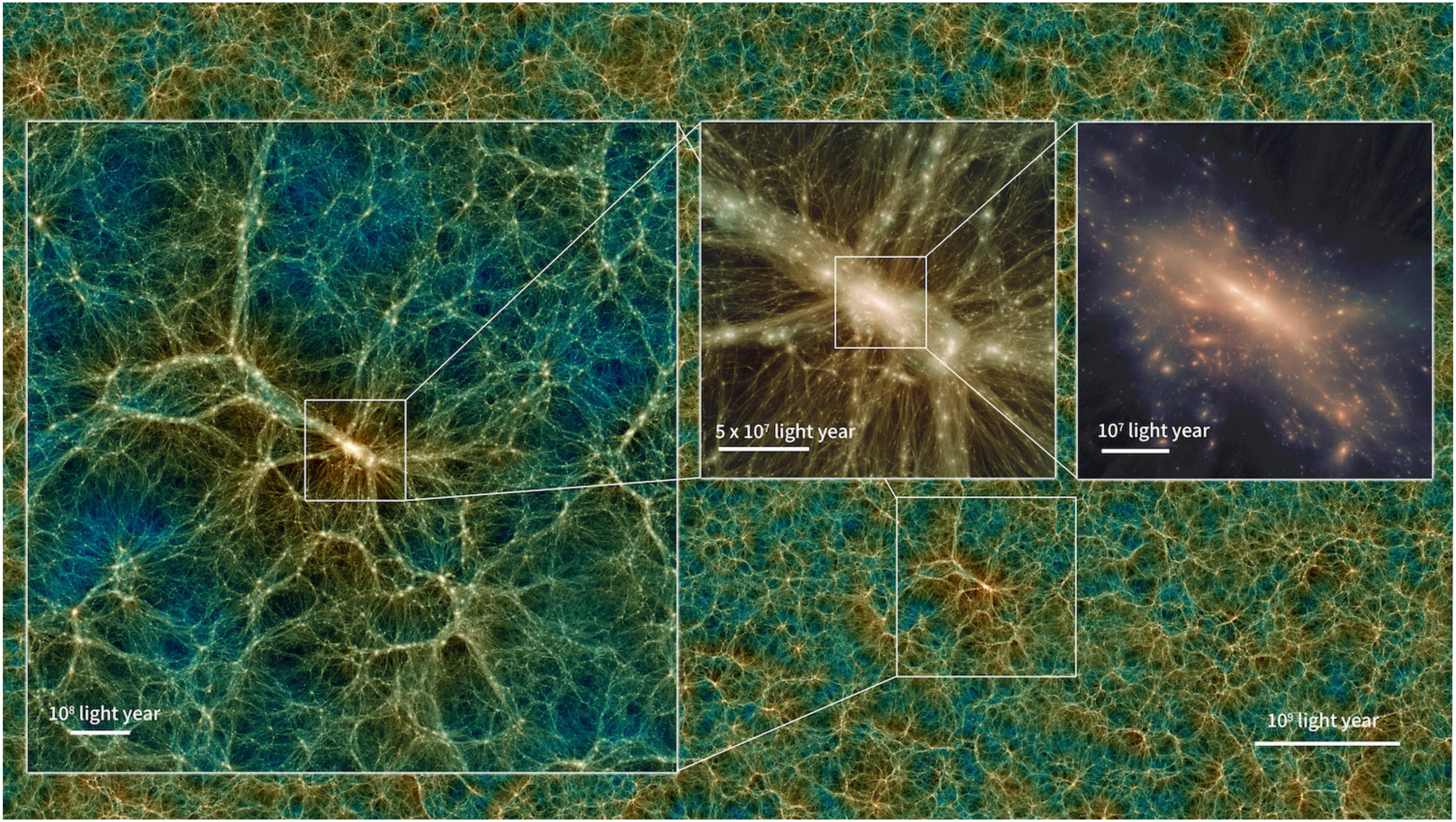


Fig. 1.—*Initial positions and velocities of the stars from Table 1, projected on the plane defined by the velocity vectors of the run-away star and its opposite. Star 4 is at the center of mass of the cluster.*

Simulación del Milenio

- *Millennium Simulation:* la simulación de N-cuerpos más grande que se ha realizado hasta el momento.
- Max Planck, Supercomputing Center, Garching, Alemania.
- Más de 10 mil millones de partículas.
- Los datos ocupan 25 TB (25 millones de Megabytes).
- Cubo de ~ 60 Gpc/h de lado.
- 20 millones de galaxias.
- Más de un mes de cálculos numéricos continuos en una SC-IBM.
- Consorcio Virgo, grupo internacional de astrofísica de UK, Alemania, Japón, Canadá y USA.

Uchuu (Outer Space)



Uchuu (Outer Space)

- Uchuu se enfoca en la estructura a gran escala del Universo: halos misteriosos de materia oscura que controlan no solo la formación de galaxias, sino también el destino de todo el Universo (2.1 billones de partículas; 13.8 mil millones de años).
- *"To produce Uchuu we have used ... all 40,200 processors (CPU cores) available exclusively for 48 hours each month. Twenty million supercomputer hours were consumed, and 3 Petabytes of data were generated, the equivalent of 894,784,853 pictures from a 12-megapixel cell phone."*
- *"This research utilized the NAOJ supercomputer ATERUI II (Cray XC50) for the Uchuu simulation. ATERUI II is operated at NAOJ Mizusawa Campus (Oshu, Iwate) with a theoretical peak performance of 3.087 Pflops"*

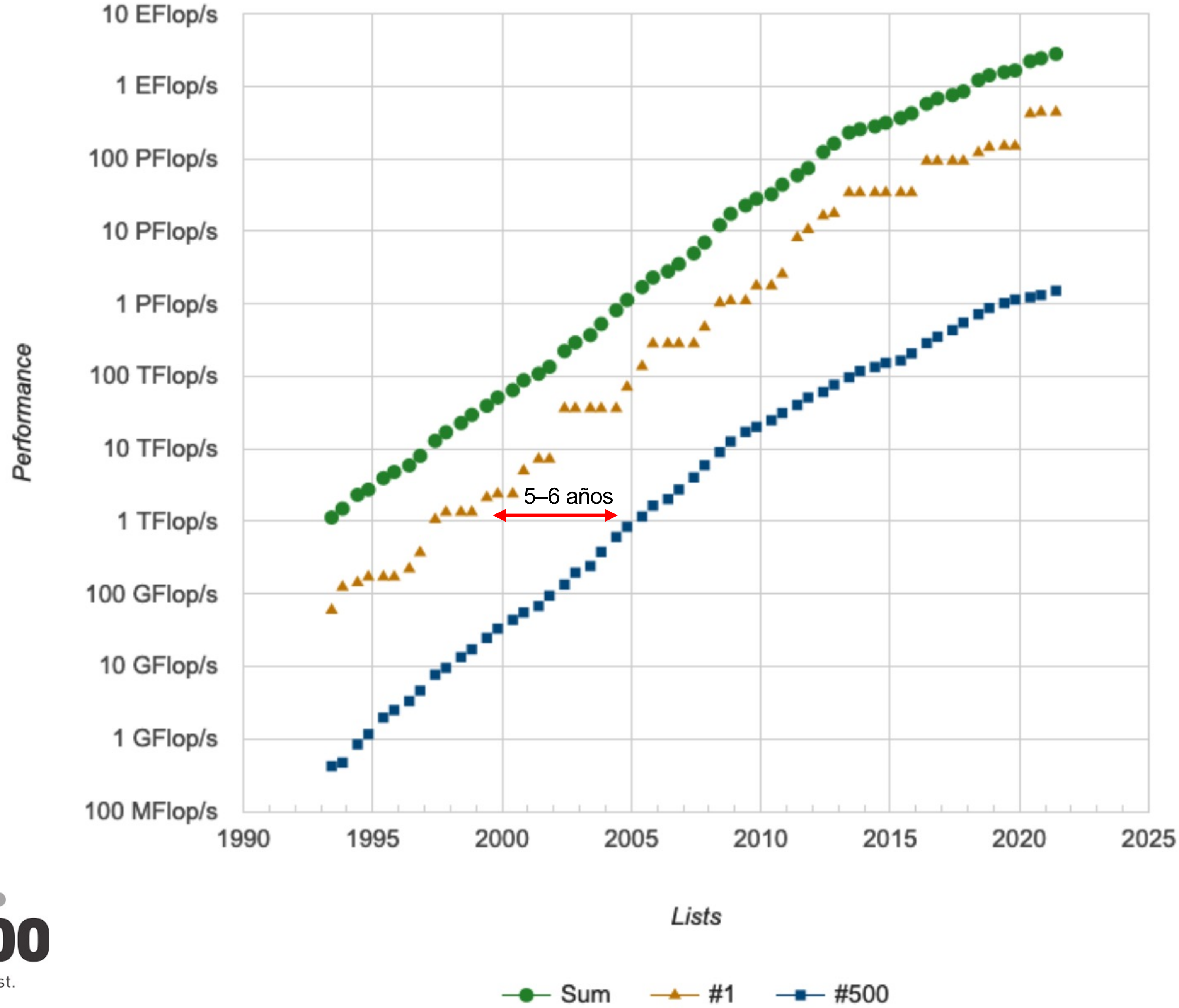
¡Supercómputo!

Supercomputer performance is measured in "flops" short for floating-point operations per second.

$$R_{peak}(\text{GFlop/s}) = 2 \times frecuencia\ (\text{GHz}) \times \#\ núcleos \times n$$

Rank	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	**Supercomputer Fugaku** - Supercomputer Fugaku, A64FX 48C 2.2GHz, Tofu interconnect D, Fujitsu RIKEN Center for Computational Science Japan	7,630,848	442,010.0	537,212.0	29,899
2	**Summit** - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, IBM DOE/SC/Oak Ridge National Laboratory United States	2,414,592	148,600.0	200,794.9	10,096
3	**Sierra** - IBM Power System AC922, IBM POWER9 22C 3.1GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR Infiniband, IBM / NVIDIA / Mellanox DOE/NNSA/LLNL United States	1,572,480	94,640.0	125,712.0	7,438
4	**Sunway TaihuLight** - Sunway MPP, Sunway SW26010 260C 1.45GHz, Sunway, NRCPC National Supercomputing Center in Wuxi China	10,649,600	93,014.6	125,435.9	15,371
5	**Perlmutter** - HPE Cray EX235n, AMD EPYC 7763 64C 2.45GHz, NVIDIA A100 SXM4 40 GB, Slingshot-10, HPE DOE/SC/LBNL/NERSC United States	706,304	64,590.0	89,794.5	2,528

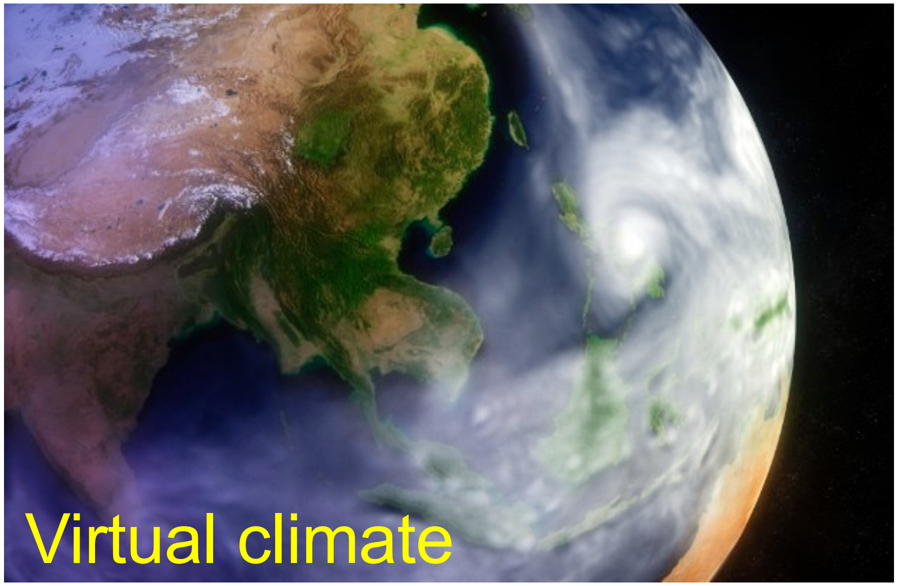
Performance Development R_{max} (Linpack)

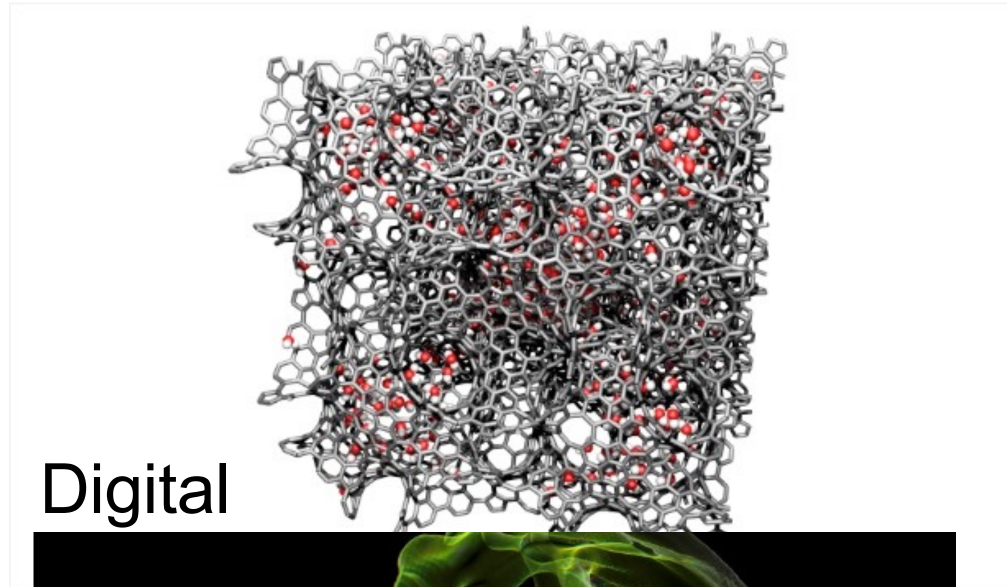


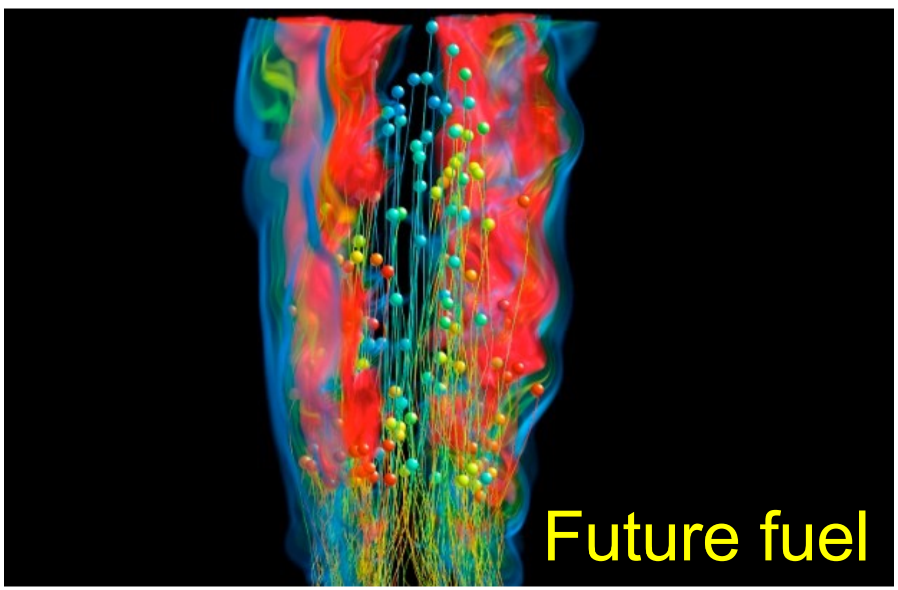
Supercómputo

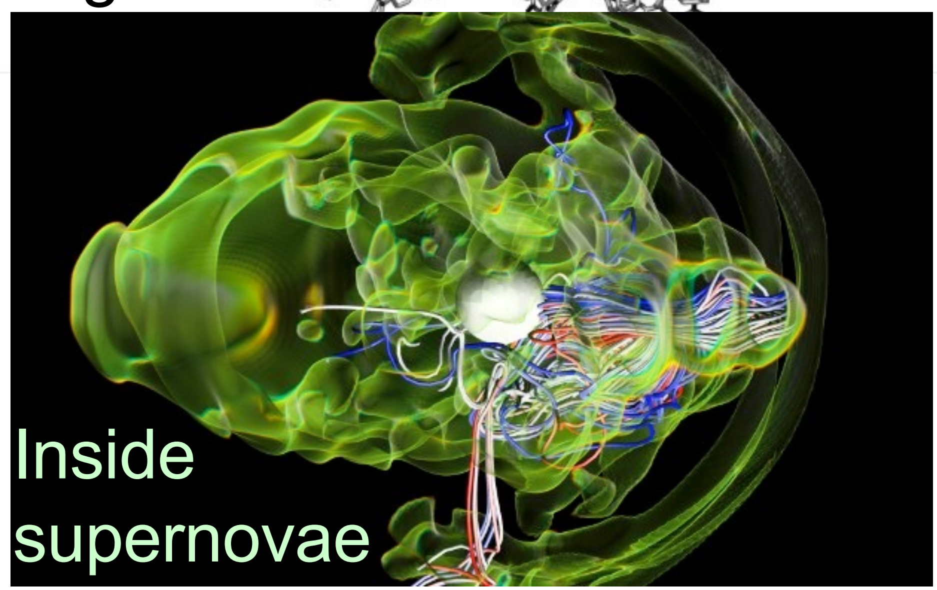
¡Los 4 problemas computacionales más difíciles en la Tierra!

Supercómputo



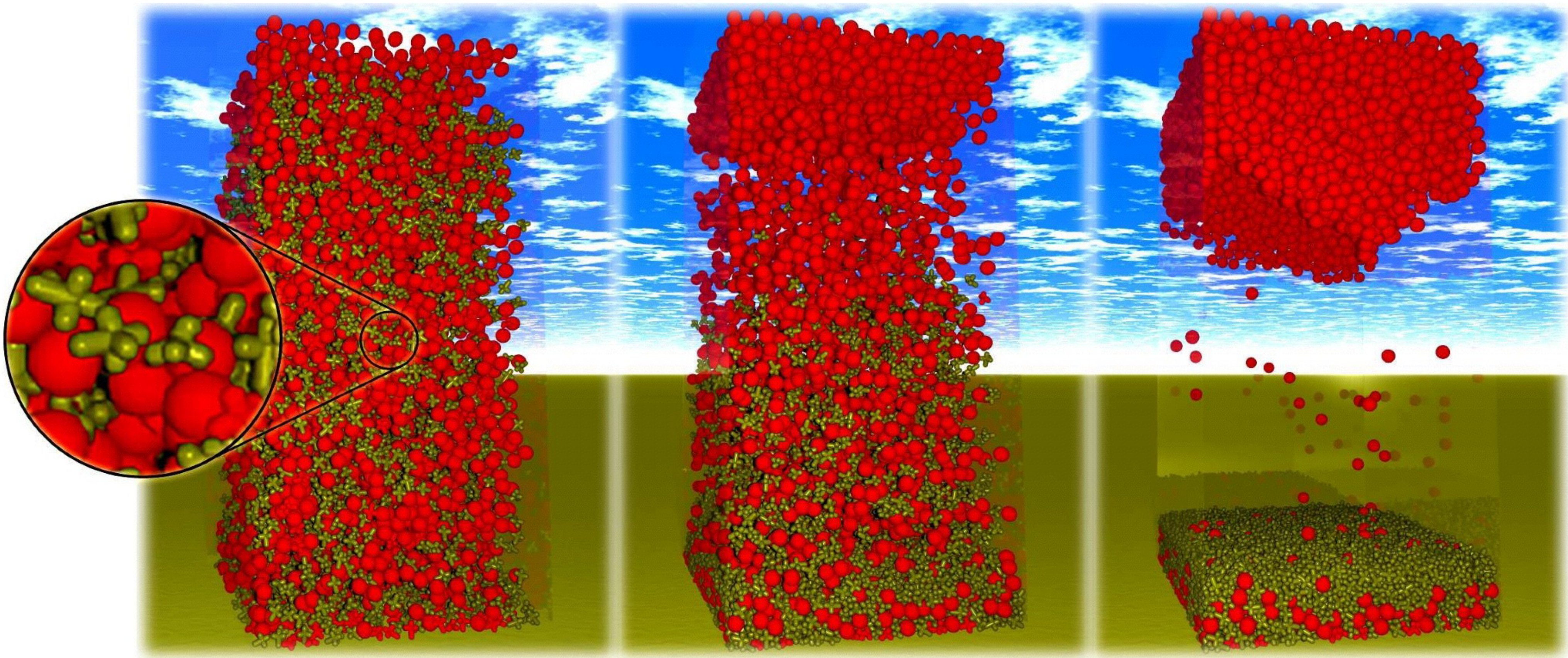






Direct Numerical Simulation of Particulate Flows on 294 912 Processor Cores

Jan G¨otz*, Klaus Iglberger*, Markus St¨urmer*, and Ulrich R¨ude*,**
*Chair for System Simulation, University Erlangen-Nuremberg, Cauerstr. 6, 91058 Erlangen, Germany
**Cluster of Excellence “Engineering of Advanced Materials”, N¨agelsbachstr. 49b, 91052 Erlangen, Germany



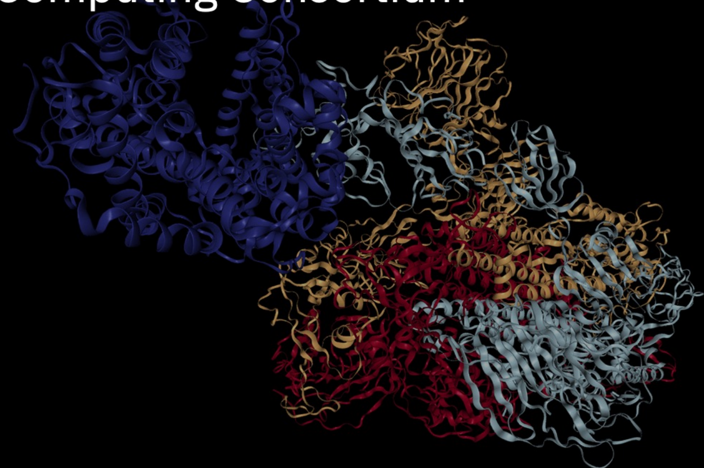
Segregation simulation of 12 013 objects with two different shapes in different time steps simulated on 2 048 cores in a box. Density values of 0.8 kg/dm3 and 1.2 kg/dm3 are used for the objects in water with density 1 kg/dm3 and a gravitation field. Light particles are rising to the top of the box, while heavy particle fall to the bottom.

The COVID-19 HPC Consortium

COVID-19 HPC Consortium | Who We Are | Collaborations | Projects | News & Press | Blog | Apply

The COVID-19 High Performance Computing Consortium

Bringing together the Federal government, industry, and academic leaders to provide access to the world's most powerful high-performance computing resources in support of COVID-19 research.



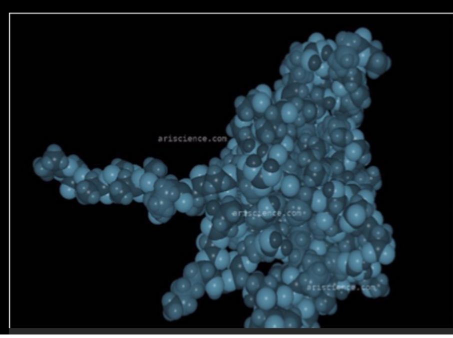
43
—
Consortium members

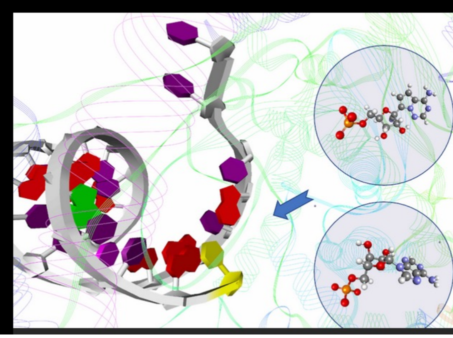
165k
—
Nodes

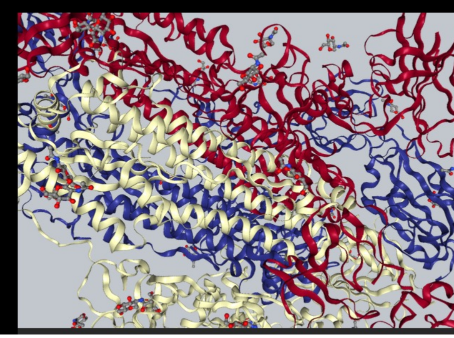
Active

Fighting COVID-19 will require extensive research in areas like bioinformatics, epidemiology, and molecular modeling to understand the threat we're facing and to develop strategies to address it.

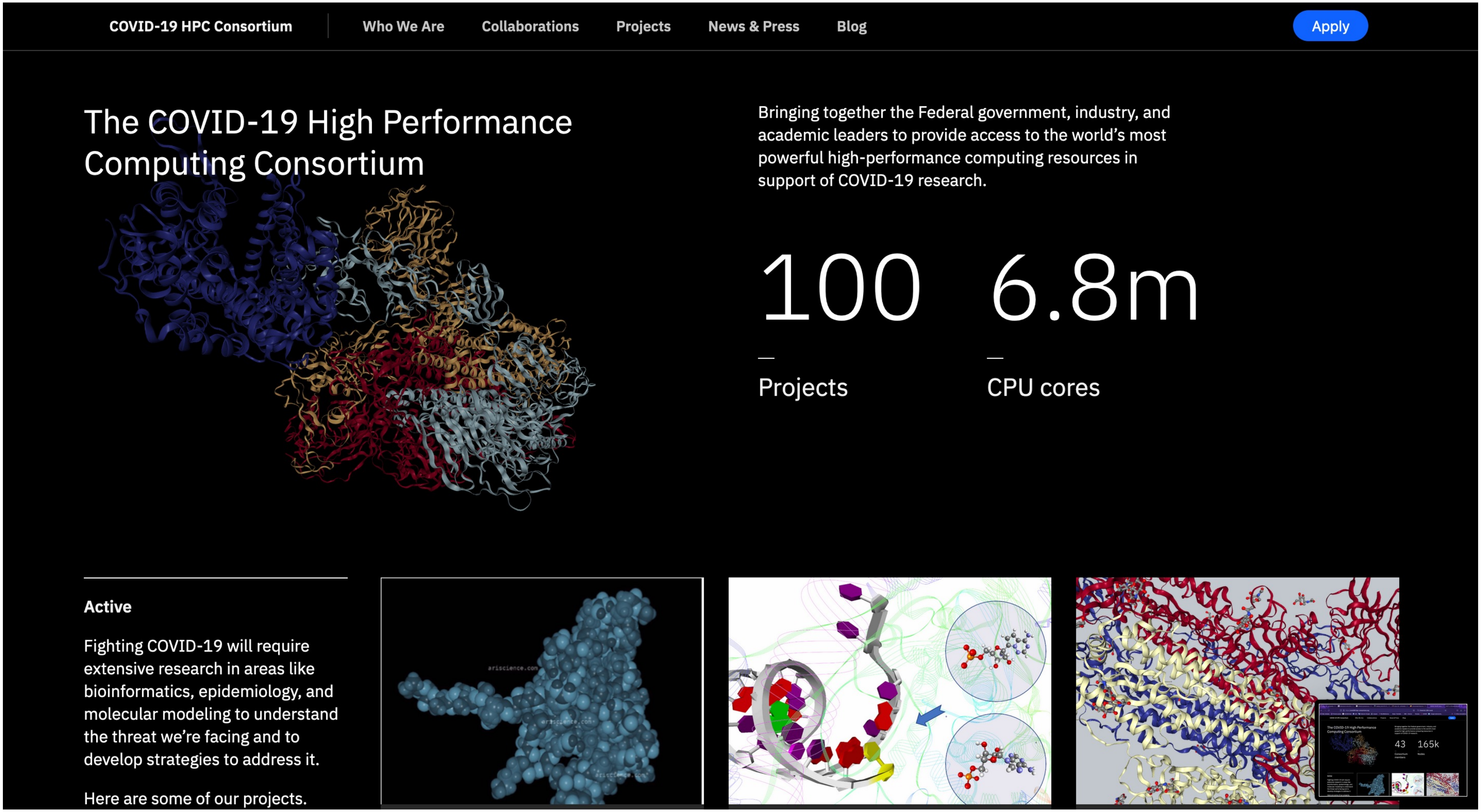
Here are some of our projects.







The COVID-19 HPC Consortium



The COVID-19 HPC Consortium

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HPC Resources

https://covid19-hpc-consortium.org/

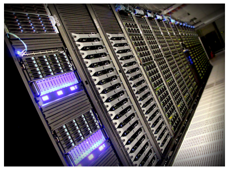
- 600 Petaflops
- 6.8m CPU cores
- 50k GPUs

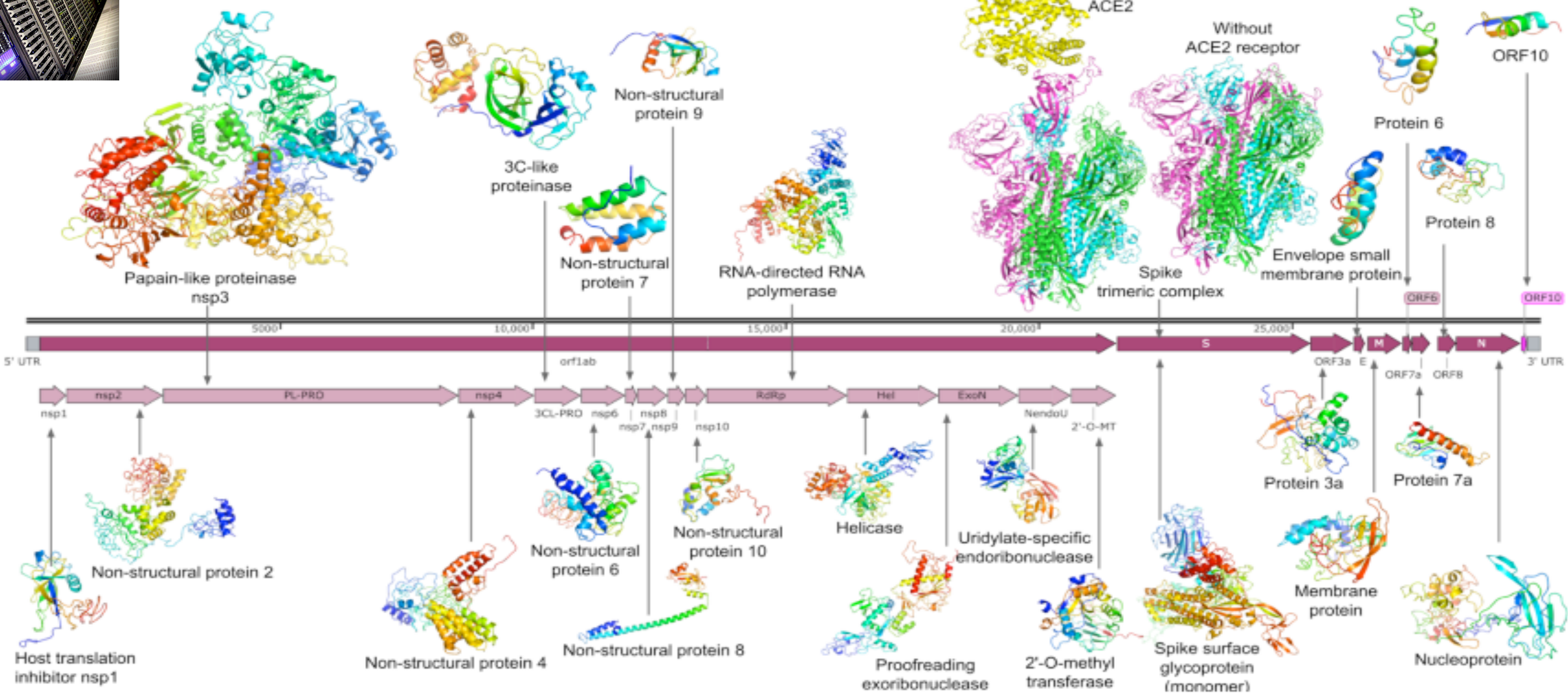
Synergy!

Consortium members and affiliates manage a range of computing capabilities: from small clusters to some of the largest supercomputers in the world. They offer not only computational resources, but also software, services, and deep technical expertise to help COVID-19 researchers execute complex computational research programs. Browse available member and affiliate resources here.

Request computing resource for de novo protein therapeutics design simulations to treat the COVID-19 disease

Yang Zhang, University of Michigan





To complete this project, we seek 5,917,839 Comet CPU SUs; 63,000 Comet GPU SUs and 742 GB storage.

How a supercomputer network of 700,000 PCs is helping to find a Covid-19 cure (aprox. Eflop/s)

¡Supercómputo Universitario!

¡Supercómputo UNAM Top 500!

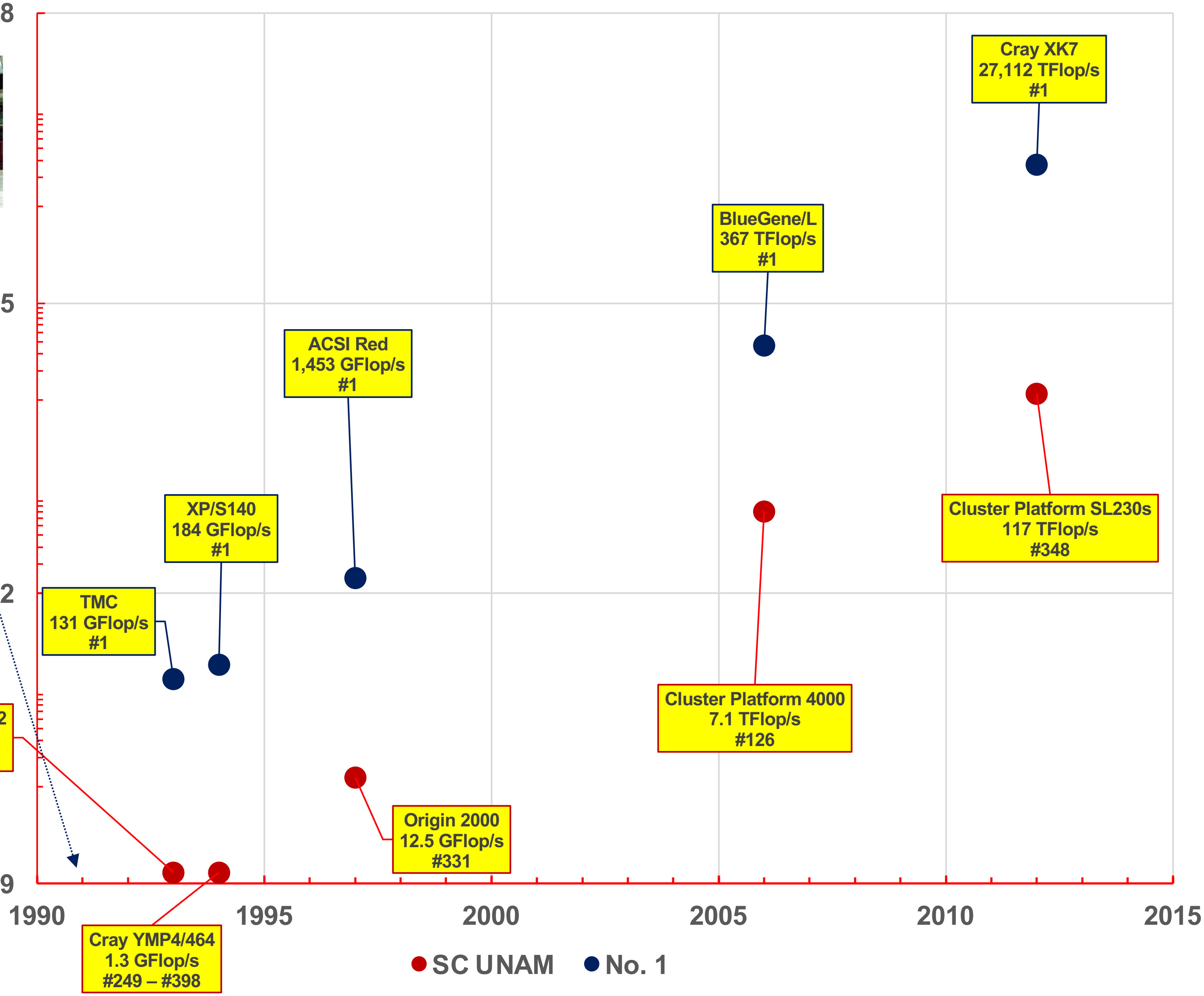
UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO

URL:	http://www.unam.mx/
Segment	Academic
City:	
Country/Region:	Mexico

SYSTEMS HISTORY

System	Year	Vendor	Cores	Rmax (GFlop/s)	Rpeak (GFlop/s)
Cluster Platform SL230s Gen8, Xeon E5-2670 8C 2.600GHz, Infiniband QDR	2012		5,616	92,282.1	116,813
Cluster Platform 4000 DL145 Opteron Dual Core 2.6 GHz Infiniband	2006		1,360	5,090	7,072
ORIGIN 2000	1997		32	10.4	12.5
Y-MP4/464	1994		4	1.2	1.3
Y-MP4/432	1991		4	1.2	1.3

SC UNAM Top500
(Rpeak)



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THE ASTROPHYSICAL JOURNAL, 423:681–692, 1994 March 10

the simulation. The numerical calculations were performed on the CRAY YMP-4/432 of DGSCA, UNAM. This work

HIERARCHICAL STRUCTURE IN NEARLY PRESSURELESS FLOWS AS A CONSEQUENCE OF SELF-SIMILAR STATISTICS

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Instituto de Astronomía, UNAM, Apdo. Postal 70-264, México D.F., 04510, México; e-mail: I: enro@astroscu.unam.mx
Received 1993 June 7; accepted 1993 September 14

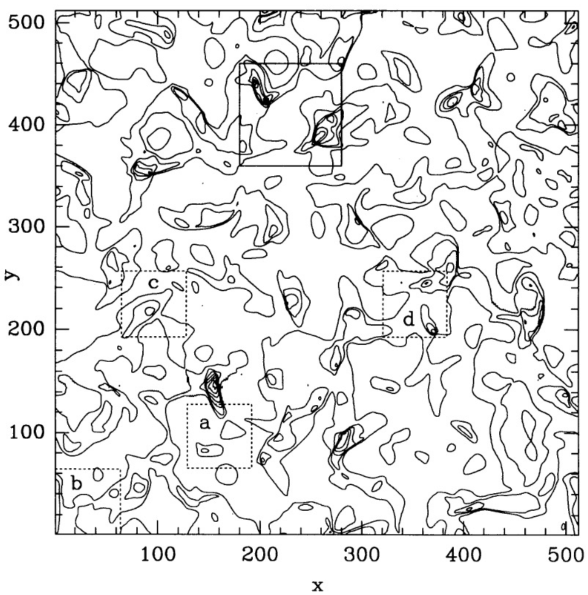


FIG. 2*a*

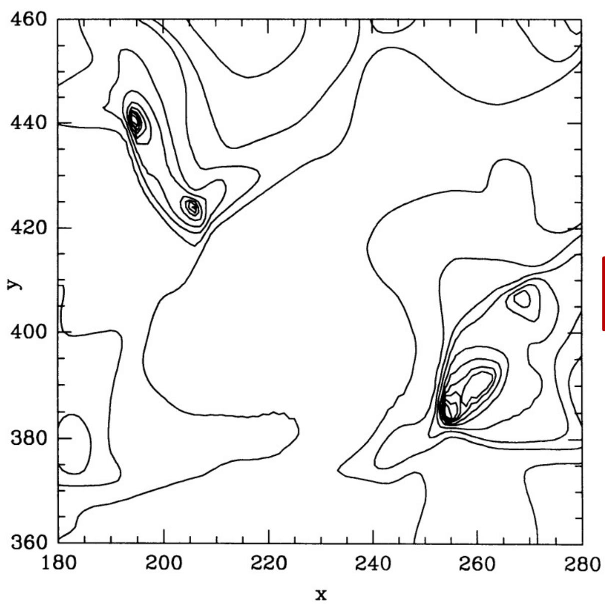


FIG. 2*b*

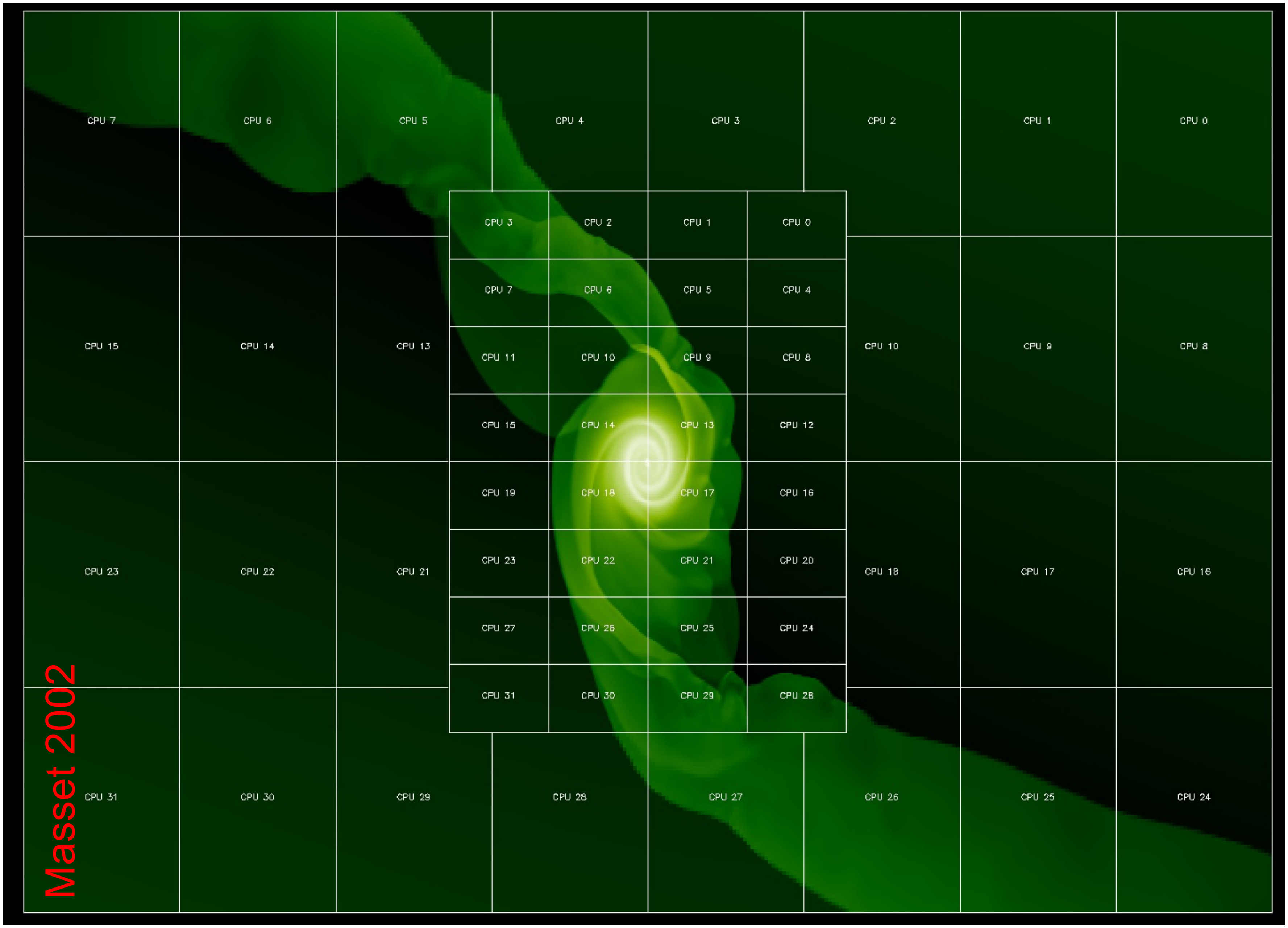
intervals of $\Delta t = 0.5$. Running on a CRAY YMP supercomputer, this calculation took ~4 CPU hr to complete. The

FIG. 2.—Two views of the density field of the numerical simulation at $t = 4$. (*a*) Entire integration domain. The coordinates give the pixel numbers. The contours span the density range $0 \le \rho \le 5$, spaced at equal intervals $\Delta\rho = 0.5$. The solid-line box is enlarged in (*b*). The dotted-line boxes correspond to the *A*-regions whose probability distribution functions are shown in Figs. 5*a*–5*d*. (*b*) Enlargement of the area enclosed by the solid-line box in Fig. 2*a*, showing the hierarchical density structure developed by the simulation. The structure ("cloud") centered at coordinates (260, 400) can be seen to contain three levels of hierarchical nesting. The contours are as in (*a*), except that contours at $\rho = 3.3, 3.6, 3.7$, and 3.8 have been added to enhance the detail of the structures.

Supercómputo

¡La era de los Clusters!

¿Qué es el Cómputo Paralelo?



Revista Mexicana de Astronomía y Astrofísica, 39, 197-205 (2003)

- In Mexico, the first Beowulf computer built in an academic institution was "Hormiga", assembled by Alberto Vela of CINVESTAV in 1997-1998 (A. Vela 2002, private communication). (10 Pentium II processors at 233 MHz, linked using twisted pair Ethernet running at 100 Mbps.)

- The second Beowoulf machine built in Mexico at an academic institution is the machine we describe here: "La Granja", built at the Ensenada branch of the Instituto de Astronoma of the National Autonomous University of Mexico (IAUNAM). (32 Pentium III processors of 450 MHz, Fast Ethernet card (10/100 Mbps).

- As far as we know, there is only a third Beowulf computer built in Mexico in an academic institution. This is a 20 Pentium III processor built at the Mexico City branch of the IAUNAM (D. Page 2002, private communication).

Revista Mexicana de Astronomía y Astrofísica, 39, 197-205 (2003)

LA GRANJA: A BEOWULF TYPE COMPUTER FOR NUMERICAL SIMULATIONS IN STELLAR AND GALACTIC DYNAMICS

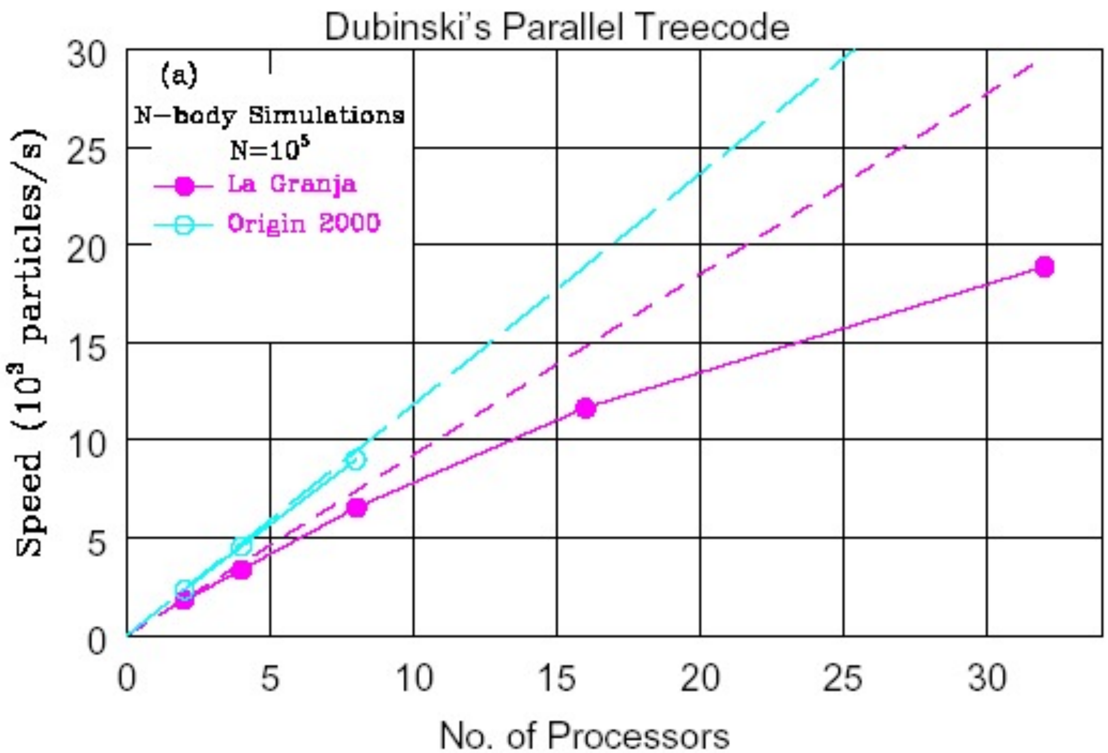
H. Velázquez and L. A. Aguilar
Instituto de Astronomía, UNAM, Ensenada, B. C., México

RESUMEN

Presentamos una computadora tipo “Beowulf" construida usando componentes comerciales y programas libres. Se compara su rendimiento en capacidad de cálculo y eficiencia en computaciones paralelas con el obtenido para una computadora Origin-2000 de la compañía SGI, usando dos códigos de N-cuerpos diferentes. Se discute el impacto de esta tecnología, que abre la posibilidad de efectuar de manera rutinaria simulaciones con alrededor de un millón de partículas con una computadora “hecha en casa". Se muestra el efecto de mayor resolución numéricacon simulaciones de un colapso sin disipación frío, y del calentamiento de la componente vertical del disco de una galaxia espiral que evoluciona aisladamente.

Problema N-Cuerpos

Problema N-Cuerpos



Revista Mexicana de Astronomía y Astrofísica, 39, 197-205 (2003)

A mis revisores Dr. Héctor Benítez, Dr. José Franco, Dr. Fabián García Nocetti
y
Dr. Dany Page. Por su paciencia y por enriquecer con sus conocimientos este trabajo. Muchas gracias.

A Salvador Curiel, Dany Page y William Lee por introducirme al cómputo paralelo.

DGTIC

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

DIVISIÓN DE ESTUDIOS DE POSGRADO
FACULTAD DE INGENIERÍA

"DISEÑO DE UN CLUSTER *BEOWULF* CÓMPUTO DE ALTO RENDIMIENTO PARA RESOLVER PROBLEMAS ASTROFÍSICOS"

T E S I S
QUE PARA OBTENER EL GRADO DE
MAESTRA EN INGENIERÍA
P R E S E N T A
LILIANA HERNÁNDEZ CERVANTES

Director de Tesis: Dr. Alfredo J. Santillán González

México, D.F. 2004

Número de Procesadores	T_{CPU} (s)	Número de zonas x ciclo	T_{WC} (s)	T_1/T_N	Eficiencia e	Fracción Serial f
1	2073	482348E+05	2048	1	1	0
2	1037	7.81324E+05	1792	1.9	0.95	0.05
4	595	1.59588E+06	640	3.5	0.88	0.04
8	297	2.93637E+06	320	7	0.88	0.02
16	154	5.37318E+06	192	13.5	0.84	0.01

Tabla 6.4. Resultados de la onda explosiva-XYZ-MHD, Bisgal

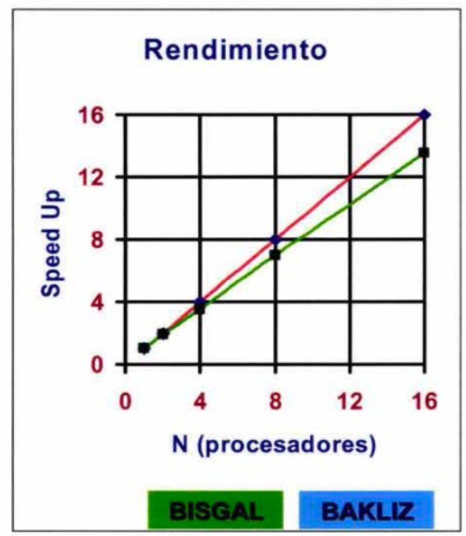
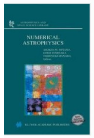


Figura 6.11. Graficación del rendimiento de la onda explosiva con campo magnético



Numerical Astrophysics pp 117-118 | Cite as

The Disk-Halo Interaction Via the Parker Instability

Authors Authors and affiliations

A. Santillan, J. Franco, M. A. Martos

Part of the Astrophysics and Space Science Library book series (ASSL, volume 240)

Abstract

Using a collection of superbubbles (SB) and High Velocity Clouds (HVC) as perturbative agents, we model the disk-halo interaction in magnetized gaseous disks of spirals with 2-D numerical MHD simulations. The gaseous disk is assumed in magnetohydrostatic equilibrium, with the B-field oriented parallel to the disk (the x-axis). The gas properties and the gravitational acceleration within the disk are defined similar to those found at the solar circle in the Milky Way (see Martos & Cox 1994). Each perturbation is introduced individually, at time intervals of Δt = 32 Myr, and at random locations in the disk. The energy injected by each SB is 10^{53} erg, and the explosion centers are located within 100 pc from the midplane (z = 0). The impinging HVCs, on the other hand, have a variety of different densities and velocities (see Franco 1986, and Tenorio-Tagle et al. 1987), and collide with the disk at different angles. Thus, the energy and momentum injection per collision varies in each event. The numerical calculations were performed with the MHD code ZEUS-3D (Stone & Norman 1992a, 1992b), using the SGI ORIGIN-2000 of the Supercomputer Center at UNAM. The total extent of the computational grid, with 400 x 100 zones, is 16 kpc and 4 kpc in the x and z directions, respectively. The upper and lower boundaries are open, but the right and left boundaries are periodic. At midplane, the gas density and temperature are n_o = 1 cm^{-3} and T = 1.1 × 10^4 K, respectively, and the field intensity is B_o = 5 G. Initially, gas is in hydrostatic equilibrium supported by magnetic and thermal pressures. The ratio of the magnetic-to-thermal energies, however, is not held constant with height but increases with increasing values of z (i. e., the disk is unstable to the Parker instability). The perturbations are introduced within a central box of the computational grid. Each SB has an initial energy density of 2.2 × 10^{13} erg/cm (equivalent to a spherical bubble with 10^{53} erg). HVCs have 120 pc in height and 200 pc long, a mass density of 8.6 × 10^{-2} g/cm, and different approaching velocities and incident angles. The B-field lines are distorted and compressed with each perturbation, increasing the field tension at the location of the event, and driving MHD waves that propagate to the rest of the disk and into the halo. All perturbations, then, create a complex (turbulent) network of flows that eventually trigger the Parker instability (Franco et al. 1995). The SBs expand mainly in the x-direction because the compressed B-field lines provide a strong pressure, reducing the SB growth along the z-axis. Hence, the SB energy is distributed by the MHD waves in a huge volume, but the SB mass is maintained within the disk in a well defined and small volume. In the case of HVC-disk collisions, the magnetic field prevents the cloud material from penetrating into the disk. Thus, the B-field provides an adequate coupling for the energy and momentum exchange between the disk and the halo but, for this restricted field geometry, also represents an effective shield that prevents a direct gas flow between the disk and the halo. Such a gas flow, however, can indeed occur via the Parker instability (see Figure 1), and the mass exchange between the disk and the halo is probably a complex two-step process. This work has been partially supported by grants from DGAPA-UNAM, CONACyT, and by a R&D grant from Cray Research Inc.

and momentum injection per collision varies in each event. The numerical calculations were performed with the MHD code ZEUS-3D (Stone & Norman 1992a, 1992b), using the SGI ORIGIN-2000 of the Supercomputer Center at UNAM. The total extent of the computational

complex two-step process. This work has been partially supported by grants from DGAPA-UNAM, CONACyT, and by a R&D grant from Cray Research Inc.

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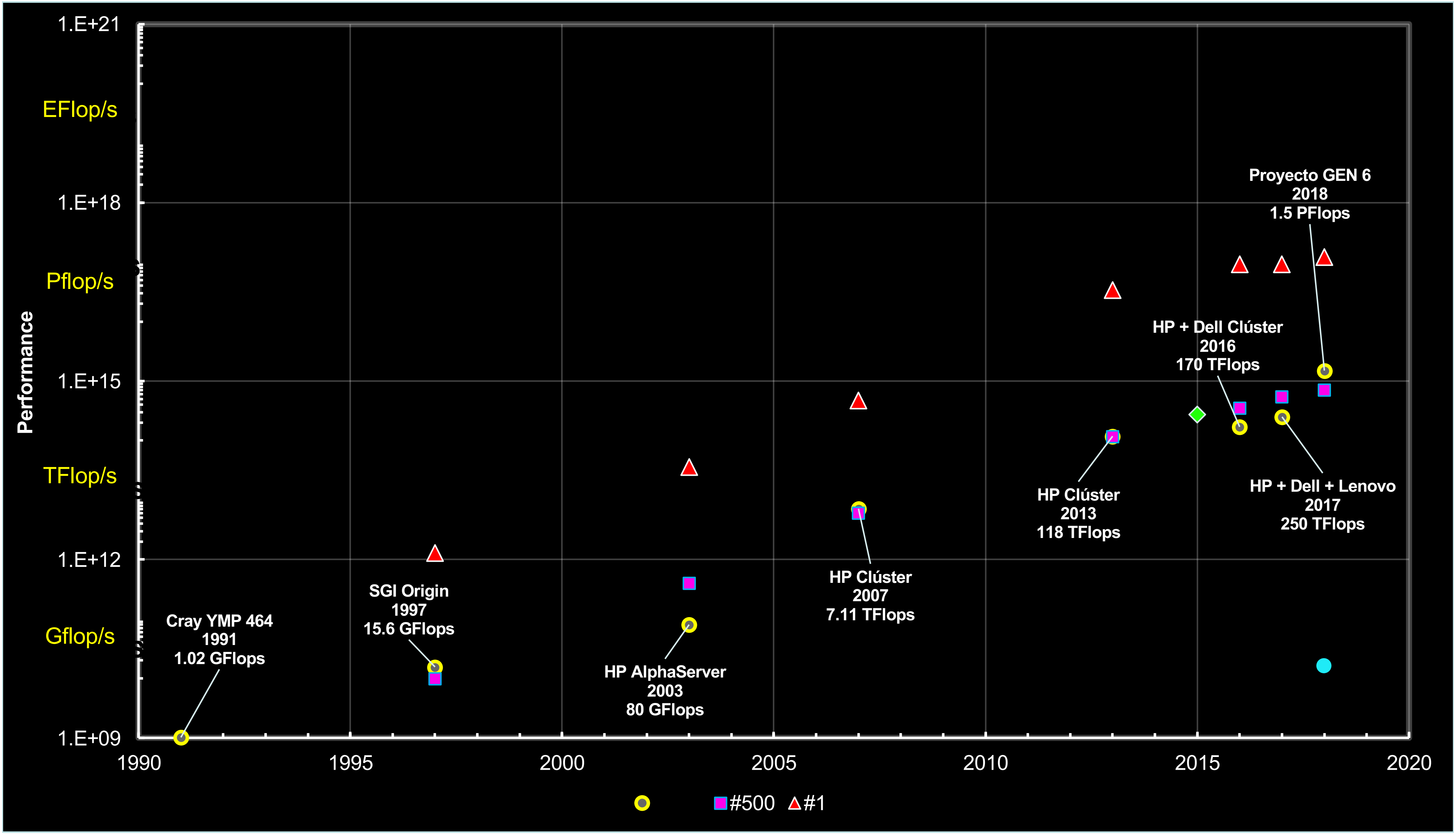
SC UNAM



1.E+21
EFlop/s
1.E+18
Pflop/s
1.E+15
TFlop/s
1.E+12
Gflop/s
1.E+09
Performance
1990
1995
2000
2005
2010
2015
2020
Proyecto GEN 6
2018
1.5 PFlops
HP + Dell Clúster
2016
170 TFlops
HP Clúster
2013
118 TFlops
HP + Dell + Lenovo
2017
250 TFlops
HP Clúster
2007
7.11 TFlops
SGI Origin
1997
15.6 GFlops
Cray YMP 464
1991
1.02 GFlops
HP AlphaServer
2003
80 GFlops
#500
#1

Cómputo Vectorial

Supercómputo

Cómputo Vectorial y Paralelo	
1991	CRAY-YMP 464 1a Supercomputadora de Latinoamérica Nace el Depto. de Supercómputo-DGSCA 4P vectoriales a 133 MHz, 64 MWords de RAM
1999	CRAY-ORIGIN 2000 40 procesadores, 195 MHz y 390Mflop/s por procesador, nodos de 2P y 512MB de memoria local, 10GB de memoria RAM total.

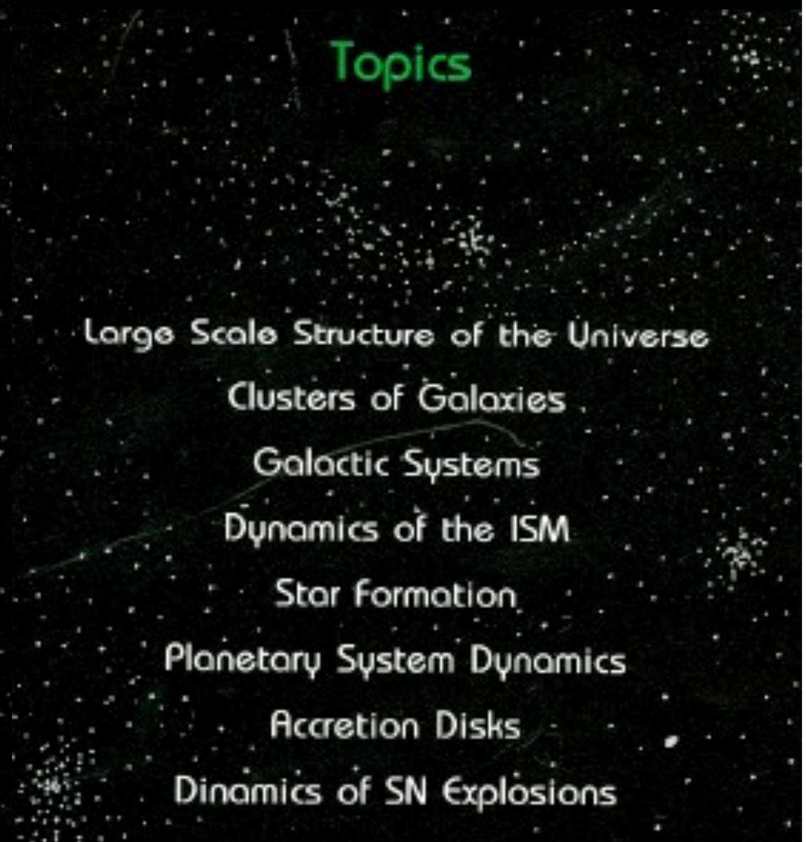
Supercómputo

Supercómputo

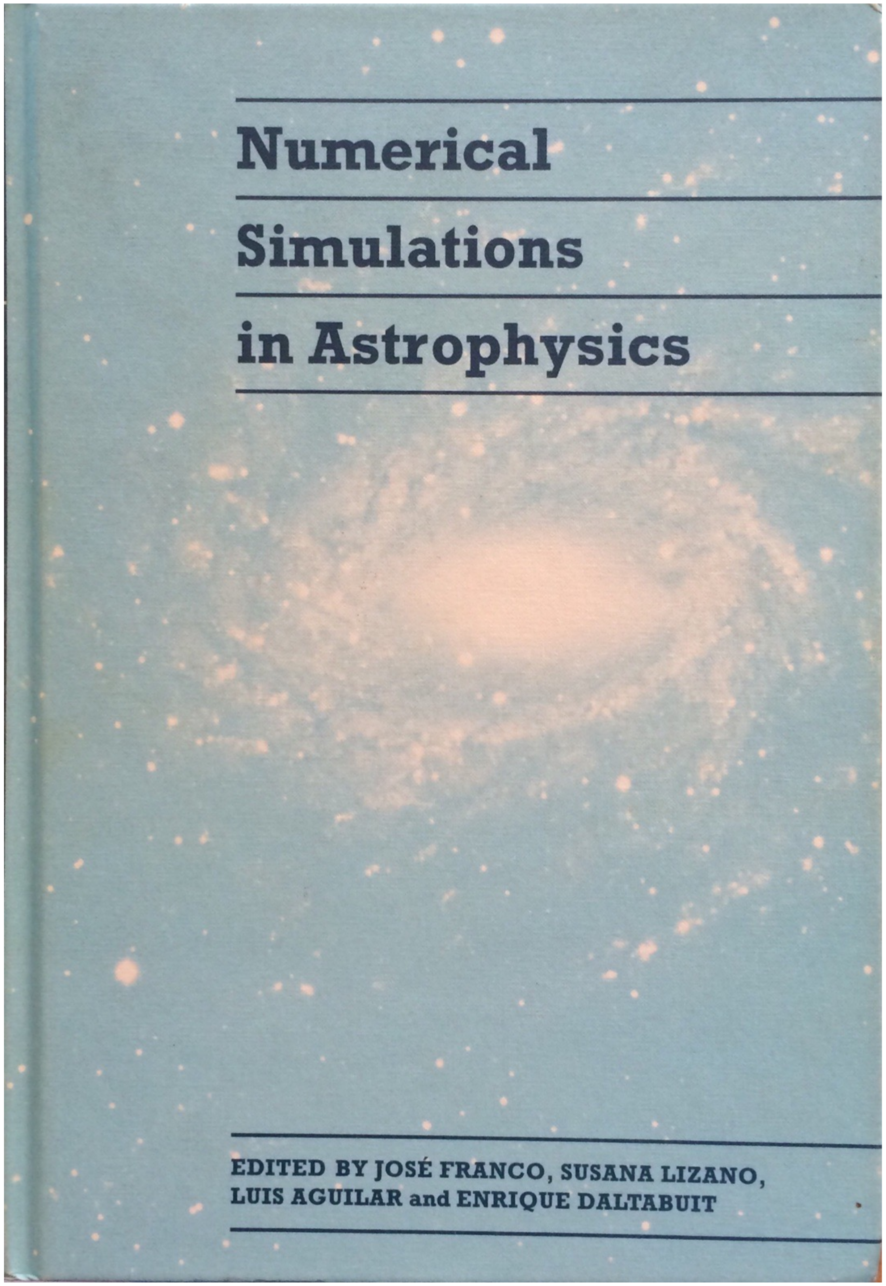
CRAY-YMP464

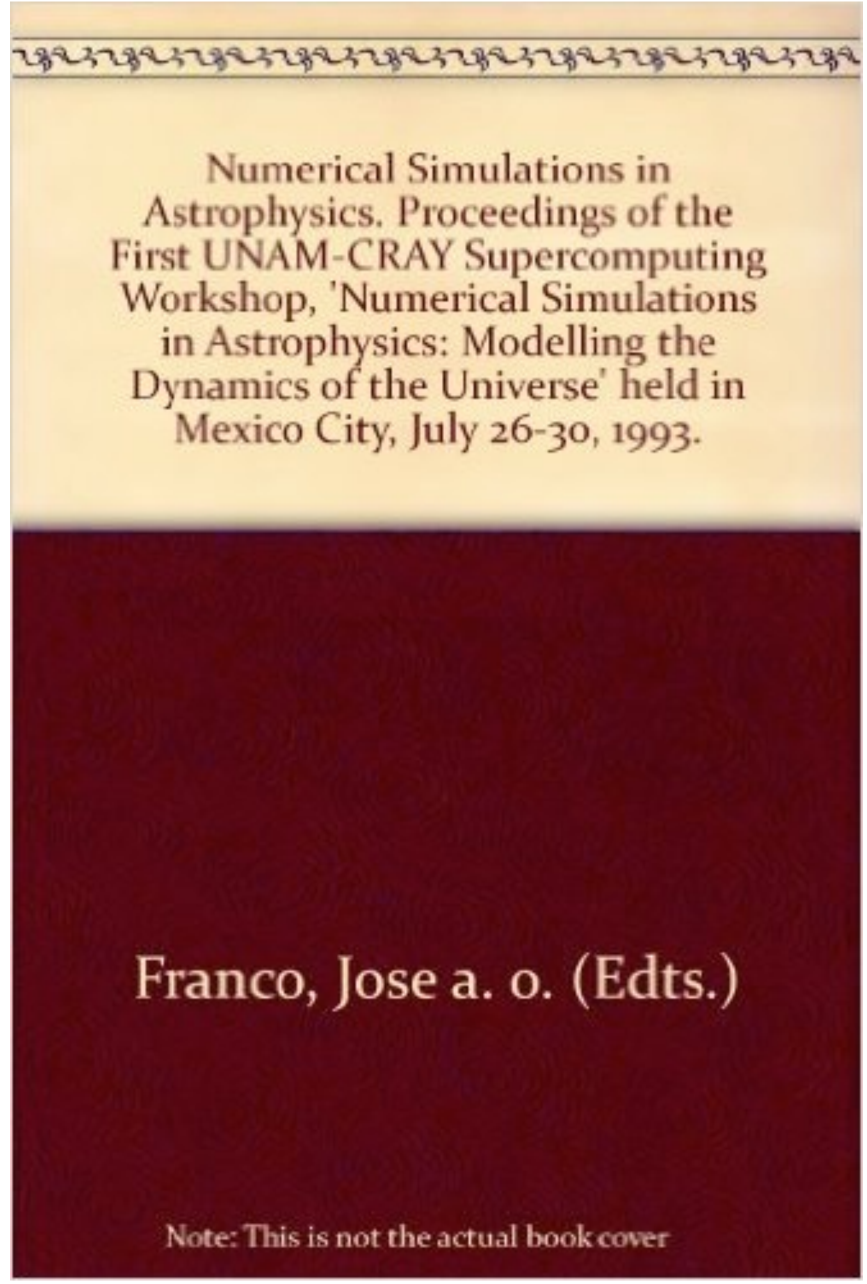
- Congresos Internacionales HPC
- Capacitación Especializada
- Financiamiento Proyectos Científicos

Franco et al. 1993



Diseño Toña Zimerman


Numerical
Simulations
in Astrophysics
EDITED BY JOSÉ FRANCO, SUSANA LIZANO,
LUIS AGUILAR and ENRIQUE DALTABUIT


Numerical Simulations in Astrophysics. Proceedings of the First UNAM-CRAY Supercomputing Workshop, 'Numerical Simulations in Astrophysics: Modelling the Dynamics of the Universe' held in Mexico City, July 26-30, 1993.
Franco, Jose a. o. (Edts.)
Note: This is not the actual book cover

Supercómputo UNAM

	1991 Sirio	1997 Berenice	2003 Bakliz	2007 KanBalam	2013 Miztli
marca	CRAY	SGI	HP	HP	HP
procesador	Vectorial	R10000	Alpha EV67	Opteron Dual Core	Intel E2670 8 cores
número de procesadores	4	40	32	1,368	5,312 8334
rendimiento numérico (GFlops)	1.02	15.6	80	7,113	118,000 228,000
memoria (Gigabytes)	0.512	10	32	3,016	23,000 45,000
almacenamiento (Gigabytes)	19	170	1,000	160,000	750,000

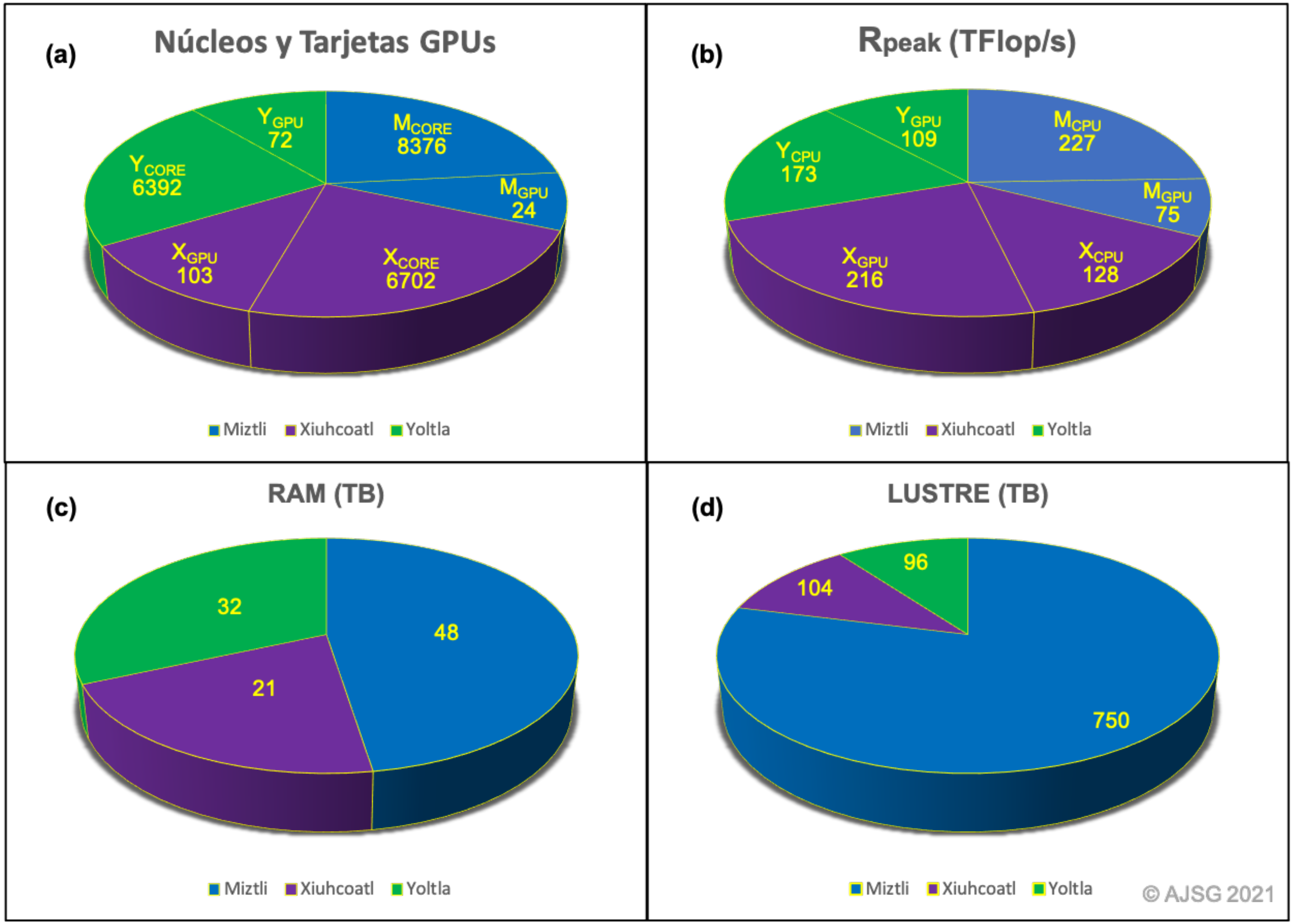
Sinergia LANCAD

Sinergia LANCAD

Equipo	Núcleos CPUs	GPUs	$R_{peak,CPU}$ (TFlop/s)	$R_{peak,GPU}$ (TFlop/s)	$R_{peak,Tot}$ (TFlop/s)	RAM (TB)	Lustre (TB)
Miztli UNAM	8,568	24	227	75	302	48	750
Xiuhcoatl CIVESTAV	6,228	103	128	216	344	21	104
Yoltla UAM	6,392	72	173	109	282	32	96
Total	21,188	199	528	400	928	101	950

SC UNAM

DGTIC



SC UNAM

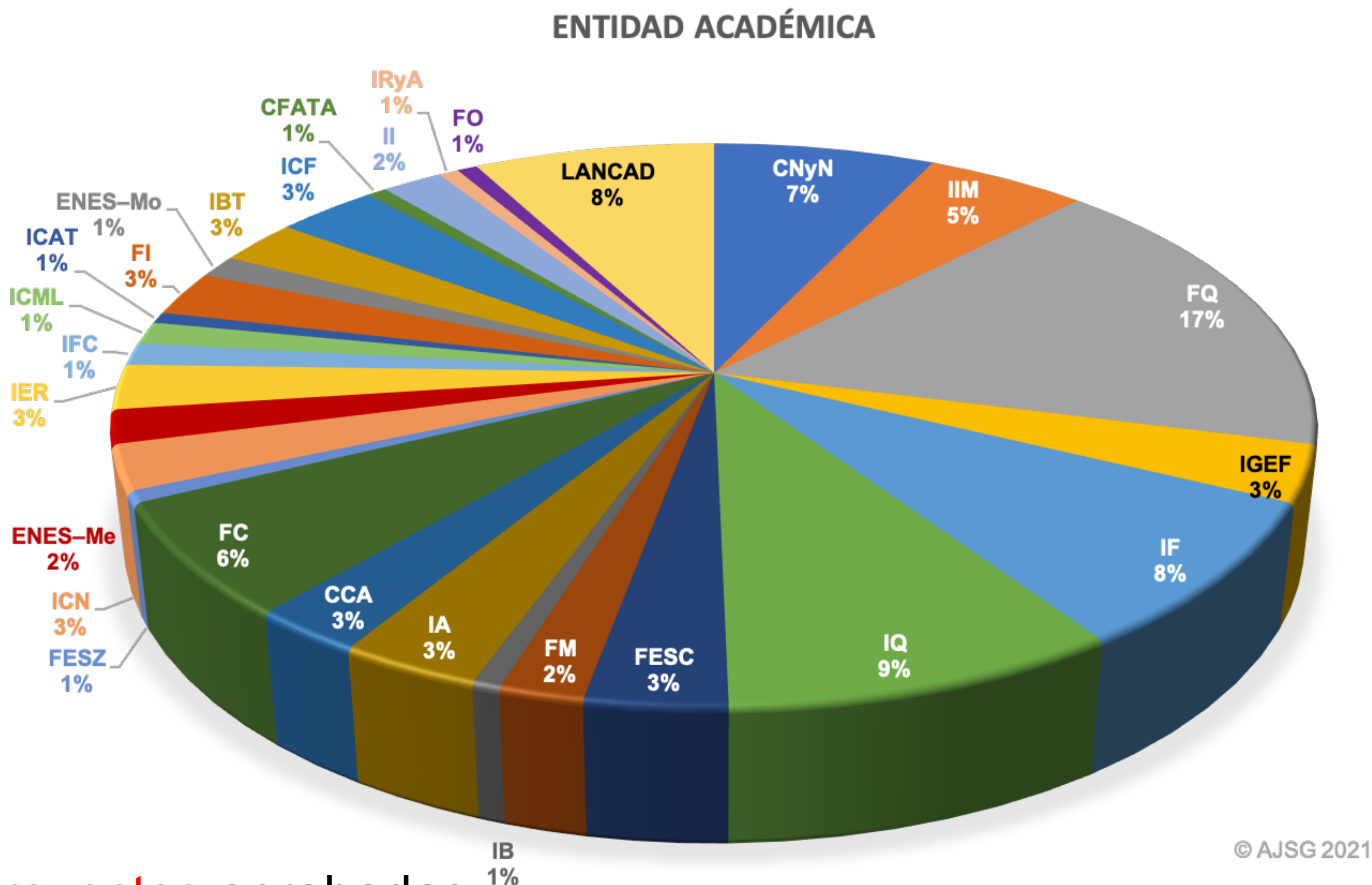
UNAM Universidad Nacional Autónoma de México | DGTIC

supercómputo en la unam

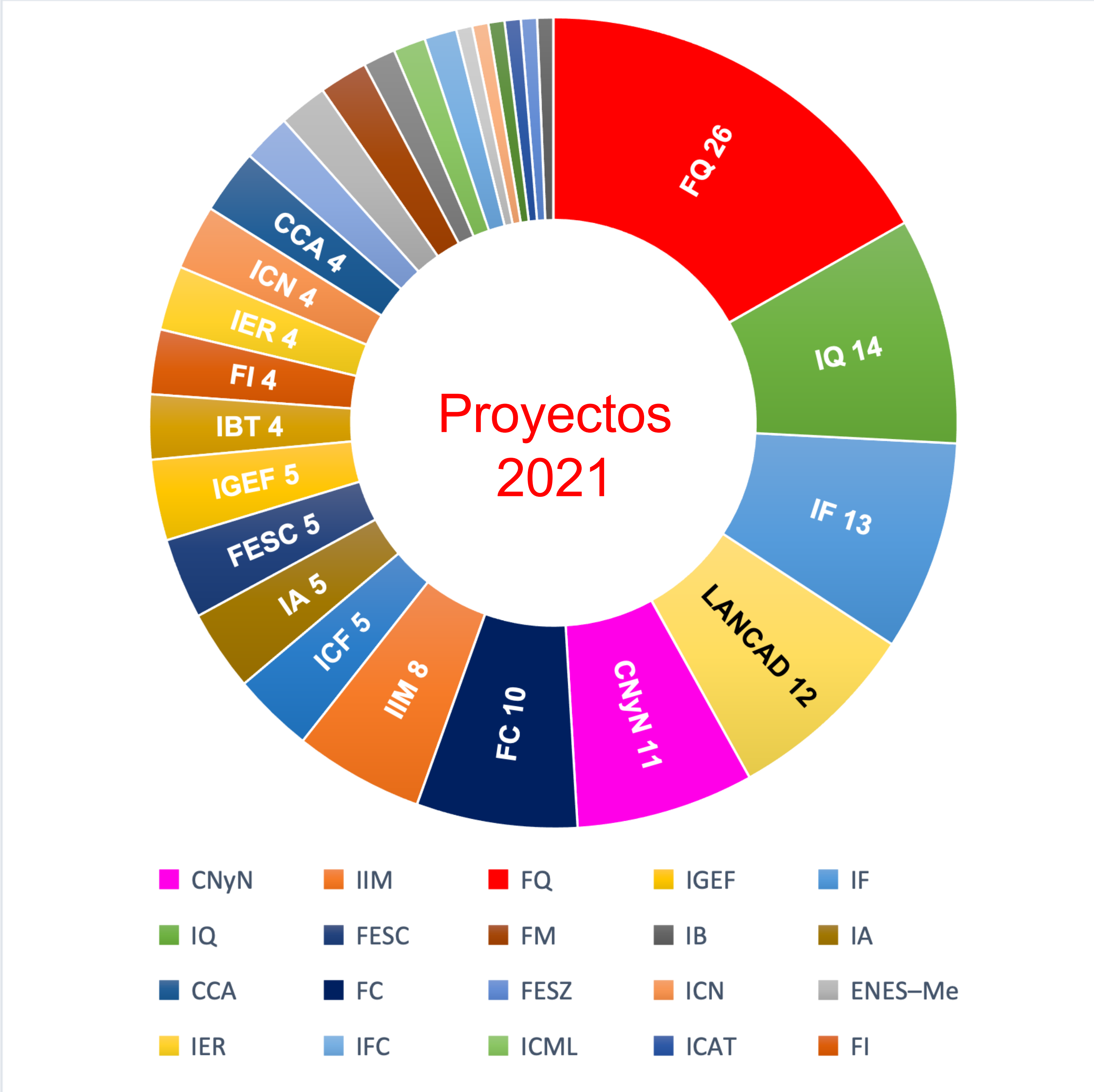
Supercómputo

Proyectos 2021
Miztli

SC UNAM

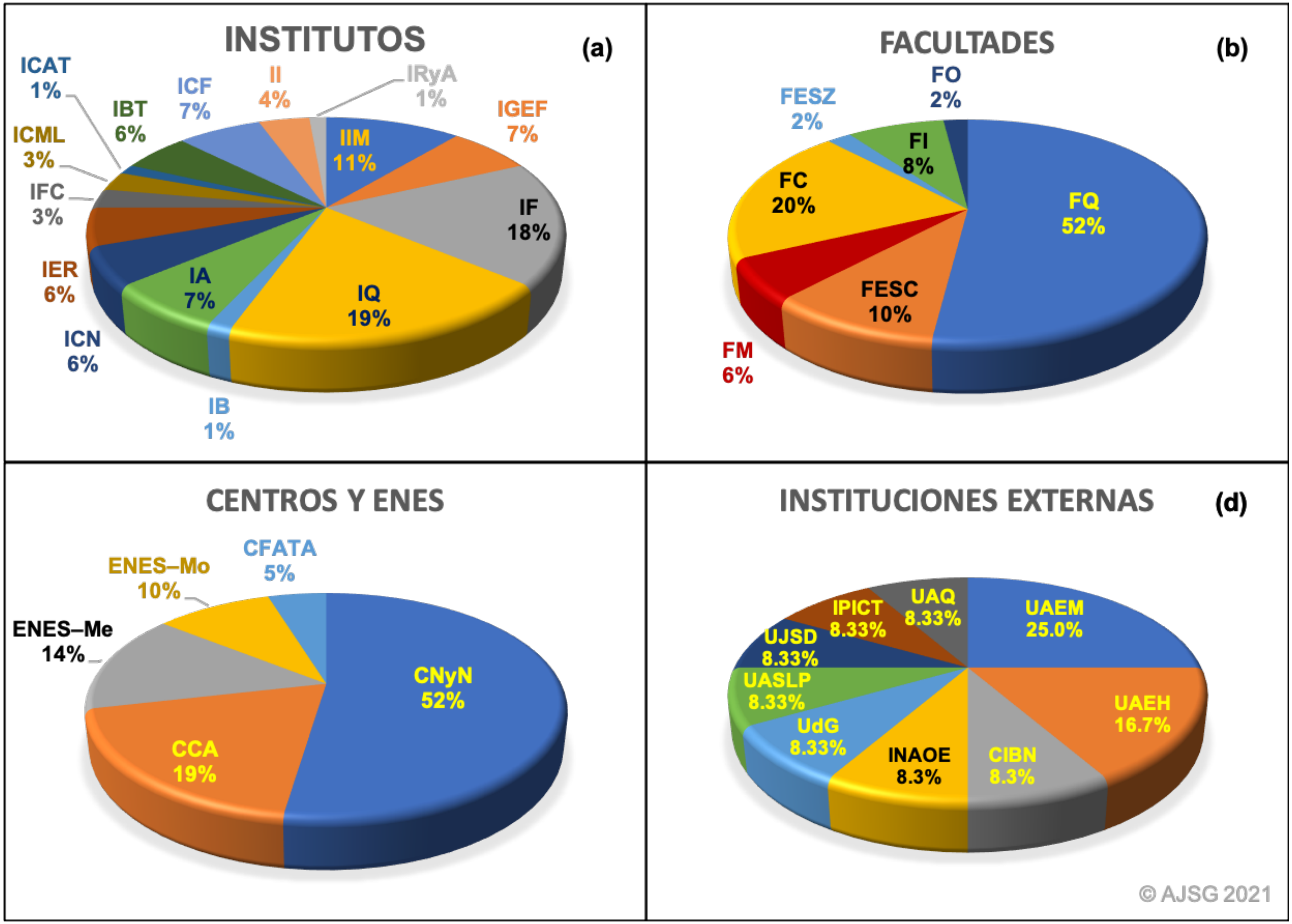


- 155 proyectos aprobados
- 27 entidades académicas de la UNAM (15 Institutos, 7 Facultades, 3 Centros y 2 Escuelas)
- 9 instituciones académicas externas (6 Universidades estatales y 3 Centros de Investigación Conacyt).


Proyectos 2021
FQ 26
IQ 14
IF 13
LANCAD 12
CNyN 11
FC 10
IIM 8
ICF 5
IA 5
FESC 5
IGEF 5
IBT 4
FI 4
IER 4
ICN 4
CCA 4
CNyN
IIM
FQ
IGEF
IF
IQ
FESC
FM
IB
IA
CCA
FC
FESZ
ICN
ENES–Me
IER
IFC
ICML
ICAT
FI

SC UNAM

DGTIC



Supercómputo UNAM

- 121 proyectos de investigación/año.
- 10% LANCAD (UNAM, CINVESTAV y UAM).
- 2016, publicación de 161 artículos en revistas científicas.
- 266 ponencias en congresos.
- formación de 12 doctores, 17 maestros.

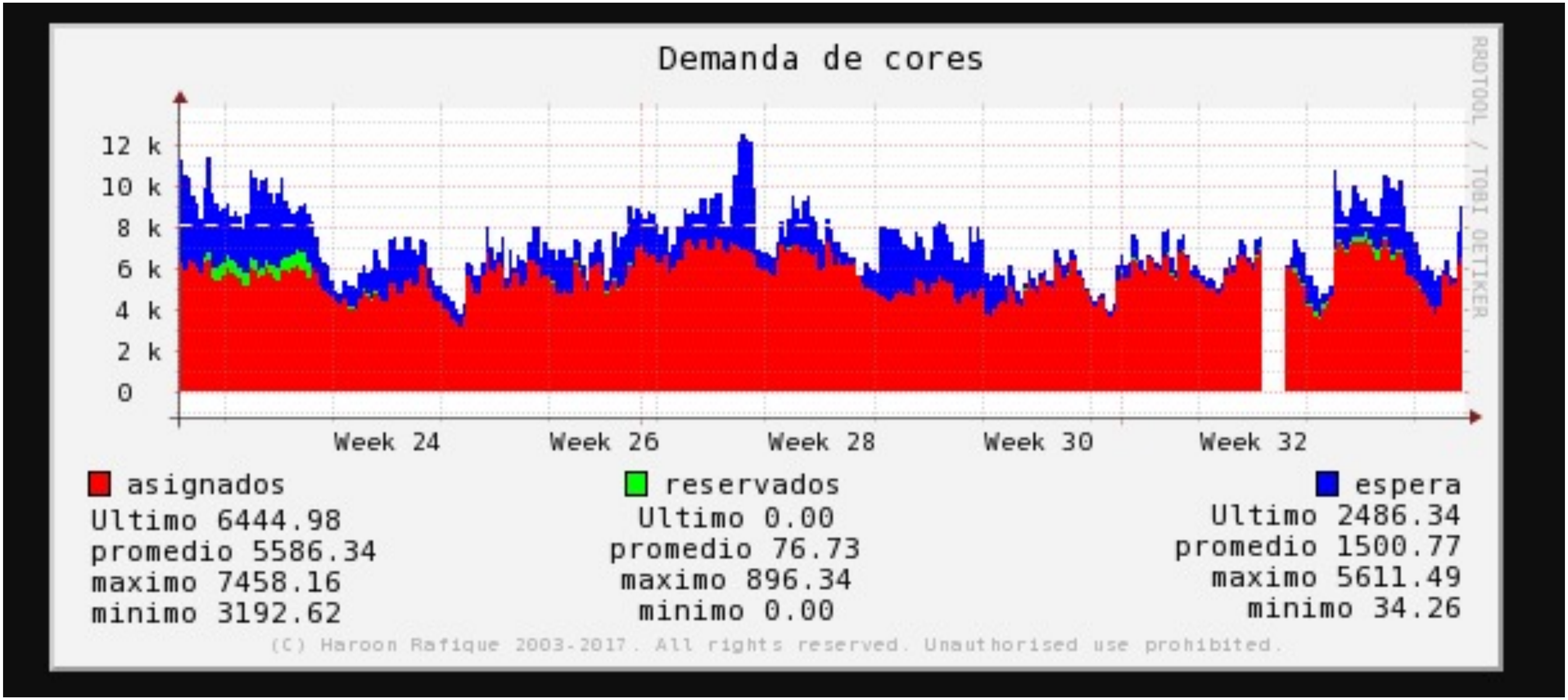
Supercómputo UNAM

- Convocatoria UNAM
  - 121 proyectos, 61 MhCPU.
- Convocatoria LANCAD
  - 5 proyectos, 1.98 MhCPU.
- Se habían considerado 2.5 MhCPU.
- TOTAL
  - 63.5 MhCPU asignadas

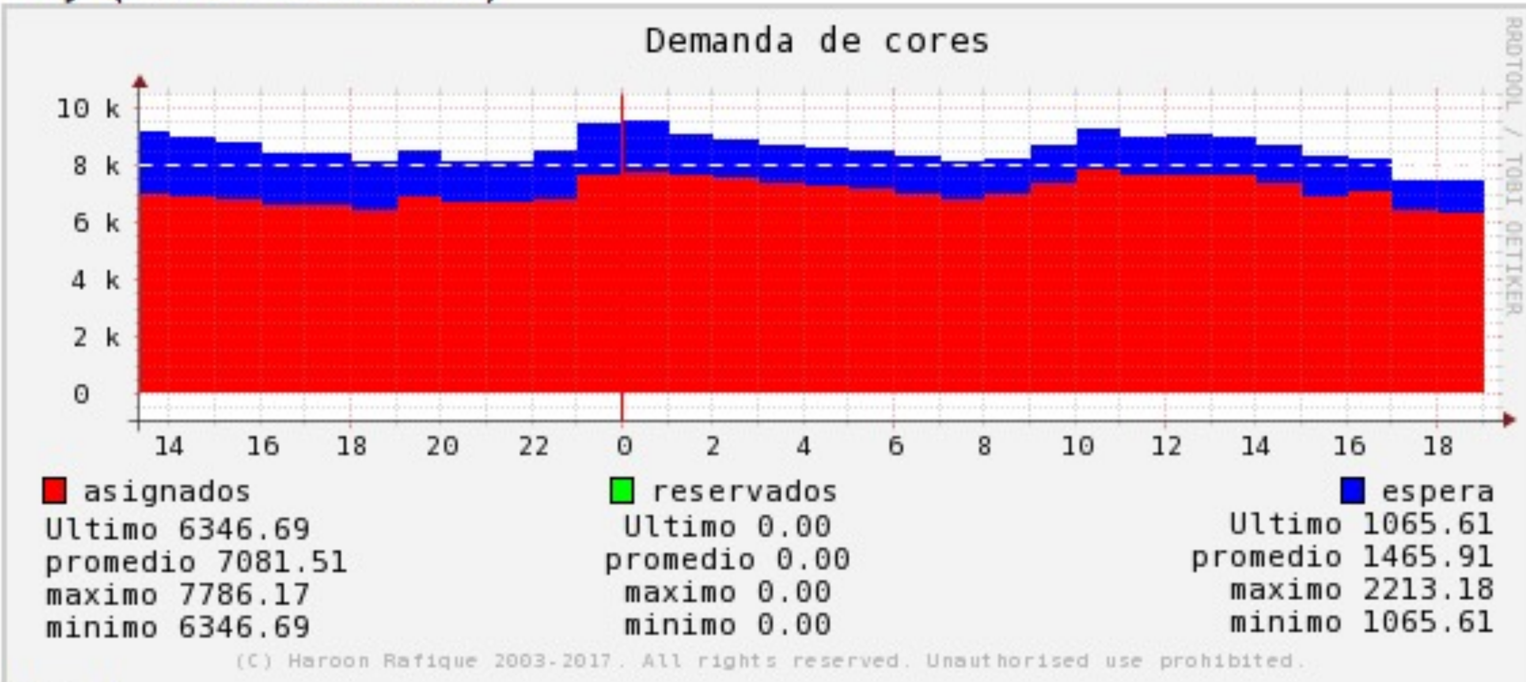
Supercómputo UNAM

- Teórico disponible (marzo-septiembre)
  - 38.6 MhCPU
- Real disponible (marzo-septiembre)
  - 37.2 MhCPU
- Disponibilidad : 96%
- Horas consumidas
  - 29.02 MhCPU.


Convocatoria 2020
Solicitud de recursos
Supercomputadora
miztli

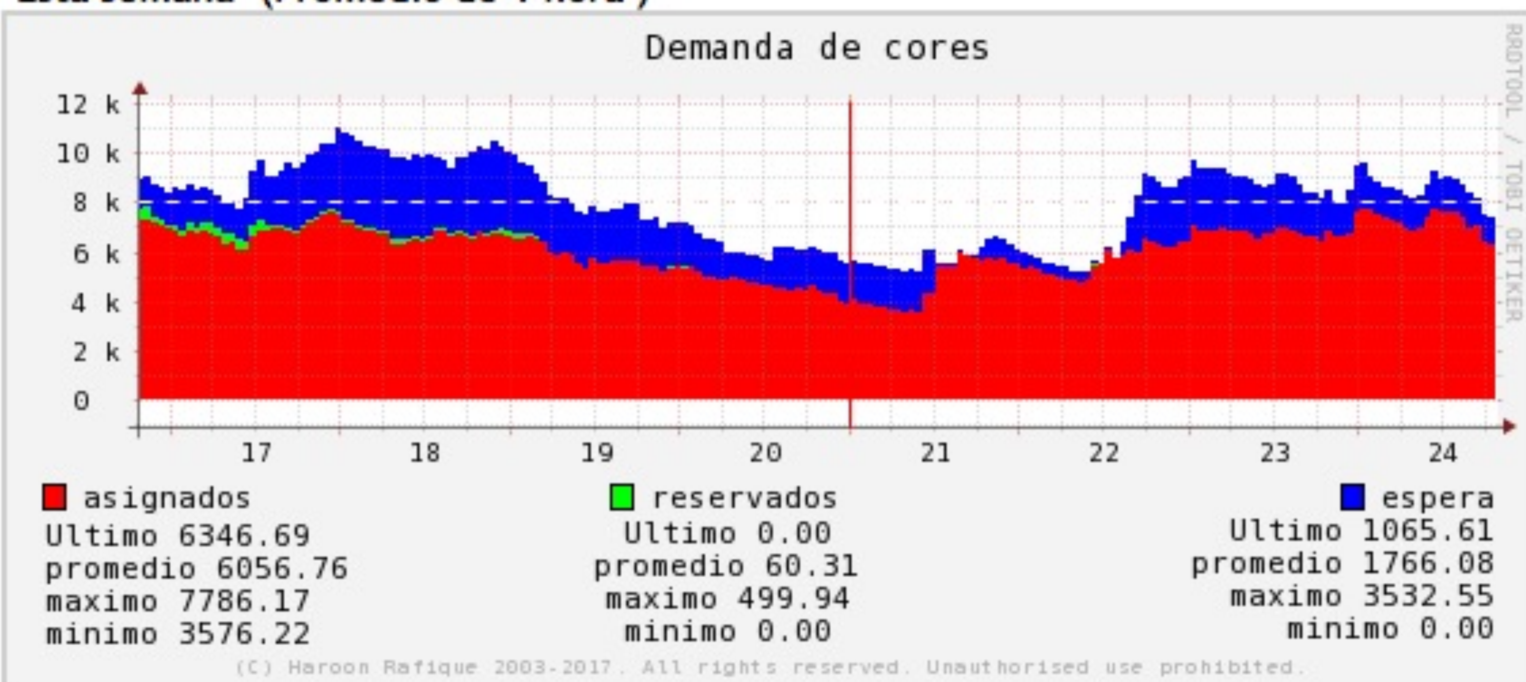

Demanda de cores
RRDTOOL / TOBI OETIKER
12 k
10 k
8 k
6 k
4 k
2 k
0
Week 24
Week 26
Week 28
Week 30
Week 32
asignados
Ultimo 6444.98
promedio 5586.34
maximo 7458.16
minimo 3192.62
reservados
Ultimo 0.00
promedio 76.73
maximo 896.34
minimo 0.00
espera
Ultimo 2486.34
promedio 1500.77
maximo 5611.49
minimo 34.26
(C) Haroon Rafique 2003-2017. All rights reserved. Unauthorised use prohibited.

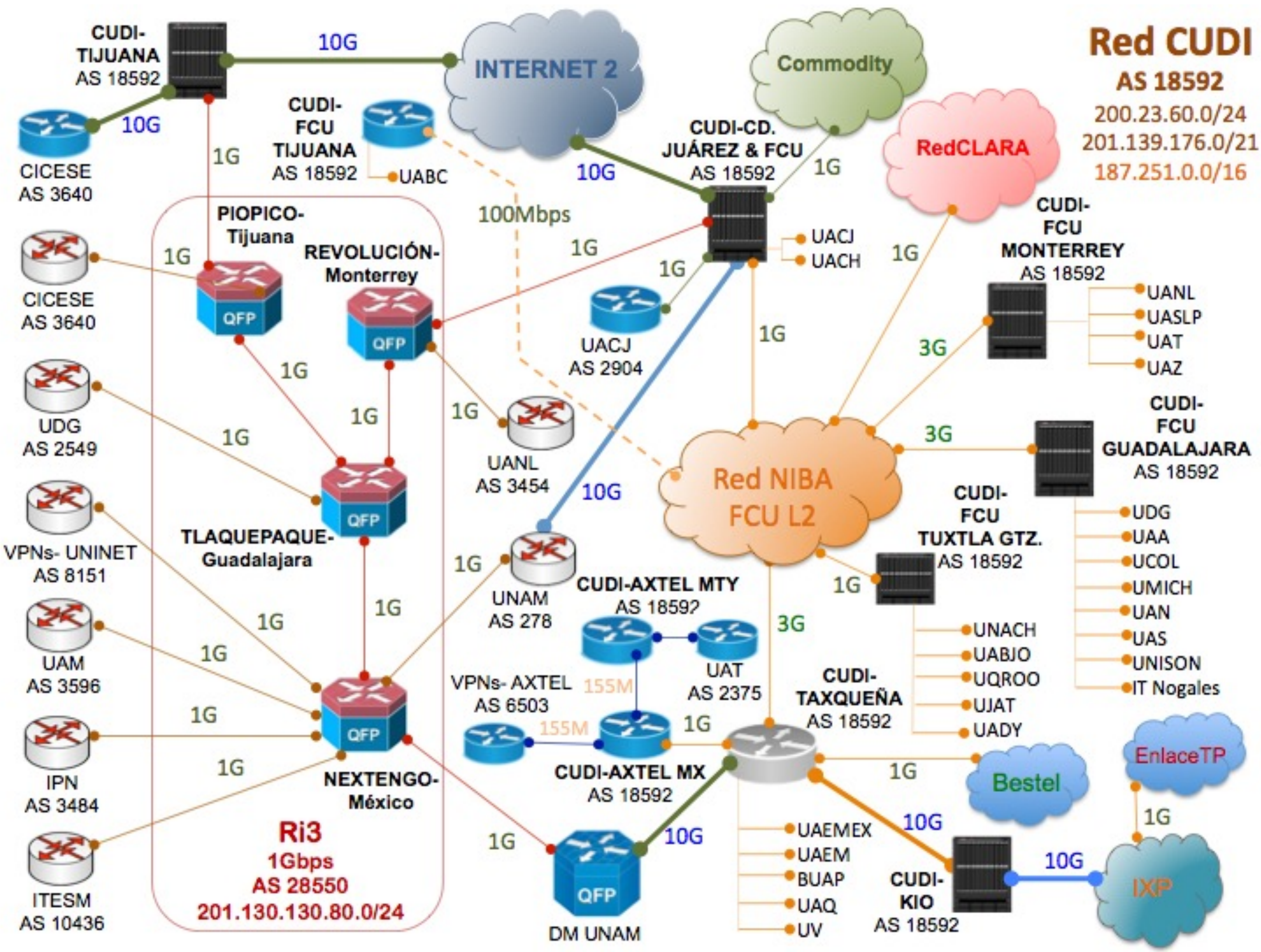
"Hoy" (Promedio de 1 hora)



[source]

"Esta semana" (Promedio de 1 hora)





Red CUDI
AS 18592
200.23.60.0/24
201.139.176.0/21
187.251.0.0/16
CUDI-TIJUANA AS 18592
10G
INTERNET 2
Commodity
RedCLARA
CICESE AS 3640
CUDI-FCU TIJUANA AS 18592
UABC
CUDI-CD. JUÁREZ & FCU AS 18592
1G
100Mbps
PIOPICO-Tijuana
REVOLUCIÓN-Monterrey
QFP
UACJ
UACH
CICESE AS 3640
UACJ AS 2904
CUDI-FCU MONTERREY AS 18592
UANL
UASLP
UAT
UAZ
3G
UDG AS 2549
UANL AS 3454
TLAQUEPAQUE-Guadalajara
Red NIBA FCU L2
CUDI-FCU GUADALAJARA AS 18592
UDG
UAA
UCOL
UMICH
UAN
UAS
UNISON
IT Nogales
VPNs- UNINET AS 8151
UNAM AS 278
CUDI-AXTEL MTY AS 18592
CUDI-FCU TUXTLA GTZ. AS 18592
UNACH
UABJO
UQROO
UJAT
UADY
UAM AS 3596
UAT AS 2375
VPNs- AXTEL AS 6503
155M
CUDI-TAXQUEÑA AS 18592
IPN AS 3484
CUDI-AXTEL MX AS 18592
Bestel
EnlaceTP
NEXTENGO-México
Ri3
1Gbps
AS 28550
201.130.130.80.0/24
UAEMEX
UAEM
BUAP
UAQ
UV
CUDI-KIO AS 18592
IXP
ITESM AS 10436
DM UNAM

Supercómputo

¡Aplicaciones Universitarias!

• *Esta tecnología de la Universidad Nacional contribuyó al trabajo de más de 160 científicos, de 60 países*
• *Héctor Manuel Velázquez es el único mexicano universitario integrante del equipo de científicos*
• *Reprodujeron en meses la creación de una galaxia similar a la Vía Láctea, lo cual en el Universo real tardó miles de millones de años; este tiempo en Miztli equivale a usar todo el tiempo 30 mil tabletas, durante un año*
• *Esta iniciativa que dirige Santi Roca Fàbrega forma parte del proyecto AGORA*

Miztli es la supercomputadora de la UNAM que utilizó un equipo internacional de expertos, junto con seis sistemas similares en el mundo, para recrear una galaxia similar a la Vía Láctea, como parte del proyecto Assembling Galaxies Of Resolved Anatomy (AGORA).

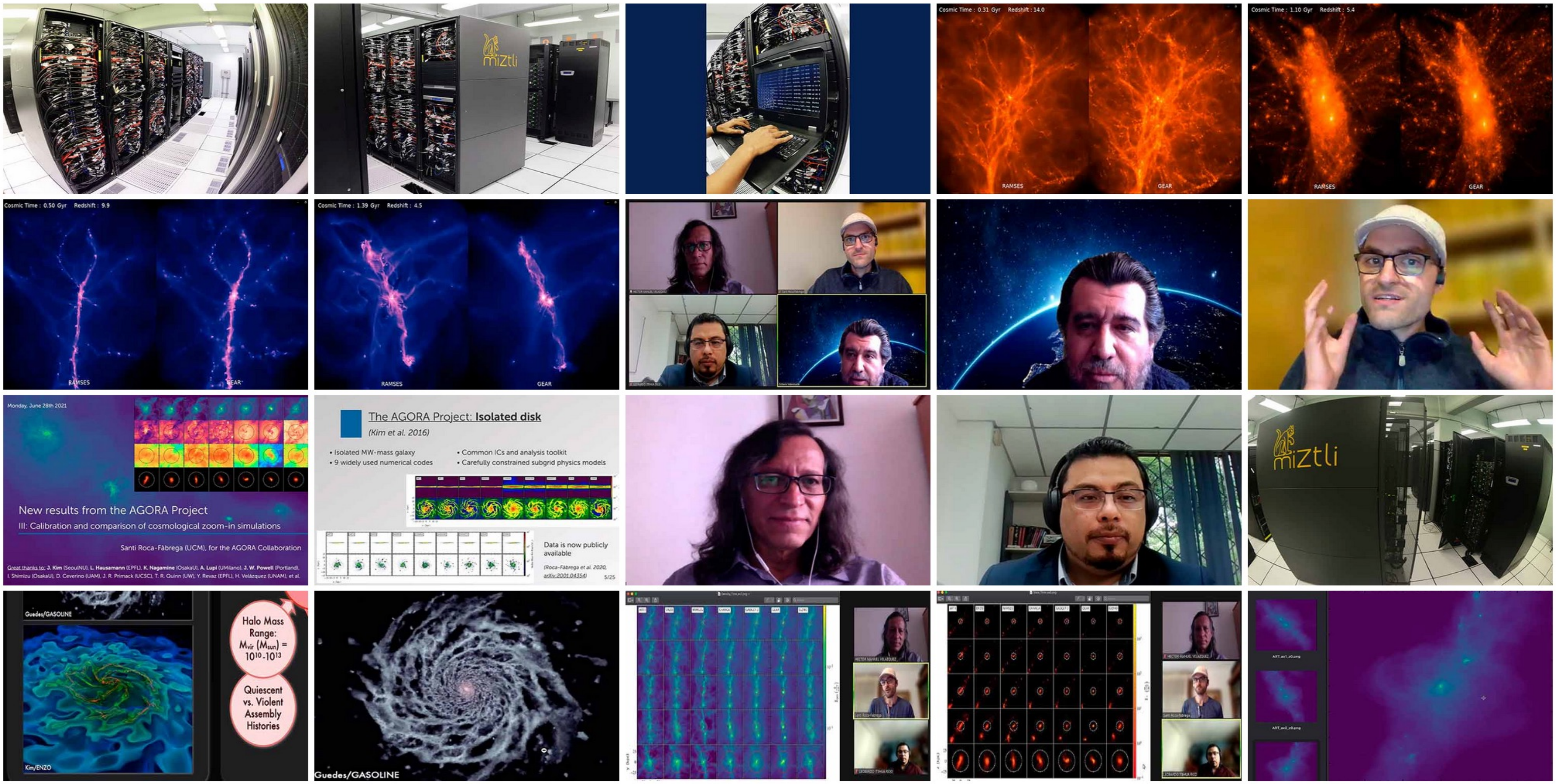
DGTIC

Boletines Recientes

Boletín UNAM-DGCS-546
Ciudad Universitaria.
17:30 hs. 28 de junio de 2021

Héctor Manuel Velázquez

Santi Roca Fàbrega



MIZTLI, SUPERCOMPUTADORA DE LA UNAM, ENTRE LAS DEL MUNDO QUE RECREARON EL DESARROLLO DE GALAXIAS

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

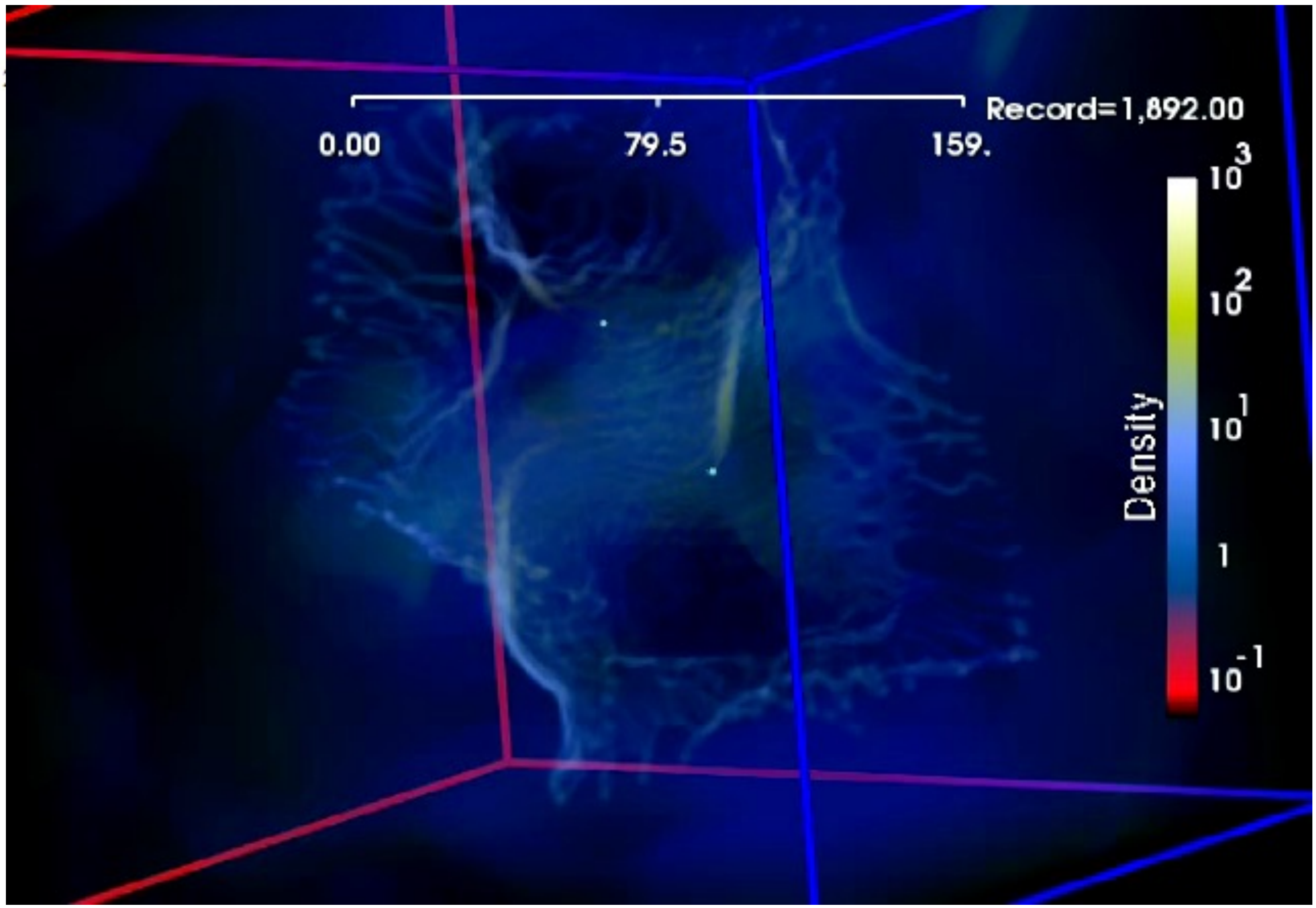
MNRAS **435,** 1701–1714 (2013) doi:10.1093/mnras/stt1409
Advance Access publication 2013 August 23

Molecular cloud evolution – V. Cloud destruction by stellar feedback

Pedro Colín,* Enrique Vázquez-Semadeni and Gilberto C. Gómez

Centro de Radiostronomía y Astrofísica, UNAM, Apartado Postal 72-3 (Xangari), 58089 Morelia, Mexico

Accepted 2013 July



Supercómputo GPUs

Planet heating prevents inward migration of planetary cores

Pablo Benítez-Llambay, Frédéric Masset, Gloria Koenigsberger & Judit Szulágyi

Affiliations | Contributions | Corresponding author

Nature **520**, 63–65 (02 April 2015) | doi:10.1038/nature14277

Received 03 December 2014 | Accepted 29 January 2015 | Published online 01 April 2015

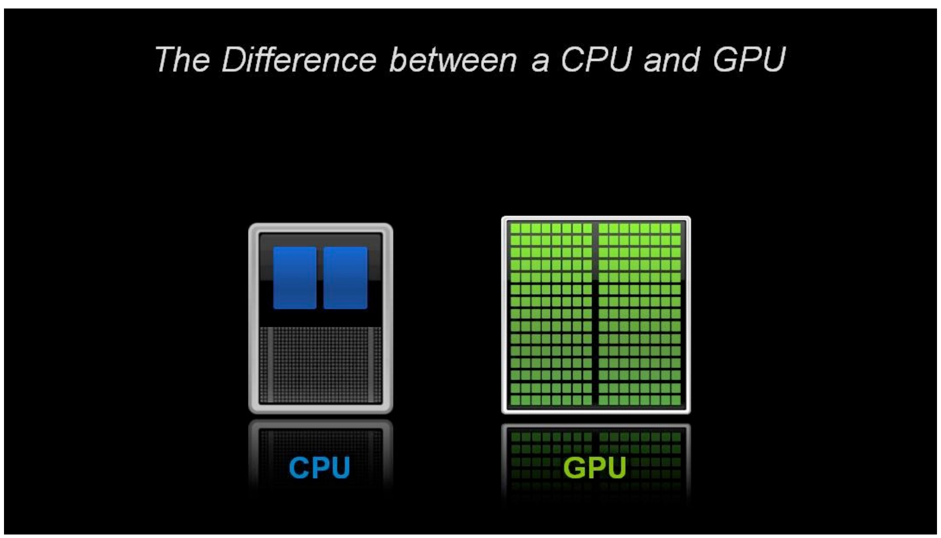
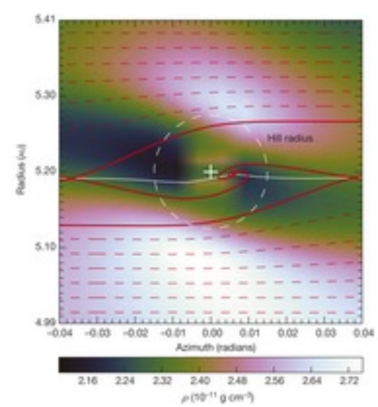
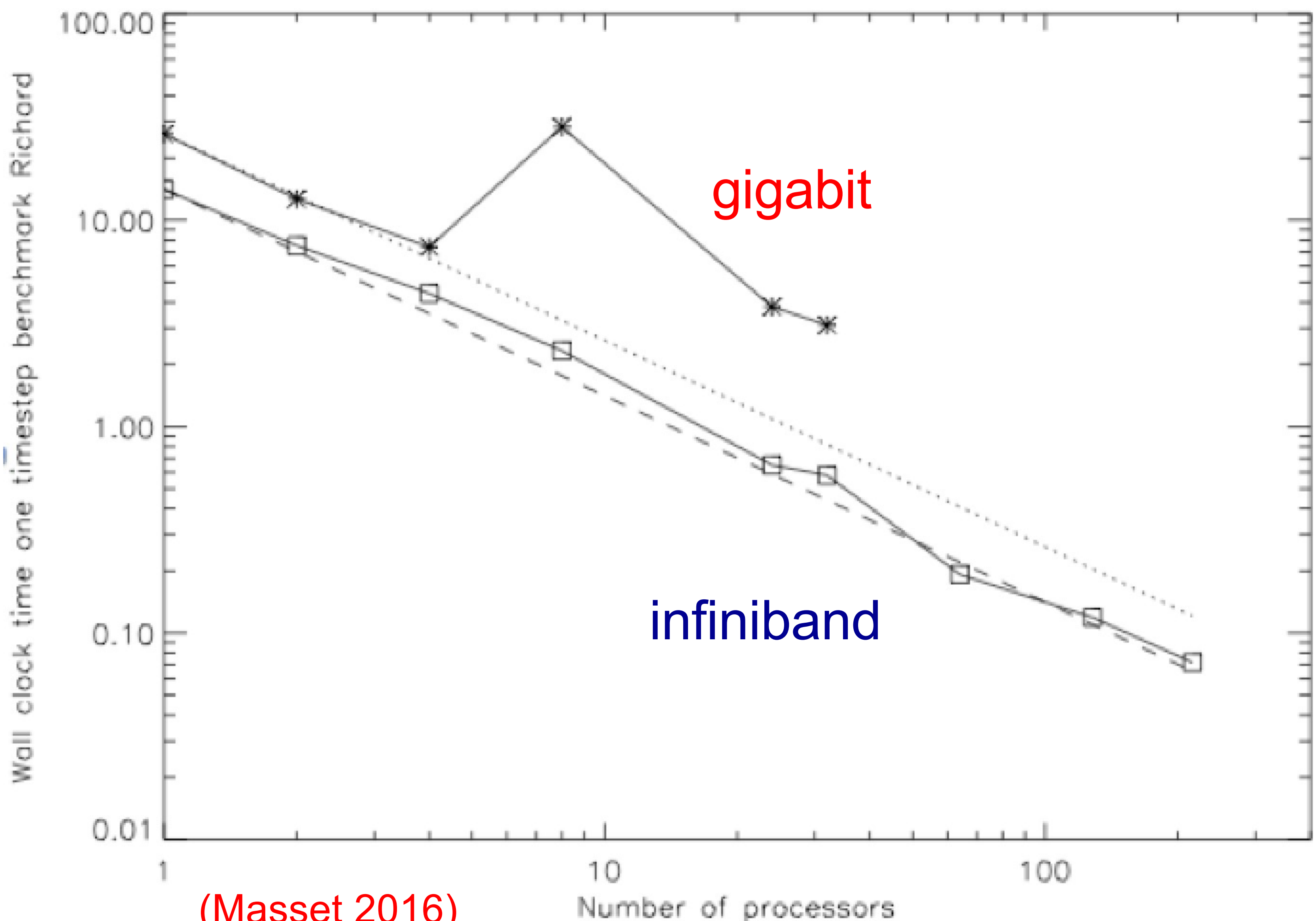


Figure 3: Density in the vicinity of an irradiating embryo.

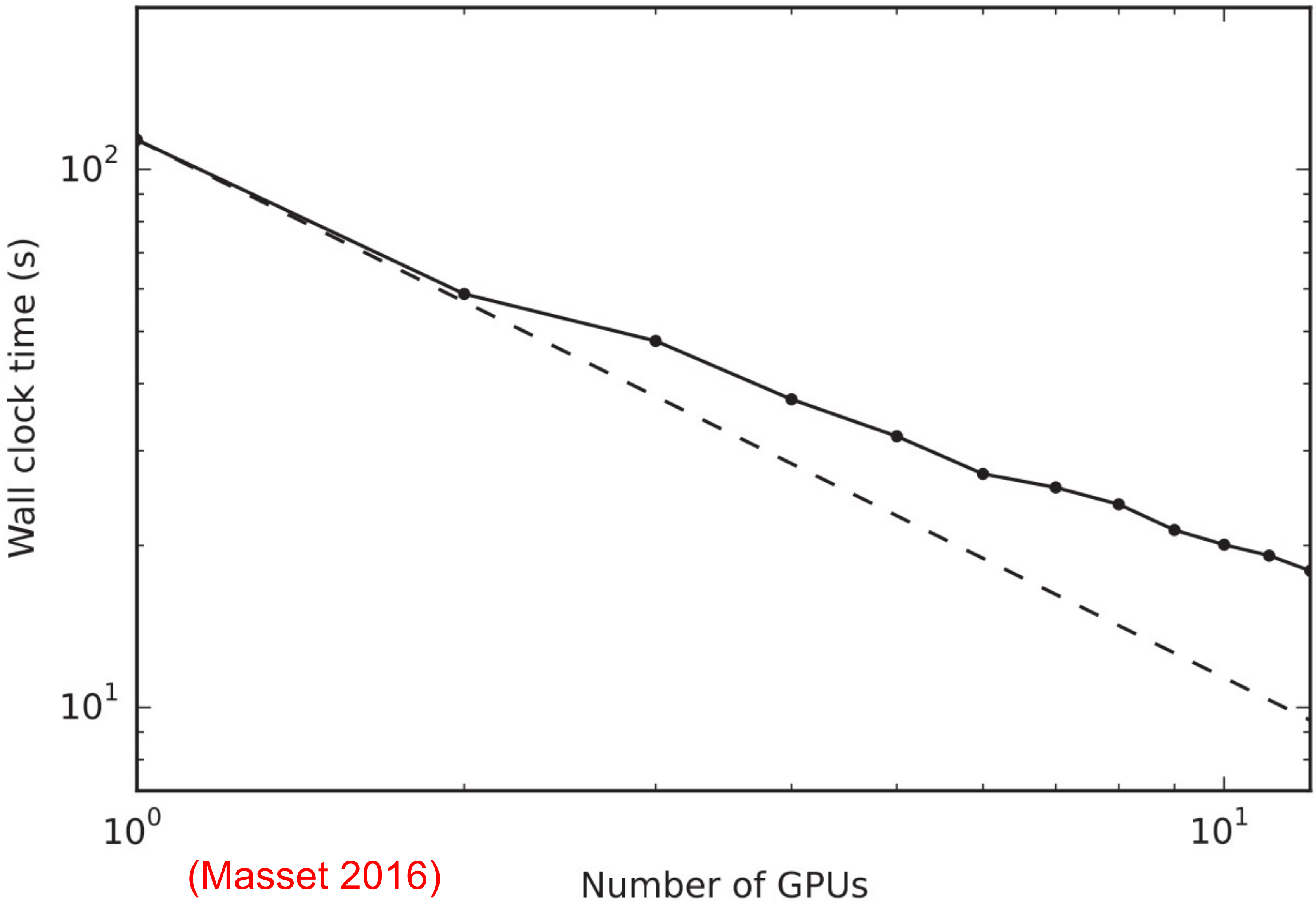


Rendimiento CPUs



(Masset 2016)

Rendimiento GPUs



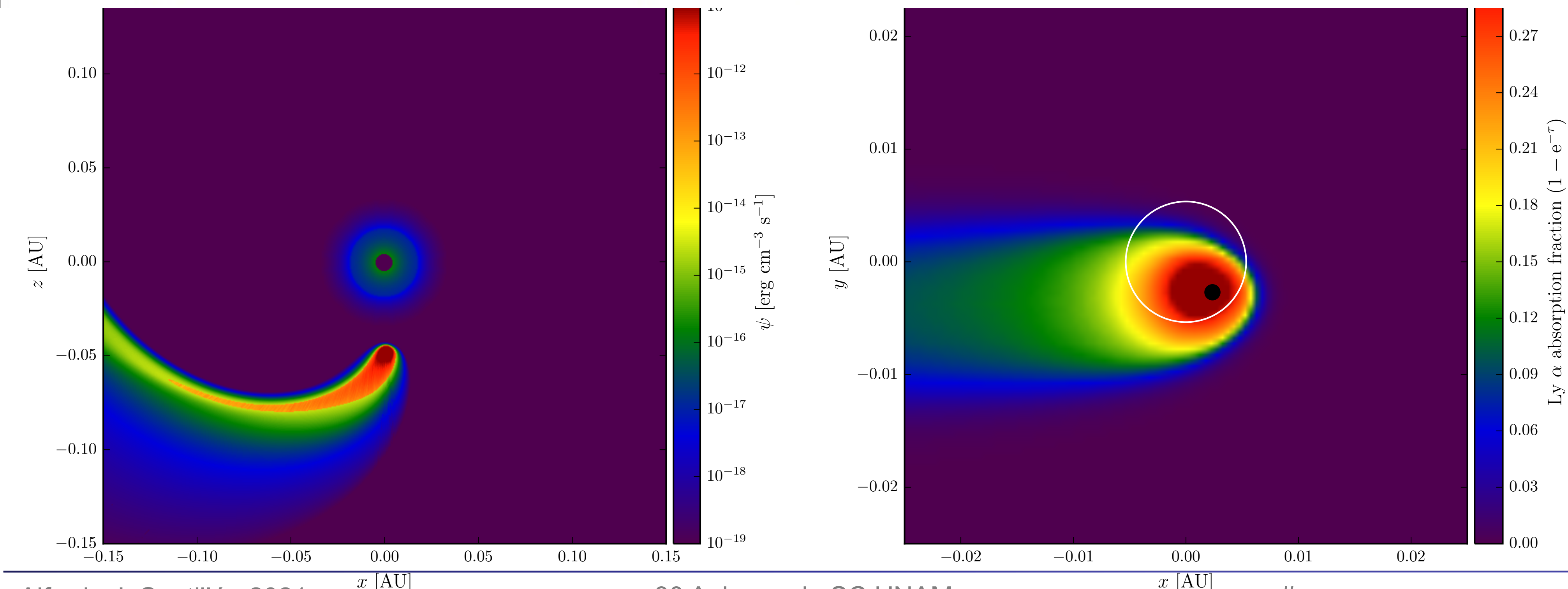
(Masset 2016)

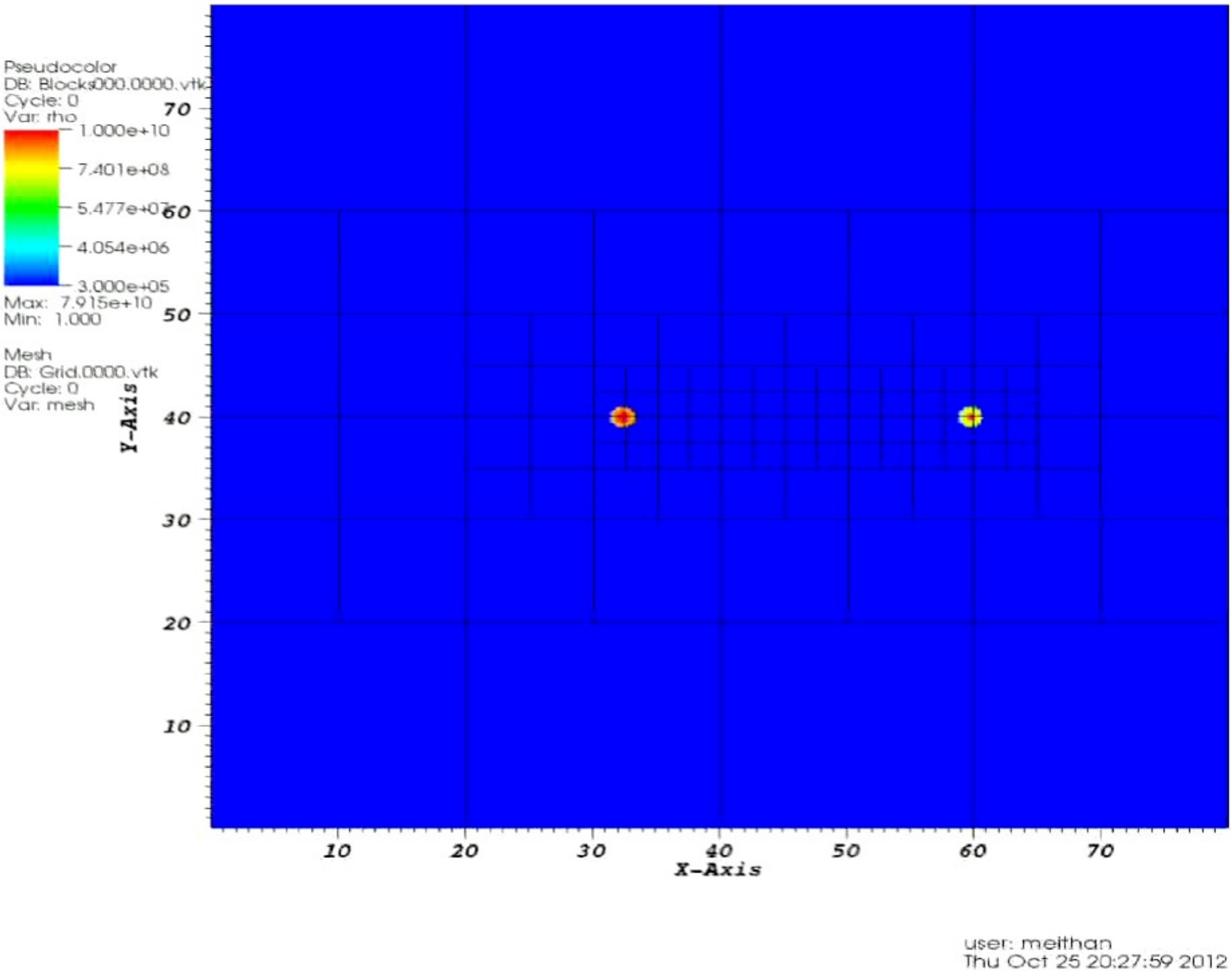
Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY
MNRAS 457, 1666–1674 (2016) doi:10.1093/mnras/stw076

Photoionization of planetary winds: case study HD 209458b

E. M. Schneiter,[1,2,3]★ A. Esquivel,[4]★ C. S. Villarreal D'Angelo,[1]★ P. F. Velázquez,[4] A. C. Raga[4] and A. Costa[1]
[1]Instituto de Astronomía Teórica y Experimental, Universidad Nacional de Córdoba, X500BGR Córdoba, Argentina
[2]Departamento de Materiales y Tecnología, UNC, X5016GCA Córdoba, Argentina
[3]Departament of Astronomy, AlbaNova, Stockholm University, SE-106 91 Sweden
[4]Instituto de Ciencias Nucleares, Universidad Nacional Autónoma de México, 70-543 México D. F. México

Accepted 2016 January 8. Received 2015 December 14; in original form 2015 July 21




Pseudocolor
DB: Blocks000.0000.vtk
Cycle: 0
Var: rho
1.000e+10
7.401e+08
5.477e+07
4.054e+06
3.000e+05
Max: 7.915e+10
Min: 1.000
Mesh
DB: Grid.0000.vtk
Cycle: 0
Var: mesh
Y-Axis
70
60
50
40
30
20
10
10
20
30
40
50
60
70
X-Axis
user: meithan
Thu Oct 25 20:27:59 2012

THE ASTROPHYSICAL JOURNAL

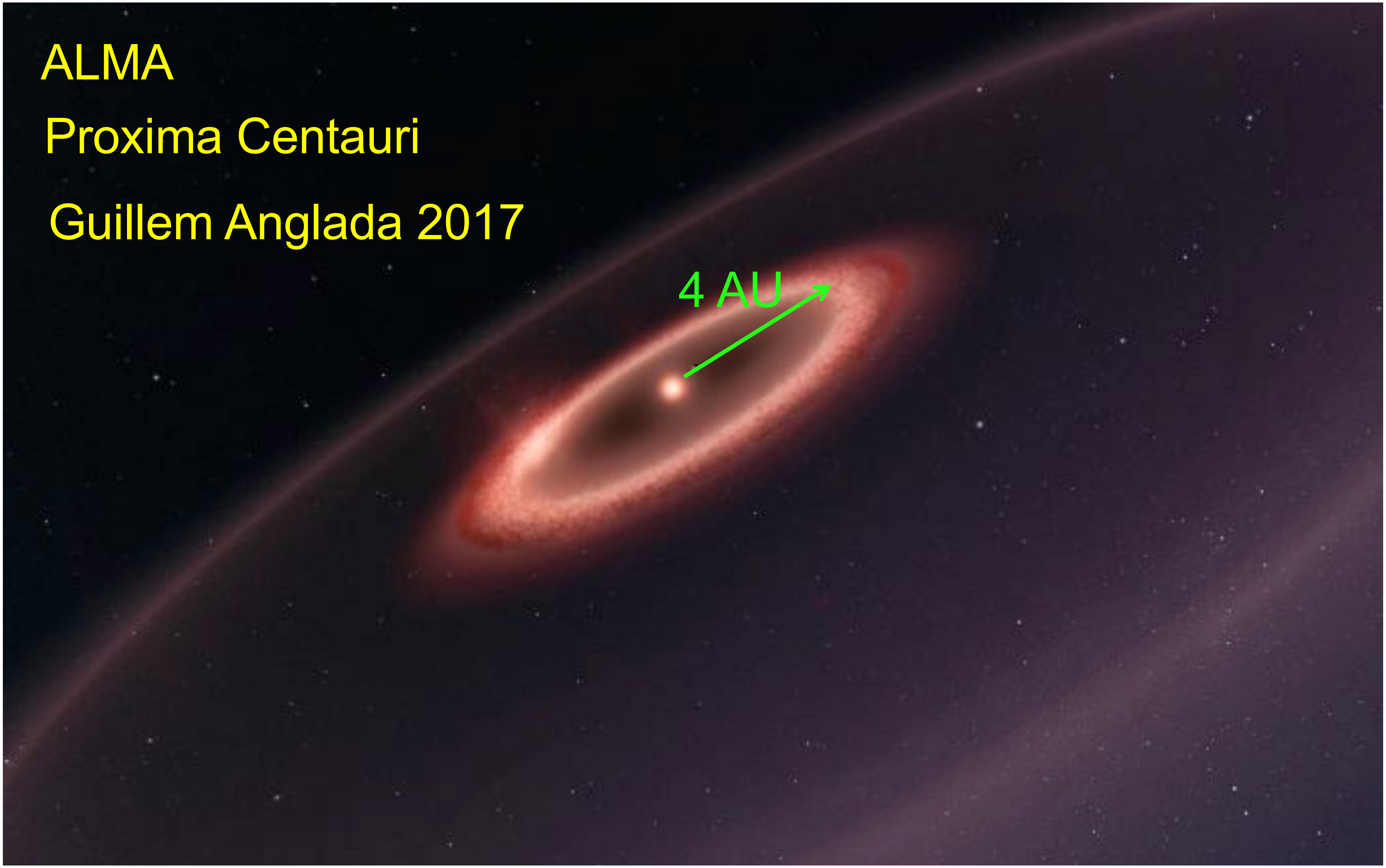
Torques on Low-mass Bodies in Retrograde Orbit in Gaseous Disks

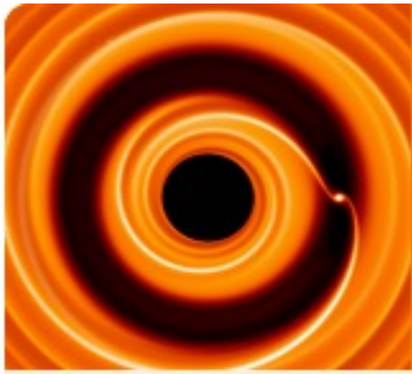
F. J. Sánchez-Salcedo[1], Raúl O. Chametla[2], and A. Santillán[3]

Published 2018 June 20 •

The Astrophysical Journal, Volume 860, Number 2

Formación Sistema Planetario





FARGO3D

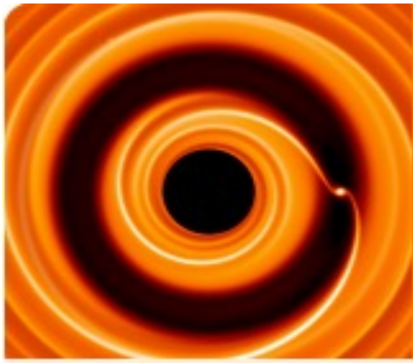
A versatile HD/MHD code that runs on clusters of CPUs or GPUs, with special emphasis on protoplanetary disks.

FARGO3D is the successor of the FARGO code, which you can still find in the legacy part of this site. The main features of FARGO3D are:

- Cartesian, cylindrical or spherical geometry
- 1-, 2- or 3-dimensional calculations
- Orbital advection (aka FARGO) for HD and MHD calculations
- As in FARGO, a simple Runge-Kutta N-body solver may be used to describe the orbital evolution of embedded point-like objects
- No need to know CUDA: you can develop new functions in C and have them translated to CUDA automatically to run on GPUs

FARGO3D was written by Pablo Benítez Llambay (main developper) and by Frédéric Masset.

HPC



FARGO3D

Home > FARGO3D > **Features**

- Solves the equations of hydrodynamics (continuity, Navier-Stokes and energy) and magnetohydrodynamics (MHD) on an Eulerian mesh.
- Multidimensional (1D, 2D & 3D).
- Several geometries (Cartesian, cylindrical and spherical).
- Non inertial reference frames (including shearing box for Cartesian setups).
- Adiabatic or Isothermal Equation of State (EOS). It is easy to implement any other EOS.
- Designed mainly for disks, but works well for general problems.
- Includes ideal MHD (Method Of Characteristics & Constrained Transport).
- Includes magnetic field diffusion (resistivity module).
- Includes the full viscous stress tensor in the three geometries.
- Simple N-body integrator, for embedded planets.
- FARGO algorithm implemented in Cartesian, cylindrical and spherical coordinates.
- The FARGO or "orbital advection" scheme is also implemented for MHD.
- Possible runtime visualization.
- Low memory footprint.
- Multiplatform:
  - Sequential Mode, one process on a CPU.
  - Parallel Mode, for clusters of CPU (distributed memory, with MPI).
  - One GPU (CUDA without MPI).
  - Parallel GPU Mode, for clusters of GPUs (mixed MPI-CUDA version).

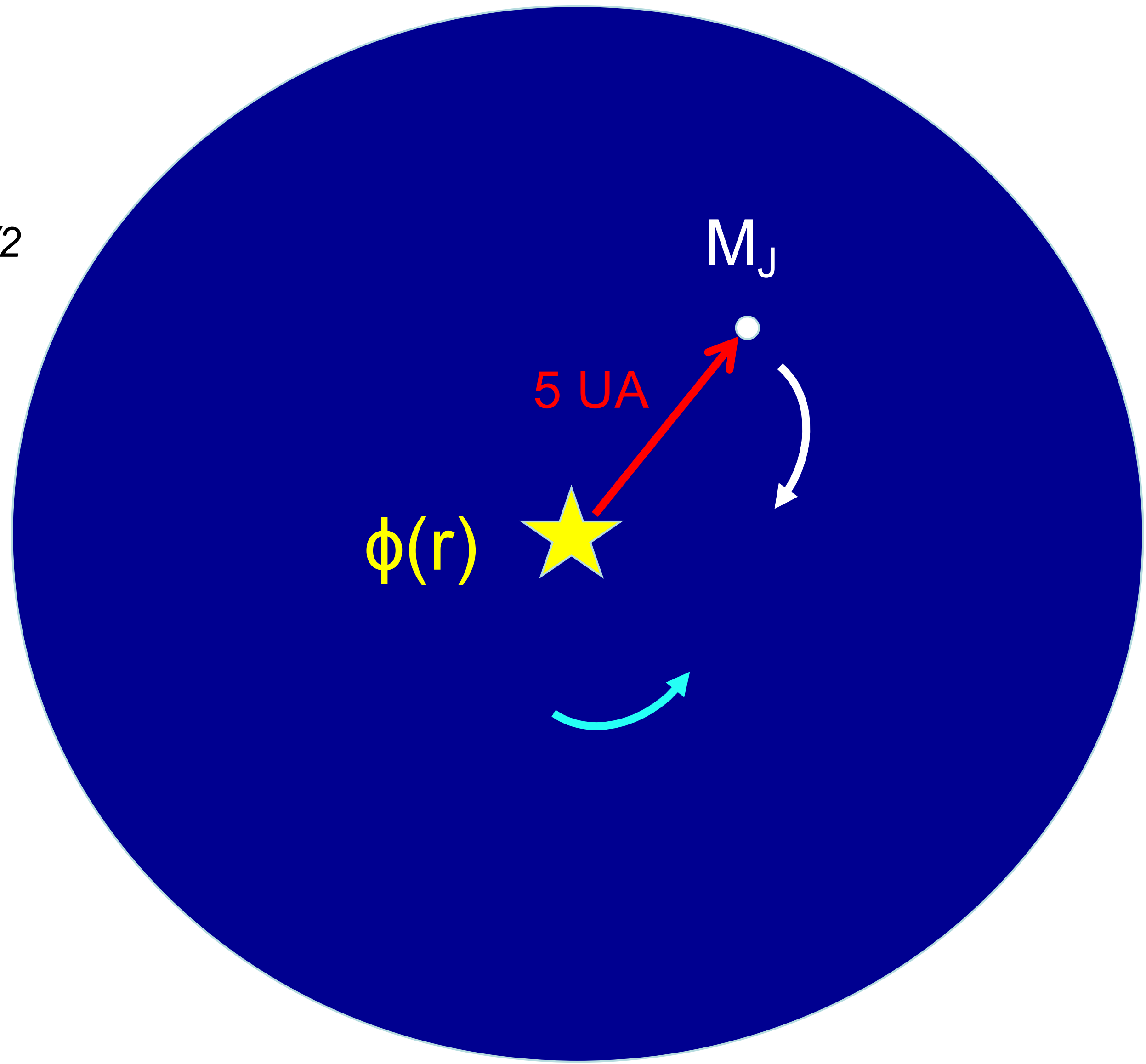
HPC

Also in this section

Features
Download
Documentation
Publications
Acknowledgments

Condiciones Iniciales

- Rotación Kepleriana $r^{-1/2}$
- $T = T(r)$
- $M_* = 1\ M_\odot$
- $M_D = 10^{-2}\ M_\odot$
- $M_J = 10^{-3}\ M_\odot$
- $V_J = 13\ \mathrm{km\ s^{-1}}$



Supercómputo UNAM

alfredo — asg@mn328:/tmpu/asg_g/asg/FARGO/FARGO3D — ssh alfredo@132.248.1.6 -p 8006 — 79×24

```
------------------------------------------------------------

Successfully completed.

Resource usage summary:

    CPU time :                                   37564836.00 sec.
    Max Memory :                                 183353.48 MB
    Average Memory :                             183178.06 MB
    Total Requested Memory :                     -
    Delta Memory :                               -
    Max Swap :                                   230531 MB
    Max Processes :                              80
    Max Threads :                                308

The output (if any) follows:

The default output directory root is ./
The output directory is ./outputs/p3diso/
Process 0 creates the directory ./outputs/p3diso/
I do not output the ghost values
I do not output the ghost values
I do not output the ghost values
--More--(3%)
```

96 cores

4.5 días

3D (r,θ,φ) (1024,196,5120)

¡1,027 millones de zonas!

Supercómputo UNAM

DGTIC

alfredo — asg@mn328:/tmpu/asg_g/asg/FARGO/FARGO3D/outputs/p3diso_HR_96 — ssh alfredo@132.248.1.6 -p 8006 — 80×24

```
-rw-r--r-- 1 asg asg_g 7.5G Sep  3 01:59 gasdens0.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  7 11:16 gasdens10.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  3 12:19 gasdens1.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  3 22:38 gasdens2.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  4 08:57 gasdens3.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  4 19:19 gasdens4.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  5 05:38 gasdens5.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  5 16:00 gasdens6.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  6 04:12 gasdens7.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  6 14:36 gasdens8.dat
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-rw-r--r-- 1 asg asg_g 7.5G Sep  3 12:20 gasenergy1.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  3 22:39 gasenergy2.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  4 08:58 gasenergy3.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  4 19:19 gasenergy4.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  5 05:38 gasenergy5.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  5 16:00 gasenergy6.dat
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-rw-r--r-- 1 asg asg_g 7.5G Sep  6 14:36 gasenergy8.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  7 00:55 gasenergy9.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  3 02:00 gasvx0.dat
-rw-r--r-- 1 asg asg_g 7.5G Sep  7 11:16 gasvx10.dat
```

Supercómputo UNAM

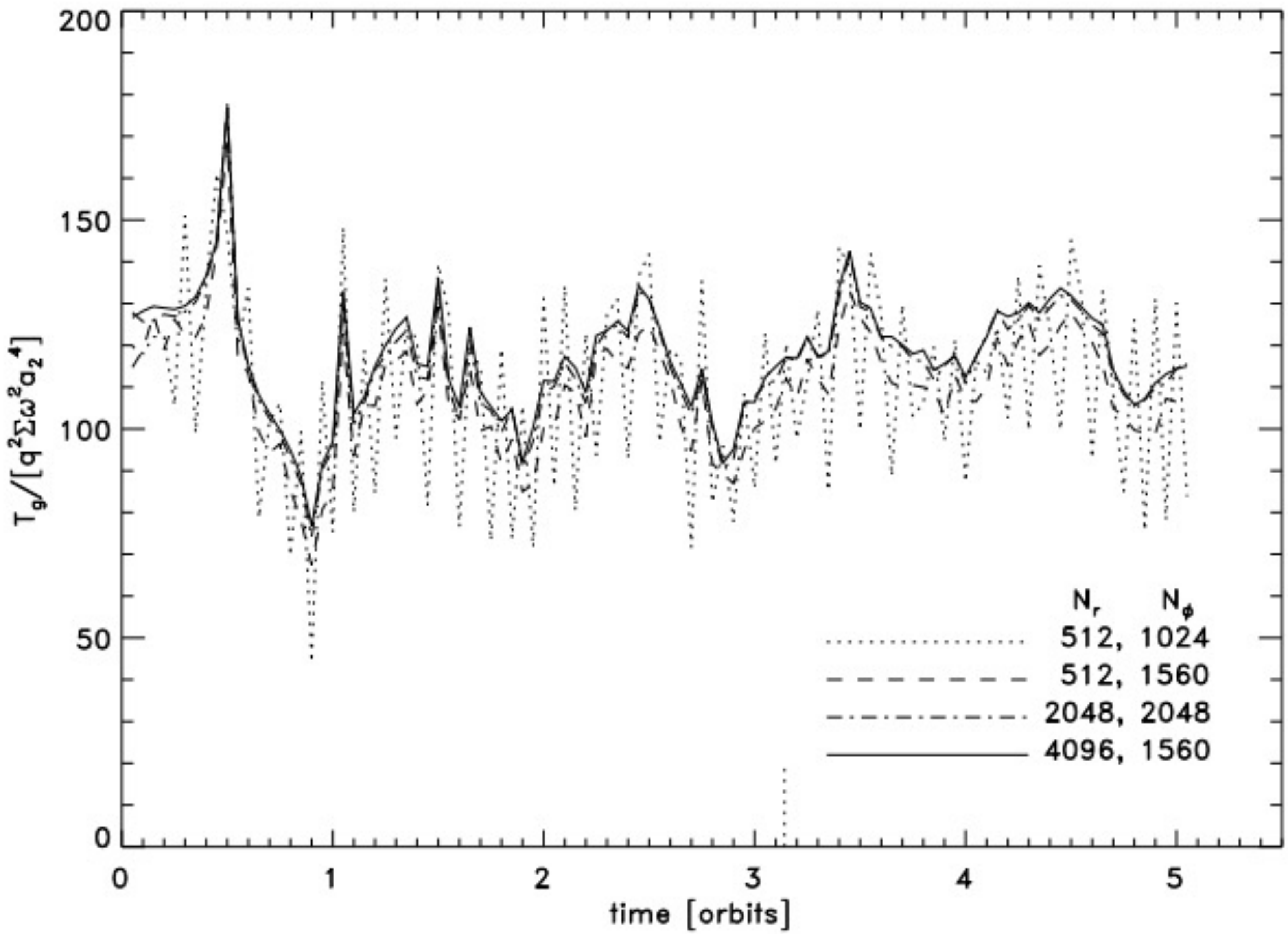
alfredo — asg@mn328:/tmpu/asg_g/asg/FARGO/FARGO3D/outputs/p3diso_HR_96 — ssh alfredo@132.248.1.6 -p 8006 — 80×24

```
[asg@mn328 p3diso_HR_96]$ du -h .
9.1M    ./FG000008
9.1M    ./FG000000
9.1M    ./FG000005
3.1M    ./FG000010
9.1M    ./FG000001
9.1M    ./FG000004
9.1M    ./FG000002
9.1M    ./FG000007
9.1M    ./FG000009
9.1M    ./FG000006
9.1M    ./FG000003
413G    .
[asg@mn328 p3diso_HR_96]$ 
```

413 GB

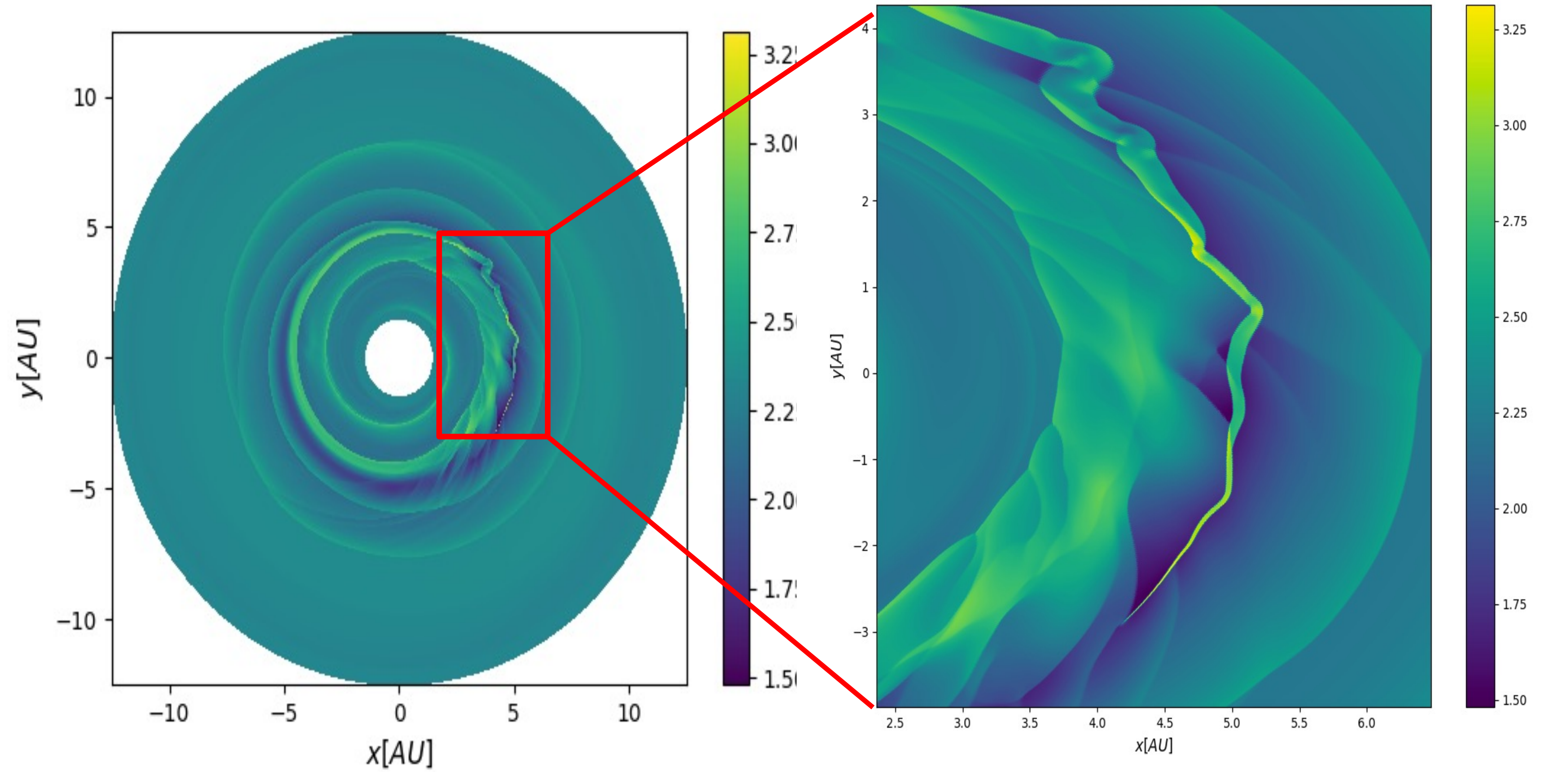
de almacenamiento

Torca vs Resolución

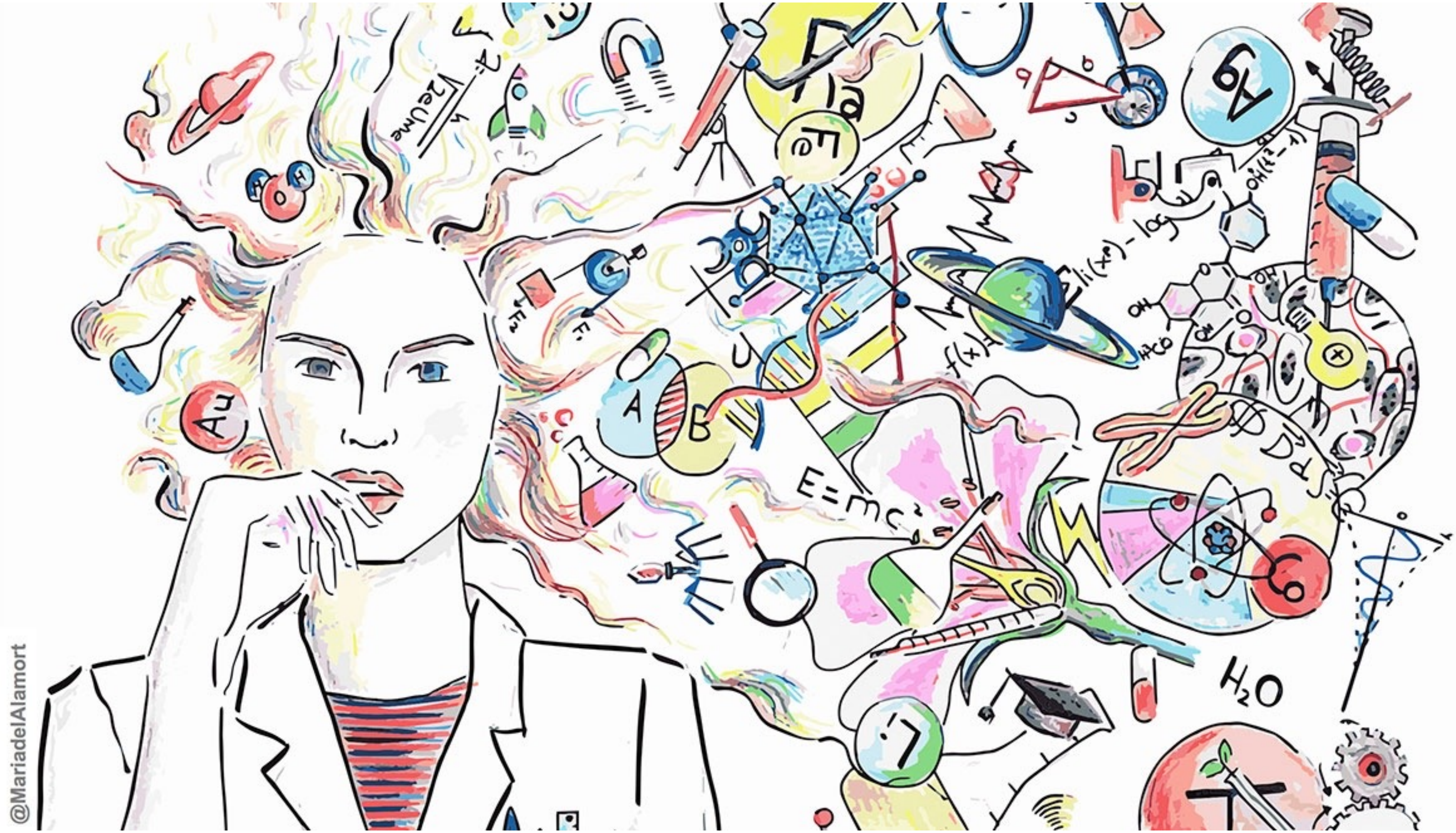


Resultados no-lineal

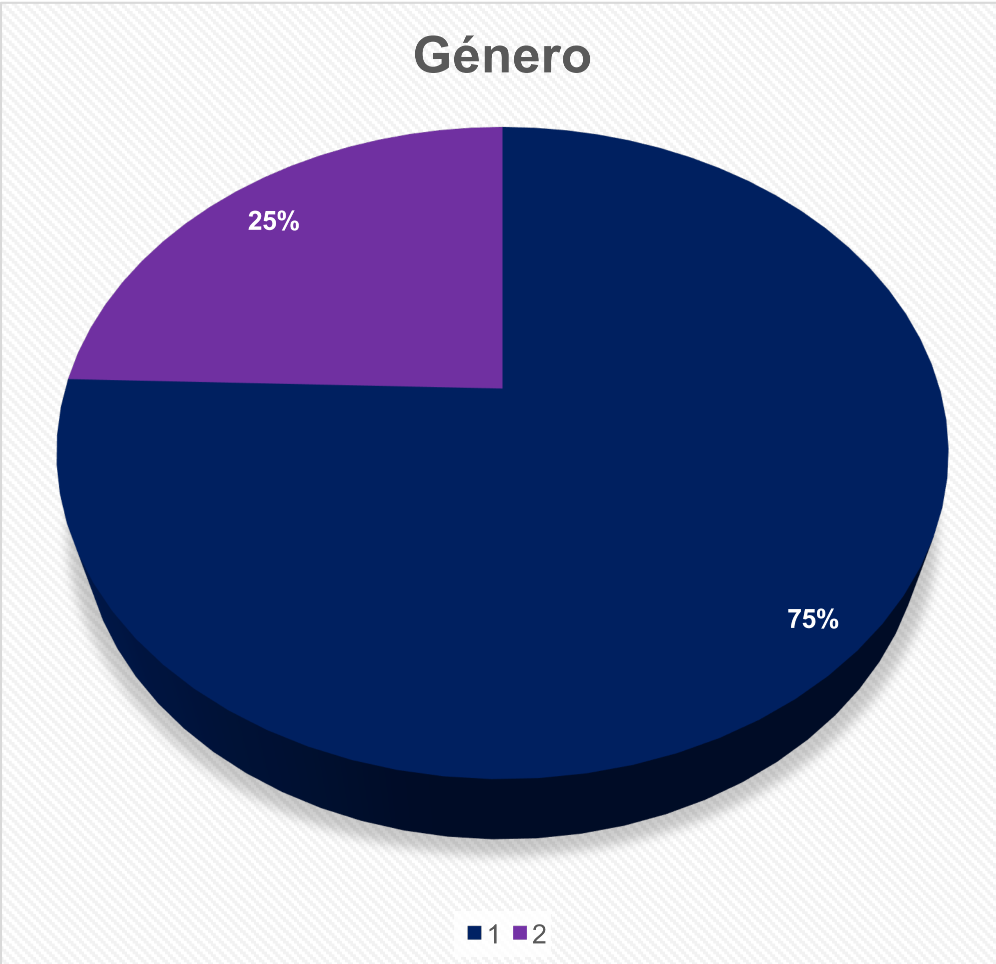
- 2D (r,φ) = (4096,2048)



Women in Science



Women in Science



- indicador *"género del responsable del proyecto"*
- disparidad; el 25% son mujeres y 75% son hombres
- *UNESCO Institute for Statistics* respecto al *"número de investigadoras"* a nivel mundial, el cual es menor al 30%.


COSMOPOLITAN
April, 1967 • 50¢
Sex and the Japanese Single Girl
A Secretary Tells How a Con Man Took Her Money
Vanessa Redgrave—Zap!
The Unfaithful Wife—A New Study
Here Comes Twiggy! Britain's New, Super Model by John Fowles
Mystery Novel—Complete by Patricia Highsmith

The Computer Girls

BY LOIS MANDEL

A trainee gets $8,000 a year ...a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate....

Ann Richardson, IBM systems engineer, designs a bridge via computer. Above (left) she checks her facts with fellow systems engineer, Marvin V. Fuchs. Right, she feeds facts into the computer. Below, Ann demonstrates on a viewing screen how her facts designed the bridge, and makes changes with a "light pen."

Twenty years ago, a girl could be a secretary, a school teacher . . . maybe a librarian, a social worker or a nurse. If she was really ambitious, she could go into the professions and compete with men . . . usually working harder and longer to earn less pay for the same job.

Now have come the big, dazzling computers—and a whole new kind of work for women: programming. Telling the miracle machines what to do and how to do it. Anything from predicting the weather to sending out billing notices from the local department store.

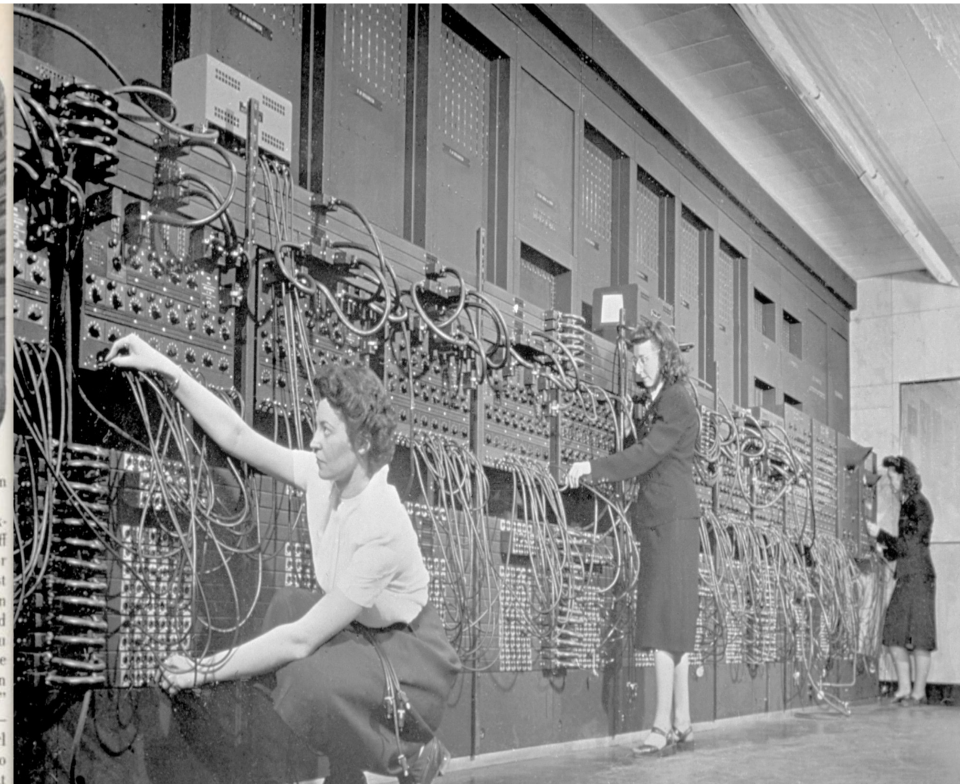
And if it doesn't sound like woman's work—well, it just is.

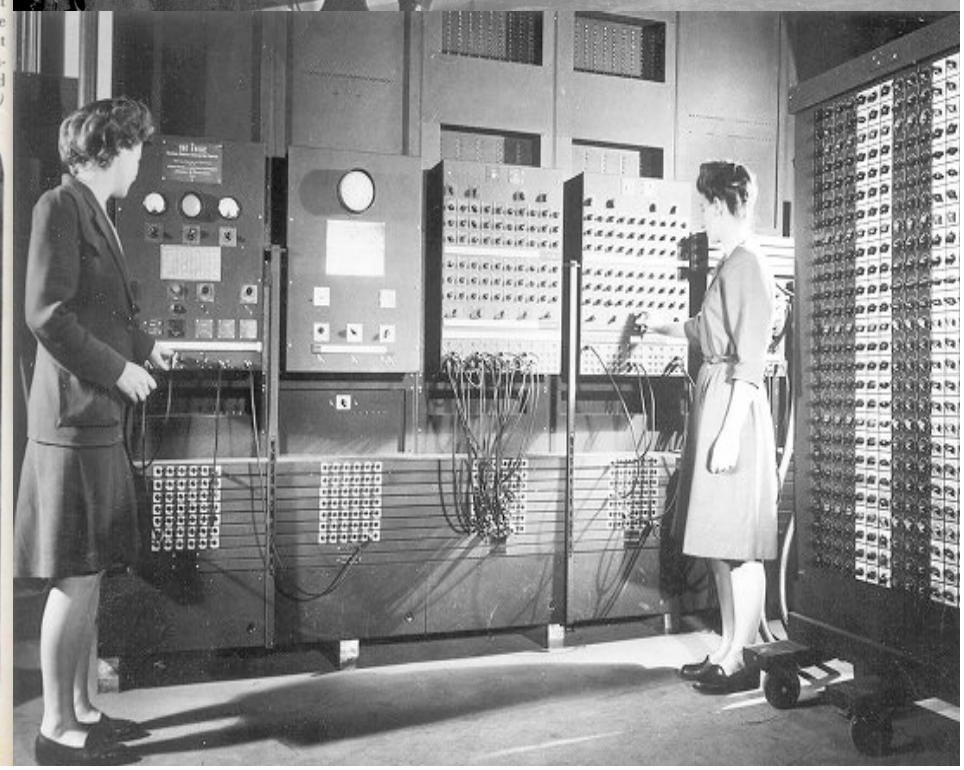
("I had this idea I'd be standing at a big machine and pressing buttons all day long," says a girl who programs for a Los Angeles bank. I couldn't have been further off the track. I figure out how the computer can solve a problem, and then instruct the machine to do it."

"It's just like planning a dinner," explains Dr. Grace Hopper, now a staff scientist in systems programming for Univac. (She helped develop the first electronic digital computer, the Eniac, in 1946.) "You have to plan ahead and schedule everything so it's ready when you need it. Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming."

What she's talking about is *aptitude*—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty thousand of them in the United *(cont. on page 54)*

Photos by Henry Grossman. Dress by Gino Charles.





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¡GRACIAS!

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