CCMC-LiU-AMNH Partnership: Bringing space weather models to planetariums

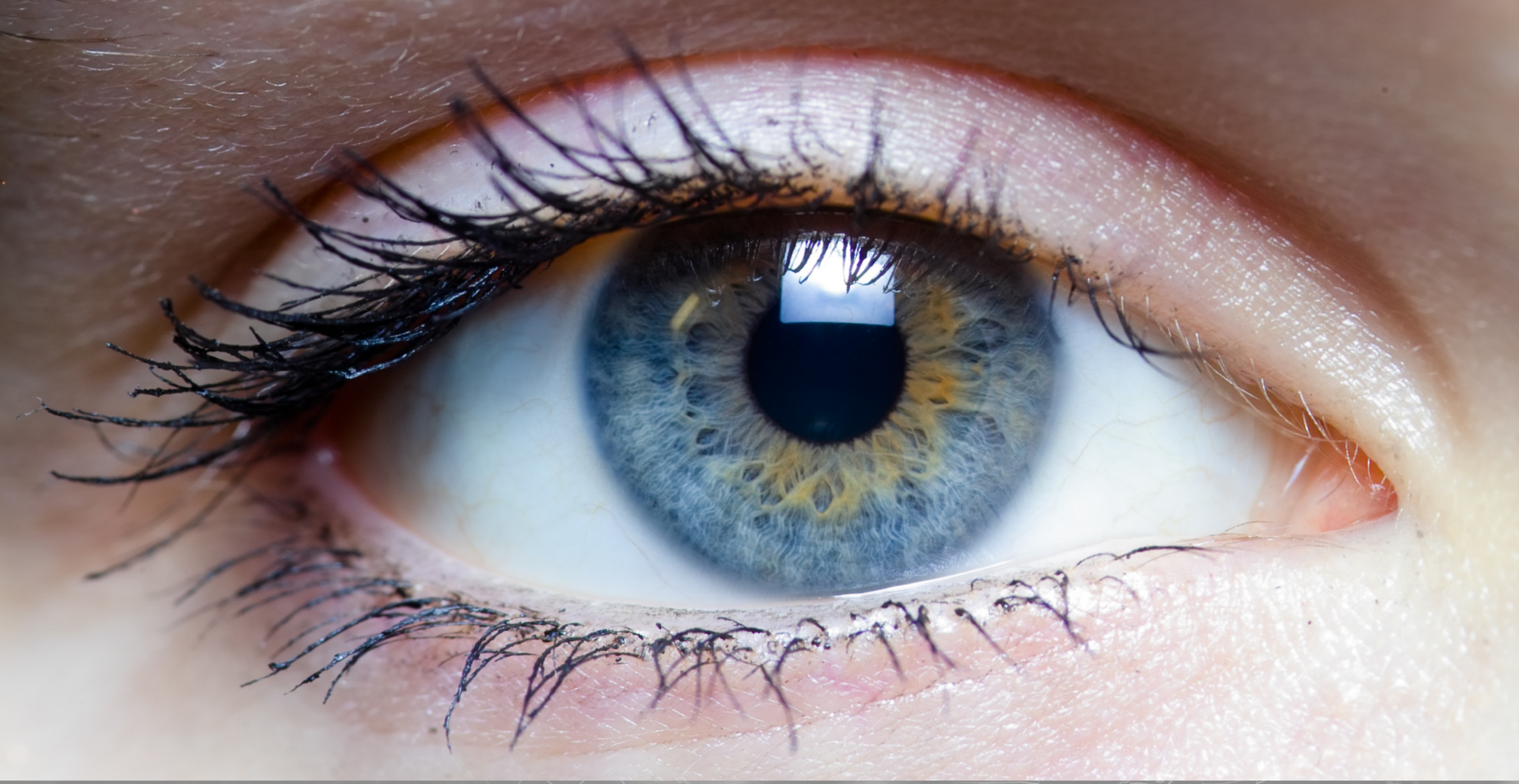
http://tinyurl.com/ccmc16-planetarium

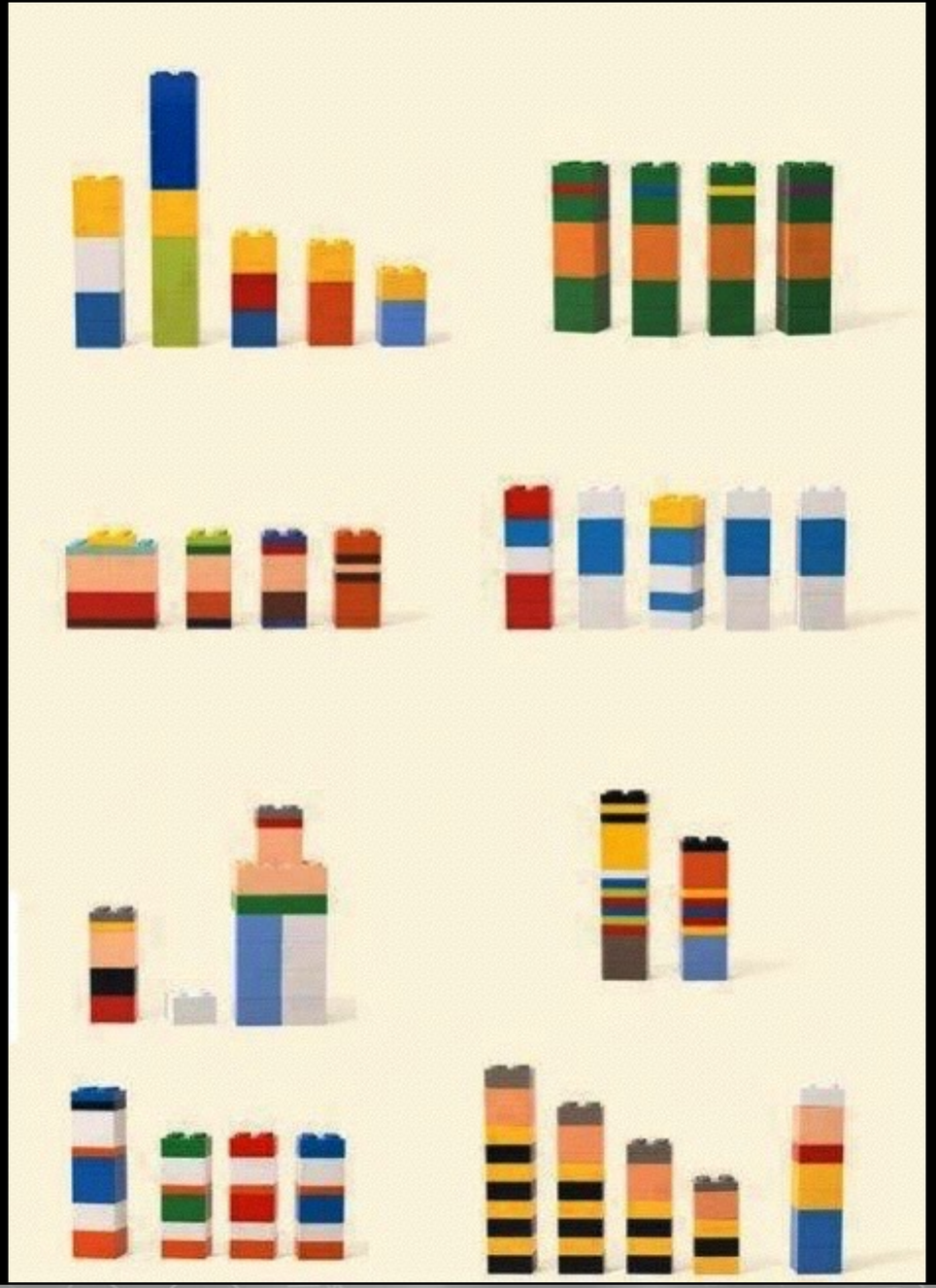
Alexander Bock
Scientific Visualization Group
Linköping University, Sweden

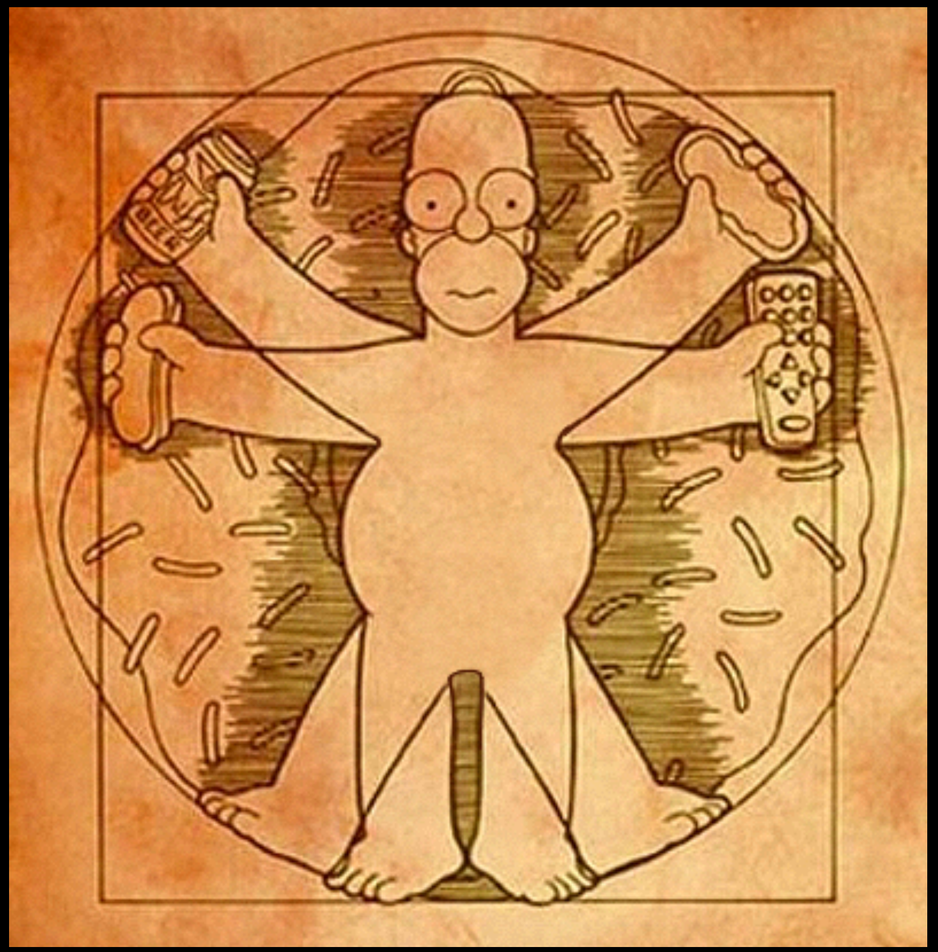
CCMC-LiU-AMNH Partnership: Bringing space weather models to planetariums

http://tinyurl.com/ccmc16-planetarium

Alexander Bock
Scientific Visualization Group
Linköping University, Sweden







vs

Bringing space weather models to planetariums

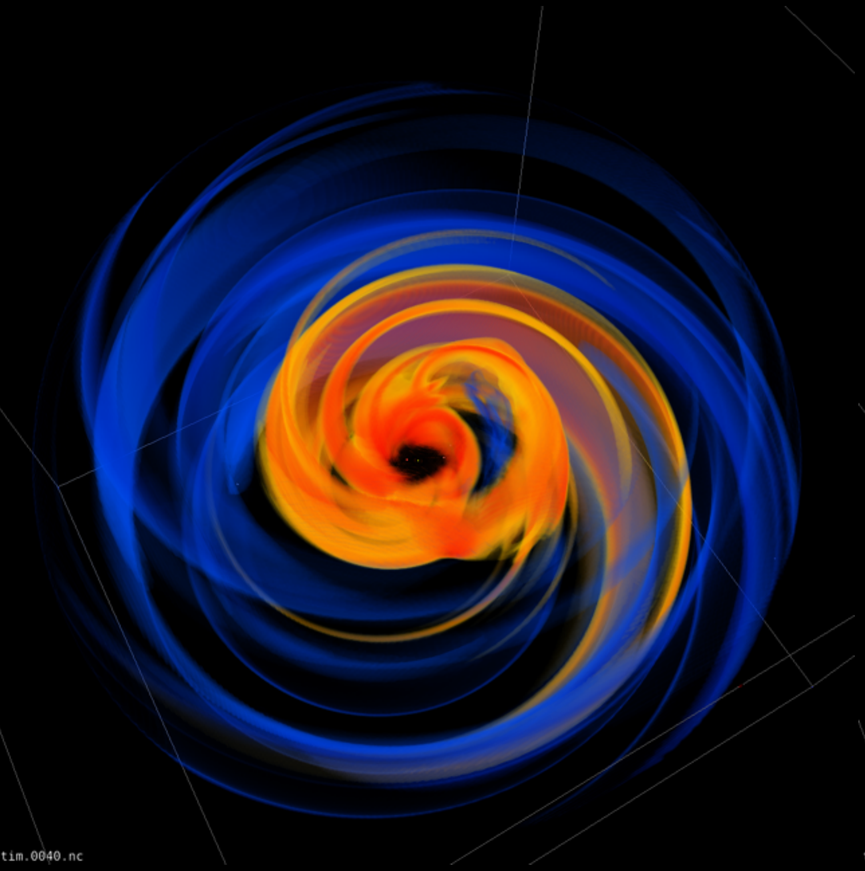
BRINGING SPACE WEATHER MODELS TO PLANETARIUMS

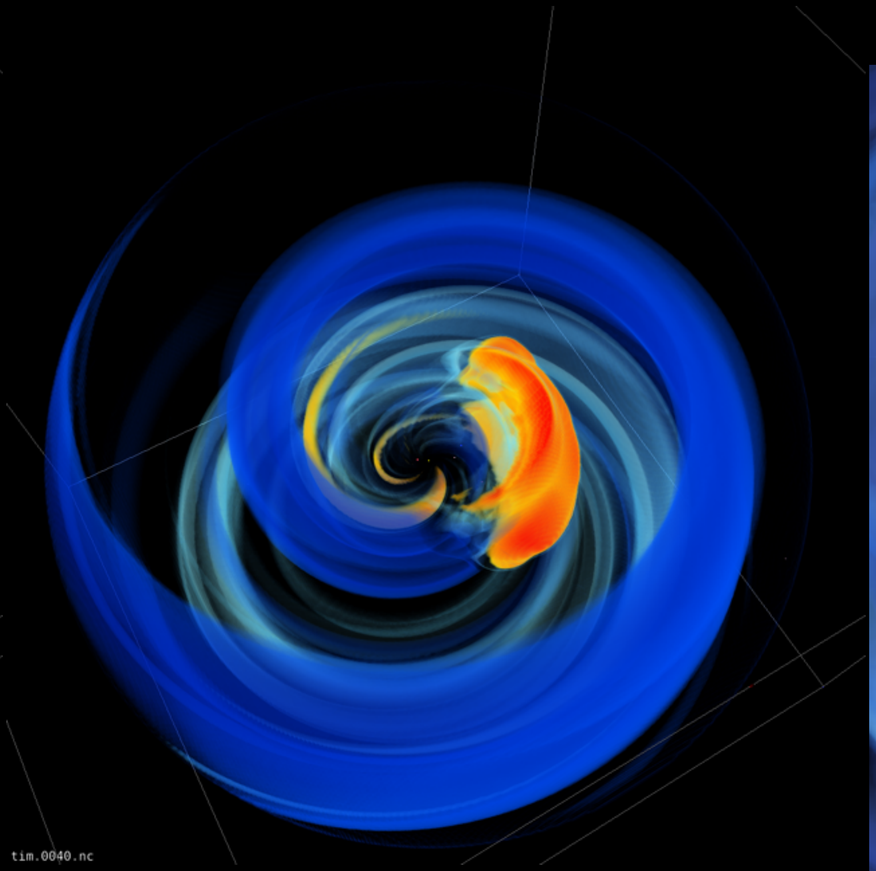
OpenSpace

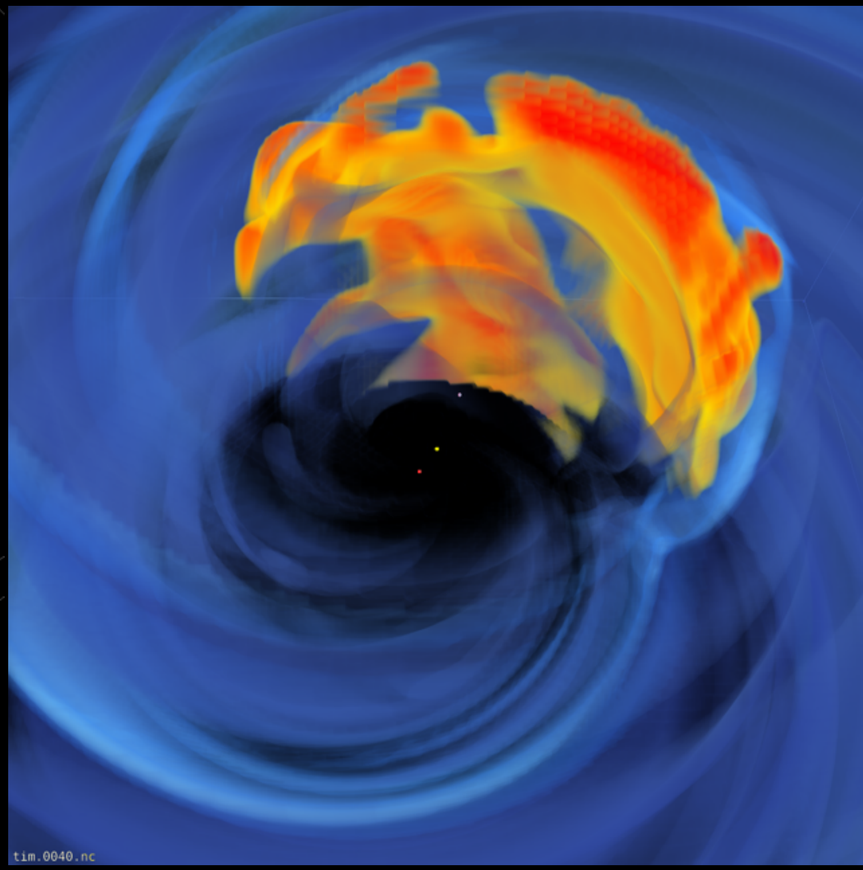




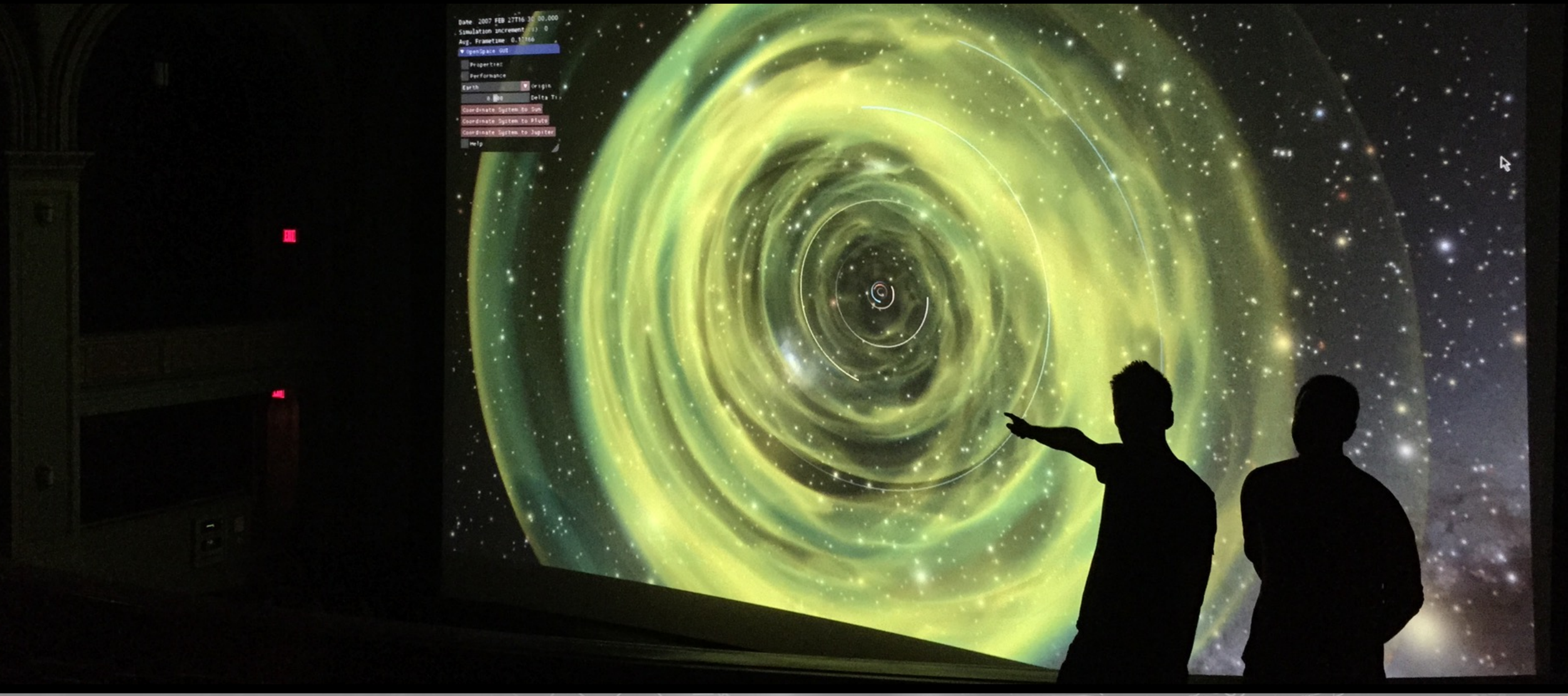




tim.0040.nc

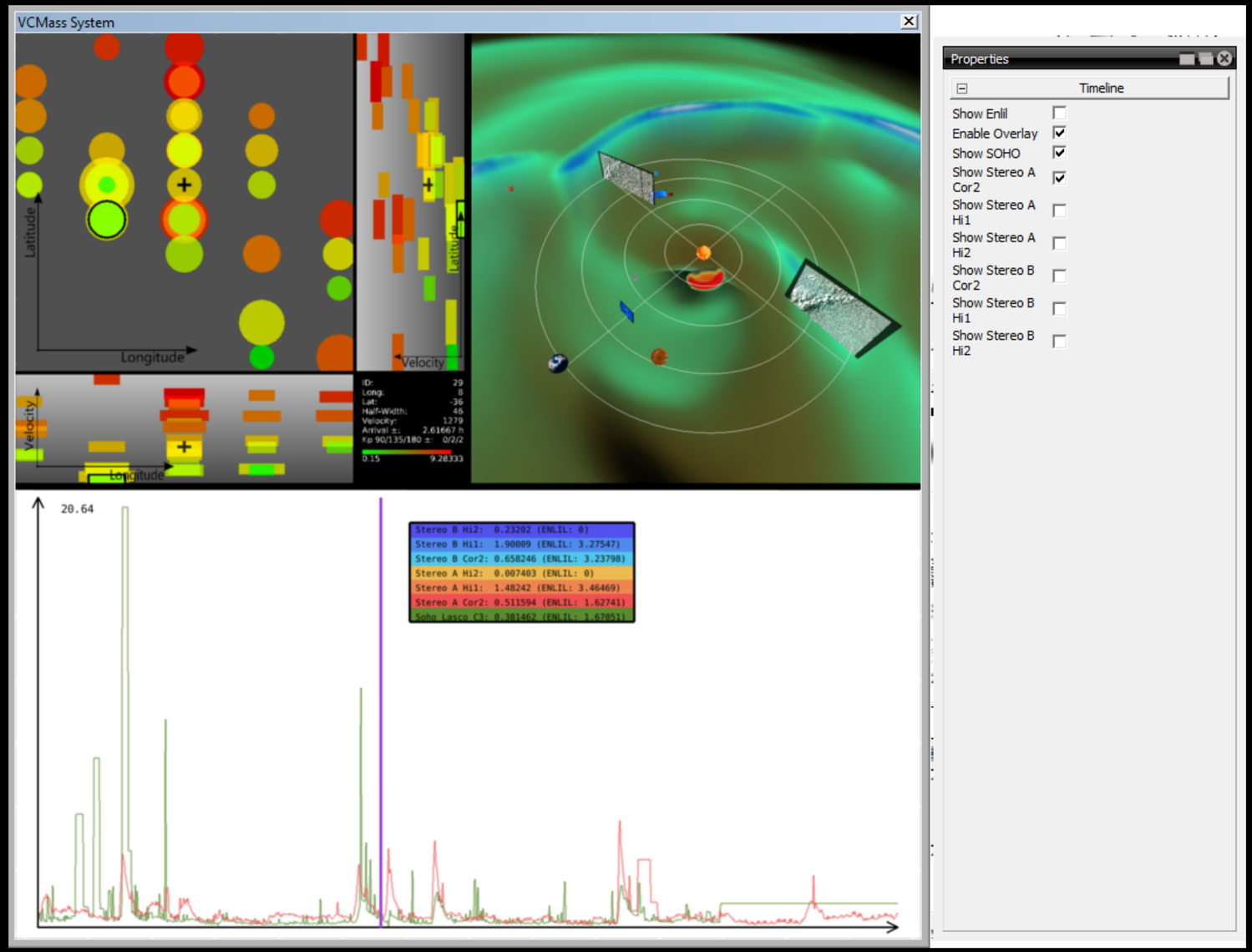

tim.0040.nc


tim.0040.nc

Time-Varying Volume Rendering



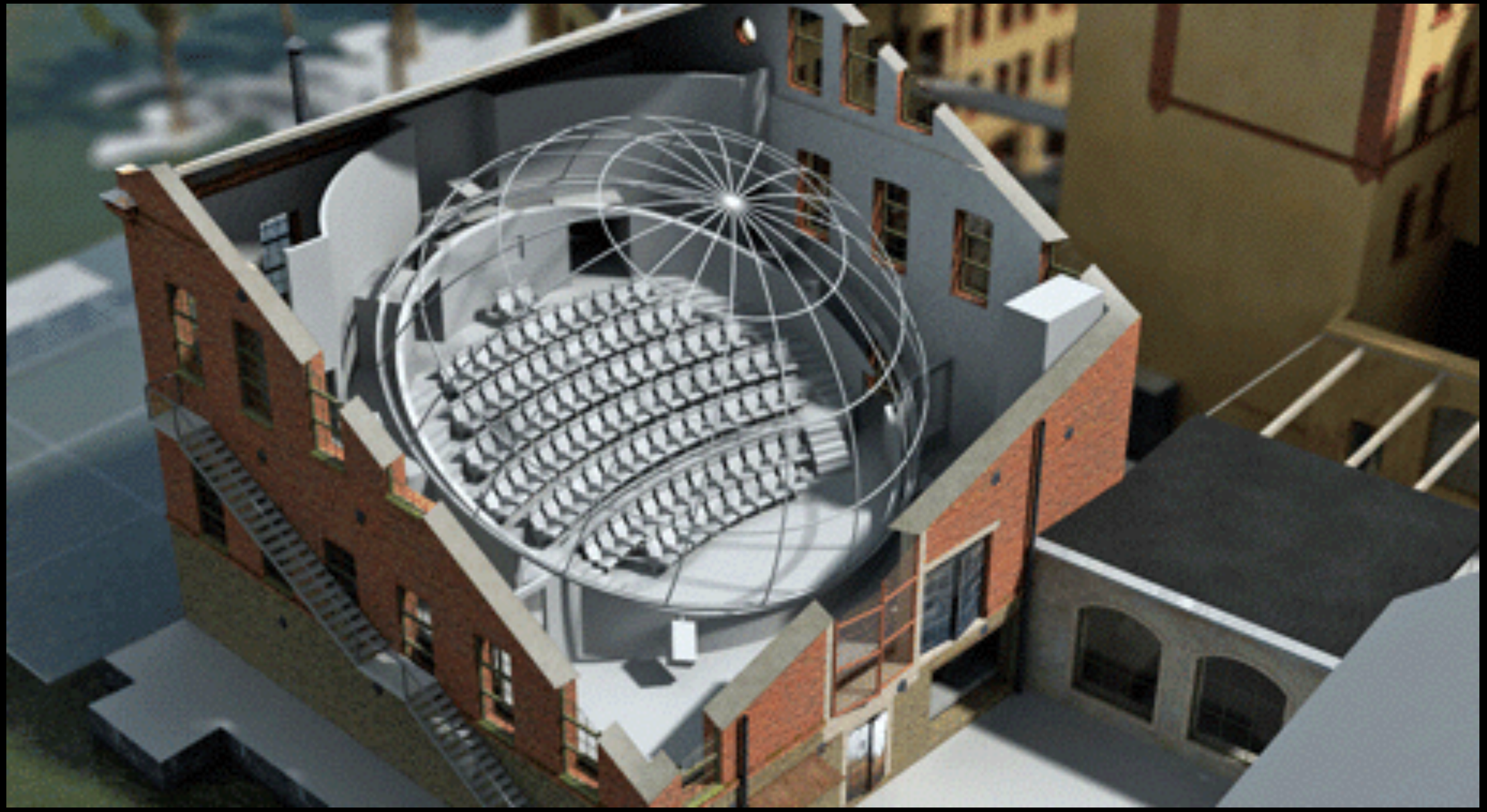
Demo



Visual Verification of Space Weather Ensemble Simulations, *Alexander Bock, Asher Pembroke, M. Leila Mays, Lutz Rastaetter, Anders Ynnerman, Timo Ropinski,* IEEE Vis 2015

Bringing space weather models to planetariums

BRINGING SPACE WEATHER MODELS TO **PLANETARIUMS**

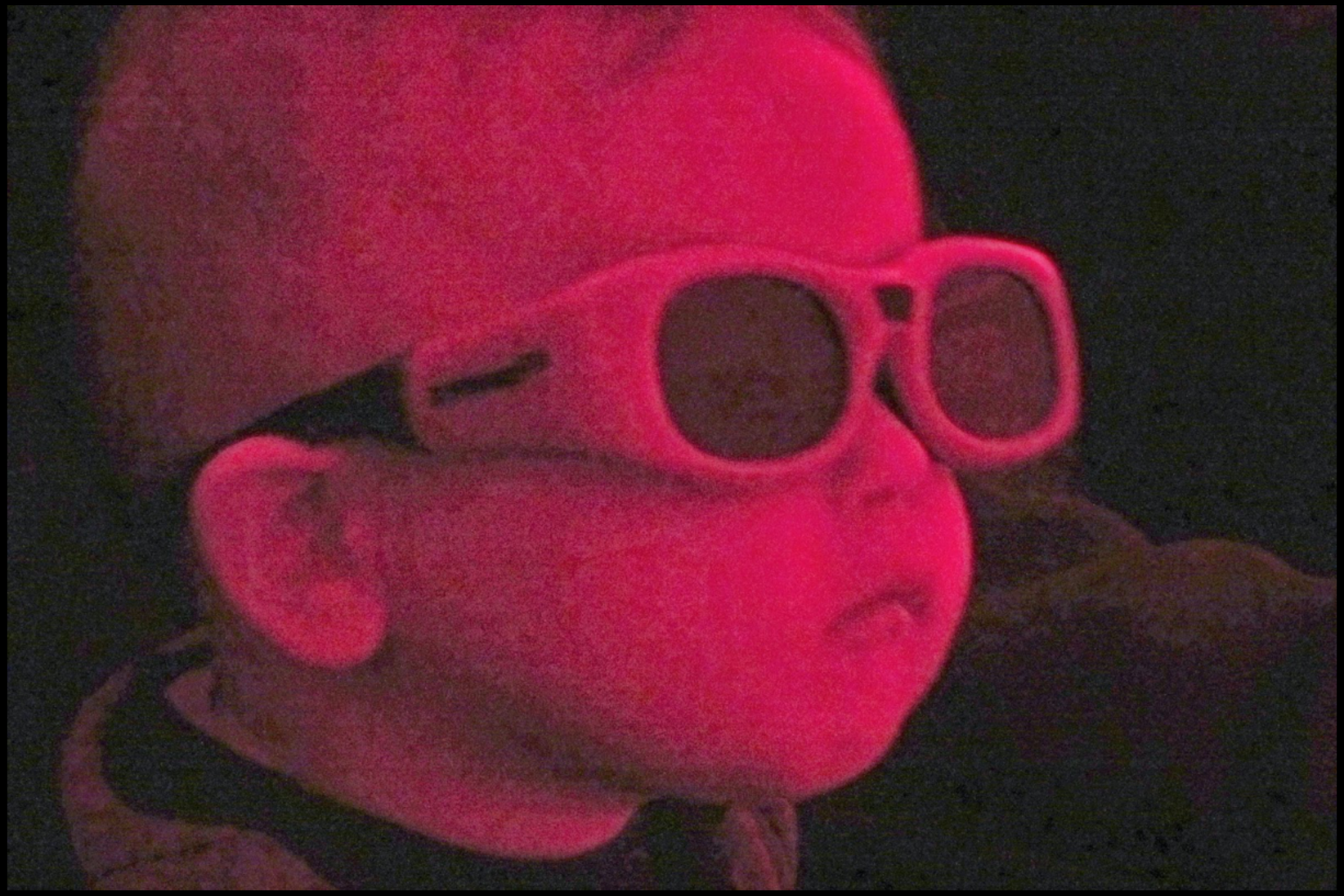



Conclusions and Outlook

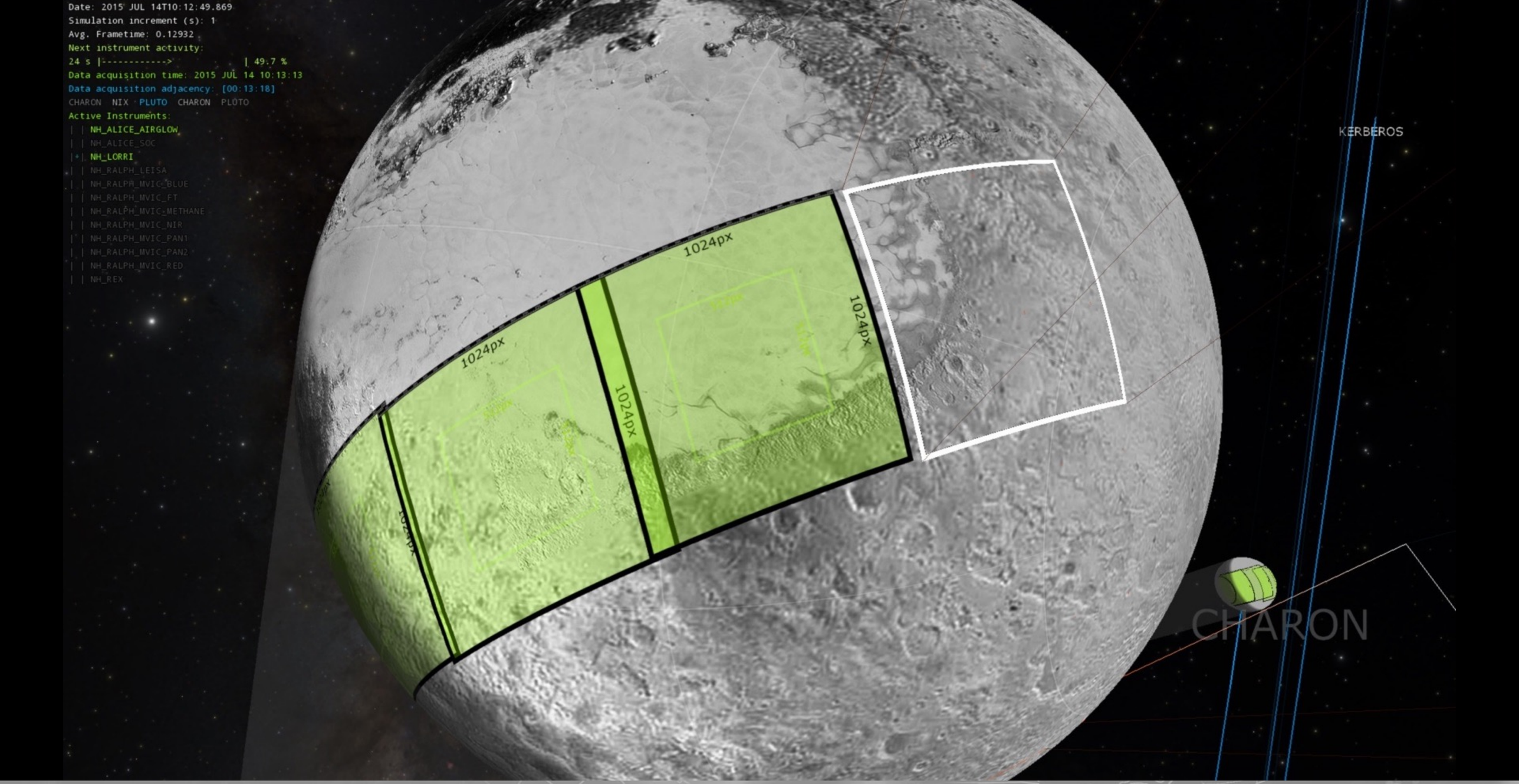
OpenSpace

- Research platform Public Dissemination Science tool

What? ⟶ How?



New Horizons

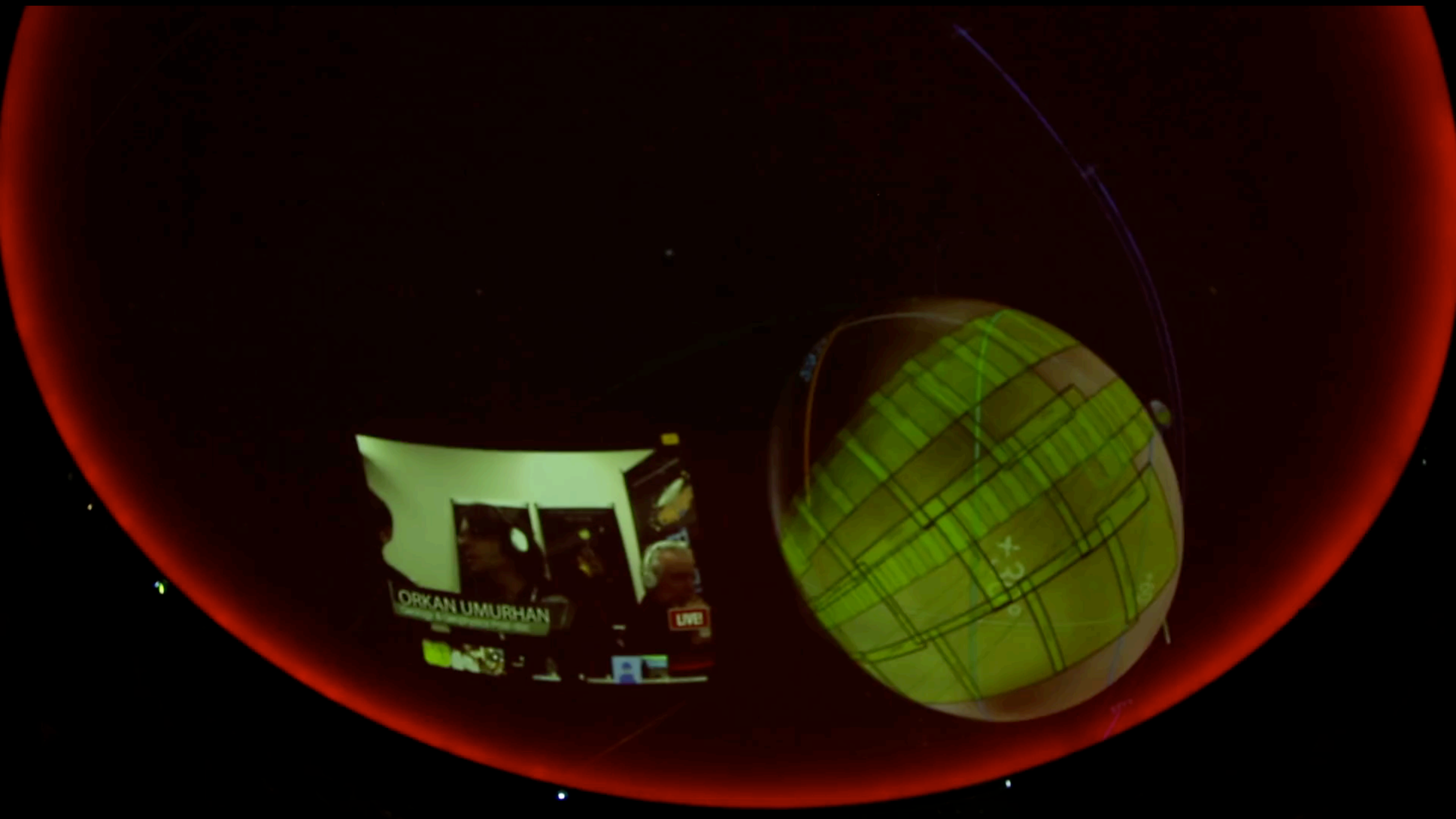

Date: 2015 JUL 14T10:12:49.869
Simulation increment (s): 1
Avg. Frametime: 0.12932
Next instrument activity:
24 s |----------> | 49.7 %
Data acquisition time: 2015 JUL 14 10:13:13
Data acquisition adjacency: [00:13:18]
CHARON NIX PLUTO CHARON PLUTO
Active Instruments:
| | NH_ALICE_AIRGLOW
| | NH_ALICE_SOC
|+| NH_LORRI
| | NH_RALPH_LEISA
| | NH_RALPH_MVIC_BLUE
| | NH_RALPH_MVIC_FT
| | NH_RALPH_MVIC_METHANE
| | NH_RALPH_MVIC_NIR
| | NH_RALPH_MVIC_PAN1
| | NH_RALPH_MVIC_PAN2
| | NH_RALPH_MVIC_RED
| | NH_REX
1024px
1024px
1024px
1024px
KERBEROS
CHARON

Pluto Fly-by, July 14th, 2015

- Norrköping, Sweden
- New York, USA
- Hamburg, Germany
- Chicago, USA
- Accra, Ghana
- Balzano, Italy
- Brisbane, Australia

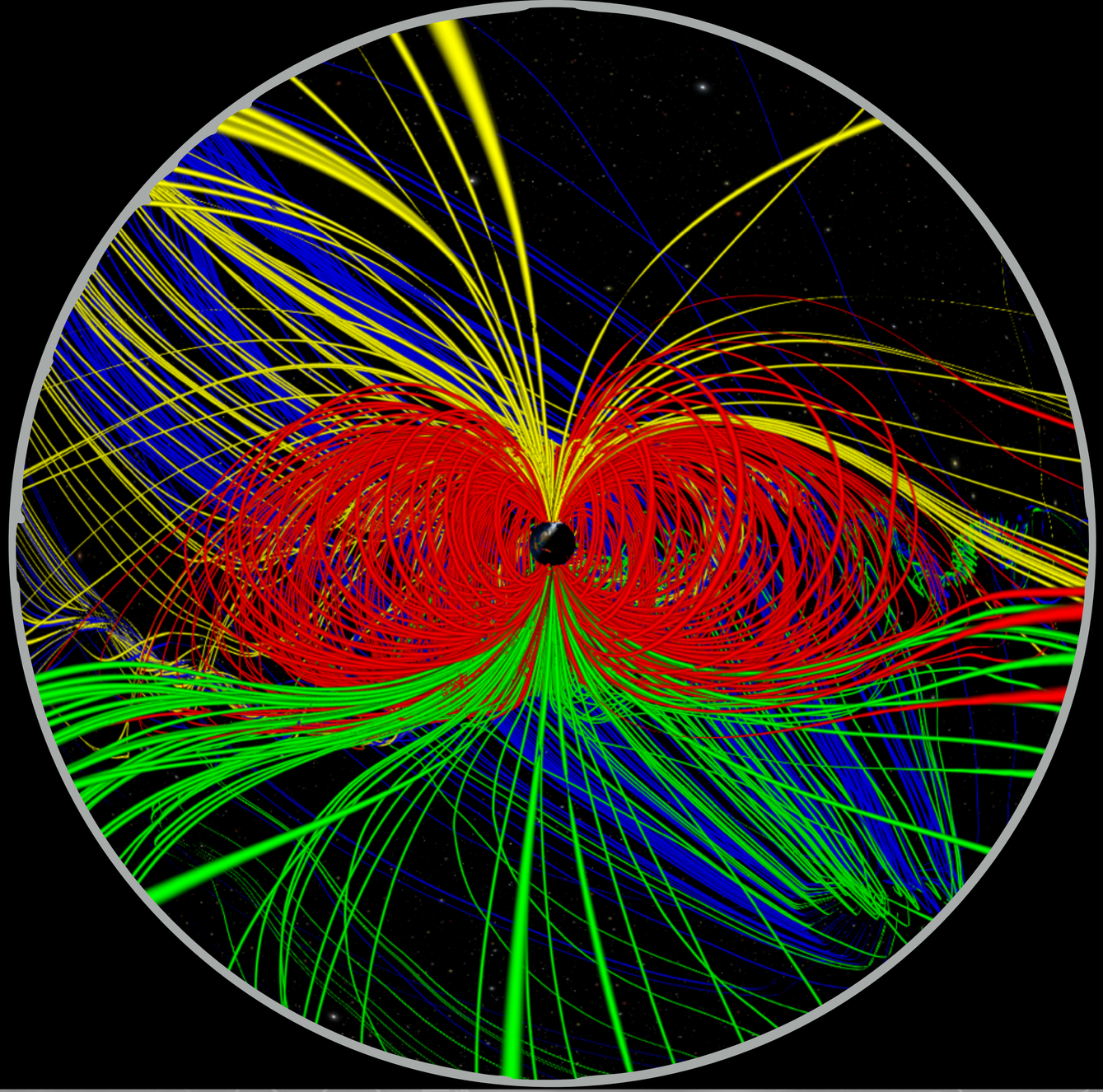
- Houston, USA
- Monmouth, USA
- Singapore
- Tokyo, Japan
- Buenos Aires, Argentina

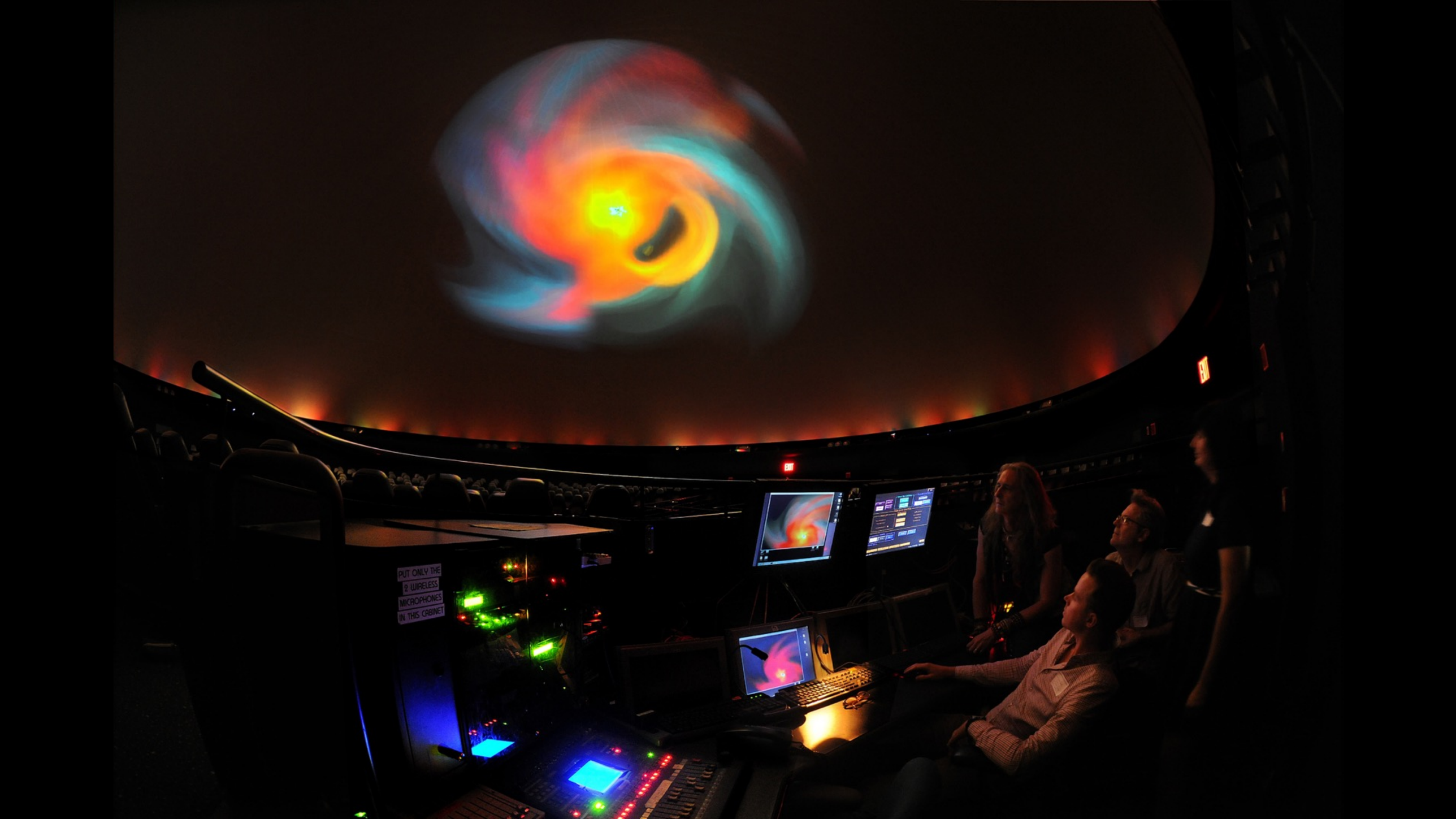
- 50000 on YouTube

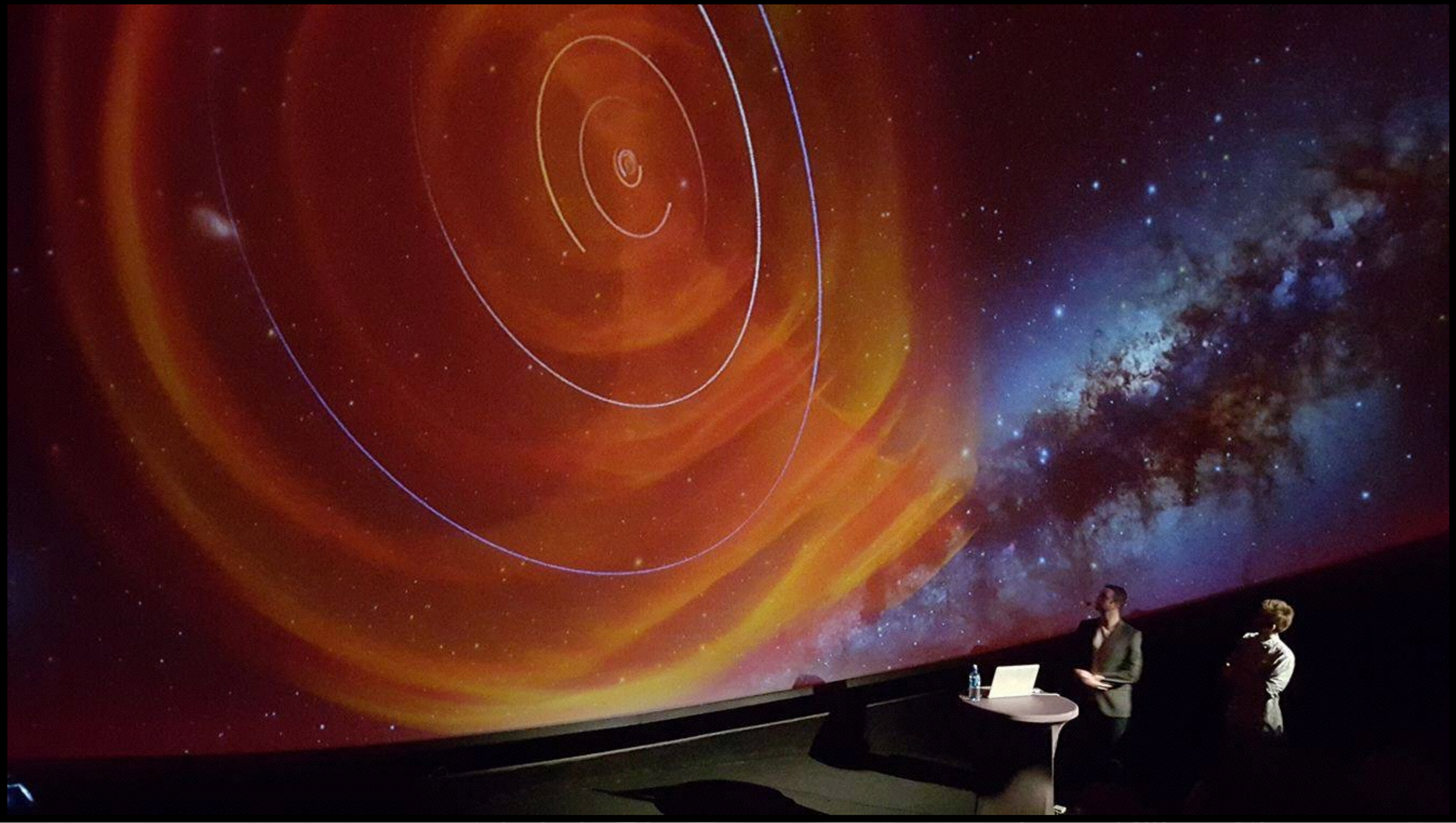

ORKAN UMURHAN
LIVE!

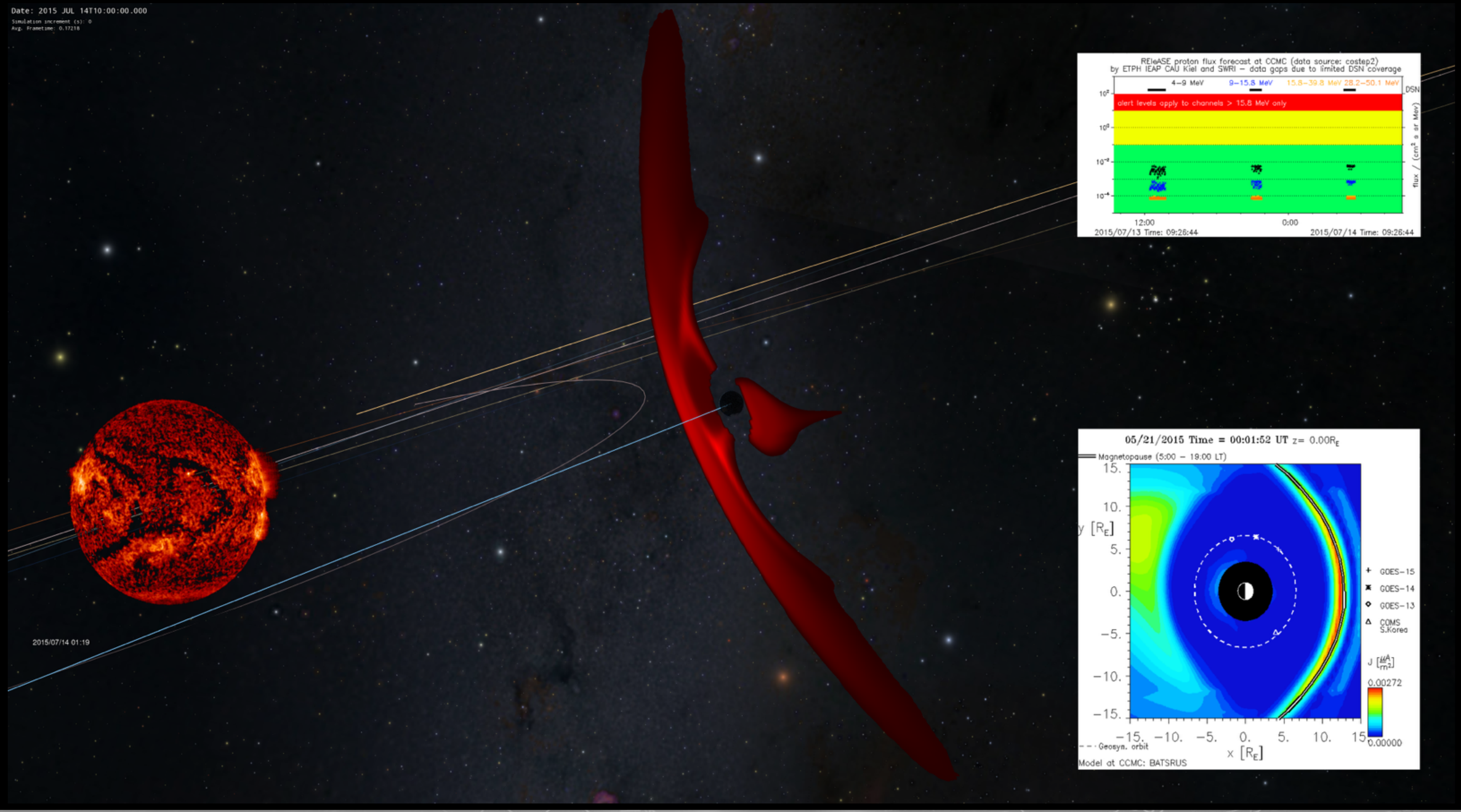
Demo

Bringing space weather models to planetariums



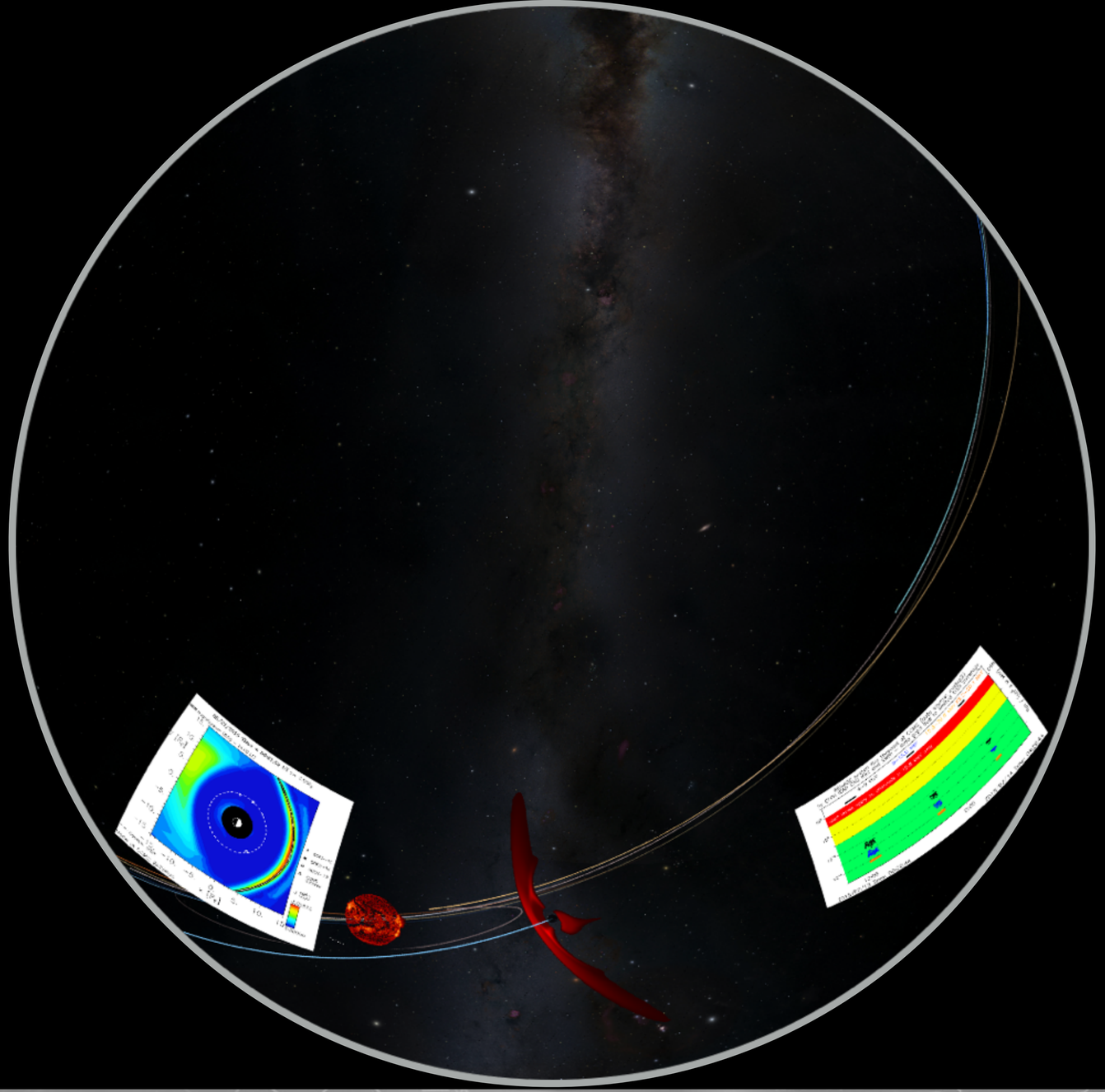

PUT ONLY THE
2 WIRELESS
MICROPHONES
IN THIS CABINET
EXIT




Date: 2015 JUL 14T10:00:00.000
Simulation increment (s): 0
Avg. Frametime: 0.17218
2015/07/14 01:19

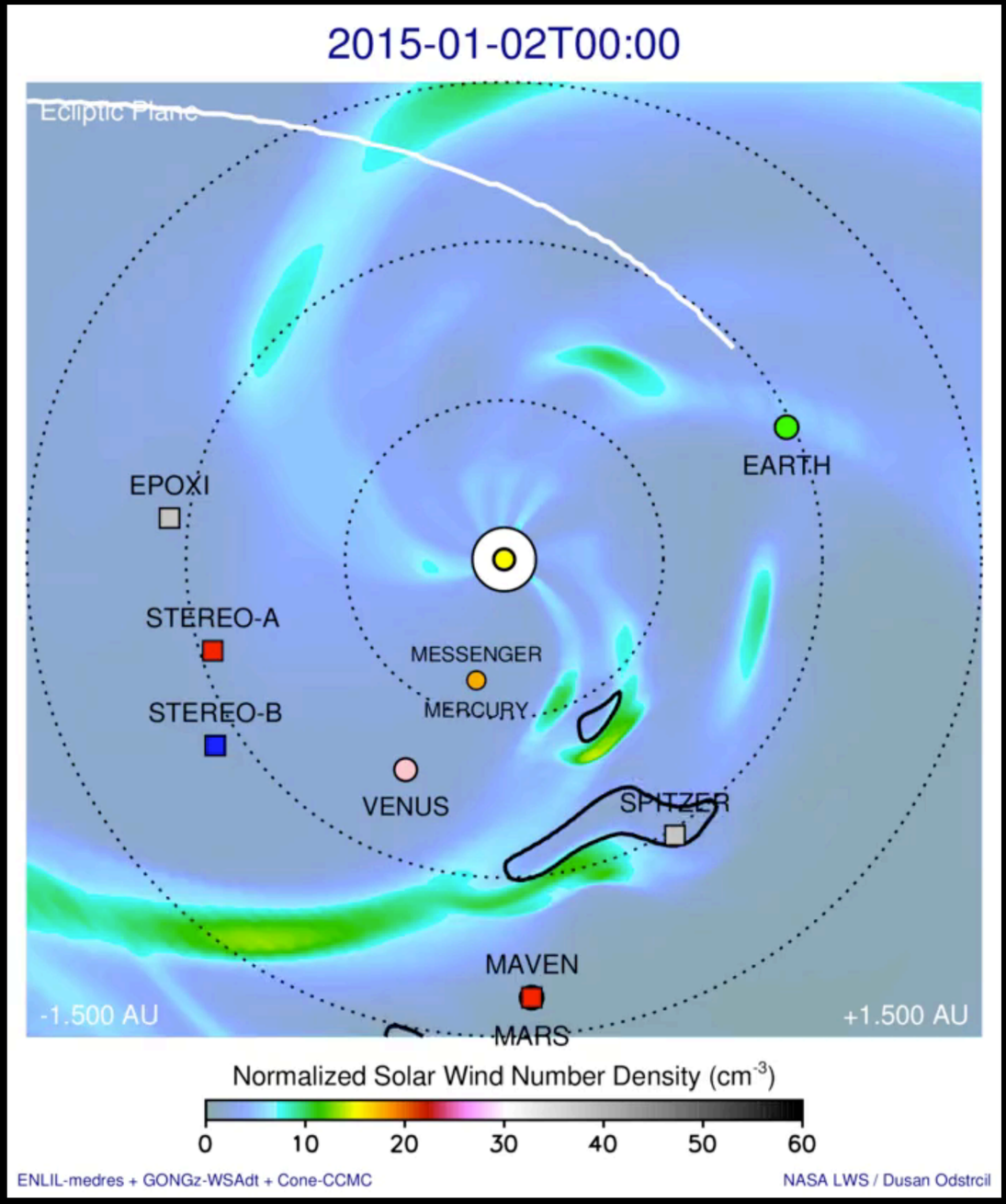
REleASE proton flux forecast at CCMC (data source: costep2)
by ETPH IEAP CAU Kiel and SWRI – data gaps due to limited DSN coverage
4–9 MeV
9–15.8 MeV
15.8–39.8 MeV
28.2–50.1 MeV
DSN
alert levels apply to channels > 15.8 MeV only
flux / (cm² s sr MeV)
12:00
0:00
2015/07/13 Time: 09:26:44
2015/07/14 Time: 09:26:44

05/21/2015 Time = 00:01:52 UT z= 0.00R_E
Magnetopause (5:00 – 19:00 LT)
y [R_E]
x [R_E]
GOES-15
GOES-14
GOES-13
COMS S.Korea
J [μA/m²]
0.00272
0.00000
Geosyn. orbit
Model at CCMC: BATSRUS



New Horizons Challenge

- ENLIL
- Detailed models around Pluto
- Visualization of SWAP



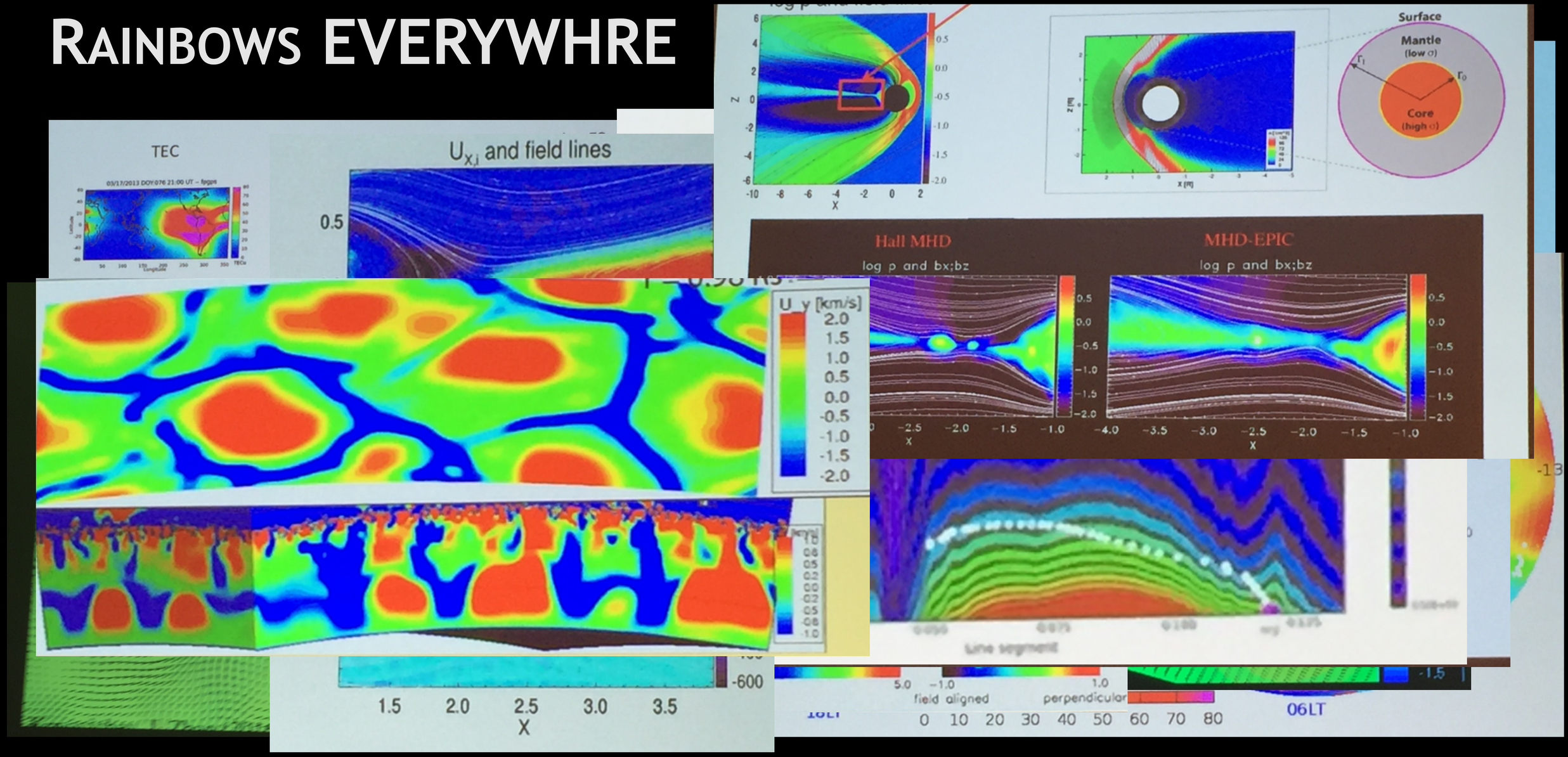
Visualization Corner

Rainbow Color Maps

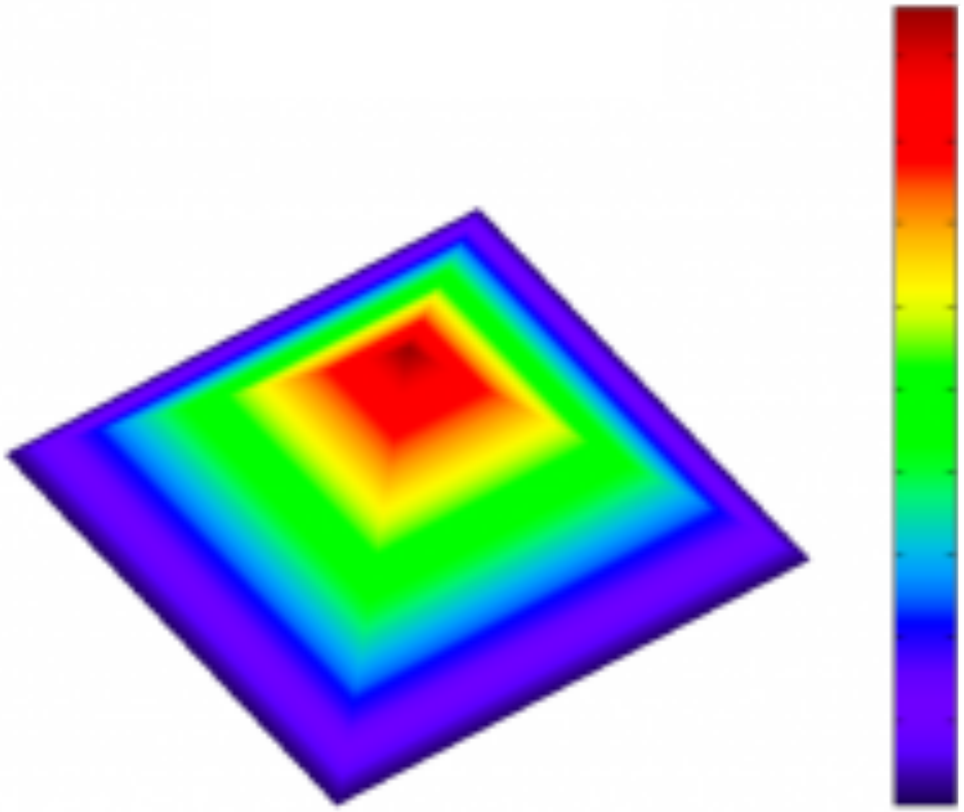
Rainbow Color Maps

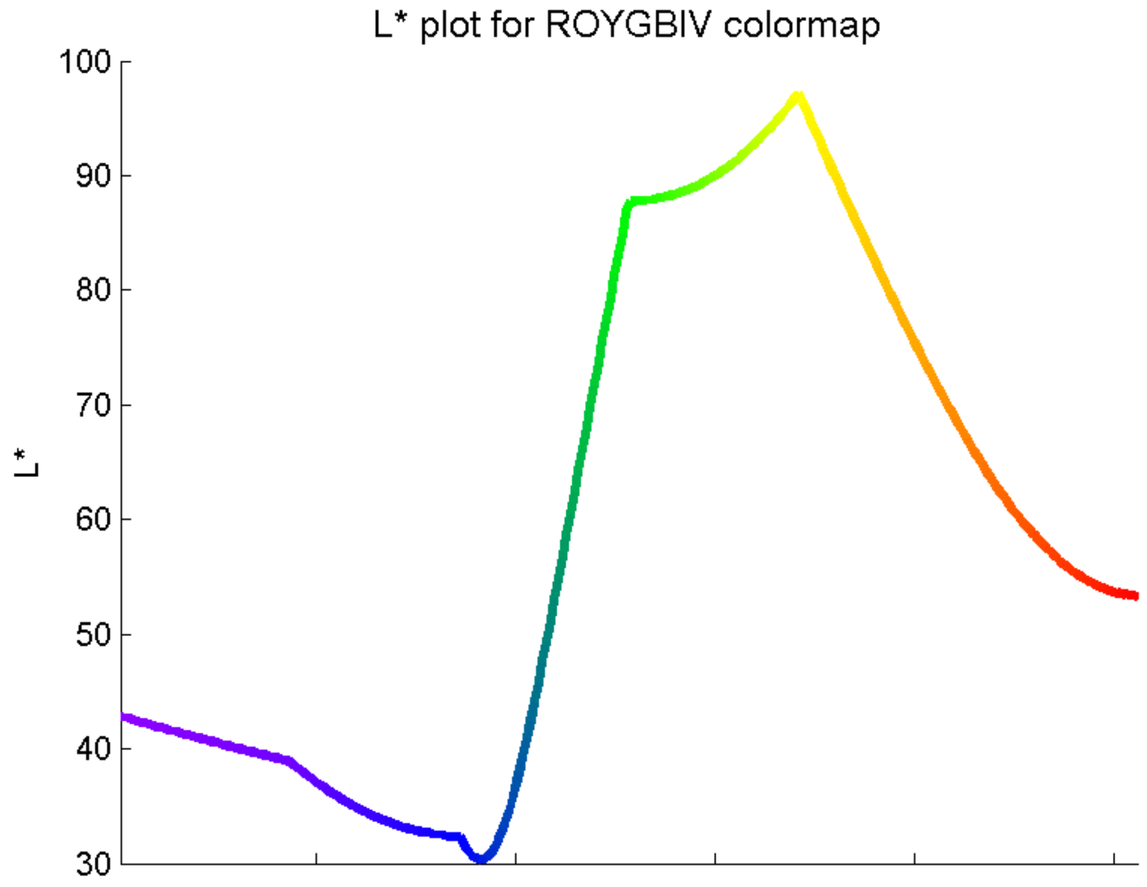
- Coline Ware, “Color sequences for univariate maps: Theory, experiments and principles”, IEEE Computer Graphics and Applications, 1988.
- B. E. Rogowitz, L. A. Treinish, and S. Bryson, “How not to lie with visualization,” Computers in Physics, vol. 10, no. 3, pp. 268–273, 1996.
- D. Borland and R. M. Taylor, “Rainbow Color Map (Still) Considered Harmful,” IEEE Computer Graphics and Applications, vol. 27, no. 2, pp. 14-17, Apr. 2007.
- http://mycarta.wordpress.com/2012/05/12/the-rainbow-is-dead-long-live-the-rainbow

RAINBOWS EVERYWHRE

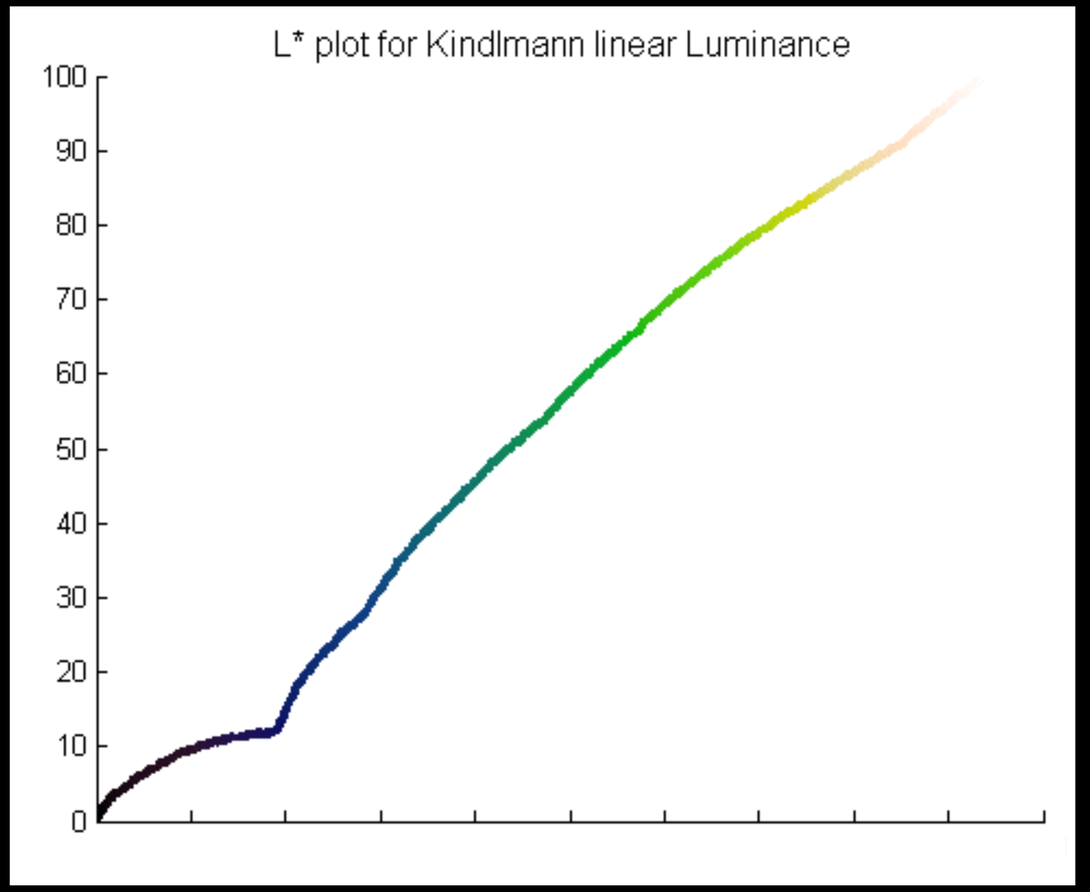


Rainbow Color Maps





A Better Alternative



Kindlmann, G. Reinhard, E. and Creem, S., 2002, Face-based Luminance Matching for Perceptual Colormap Generation, IEEE – Proceedings of the conference on Visualization ’02

A Better Alternative

- Matplotlib
  - Viridis 
  - http://matplotlib.org/style_changes.html
- Matlab
  - Parula 
  - http://blogs.mathworks.com/steve/2014/10/13/a-new-colormap-for-matlab-part-1-introduction/
- Anything else

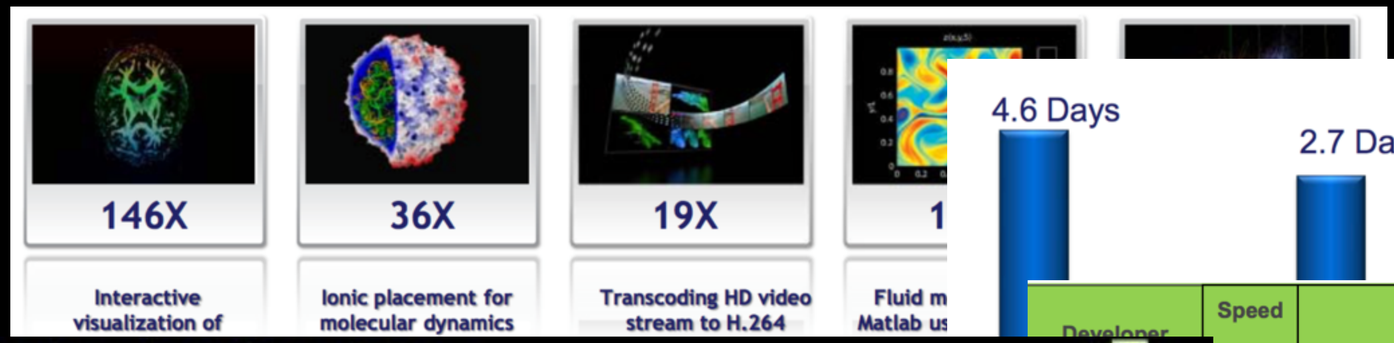
GPGPU PROGRAMMING

Pleiades

- 2008: 487 teraflops
- 2016: 4 petaflops

Graphics Cards

- 2008: GeForce 280
  - 240 cores
  - 933 gigaflops [0.2% of 2008 Pleiades]
- 2013: GeForce Titan
  - 2688 cores
  - 4.5 teraflops [1% of 2008 Pleiades]
- 2014: GeForce Titan X
  - 3072 cores
  - 7 teraflops [1.5% of 2008 Pleiades]
- Q3 2016: GeForce 1080
  - 3840 cores
  - 12 teraflops [2.4% of 2008 Pleiades]



Bioinformatics Applications

NVIDIA

Application	Features Supported	GPU Speedup	Release Status	Website
BarraCUDA	Alignment of short sequencing reads	6-10x	Version 0.6.2 - 3/2012 Multi-GPU, multi-node	http://seqbarracuda.sourceforge.net/
CUDASW++	Parallel search of Smith-Waterman database	10-50x	Version 2.0.8 - Q1/2012 Multi-GPU, multi-node	http://sourceforge.net/projects/cudasw/
CUSHAW	Parallel, accurate long read aligner for large genomes	10x	Version 1.0.40 - 6/2012 Multiple-GPU	http://cushaw.sourceforge.net/
GPU-BLAST	Protein alignment according to BLASTP	3-4x	Version 2.2.26 - 3/2012 Single GPU	http://eudoxus.cheme.cmu.edu/gpublast/gpublast.html
GPU-HMMER	Parallel local and global search of Hidden Markov Models	60-100x	Version 2.3.2 - Q1/2012 Multi-GPU, multi-node	http://www.mpihmmer.org/installguideGPUHMMER.htm
mCUDA-MEME	Scalable motif discovery algorithm based on MEME	4-10x	Version 3.0.12 Multi-GPU, multi-node	https://sites.google.com/site/yongchaosoftware/mcuda-meme
SeqNFind	Hardware and software for reference assembly, blast, SW, HMM, de novo assembly	400x	Released. Multi-GPU, multi-node	http://www.seqnfind.com/
UGENE	Fast short read alignment	6-8x	Version 1.11 - 5/2012 Multi-GPU, multi-node	http://ugene.unipro.ru/
	Parallel linear regression on		Version 0.1-1 - 3/2012	

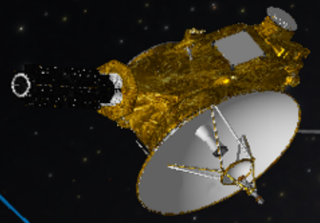
GPU Perf compared against same or similar code running on single CPU machine
Performance measured internally or independently

Developer	Speed Up	Reference
	300x	http://www.opticsinfobase.org/oe/abstract.cfm?uri=oe-17-22-20178
	160x	http://cyberaide.googlecode.com/svn/trunk/papers/08-cuda-biostat/vonLaszewski-08-cuda-biostat.pdf
	150x	http://arxiv.org/PS_cache/arxiv/pdf/0709/0709.3225v1.pdf
	130x	http://www.springerlink.com/content/u1704254764133t5/?p=c5eead9af73340e58a313d95581cfd40&pi=49
	130x	http://ic.ese.upenn.edu/abstracts/spice_fpl2009.html
	130x	http://www.opticsinfobase.org/abstract.cfm?URI=oe-17-25-23147

OpenSpace

http://openspace.itn.liu.se

http://tinyurl.com/ccmc16-planetarium



PLUTO

STYX

Linköping University
expanding reality

Community Coordinated Modeling Center

American Museum of Natural History

Norrköping Visualization Center

CRESEARCH