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arXiv Sustainability Planning Initiative

Oya Y. Rieger
Cornell University Library

High Energy Physics Advisory Panel Meeting,
Washington, DC
November 2010

8 million volumes in print, over 360,000 e-books and about 88,000 print and electronic journals and other serials;
20,000 students and 1,600 faculty

"a university where any person can find instruction in any study"

arXiv.org

Universal properties in galaxies and cored DM profiles

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1 Abstract

In this paper I report the highlights of the talk: "Universal properties in galaxies and cored DM profiles", given at: Colloquium Lectures, Ecole Internationale d'Astrophysique Daniel Chalonge. The 14th Paris Cosmology Colloquium 2010 "The Standard Model of the Universe: Theory and Observations".

2 Highlights

The presence of large amounts of unseen matter in galaxies, distributed differently from stars and gas, is well established from rotation curves (RCs) which do not show the expected Keplerian fall-off at large radii (Rubin *et al.* 1980), but increase, remain flat or start to gently decrease according to a well organized pattern that involves an invisible mass component becoming progressively more abundant at outer radii and in the less luminous galaxies (Persic, Salucci & Stel 1996).

In Spirals we have the best opportunity to study the mass distribution: the gravitational potentials of a spherical stellar bulge, a dark halo, a stellar disk and a gaseous disk give rise to an observed equilibrium circular velocity

$$V^2_{tot}(r) = r\frac{d}{dr}\phi_{tot} = V^2_b + V^2_{DM} + V^2_* + V^2_{HI}.$$

The Poisson equation relates the surface (spatial) densities of these components to the corresponding gravitational potentials. The investigation is not difficult: e.g. $\Sigma_*(r)$, the surface stellar density, is proportional (by the mass-to-light ratio) to the observed surface brightness:

$$\Sigma_*(r) = \frac{M_D}{2\pi R_D^2}\, e^{-r/R_D}$$

and then

$$V^2_*(r) = \frac{GM_D}{2R_D} x^2 B\left(\frac{x}{2}\right),$$

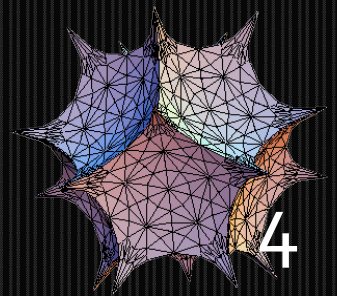
where M_D is the disk mass, R_D the disk length-scale and $B(x)$ a combination of Bessel functions.

Dark and luminous matter in spirals are coupled: at any galactocentric radii R_n measured in terms of disk length-scale $R_n = (n/5)\ R_{opt}\ (R_{opt} = 3.2R_D)$, there is a *Radial* Tully-Fisher relation (Yegorova & Salucci 2007), i.e. a relation between the local rotation velocity $V(R_n)$ and the total galaxy luminosity: $M_{band} = a_n \log V_n + b_n$. Spirals present universal features in their kinematics that correlate with their global galactic properties (PSS and Salucci *et al.* 2007).

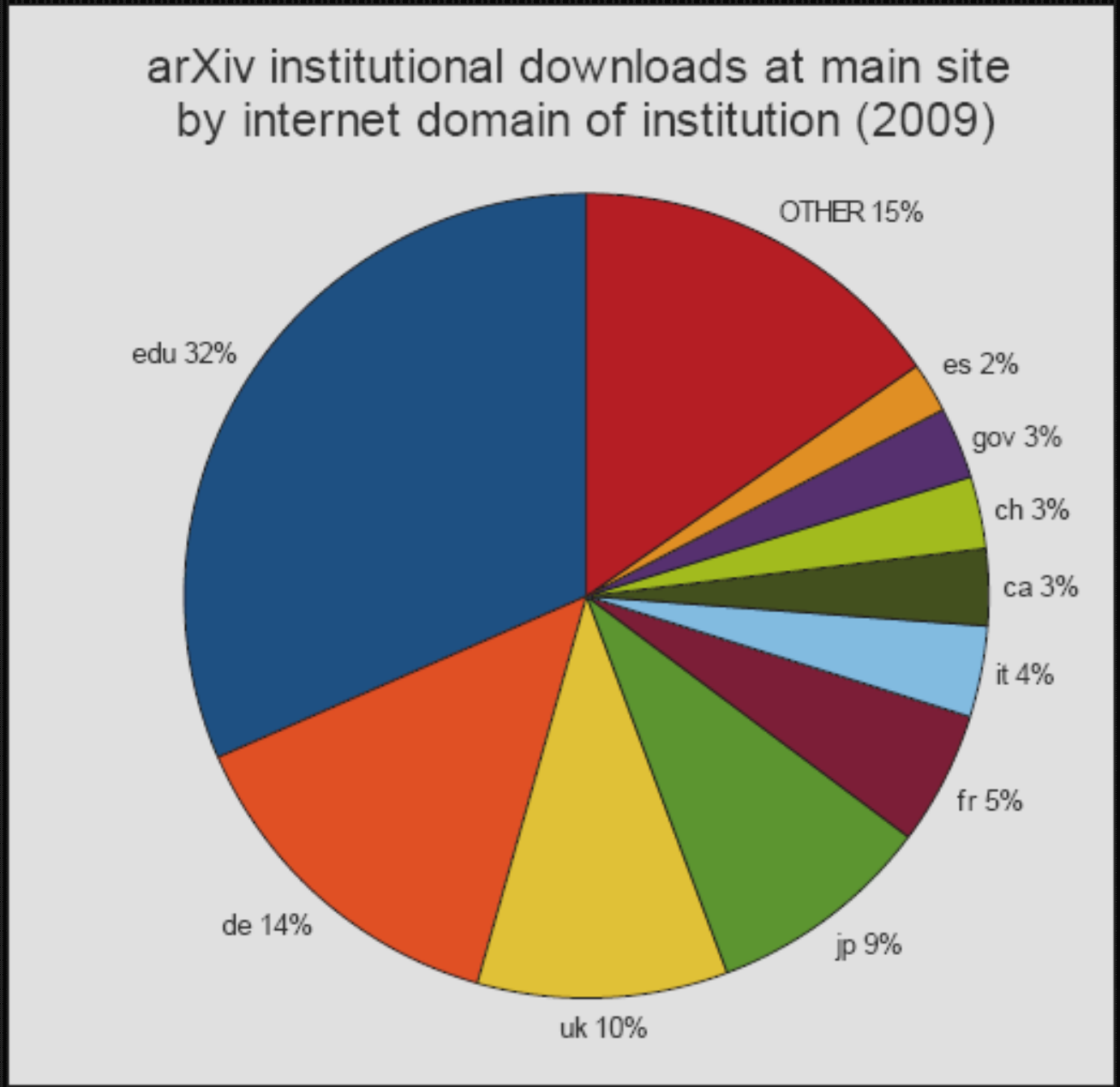
This led to the discovery, from 3200 individual RCs, of the "Universal Rotation Curve" of Spirals $V_{URC}(r; L)$ (see PSS and Fig. 1), i.e. a function of galactocentric radius r, that, tuned by a global galaxy property (e.g. the luminosity), well reproduces, out to the virial radius (Shankar *et al.* 2006), the RC of any spiral (Salucci *et al.* 2007). V_{URC} is the observational counterpart to which the circular velocity profile emerging in cosmological simulations must comply (link to www.youtube.com/user/dvdfilm#p/a/u/1/YegafVb-WJI for a 3-D visualization of the URC).

In the same way of individual RCs, it underlies a mass model that includes a Freeman disk and a DM

- established in 1991 by Paul Ginsparg as a pre-print archive
- has been hosted at Cornell since 2001



- Broad international use



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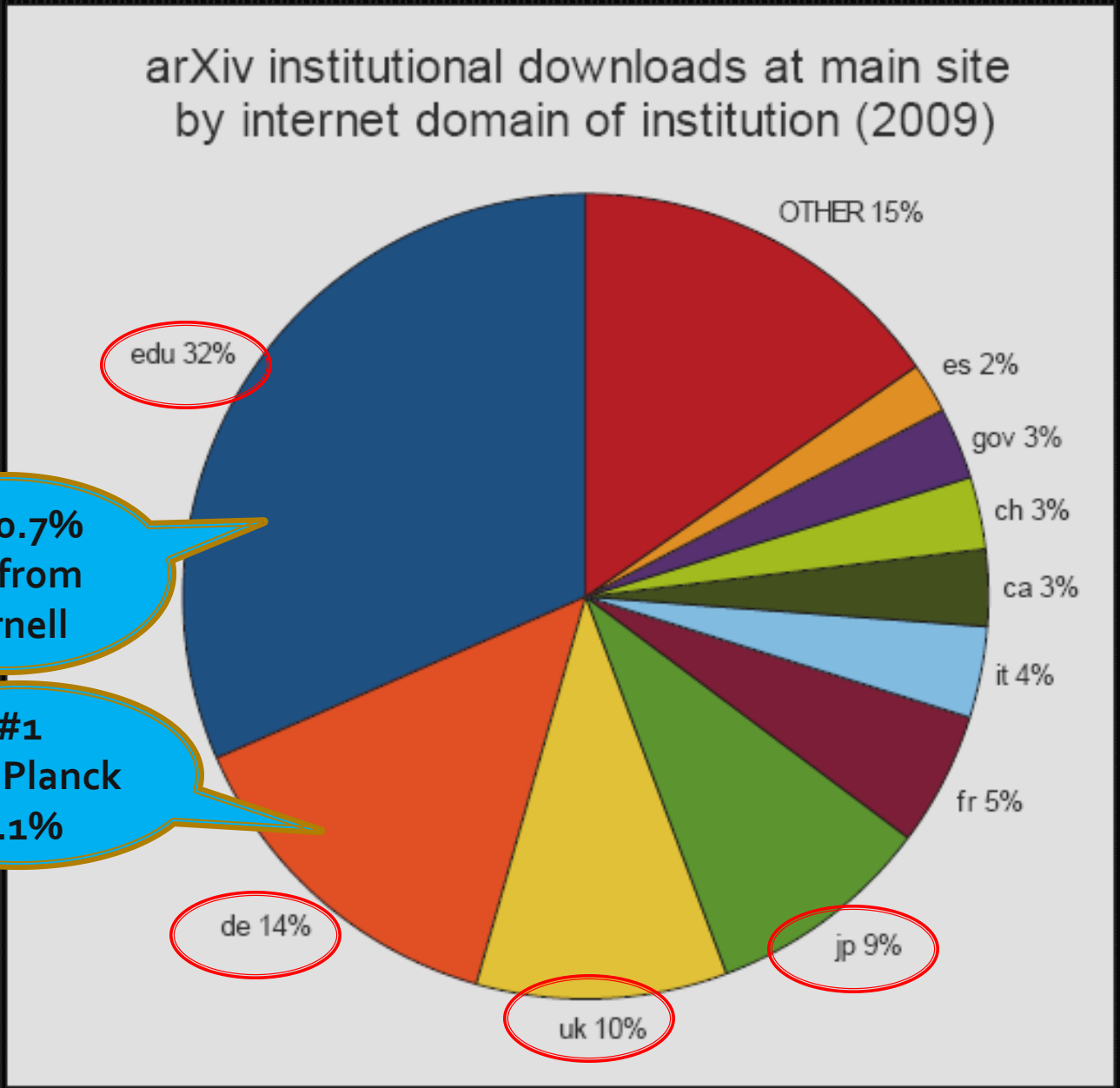
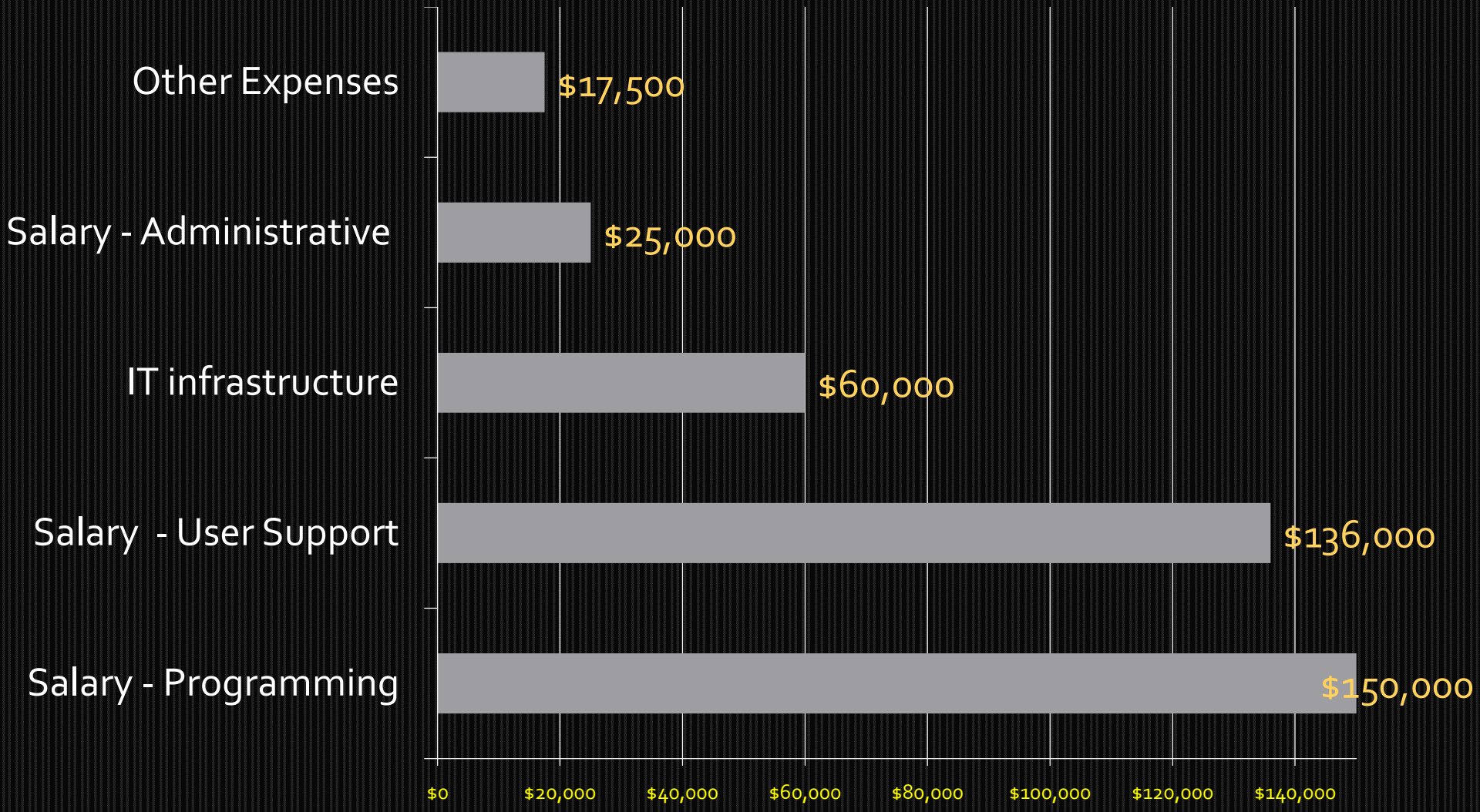


CY 2010 Budget








sustainability *is the ability to secure resources needed to protect and enhance the value of a service based on the needs of the user community*

- *cover operation costs through a combination of revenue sources and cost-management strategies*

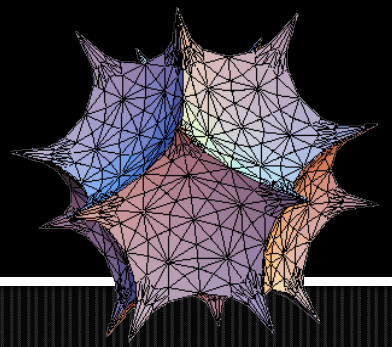
- *enhance value based on the needs of the user community*

Source: *Sustainability and Revenue Models for Online Academic Resources. An Ithaka Report. 2008*

Business Planning Process 2009-2010

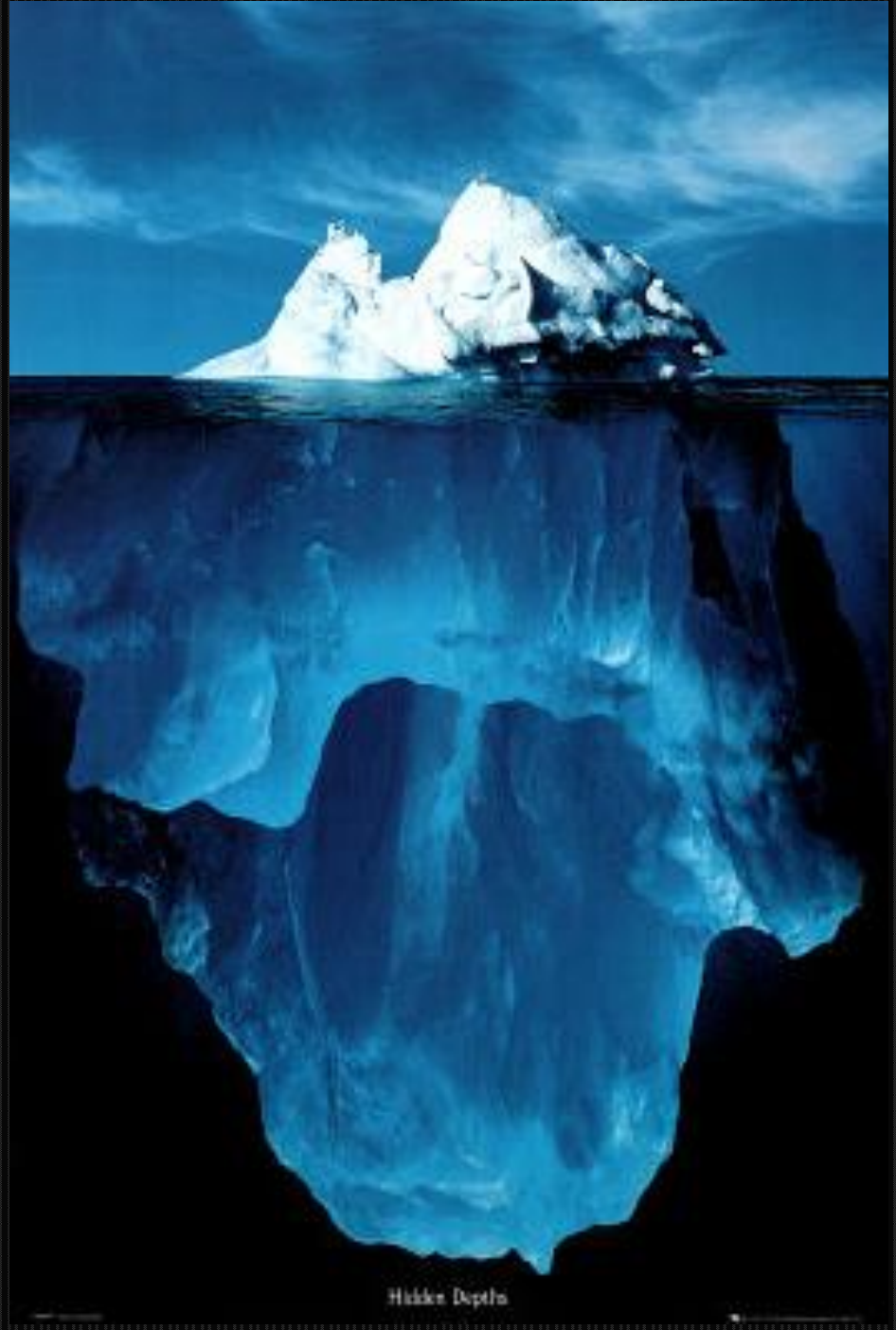
- Interviewed with institutions that run similar disciplinary scholarly resources
- Gathered input from libraries, research centers, and scientists about sustainability issues
- Created a communication strategy to share information about the planning process
  - http://arxiv.org/help/support

Sustainability Planning
INTERIM MODEL



- Developed a 3-year collaborative support model requesting **voluntary** contributions from libraries and research institutes
  - Target the top 200 based on downloads from institutional domain names
  - Annual contribution tiers per institution:

    $4,000 $3,200 $2,300
  - Since January 2010, **secured $340K from 122 institutions**, representing 10 countries


Hidden Depths

infrastructures are invisible and seamless therefore become background information

infrastructures are taken for granted & become visible when they fail

infrastructures require investment

issues raised by users

- Will there be charge for using arXiv?
- Might this sustainability initiative harm the open access cause?
- Did you try other ways of raising money?
  - "surely agency X will support arXiv"
- Isn't arXiv the most important thing Cornell University Library does?

issues raised by libraries & research centers

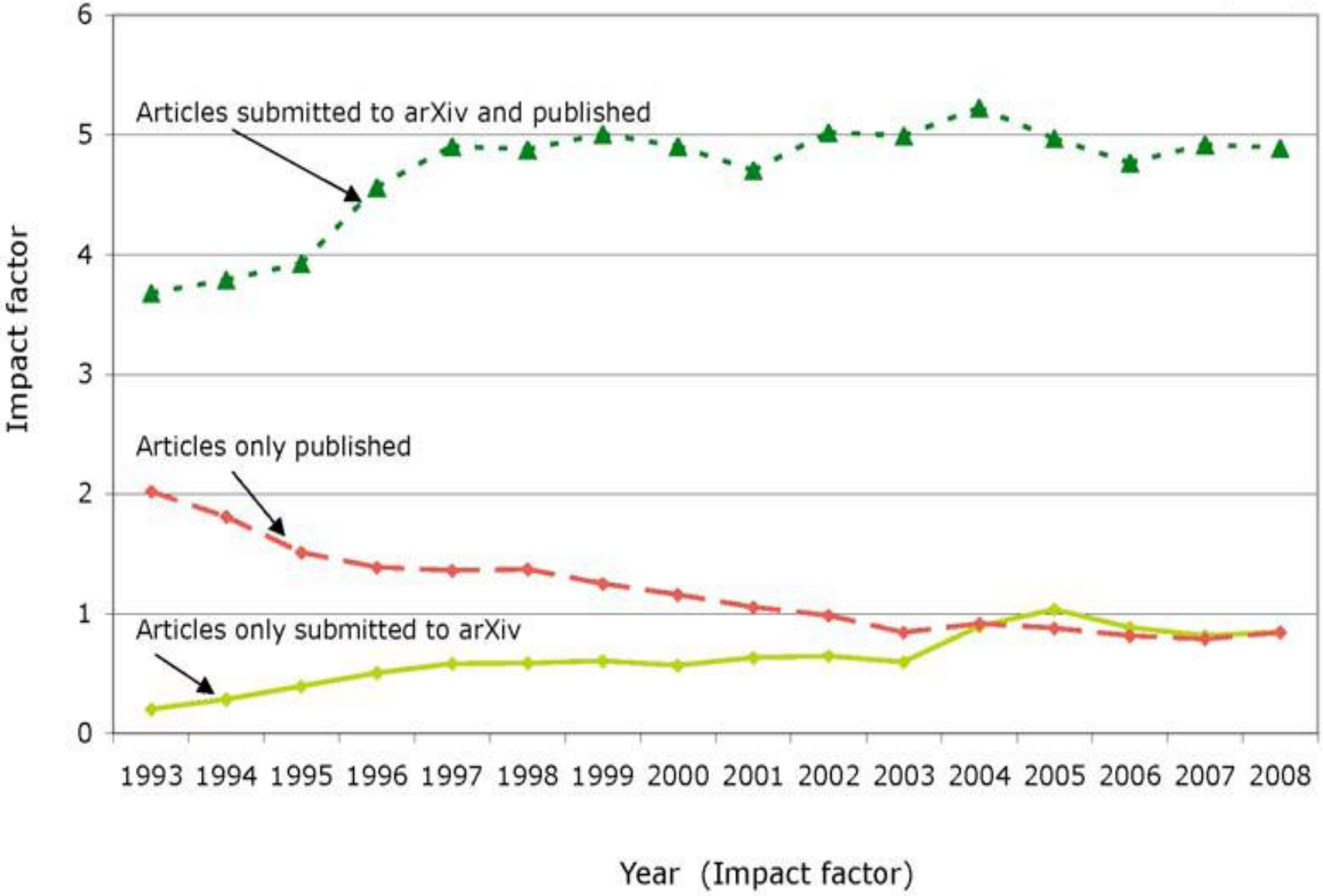
- How will you address the free rider problem?
- Why not charge scholars per submission?
- Are you opening a floodgate?
- When is arXiv going to replace the formal journals?
- Why should my organization contribute to arXiv?

Why invest in arXiv?

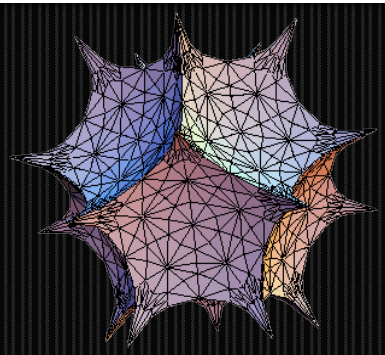
arXiv's Value Proposition

- Scholarly communication process
  - Awareness, registration, certification, discovery, archiving, data mining, etc.

arxiv:0906.5418
Gentil-Beccot, Mele, Brooks



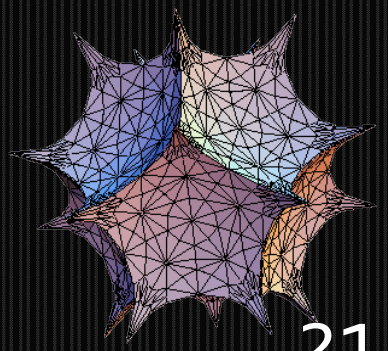
HEP Scholarly Communication Infrastructure



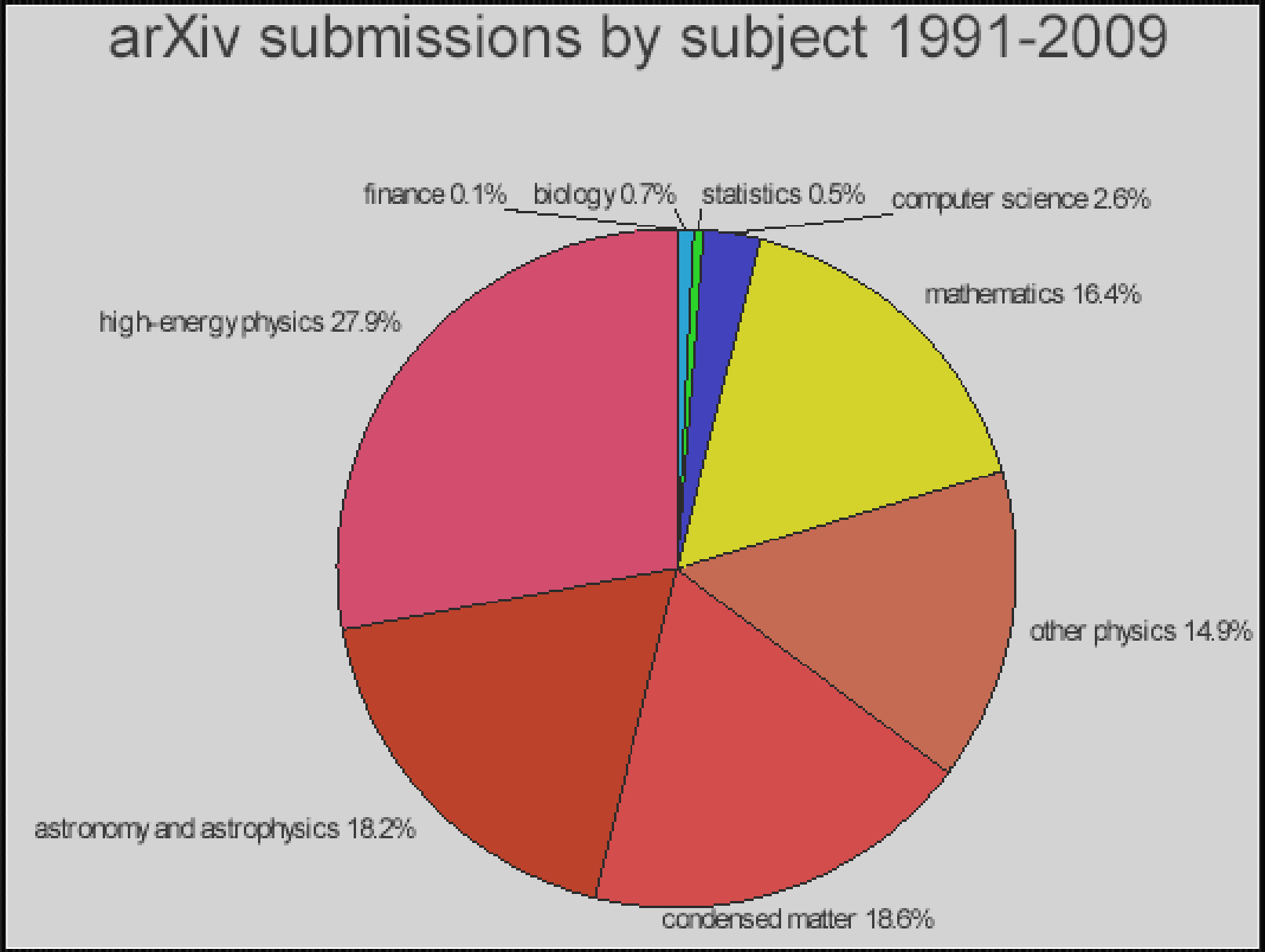
- arXiv
  - Facilitation scholarly discourse since 1991
  - Cornell University Library & Cornell IS
- SPIRES
  - Metadata for 780K HEP articles since 1974
  - SLAC , DESY, and Fermilab
- Astrophysics Data System (ADS)
  - 8.6 million bibliographic records (astronomy and physics)
  - Smithsonian Astrophysical Observatory (NASA grant)

Deep Integration into Academic Community & Scholarly Processes

- arXiv use metrics:
  - includes 630,000 articles
  - 60,000 new submissions (2009)
  - 30,000,000 downloads (2009)



- Growing subject coverage



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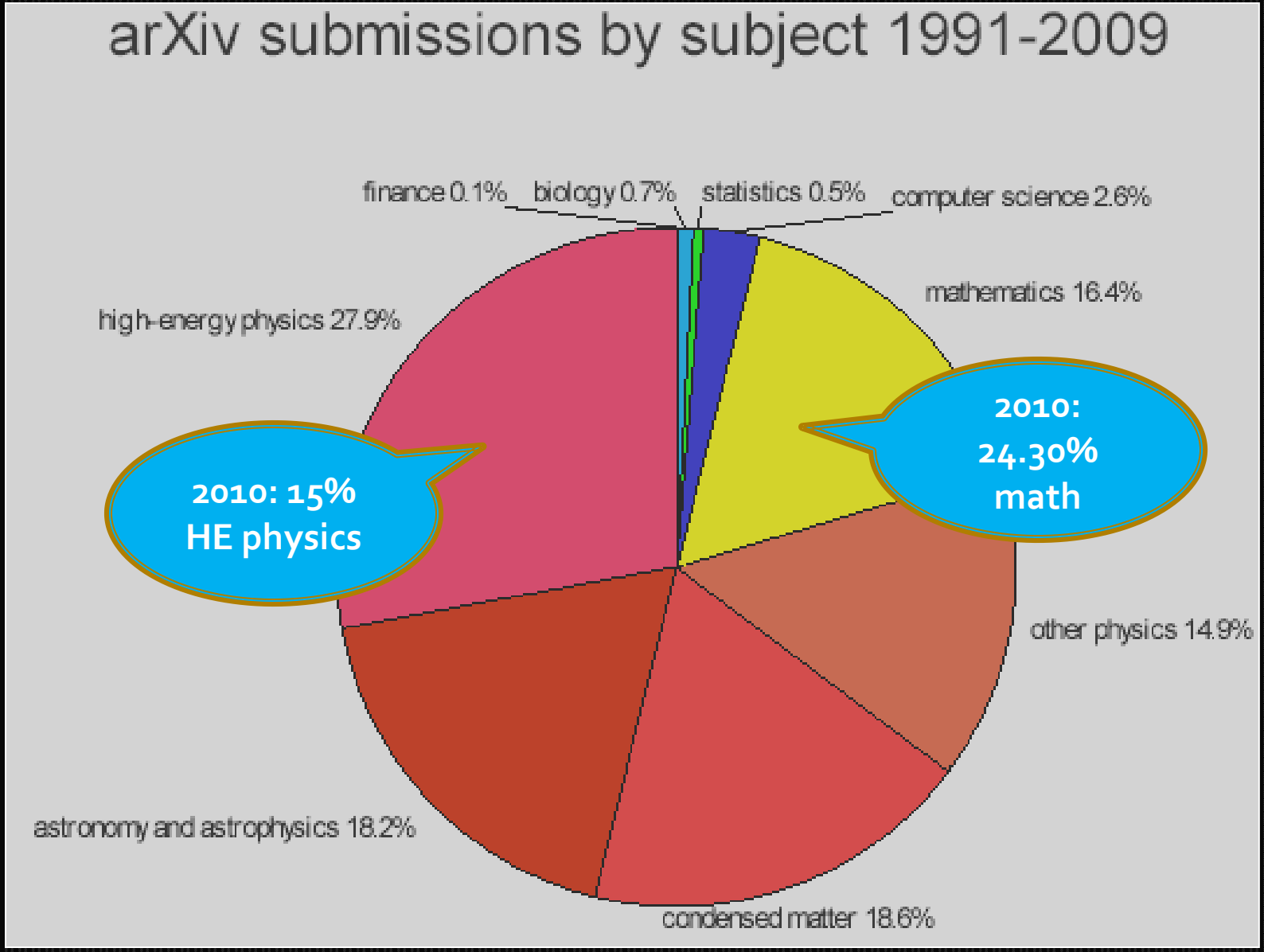


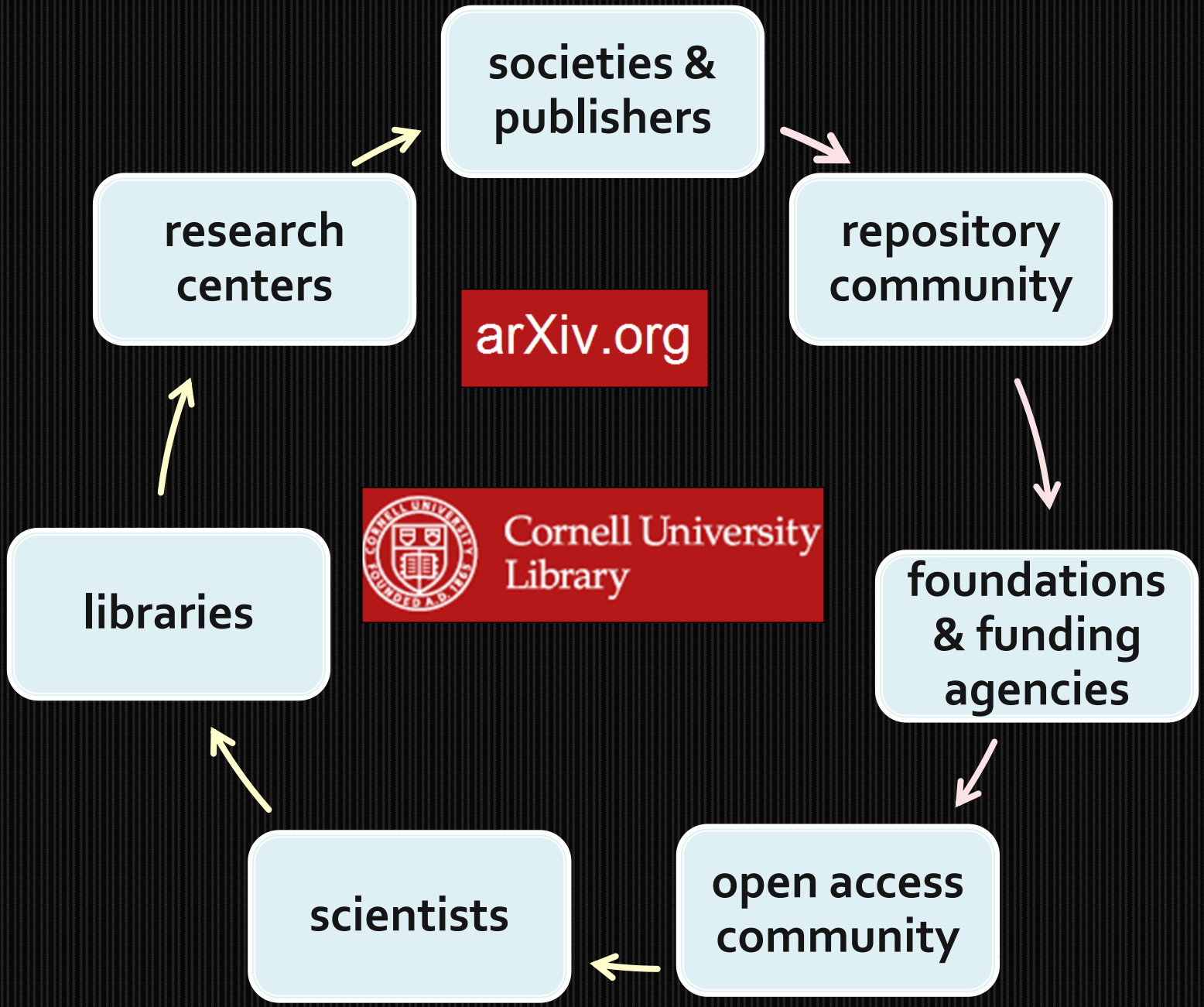
CY 2010 Budget

- Annual budget = ~ $380,000 plus **in-kind contributions**
- Per unit costs:
  - **$7 per submission**
  - **1.4 cents per download**

Looking Ahead

- Work with the international sustainability advisory group & scientific advisory board in long-term planning
- Hold discussions with a group of publishers and societies
- Continue to identify funding sources from agencies and foundations
- Review arXiv architecture & services

factor in various stakeholders' perspectives



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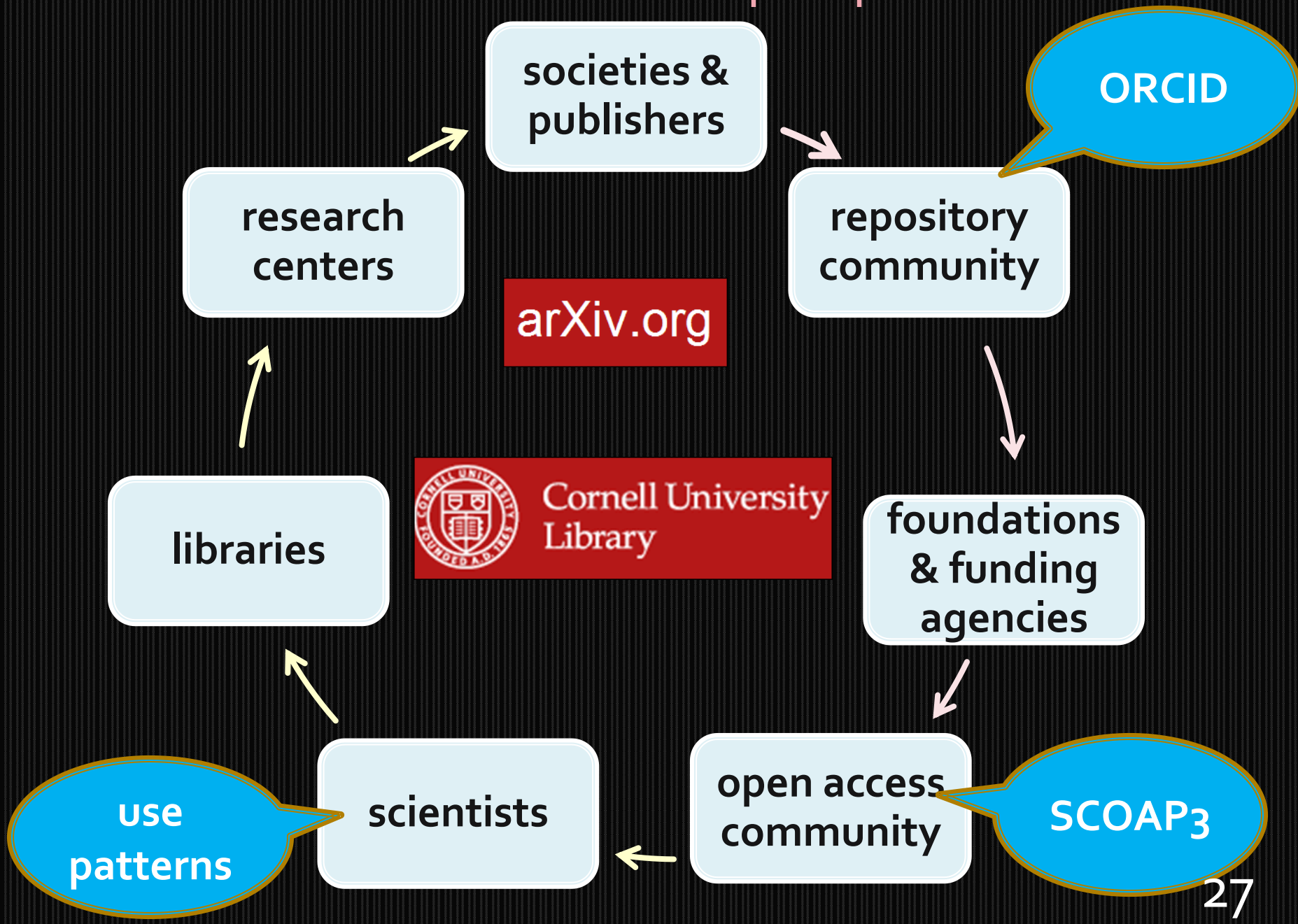

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arXiv Support

Cornell University Library is beginning an effort to expand funding sources for arXiv to ensure its stability and continued development. We are working to establish a collaborative business model that will engage the institutions that benefit most from arXiv — academic institutions, research centers and government labs — by asking them for voluntary contributions. Our plans are outlined in the 2010-01-21 press release and additional information is given in:

- arXiv Support FAQ
- arXiv 2010 Supporters
- arXiv 2009 Institutional Usage Statistics
- arXiv Business Model White Paper
- arXiv Support Updates (July 2010)

Contacting arXiv Funding Support

For questions related to institutional contributions or other funding for arXiv please contact arXiv at support@arxiv.org. For technical or moderation queries please contact arXiv administrators and do not send email to the support address.

Contact arXiv Funding Support

thank you!

http://arxiv.org/help/support

rieger@cornell.edu

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