

ASTR695, Research in Astronomy:
From Nearby Galaxies to nearby Asteroids
fall 2010

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Past & Current Research Topics: Do you want to contribute?

- Caveat:**
- No funding available, currently
 - Funding may be available for 3 of 4 projects
 - Chances are typically $\frac{1}{4}$ – $\frac{1}{5}$

Research Projects

- **(NF) Shape of Dark Matter Halos in Nearby Galaxies**
 - Shapes can be determined for ~10 systems
- **(PF) Search for the Elusive Wide Stellar Binaries**
 - Their presence sets limits on dark-matter mini halos
 - with Ed Shaya
- **(PF) Low-level AGN variability in the Kepler field**
 - Kepler samples ~6k galaxies 1/month: unique long-term data set
 - with Shaya & Mushotzky
- **(PF) To go where no one has gone before:**
 - Searching for Killer Asteroids with EPOXI++**
 - The Deep Impact S/C scans the whole Earth orbit in 8 years
 - with A'Hearn, Deming et al

Research Projects:

1) The Shape of Dark Matter Halos

(no funding)

- Dark Matter is known to exist (standard cosmology)
(but see McGaugh et al)
- Properties elusive
 - Only gravitational interaction with rest of world
 - Present in: clusters of galaxies, ellipticals and spirals
 - How are they shaped?
 - Flat, round, in between, tri-axial?
 - Theory: in between tri-axial !

Research Projects, 1)

The Shape of Dark Matter Halos: Observations

- 1) X-ray isophotes of isolated elliptical galaxies
- 2) Warping/precessing neutral hydrogen (HI) disks
- 3) Rotation curves of polar-ring galaxies
- 4) Stacking weak-lensing maps of 1000s of galaxies
- 5) **Thickness of HI layer of spirals galaxies**

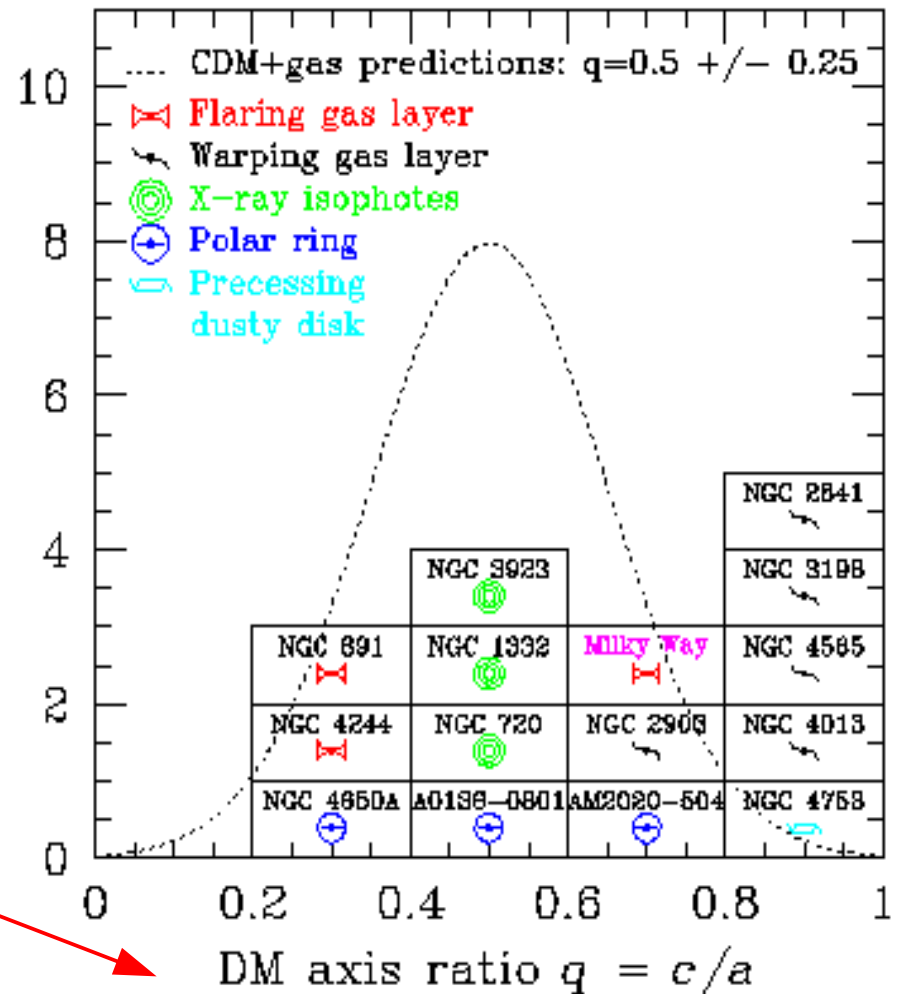
(RPO, 1995a, 1996a,b; Olling & Merrifield, 2000, 2001)

Research Projects, 1)

The Shape of Dark Matter Halos: Observations Summary

Dark-Matter axis ratio

$$q = \frac{\text{short_axis}}{\text{long_axis}}$$



Research Projects:

2) Search for Wide Binaries

(w. Shaya, funding 4 grad. student requested)

- **Stellar binaries are quite common,**
 - **60-100% of stars are part of multiple system, at birth**
 - **After that they evolve due to gravitational interactions**
 - Typically, tight systems get tighter (“harder”)
 - Wide systems get wider (“softer”)
 - **Observed distribution is ~log-normal in separation (period)**
 - $\langle a \rangle = 35 \text{ AU}$ $\langle P \rangle = 173 \text{ yr}$
 - 1-sigma ranges: 1 AU – 1,200 AU; 316 days – 34,000 yr
 - **Many wider systems:**
 - $\alpha \text{ Cen AB}$ – Proxima Cen has 10 kAU ~ 0.05 pc
 - LP 268-35 – LP 268-33 has 84 kAU ~ 0.41 pc
 - $\alpha \text{ Lib}$ – KU Lib has 217 kAU ~ 0.82 pc

Research Projects, 2)

Search for Wide Binaries, Our results!

Searched for binaries
up to ~10 deg separation
and distance up to 100 pc

Found:
~200 w. a in [0.01,1] pc
~300 w. a in [1,8] pc

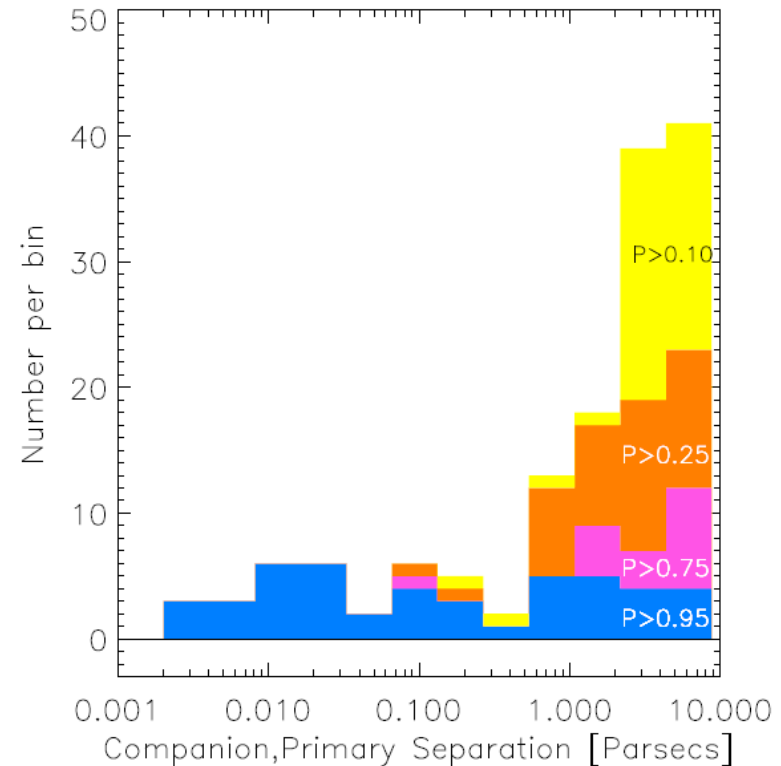
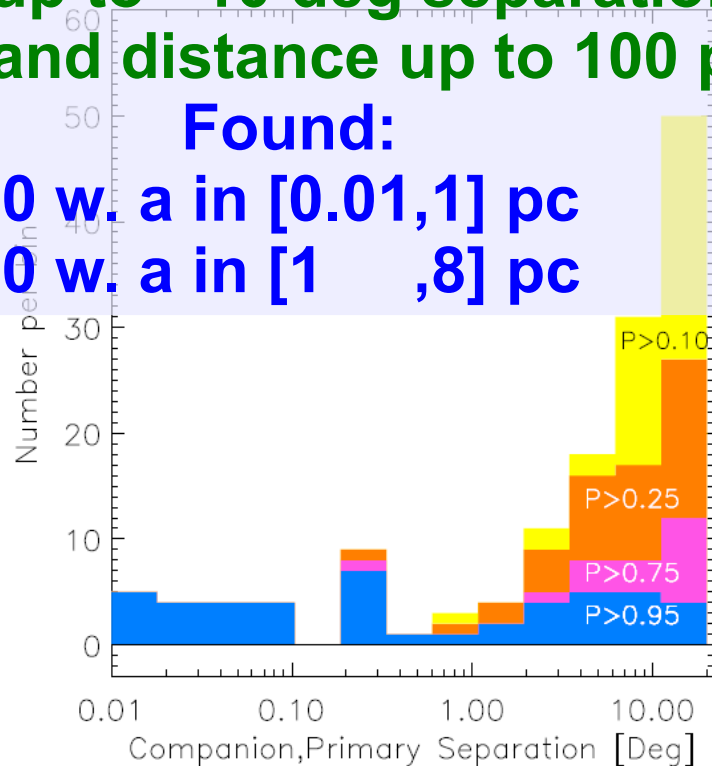


Fig. 7.— *Number and Probability vs. Separation, 0 – 25 pc distances* - The companion separation histogram for primaries within 25 pc showing the contributions from different probability ranges as in previous figure. The left shows angular separation and the right is plane of the sky separation times distance to give parsecs.

Shaya & Olling ('11)

Research Projects, 2)
Search for Wide Binaries:
Why is this interesting?

According to our NSF proposal:

- **To fund a graduate student**
- **To learn about the outcomes of the star formation process**
 - **SF sites are often smaller than ~ 0.1 pc**
 - **How do such wide binaries form?**
- **Tell us something about the breaking-up of wide binaries**
 - **Galactic tides**
 - **Passing stars**
 - **Encounters w. GMCs**
 - **Encounters w. dark-matter mini halos**

Research Projects:
2) Search for Wide Binaries
What is the Project?

Create volume-limited complete sample
(4 proper statistical interpretation; RPO & EJS)

Student: Interpret data along lines of:

Birth of wide binaries in clusters

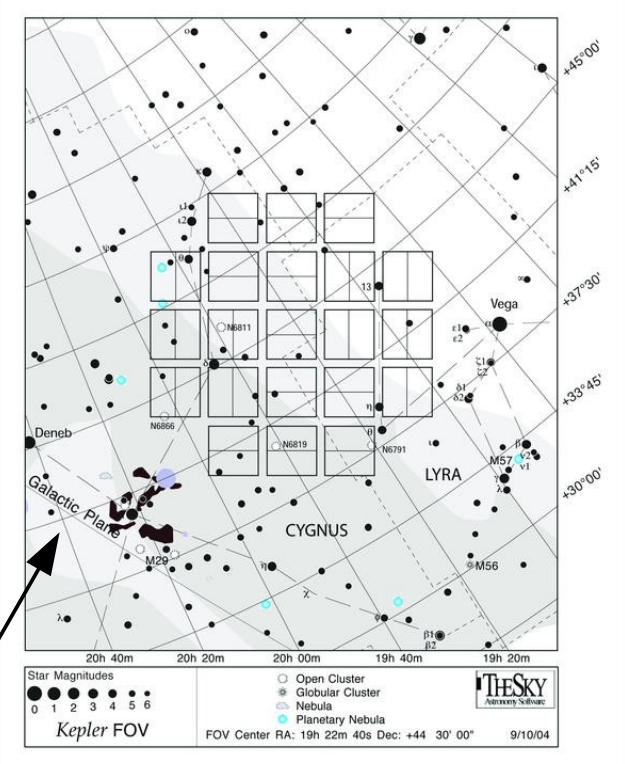
Destruction of wide binaries due to dynamical effects

- Operate on different time scales
- Have dependencies on total & component masses
- Employ existing formalisms

Research Projects, 3)

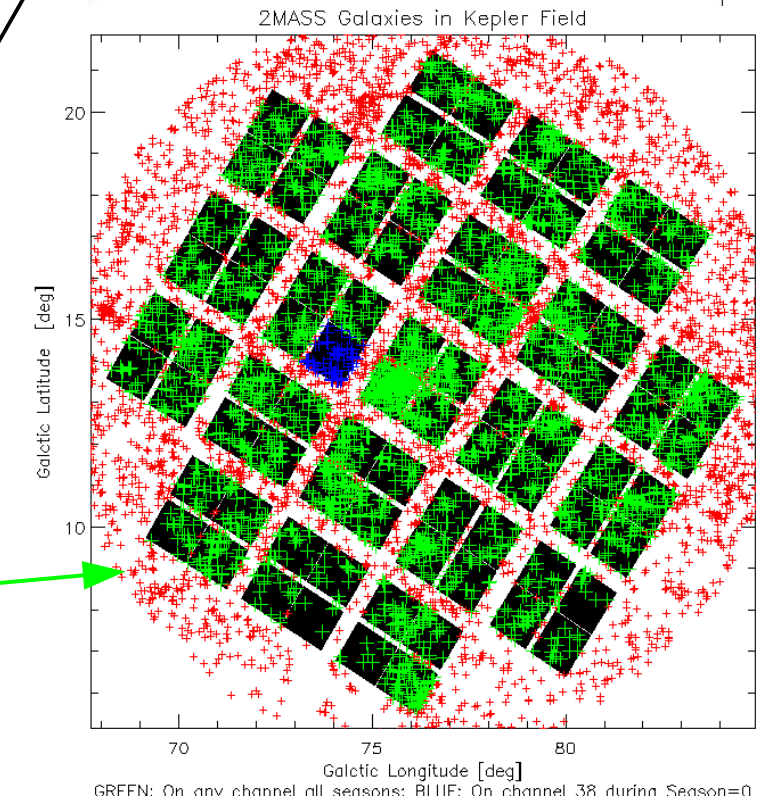
AGN in the Kepler Field

(w. Shaya & Mushotzky; funding???)



While close to Galactic plane,

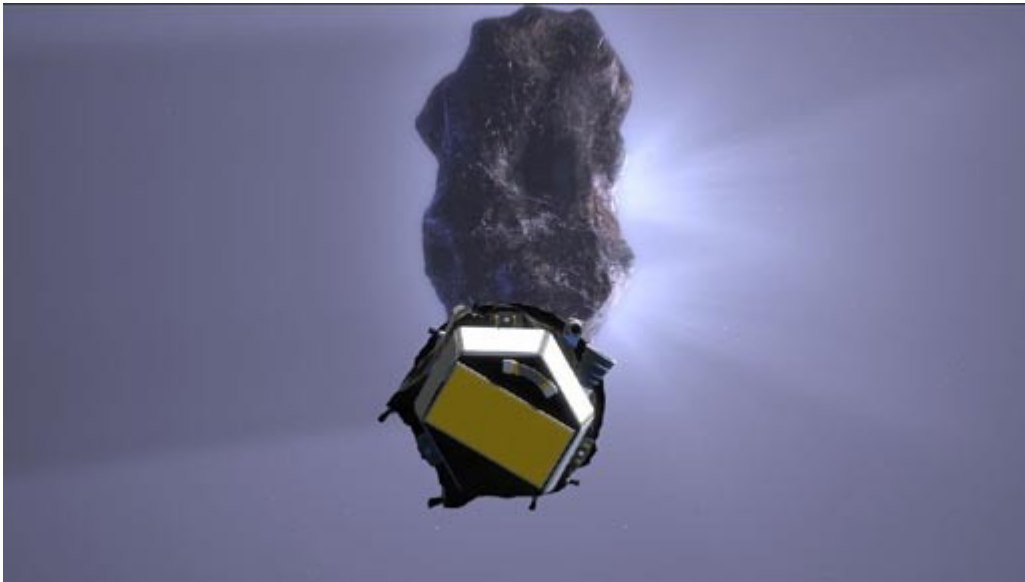
Many galaxies in Kepler's 100 $^{\circ}$ FOV



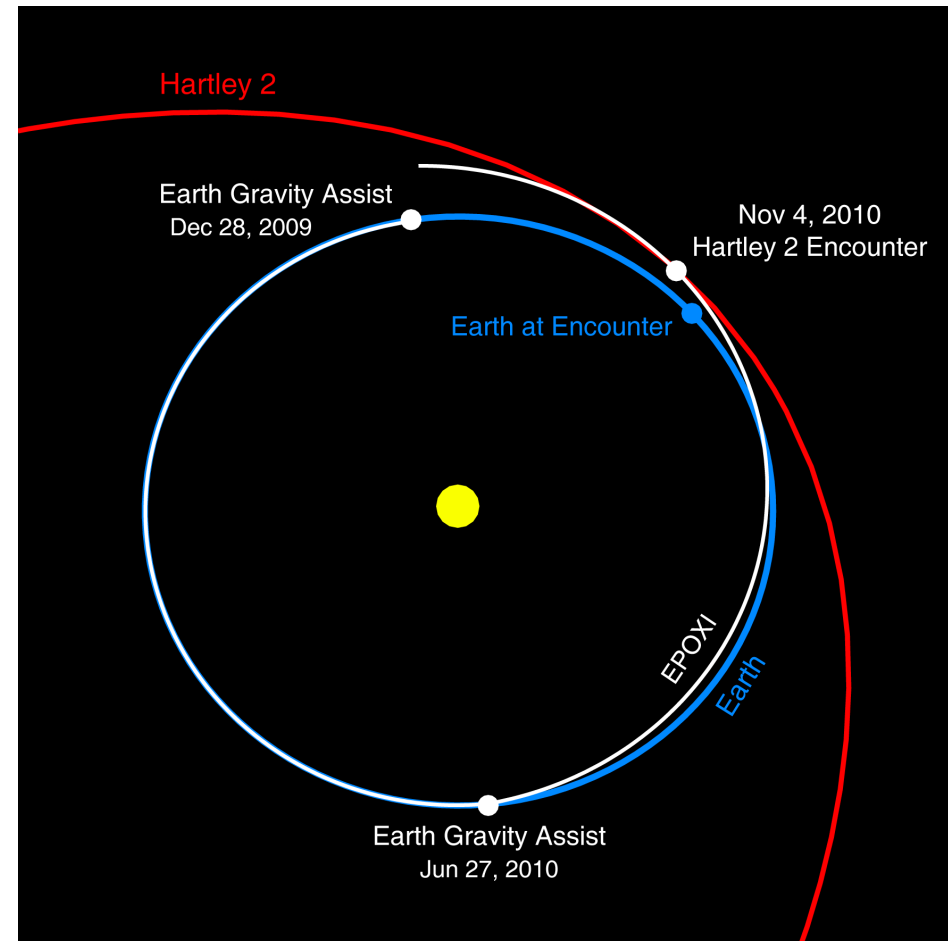
Research Projects

4) Searching for Killer Asteroids w. Deep Impact

(w. A' Hearn, Deming et al ; funding, probably/possibly?)



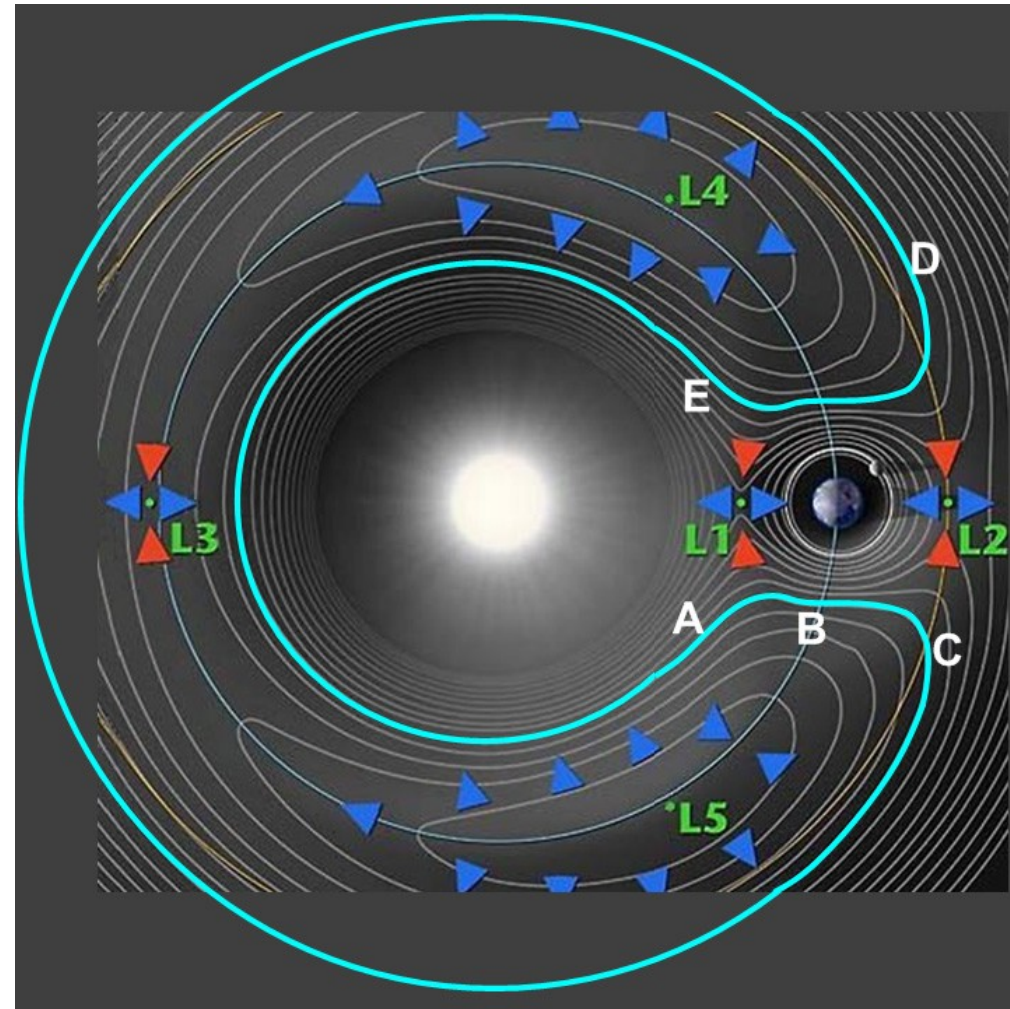
**Deep Impact S/C
travels “along” Earth's orbit
In about 8 years**



Research Projects

4) Searching for Killer Asteroids w. Deep Impact

Looking for Hoerseshoe and Tadpole Asteroids



http://en.wikipedia.org/wiki/3753_Cruithne

Research Projects

4) Searching for Killer Asteroids w. Deep Impact

Looking for Hoerseshoe and Tadpole Asteroids

http://www.astro.umd.edu/~olling/Images/EPOXI_SC_NEO_Selection_Geometry_Tabachnik_Eva