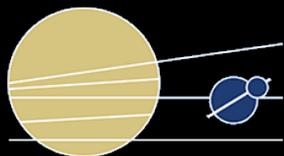


Catalina Sky Survey Update



Eric J. Christensen

The University of Arizona



DEPARTMENT OF PLANETARY SCIENCES

Lunar and Planetary Laboratory



Catalina Sky Survey

- Founded in 1998
- Discovered 8,700+ NEOs to date (46% of all known NEOs)
- Operates an **ensemble** of telescopes every clear night except around full moon, Arizona monsoon
- Currently discovering NEOs at a rate of ~1,000 per year



CSS : Survey Telescopes



0.7-m Schmidt Telescope (703)
Mt. Bigelow

4,000 deg² @ 50% $V_{\text{lim}} \sim 19.3$



1.5-m Prime Focus Telescope (G96)
Mt. Lemmon

1,000 deg² @ 50% $V_{\text{lim}} \sim 21.1$

703

SKY COVERAGE

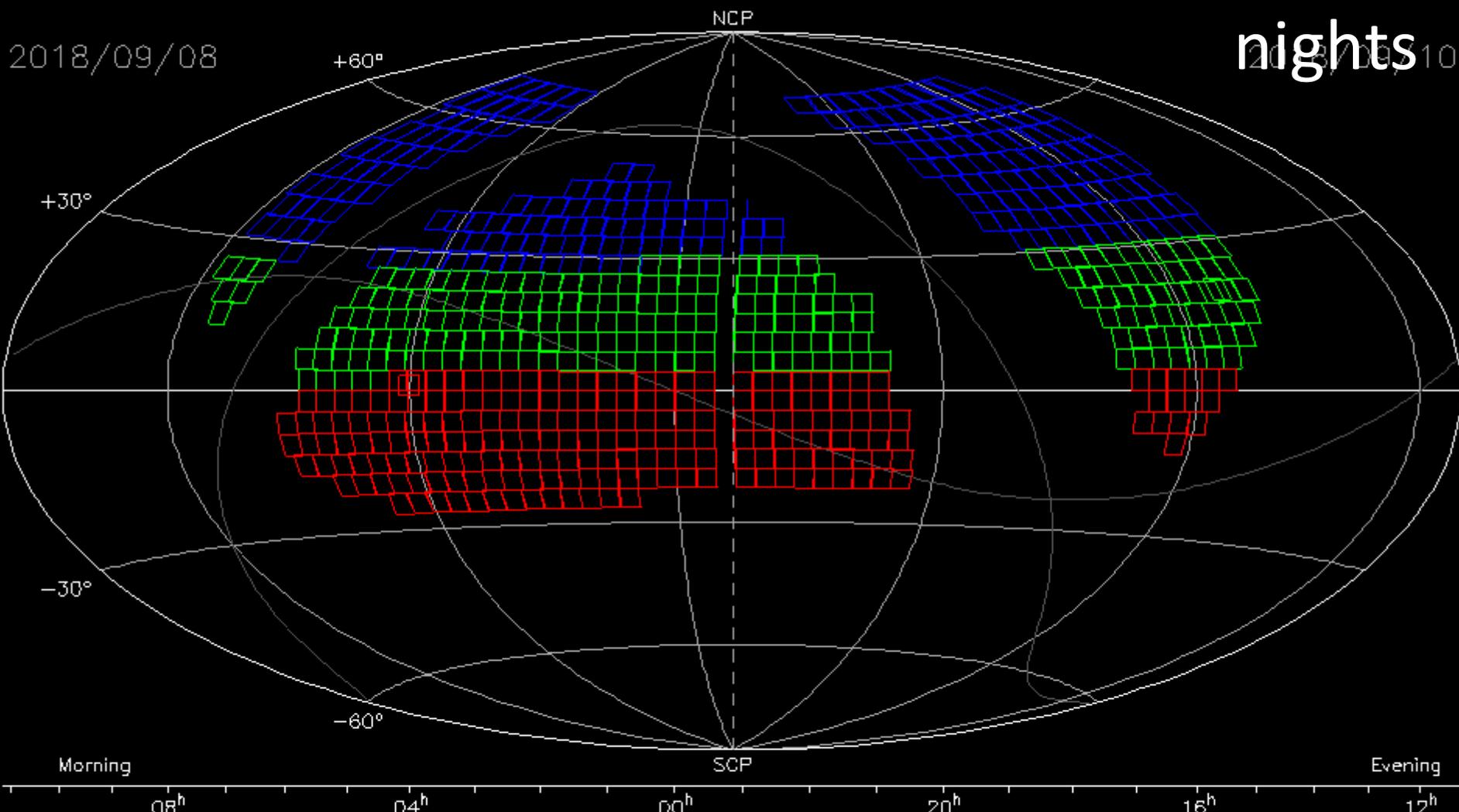
Plot prepared 2018/10/18.955 by the Minor Planet Center

3-4

nights

2018/09/08

2018/09/09, 10



■ 2018/09/10 (2018 253)

■ 2018/09/09 (2018 252)

■ 2018/09/08 (2018 251)

Opposition Point = 23 08.5, -05 31. Fields reaching fainter than $V = 19.0$.

G96

SKY COVERAGE

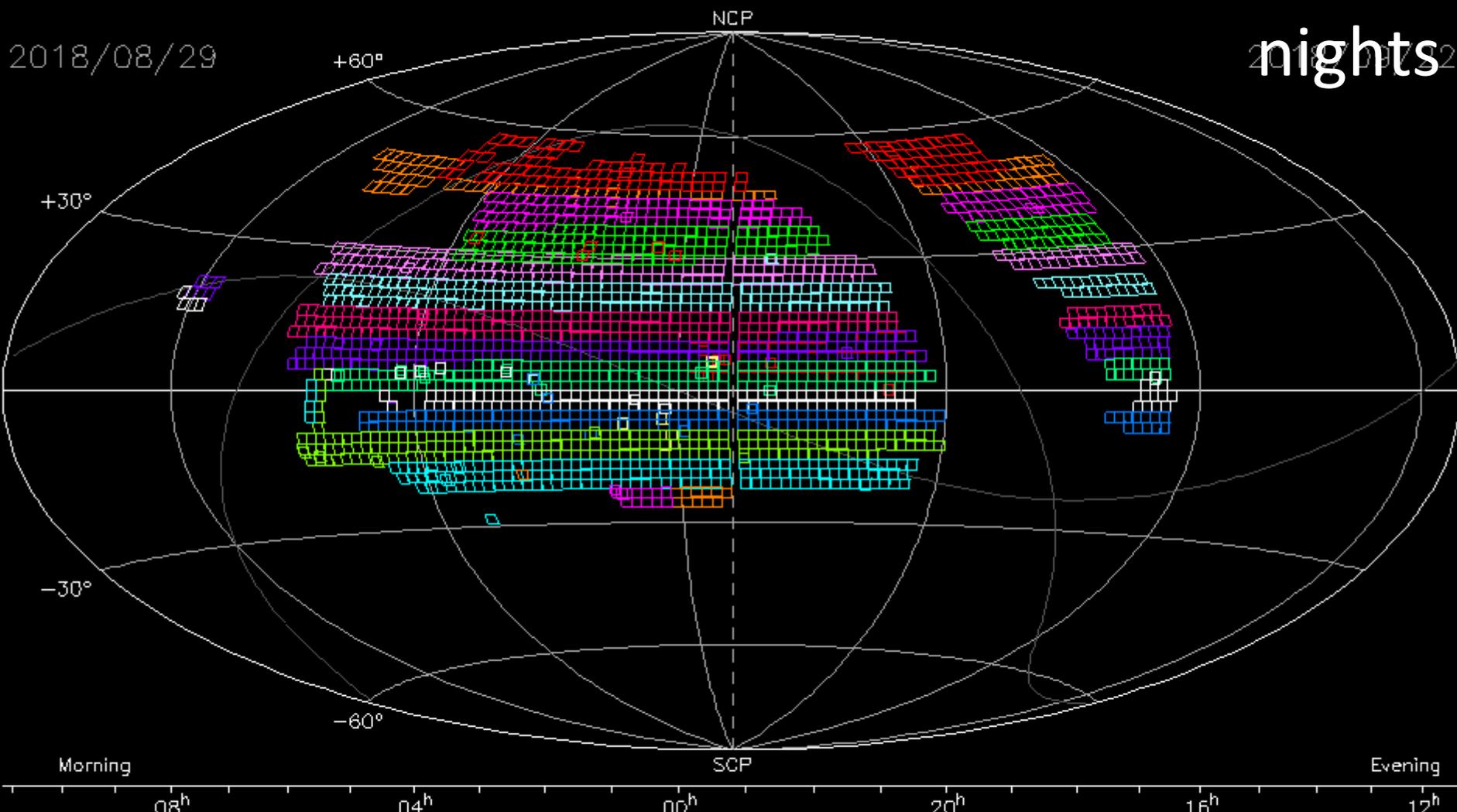
Plot prepared 2018/10/18.951 by the Minor Planet Center

12-24

nights

2018/08/29

2018/09/22



Morning

Evening

08^h

04^h

00^h

20^h

16^h

12^h

Opposition Point = 23 12.1, -05 08. Fields reaching fainter than $V = 20.0$.

- | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 2018/09/22 (2018 265) | 2018/09/21 (2018 264) | 2018/09/20 (2018 263) | 2018/09/19 (2018 262) | 2018/09/18 (2018 261) |
| 2018/09/17 (2018 260) | 2018/09/16 (2018 259) | 2018/09/15 (2018 258) | 2018/09/14 (2018 257) | 2018/09/13 (2018 256) |
| 2018/09/12 (2018 255) | 2018/09/11 (2018 254) | 2018/09/10 (2018 253) | 2018/09/09 (2018 252) | 2018/09/08 (2018 251) |
| 2018/09/07 (2018 250) | 2018/09/06 (2018 249) | 2018/09/05 (2018 248) | 2018/09/04 (2018 247) | 2018/09/03 (2018 246) |
| 2018/09/02 (2018 245) | 2018/09/01 (2018 244) | 2018/08/31 (2018 243) | 2018/08/30 (2018 242) | 2018/08/29 (2018 241) |

CSS: Survey Upgrades

- Both survey telescopes have new 10K x 10K cameras
 - G96 finished commissioning in fall 2016. FoV increased by 4x
 - 703 finished commissioning in fall 2017. FoV increased by 2.4x
- G96 accounts for ~80% of CSS discoveries

CSS : Follow-up Telescopes



1.0-m follow-up (I52)

Mt. Lemmon

Full-time: 24 nights / lunation

Remotely-operated from V06,
703, or UA Campus



1.5-m follow-up (V06)

Mt. Bigelow

Part-time: 6-9 nights / lunation

Competitively allocated

152+V06

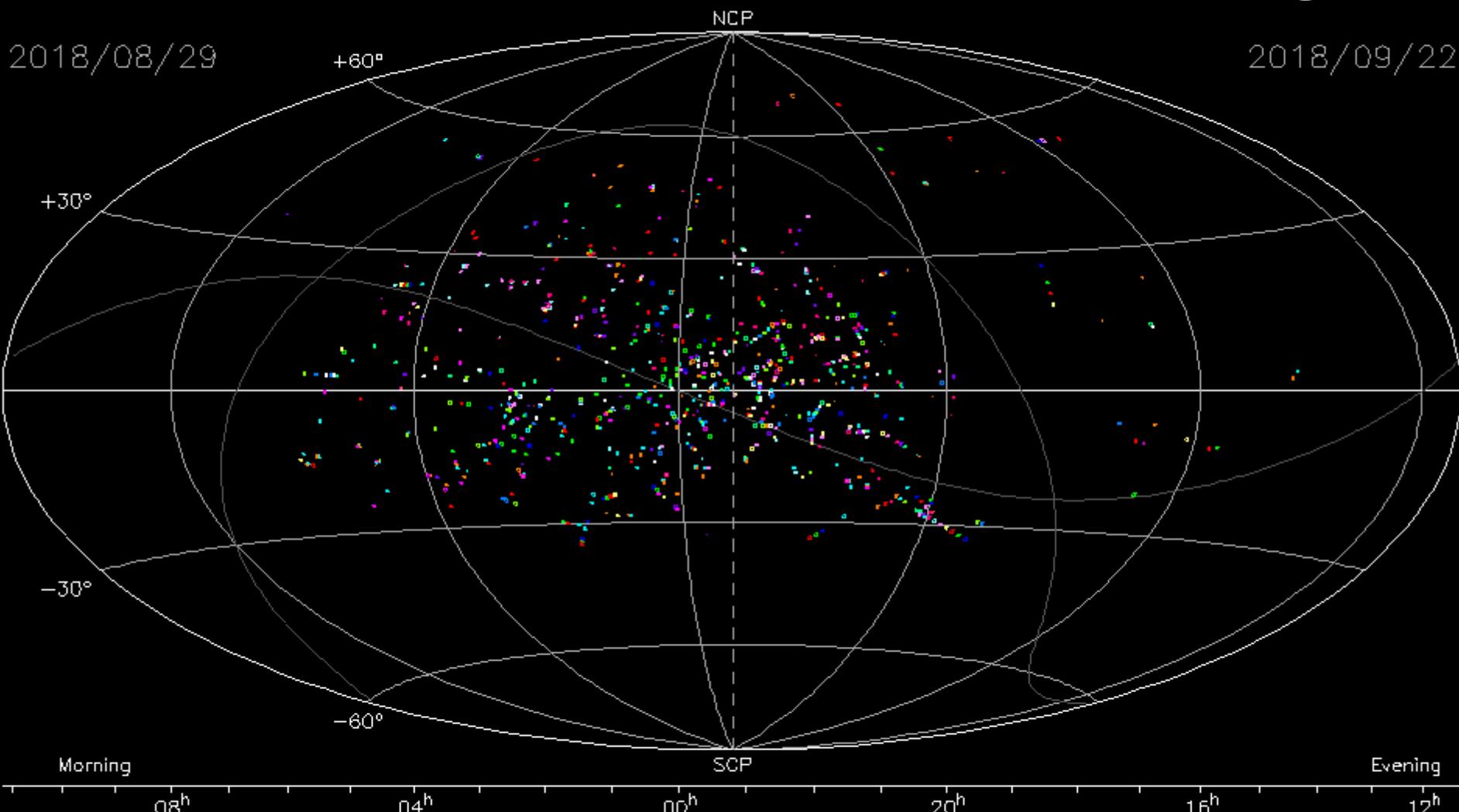
SKY COVERAGE

24 nights

Plot prepared 2018/10/18.952 by the Minor Planet Center

2018/08/29

2018/09/22



Morning

Evening

08^h

04^h

00^h

20^h

16^h

12^h

Opposition Point = 23 12.1, -05 08. Fields reaching fainter than $V = 20.0$.

2018/09/22 (2018 265)	2018/09/21 (2018 264)	2018/09/20 (2018 263)	2018/09/19 (2018 262)	2018/09/18 (2018 261)
2018/09/17 (2018 260)	2018/09/16 (2018 259)	2018/09/15 (2018 258)	2018/09/14 (2018 257)	2018/09/13 (2018 256)
2018/09/12 (2018 255)	2018/09/11 (2018 254)	2018/09/10 (2018 253)	2018/09/09 (2018 252)	2018/09/08 (2018 251)
2018/09/07 (2018 250)	2018/09/06 (2018 249)	2018/09/05 (2018 248)	2018/09/04 (2018 247)	2018/09/03 (2018 246)
2018/09/02 (2018 245)	2018/09/01 (2018 244)	2018/08/31 (2018 243)	2018/08/30 (2018 242)	2018/08/29 (2018 241)

Follow-up

- I52 + V06 target NEOCP objects from CSS and other surveys, arc extensions + recoveries of known NEOs
- I52 is **the most prolific NEO follow-up telescope**; V06 compares favorably despite only ~3 nights/lunation during sample period

Site	Num obs.	Mean V
I52	21,221	20.09
H21	9,630	20.57
926	4,402	20.03
H01	3,270	20.27
291	3,205	21.39
691	2,819	20.06
V06	2,029	21.12
568	1,491	22.23
T12	1,050	22.02

Follow-up sites with > 1,000 NEO measurements AND mean V mag >20.0

From July 2017 – June 2018

Follow-up

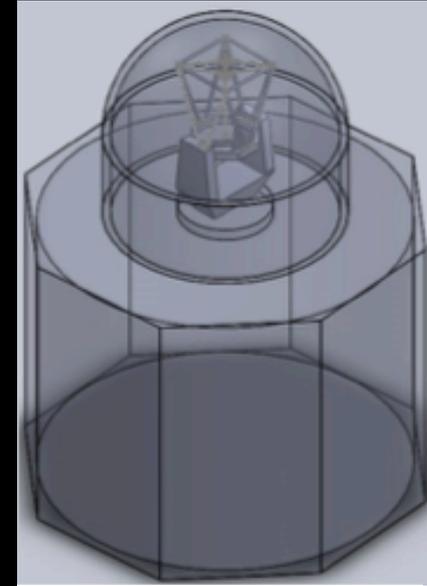
- Developing a community target broker called *NEOfixer*, which aims to answer the question:
“What is the most valuable NEO observation I can make, from my site, at a given time?”
- All NEOs are assigned scores based on
 - Importance of object (large, hazardous?)
 - Benefit to orbit (how much will new obs help?)
 - Cost to observe (faint, uncertain?)
 - Community interaction (who else might observe it?)

Imminent Impactors

- 2018 LA: the third asteroid discovered prior to impact
- CSS is **the only system** with demonstrated sensitivity to small impacting asteroids. Why?
 - Good detection efficiency of fast objects
 - Real-time validation and reporting
 - Integrated follow-up capabilities
- Optimizing sensitivity to impactors could *decrease* sensitivity to $H < 22$ NEOs

CSS Future Projects?

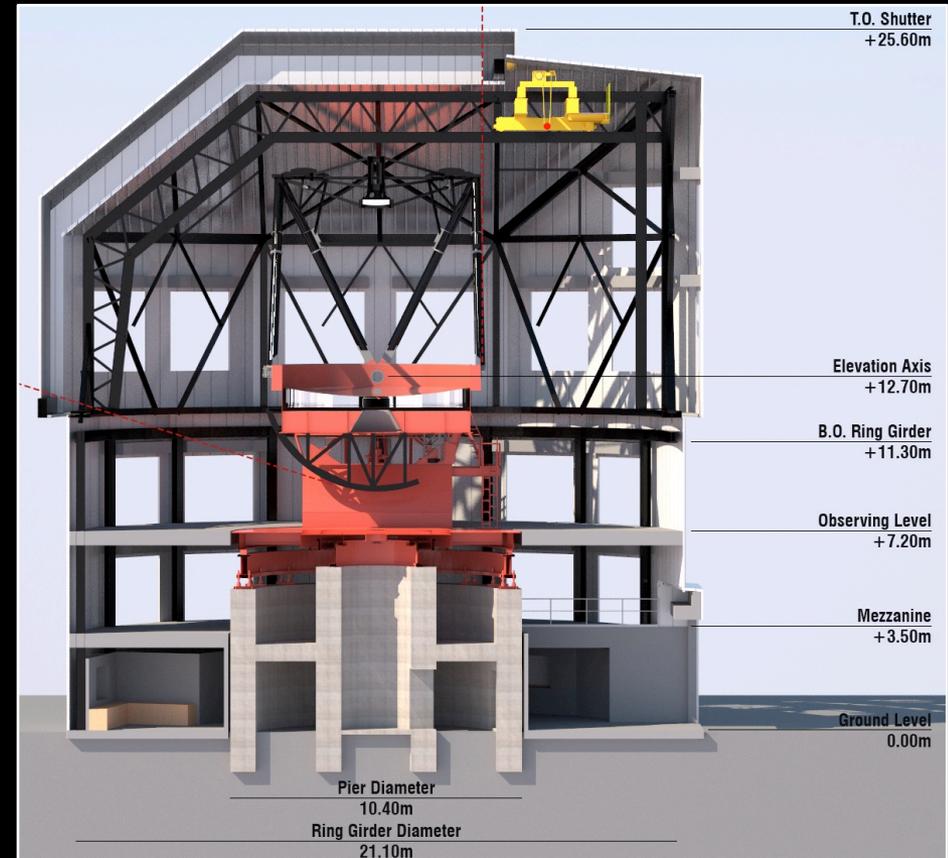
- Proposal to refurbish the 2.0-m former MAGNUM telescope, install at Mt. Lemmon



- ~2 years to re-commission, with subsequent NEO follow-up operations for a majority of the available time

CSS Future Projects?

- UA + commercial partners have developed a 6.5-m “turn-key” observatory
- CSS is evaluating requirements and capabilities of a NEO-optimized design, sited in the Northern Hemisphere
- **International partnerships welcome!**



Arizona Large Telescope Consortium 6.5-m Observatory
SPIE 2018, paper 10700-163

Questions?  eric@LPL.arizona.edu

<https://catalina.lpl.arizona.edu>



Image credit : Mt. Lemmon SkyCenter