Figure of Merit (FOM) for Infrared Sky Survey

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Approach

storm potential terms in FOM.

some concerns: many addressed, but not all. This will be a job fo
Science Working Group.

est a potential FOM at the end, but obviously should not be consi

apabilities vs. Implementation Pla

ld FOM be based on telescope design, or should it be based on a
d survey(s)?

her addresses telescope capabilities, but doesn't address implemen
urvey plan doing only a single image per sky position is not as goo
ystematics as one doing 3+ images per sky position)

r doesn't address guest observer (GO) capabilities, but could easi
a FOM to the etendue (area x depth) of surveys.

preferred solution: go with satellite capabilities to define FOM.

General Form of FOM

$$\mathbf{FOM \sim D^2 \times FOV \times N_{modes} \times T}$$

ntially defines the FOM as the etendue of the telescope (collecting
ield of view) times the number of observing modes times the mis
e

slides will discuss concerns with each of these terms.

Telescope Diameter

ly using the telescope diameter doesn't address optical design (e.g
axis anistigmic), mirror throughput (which could be wavelength
dent), etc...

her than scaling by D^2, scale by the effective diameter, D_{eff}^2.

Field of View (FOV)

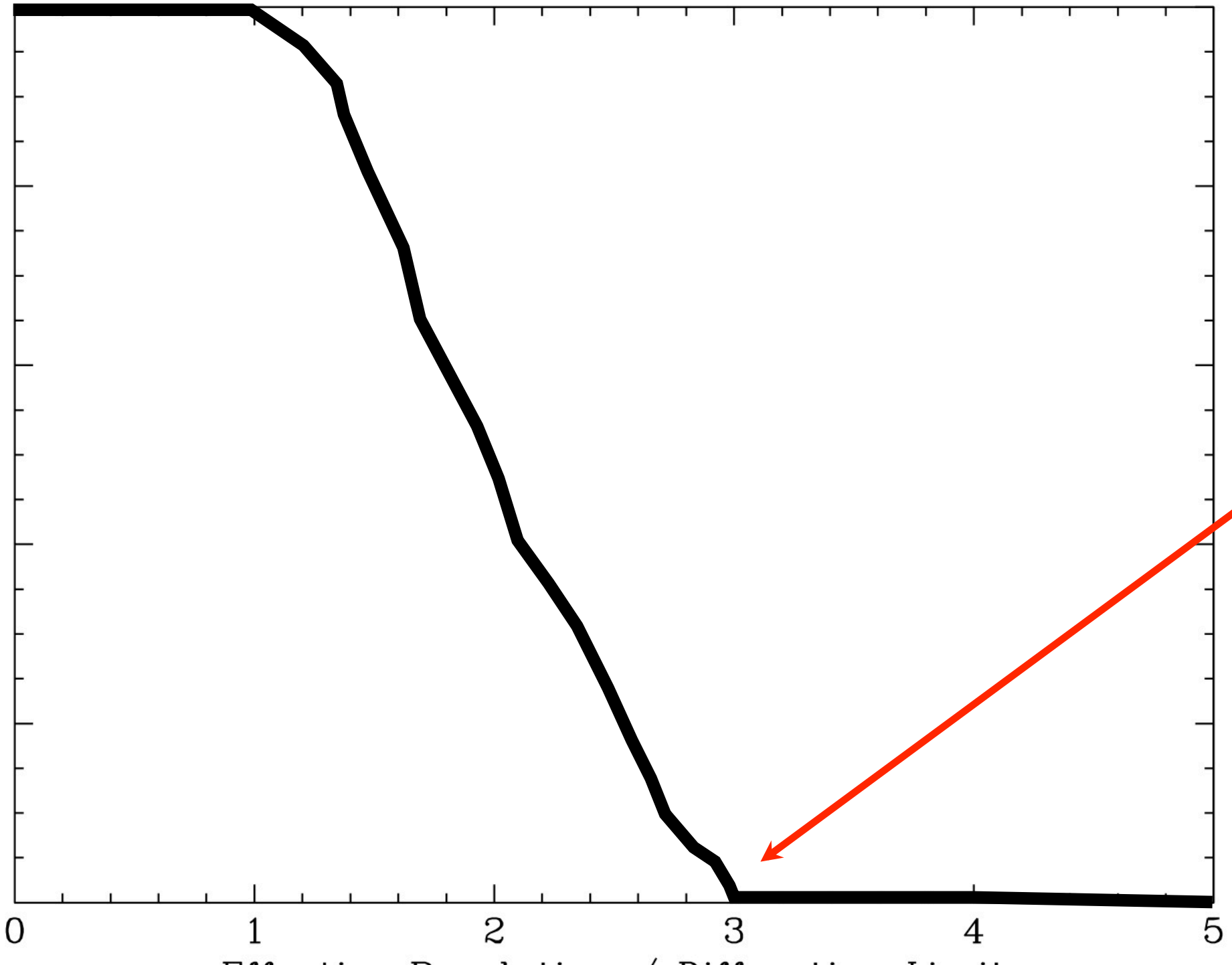
ly using the telescope FOV doesn't address pixellation. Want to h
sort of weighting to FOM that pushes design towards the diffracti
imaging.

l a fudge factor to FOV, such as

$$f(FOV) = 1, \text{ if } x \leq 1$$
$$f(FOV) = 1 - \kappa(x-1)^2/x^2, \text{ if } 1 \leq x \leq XX$$
$$f(FOV) = 0, \text{ if } x \geq XX$$

here x = (pixel scale / diffraction limit)

Field of View (FOV)



or sho
this b
x=10?

asymp
to zer

Field of View (FOV)

ly using the pixel scale as the resolution doesn't address survey
gies which could "buy back" diffraction limited imaging through pos
sing ("drizzling").

ld also give extra weight to resolutions that are not accessible fro
l.

e the effective resolution, e.g., for a mosaicked wide-area shallow s
ised of 4 drizzled images per sky position.

A Few Related Concerns

till concerned about not penalizing observing plans that are insuffi
lant. Really want 3+ images per sky position to be able to control
atics (e.g., bad pixels, cosmic rays, scattered light, etc...). But this is
s a secondary point if we base the FOM on satellite capabilities ra
urvey implementation design.

edly, I'm concerned about surveys that would hit the confusion lir
pth of survey is more relevant than collecting area. However, this
s a pedantic point for the ensemble of likely WFIRST designs.

- Were FOM to be designed for survey strate

Ned suggested weighting by coverage:

- coverage ≥ 4 : weight = 1
- coverage = 3 : weight = 0.5
- coverage = 2 : weight = 0.25

N (m.): Number of Imaging Mode

t to reward more flexible missions, e.g., those with multiple filters.

cern #1: Filter throughput / sensitivity should be included as a we
Implies making FOM ~ Σ(weighted imaging modes) rather than
ying by number of imaging modes.

cern #2: If weighting by sensitivity, need to worry about confusion
nether or not observations are background limited. However, thes
d on survey implementation.

cern #3: Should give extra weight to space-unique capabilities. E.g
imaging mode by sqrt(background from the ground / background
This would make 3 micron channel ~40x more compelling than 2
channel, and ~100x more compelling than 1 micron channel.

sp.): Number of Spectroscopic Mo

cern #1: How to combine imaging and spectroscopy / how to do
e weighting.

cern #2: FOM presumably scales with wavelength coverage.

cern #3: How to weight spectral resolution, R?

?: mission lifetime

er mission is obviously better.

ltiple modes can be exercised simultaneously, then this is obviousl
boost.

Suggested Form of FOM

$$\mathrm{FOM} \sim \mathrm{T} \times \sum \mathrm{D_{eff}^2} \times \mathrm{FOV} \times f_{\mathrm{mode}}$$

over observing modes, with a fudge factor f_{mode} to account for:
m throughput
ution relative to diffraction limit
ground level relative to ground-based observations
tral resolution

need to scale by number of modes that can be done simultaneous

Implementation-Based FOM

f FOM were to be based on survey implementation instead of sat
ities, then an alternative form of the FOM might be:

$$\mathbf{FOM \sim area \times depth \times N_{modes}}$$