



“What Do You Want Out of a Southern Water Cherenkov Observatory?”

Southern Observatory Workshop

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A Theorist



- More extended PWN at TeV energies
 - HAWC sees $\sim 1/2$ the galactic plane and has seen 2 extended PWN
 - Current IACTs have difficulties finding them
 - Maybe ~ 2 more in other half of plane? Let's find out.
- Transients
 - Particularly if we can see down to 100GeV or below, where there won't be a transient factory once Fermi-LAT eventually goes away
- Southern extragalactic catalog



An Optimistic CTA Collaborator



- Extragalactic sky survey
 - Especially if we can go down a bit in energy from current HAWC catalogs
- Extended sources in the plane
- Diffuse emission
- Orthogonal technology
 - Don't put all eggs in one basket
 - Multiple kinds of observations limits unknown unknowns
 - If CTA sees something interesting, want to prove it's real using different experiment



A Pessimistic CTA Collaborator



- CTA covers lower energies that water Cherenkov never can
- CTA can find its own sources by splitting up its telescopes into different tiling fovs
- No point to extragalactic Southern catalog since those are all at lower energy where water Cherenkov has no sensitivity anyway
- “Large” CTA fov can do extended sources
- Even HAWC catalog won't be good enough sensitivity – is why CTA North doing sky survey
- “Nothing” - maybe MACHETE instead?



Nobody (So Far)



- Source Finder for CTA
- High energy reach
 - Just not many sources to look for
 - Is CTA's best sensitivity



Me - Some arguments for a Southern Observatory

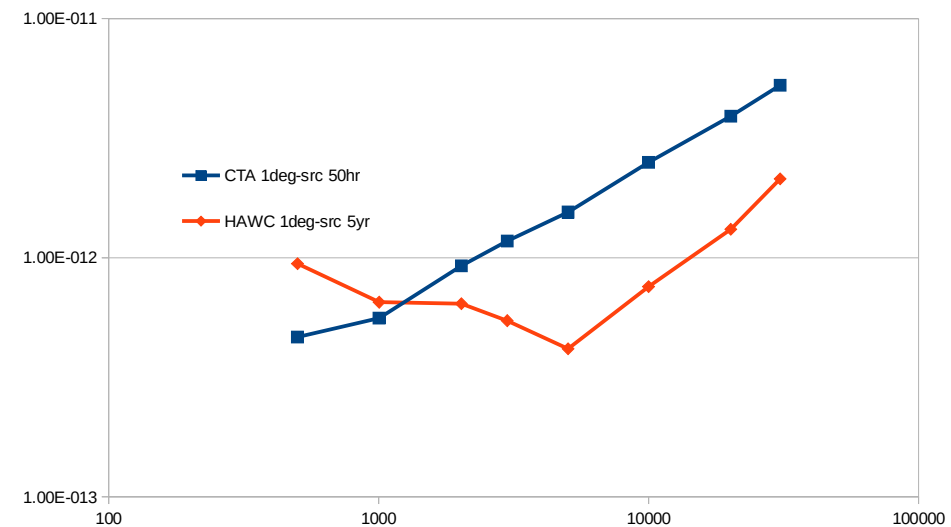
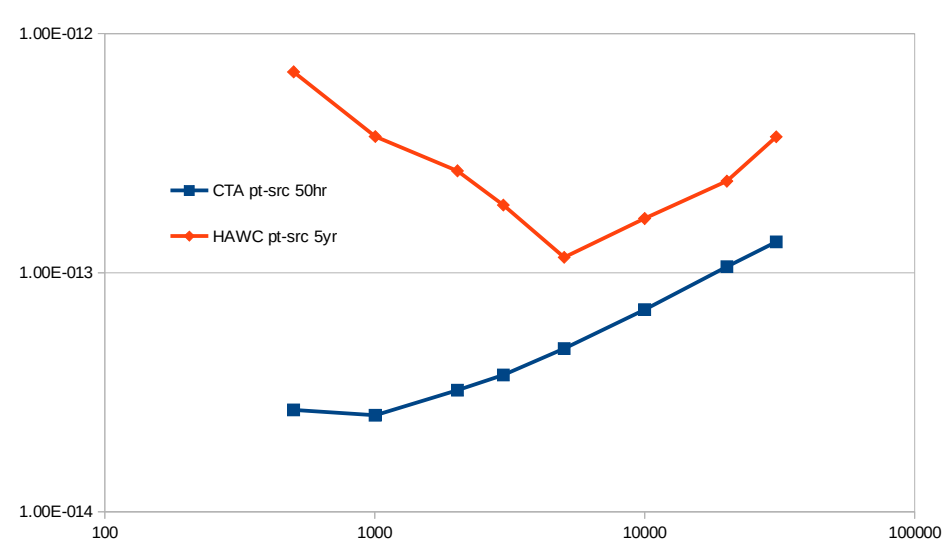


- Extended Sources
 - ~Half of 2FHL, 3FHL galactic sources are extended ($>0.2\text{deg}$)
 - ~1/4 $>0.5\text{deg}$
- Ligo/Virgo
 - GWs only well-localized in southern hemisphere
 - Cannot put definitive limits on North because of banana localizations
- Cosmic rays

Extended Sources

Rescaled HAWC, CTA sensitivity curves by 1deg/psf to get extended-source sensitivity-ish

Rough, but water Cherenkov has much better high-energy sensitivity to extended sources



Notes on the Figures

- At high end of CTA sensitivity, limited by signal counts (>10 gammas?)
 - So extended may actually not get quite so bad
- But...
- For short observation times, the high-energy CTA should get worse than nominal for the same reason
 - Improve as t not \sqrt{t} , but degrades as t not \sqrt{t} too
 - Water Cherenkov can help with these high-energy observations



Southern Observatory Niches/Needs



- Need: **Low-energy sensitivity (bigger?, higher?, algorithms?, denser array?)**
 - Needed for transients, extragalactic, greater CTA overlap
- Niche: Transients
- Niche: All-sky map
 - Extragalactic sources
- Niche: Diffuse
- Niche: **Extended**
- Niche: Cosmic Rays