Global Fit Activities – Past, Present & Future

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Slides (always) available from
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Actually, who the hell is Pat?

ANU (Stromlo) $\rightarrow$ Stockholm (Oskar Klein) $\rightarrow$ McGill

Nominally theorist/phenomenologist, in practice sit midway between theory + experiment, and particle + astro

Affiliations:

- *Fermi*-LAT: affiliated scientist
- IceCube: associate member
  (different from affiliated? not really)
- SuperBayeS: 'author'
  (= development author since 2011, not original author)

Global fits – Past

Mostly CMSSM, using SuperBayeS...

1. **Segue 1 *Fermi* gamma-ray data in CMSSM global fit (*Fermi*-LAT 'Cat II')**
   - PS, Conrad, Edsjö et al, JCAP, arXiv:0909.3300
   - Direct likelihood with flux data + 'fast detector simulation'
2. **Genetic Algorithmic exploration of CMSSM profile likelihood**
   - Akrami, PS, Edsjö, Conrad et al, JHEP, arXiv:0910.3950
   - Showed vanilla Bayesian scan techniques not OK for profile likelihood
3. **HESS gamma-ray fluxes from Galctic Centre + dwarfs + halo into CMSSM fit**
   - Ripken, Conrad, PS, JCAP, arXiv:1012.3939
   - Severe constraint on stau co-annihilation from internal bremsstrahlung, but questionable *J* factors
4. **Direct detection – future prospects and coverage tests**
   - 2 $\times$ Akrami, Savage, PS, Conrad, Edsjö, JCAP, arXiv:1012.4292/4318

Global fits – Present

Slowly moving away from CMSSM, SuperBayeS...

1. **Neutrino telescope likelihood module (in DarkSUSY)**
   - PS, Savage, Edsjö + the entire IceCube Collab, JCAP, arXiv:1207.0810
   - Event-by-event, unbinned likelihood (IC22 only, CMSSM/MSSM-7)
2. **Semi-random scan in MSSM-25 with new likelihood module, IC86 predictions**
   - Silverwood, PS, Danninger, Savage, Edsjö, et al, arXiv:1210.0844
   - Statistically simplistic, but at least it's MSSM-25
3. **Pippi – parse it, plot it**
   - PS, EPJ Plus, arXiv:1206.2245
   - Simple but powerful plotting scripts/package for marginalistation, profiling, post-processing, etc.

Global fits – Future

~~CMSSM~~, time for a new code

1. **IC79 SUSY global fit analysis (with DarkSUSY 5.0.6+)**
   - PS, Danninger, Savage, Edsjö + IceCube
2. **Differential evolution scanner**
   - Putze, Roebber (McGill PhD), PS
3. **Anti-deuteron likelihood in SUSY global fits**
   - Putze, Savage, PS, Edsjö
4. **Light DM global fits + model comparison with SuperBayeS offshoot DMBayeS**
   - Savage, PS, Weniger, Cline
5. **Galactic Centre *Fermi* analysis with DMBayeS**
   - Strege (Imperial PhD), PS, Trotta, Johanesson, Dupuis (McGill PhD), et al + *Fermi*-LAT
6. **MSSM-25 LHC likelihood attempt**
   - Giguere, Duplessis (both McGill Masters) + PS
7. ***Fermi*-LAT all-dwarf likelihood in SUSY global fits**
   - Llena-Garde (Stockholm PhD), PS, Conrad + *Fermi*-LAT

Global fits – new code

SUFit ?→ new BSM global fit code

My vision of this code: flexible and modular

- General enough to allow fast definition of new datasets and theoretical models
- Not just small modifications to CMSSM (NUHM, VCMSSM, blah, blah), and not just SUSY!
- Many statistical options – Bayesian/frequentist, likelihood definitions, scanning algorithms
- Plug and play scanning, physics and likelihood packages
- Something smart and fast for LHC likelihoods