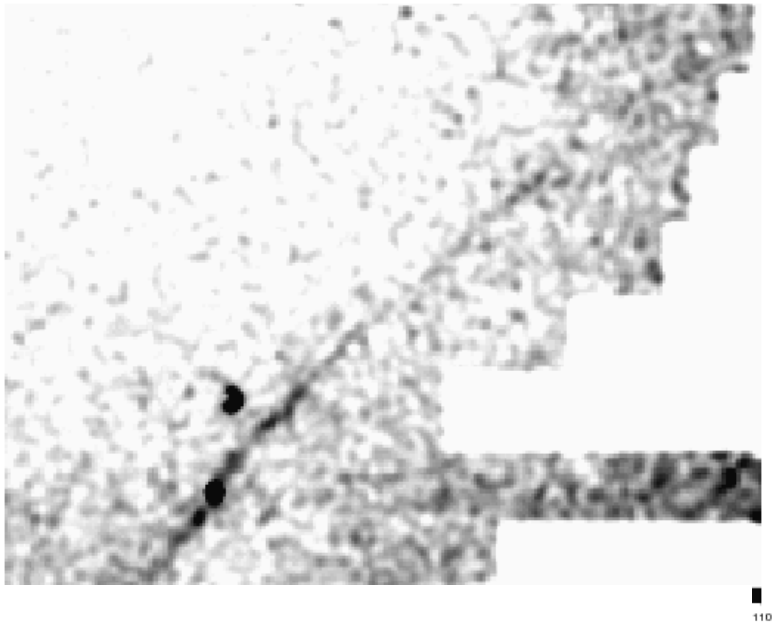
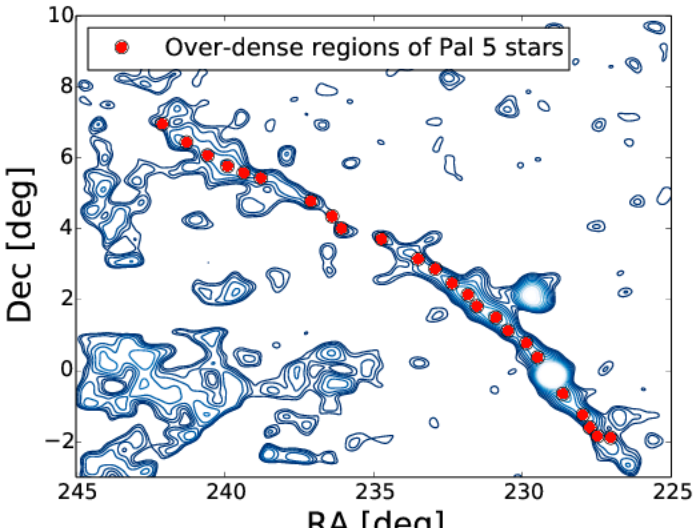
Astr 5465 Feb. 14, 2020

Steller Streams as Fossils of Galaxy Assembly

- **Large Stellar Surveys Reveal Stellar Streams**
  - **Self Gravitating Globular Clusters Often Modeled as a "King Profile" (Isothermal Distribution with a Tidal Cut-off, King et al. 1968)**
  - **Photometric Selection Reduces Background Grilmair et al 1995)**
  - **Early SDSS Data Surrounding Pal 5 Revealed Enormous Tidal Feature (see figure)**
- **Strong Evidence for Clumpy Distribution Over 23-deg! (Carlberg, Grillmair & Hetherington 2012)**
  - **Ages range from 2 Gyr to 7 Gyr**
  - **Gap Statistics Rule Out Simple Epicyclic Tidal Pumping Model**
  - **Gaps Consistent with Dark Matter Clumping!**
  - **Implication is MW DM Halo Comprised of 1 – 7 x 10^5 Sub-halos or 1 – 5,000 Within 30 kpc (Consistent with LCDM Predictions)!**



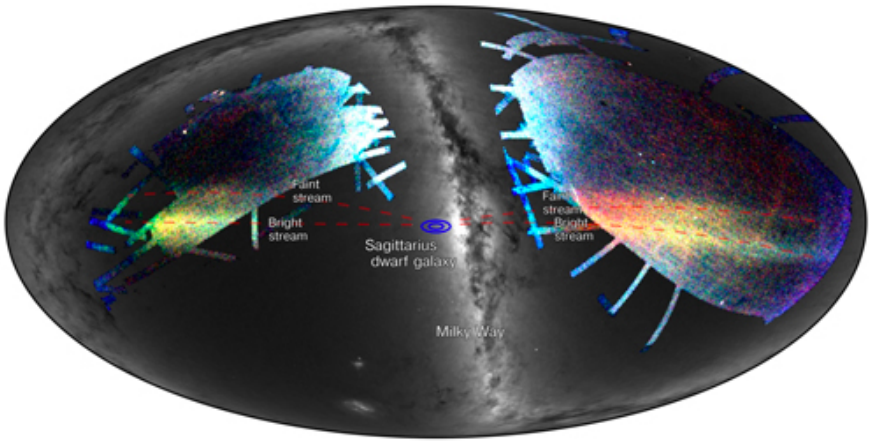


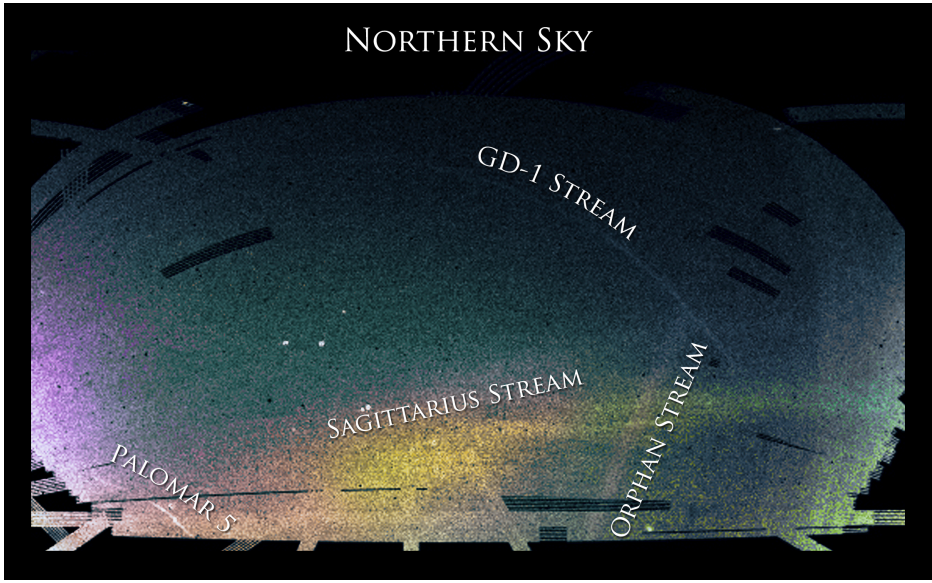
Stellar Streams in the MW Halo

- **SDSS Full Data Set Reveals "Field of Streams"**
- **LSST**
  - **Sagittarius Dwarf Galaxy**
    - **SDG Stream Dominates Halo**
    - **Over 720-deg Long!**
  - **Additional Streams Revealed**
- **Dark Energy Survey Streams (Shipp et al. 2018, arXiv:1801.03097)**
  - **Numerous Streams Revealed (3 known + 11 new and 4 New Tidal Features of GCs**
  - **Fantastic Movie:**

  https://www.noao.edu/news/2018/img/residual_bkg.gif

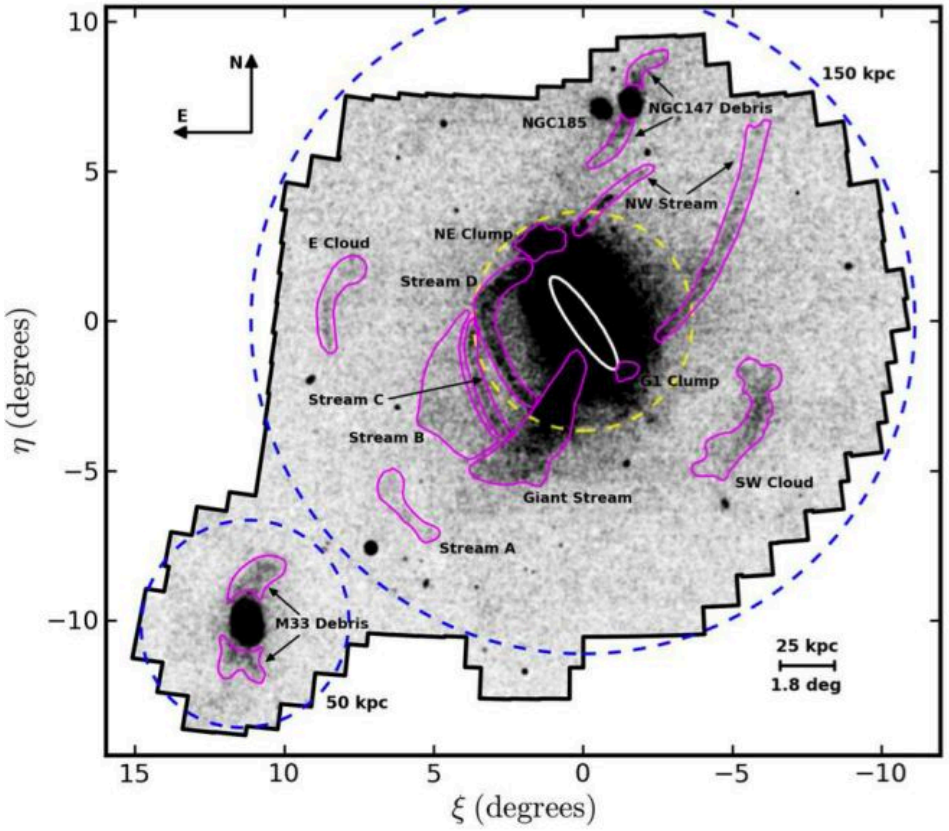
- **LSST Expected to Reveal Hundreds of Streams**
  - **Should Result in Much Tighter Constraints on Sub-clumping of the MW's DM Halo**

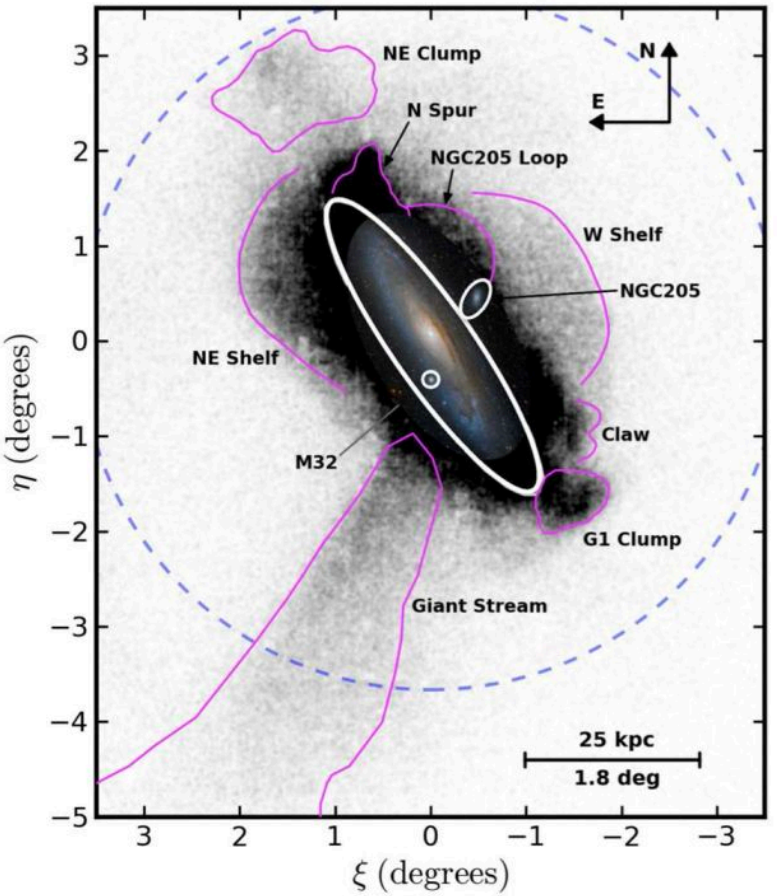




M31 Halo Streams

- **Deep Imaging Surveys of M31 Reveal Incredible Stellar Streams**
  - **PAndAS Survey of RGB Stars (Ibata et al. 2014)**
  - **Large Streams and Clumps/Clouds on Small Scales**
  - **Enormous Features on Large Scale**
  - **Dwarf Galaxy Features & M33 Streams**





- **Kinematics & Models**

GSS Originates From Line-of-Sight Merger of 1 – 5 x 10^9 Solar Masses in Stars

Other Galaxies

- **NGC 474**
  - **First Example of Elliptical "Shell Galaxy"**
  - **Major Merger**
- **NGC 5907**
  - **Deep Imaging Reveals Minor Dwarf Satellite Merger**
  - **Similar to Local Group Examples?**

See APOD for Numerous Cool Examples of Minor Mergers & Major Mergers (soon LSST!)