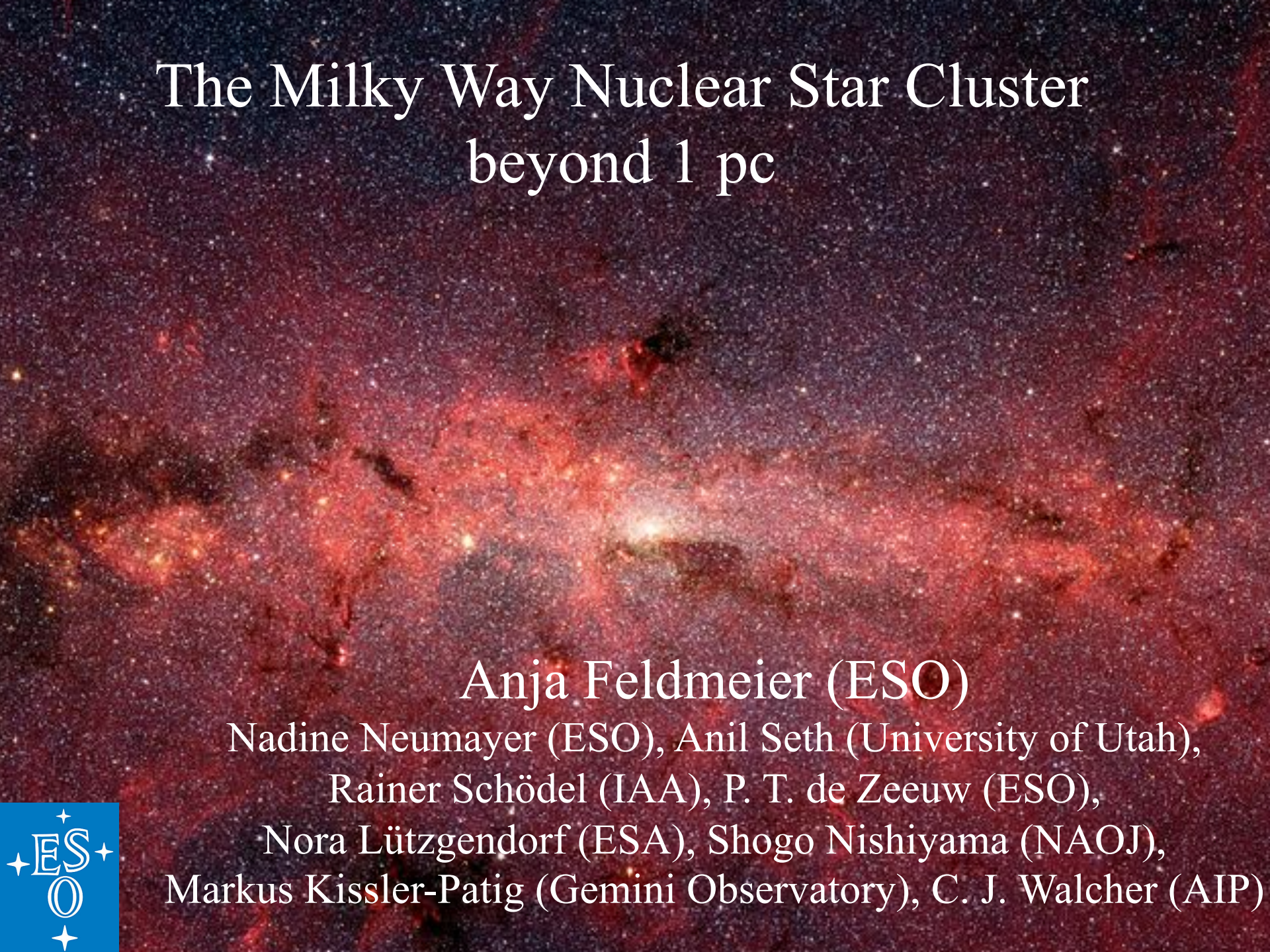
The Milky Way Nuclear Star Cluster beyond 1 pc

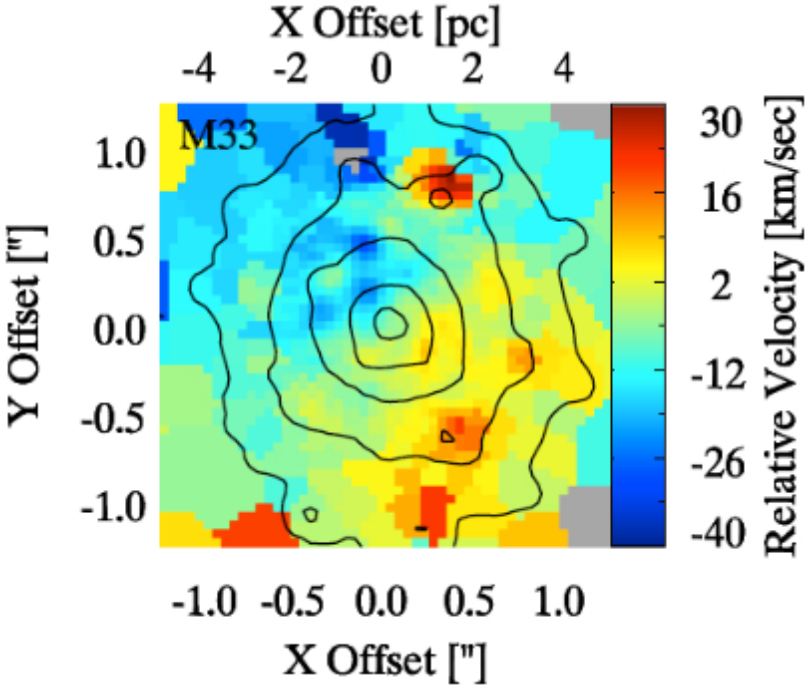


Anja Feldmeier (ESO)

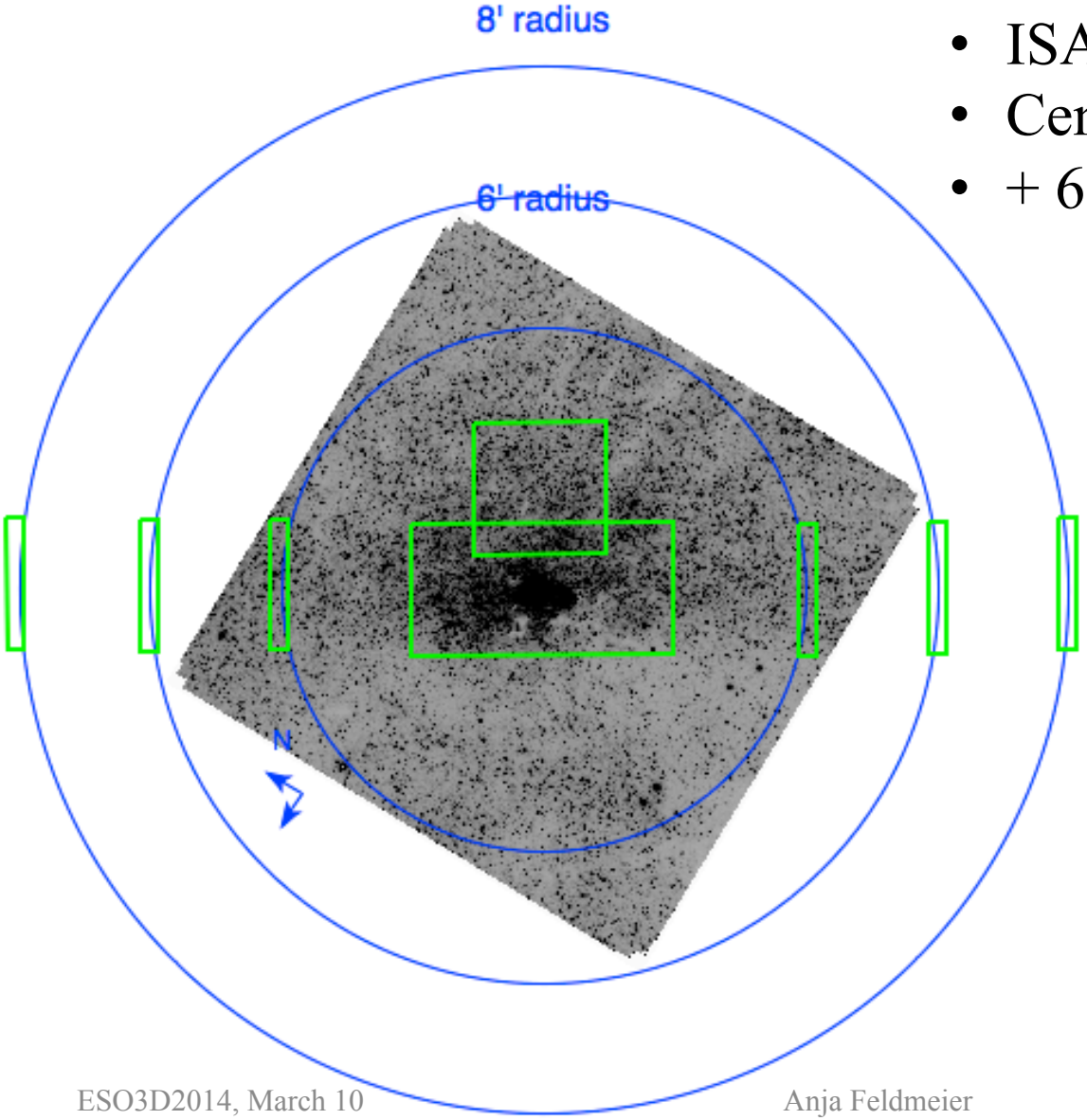
Nadine Neumayer (ESO), Anil Seth (University of Utah),
Rainer Schödel (IAA), P. T. de Zeeuw (ESO),
Nora Lützgendorf (ESA), Shogo Nishiyama (NAOJ),
Markus Kissler-Patig (Gemini Observatory), C. J. Walcher (AIP)

Nuclear Star Clusters (NSCs)

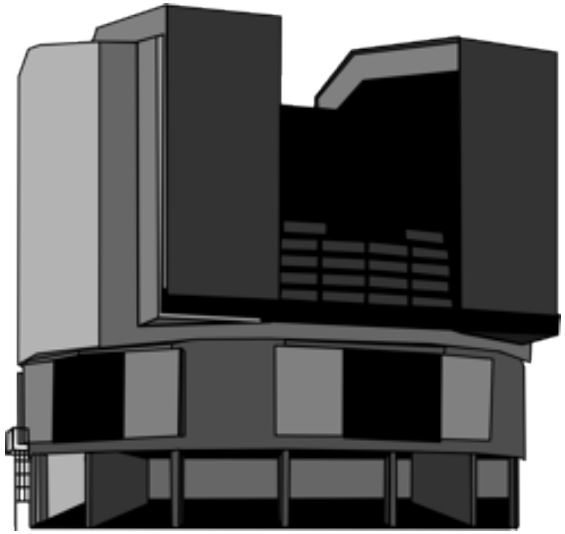
- Two different formation scenarios
  1) SF in the center (e.g. Schinnerer et al. 2008, Milosaljević 2004)
  2) Cluster merger (e.g. Tremaine 1975, Gnedin et al. 2013, Antonini 2013,2014)
- Record of accretion history
  in stellar kinematics



Spectroscopic data set

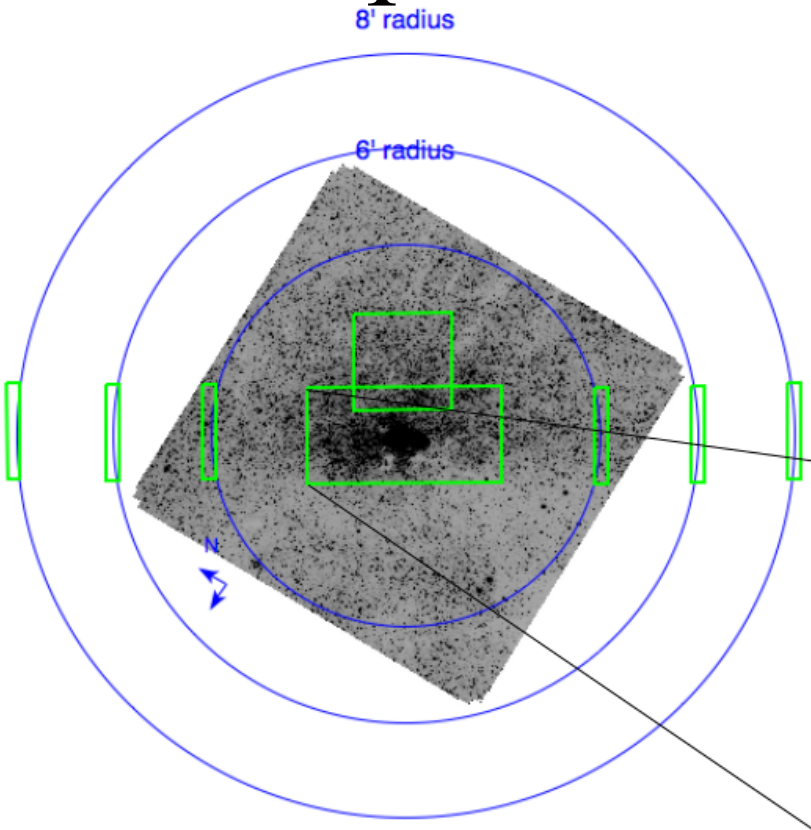


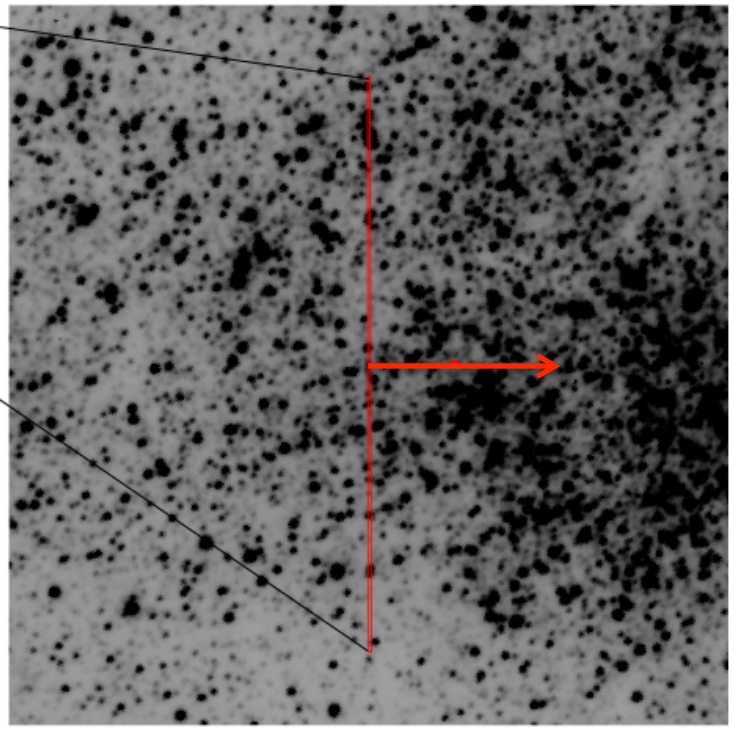
- ISAAC long slit spectrograph
- Central field: ~4'x3.5'
- + 6 fields of 16"x2' size



Spectroscopic data set

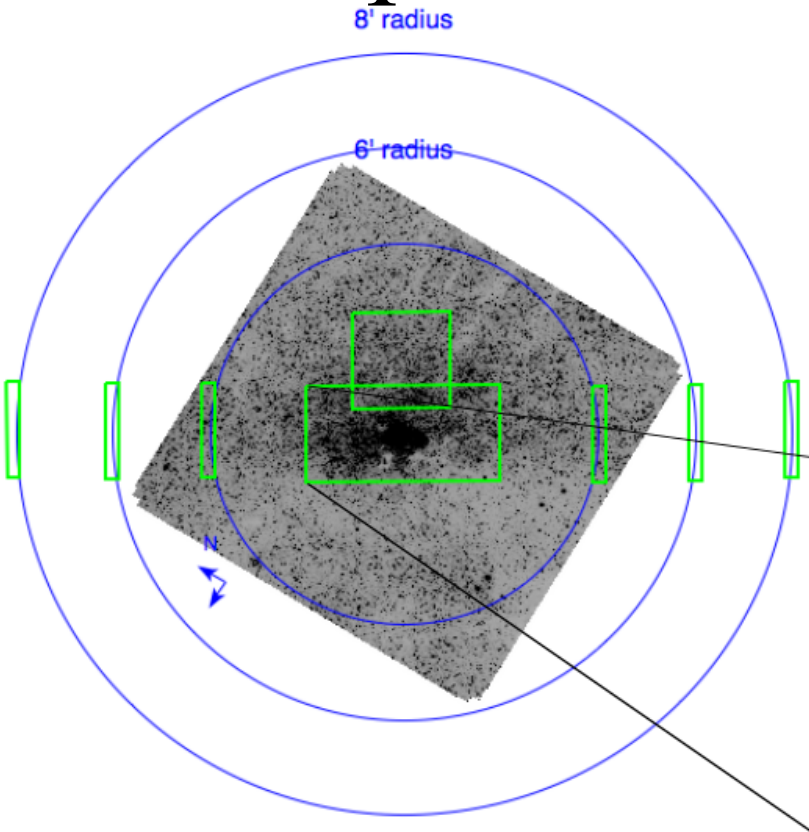
- ISAAC long slit spectrograph
- Central field: ~4’x3.5’
- + 6 fields of 2’x16” size





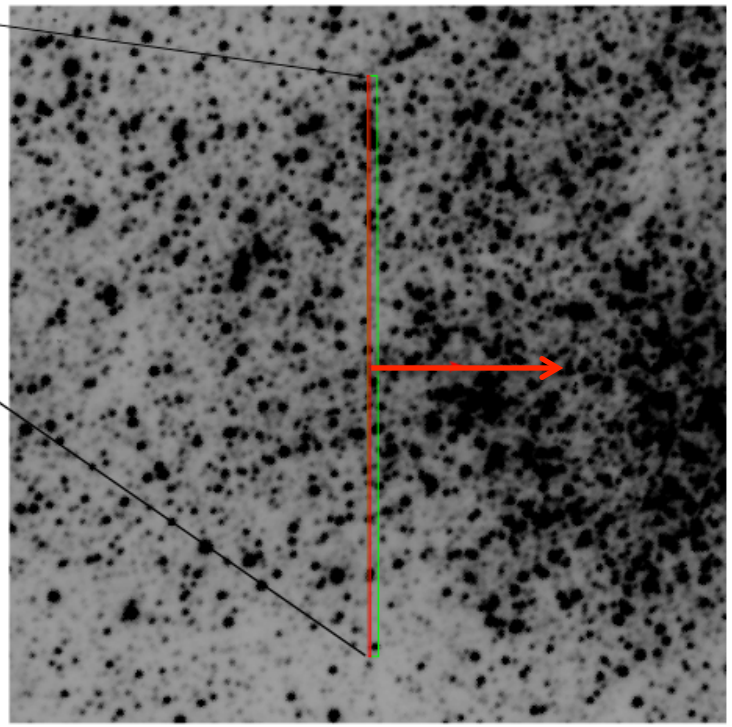
Slit length: 120"
Slit width: 0.6"

Spectroscopic data set



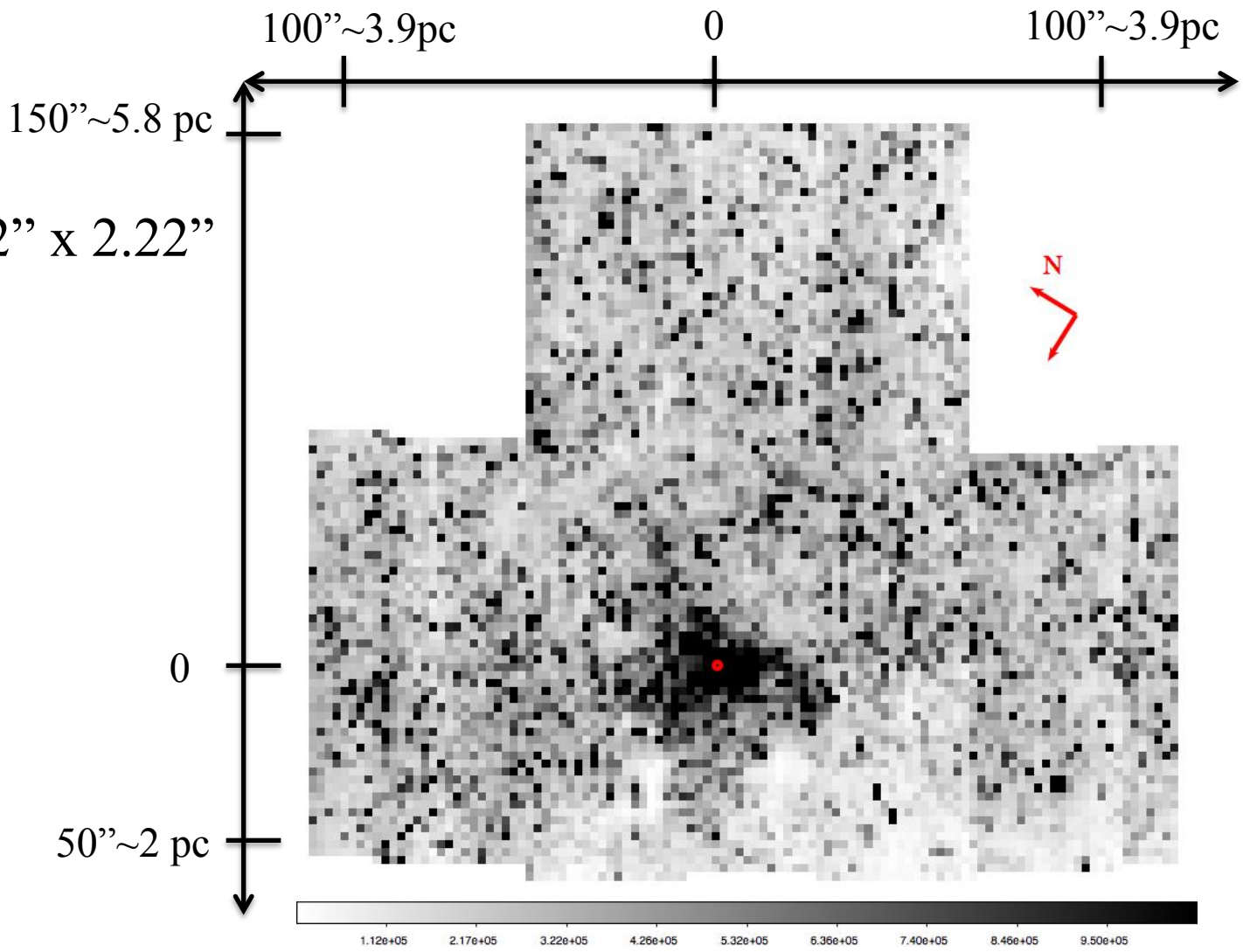
- ISAAC long slit spectrograph
- Central field: ~4'x3.5'
- + 6 fields of 2'x16" size
- ~2.29 – 2.41 μm,

Slit length: 120"
Slit width: 0.6"
Drift: 2"



Spectroscopic data set

Binning to 2.22” x 2.22”



Spectroscopic data set

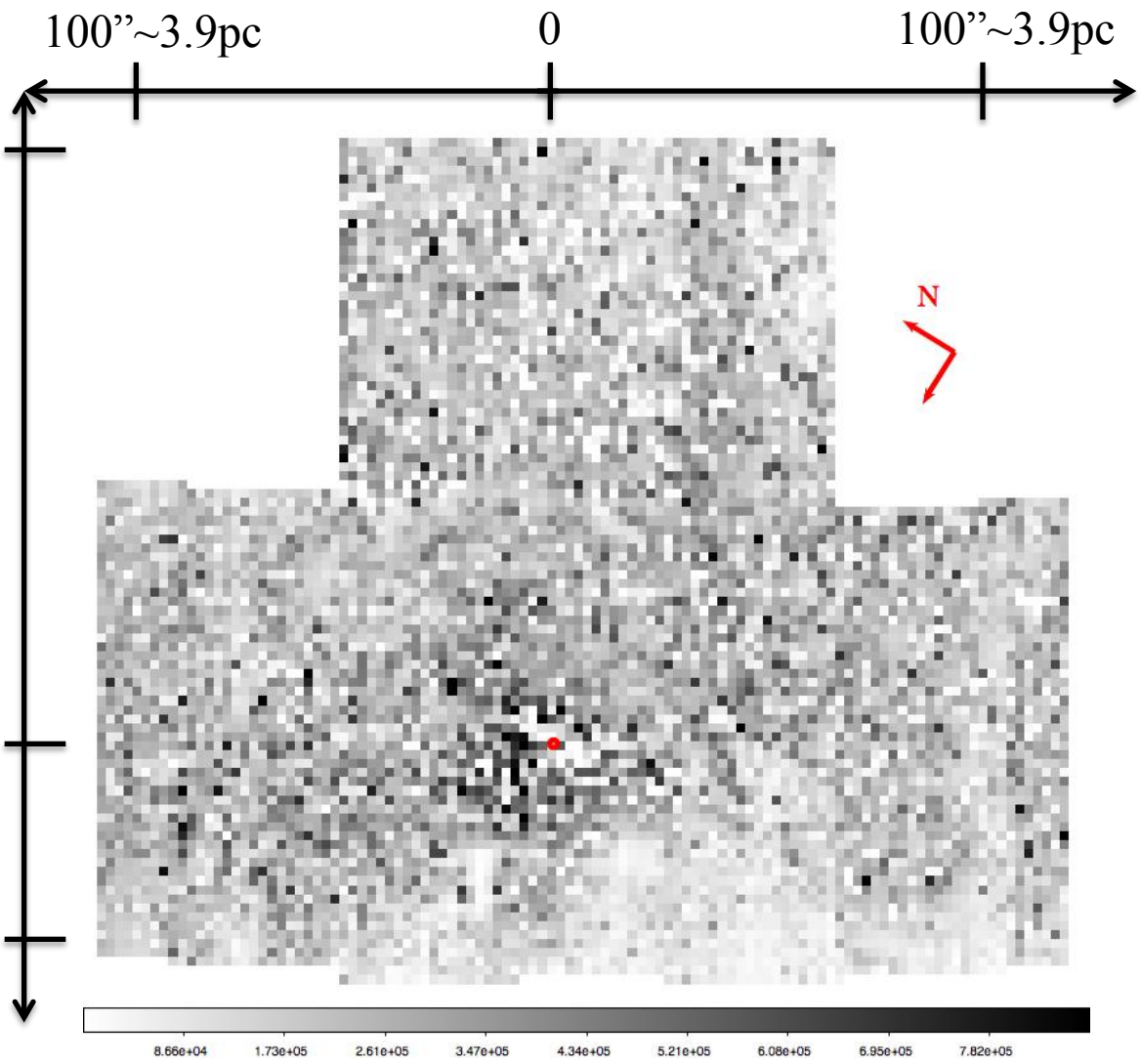
Binning to 2.22” x 2.22”

Cut out foreground and brightest stars:

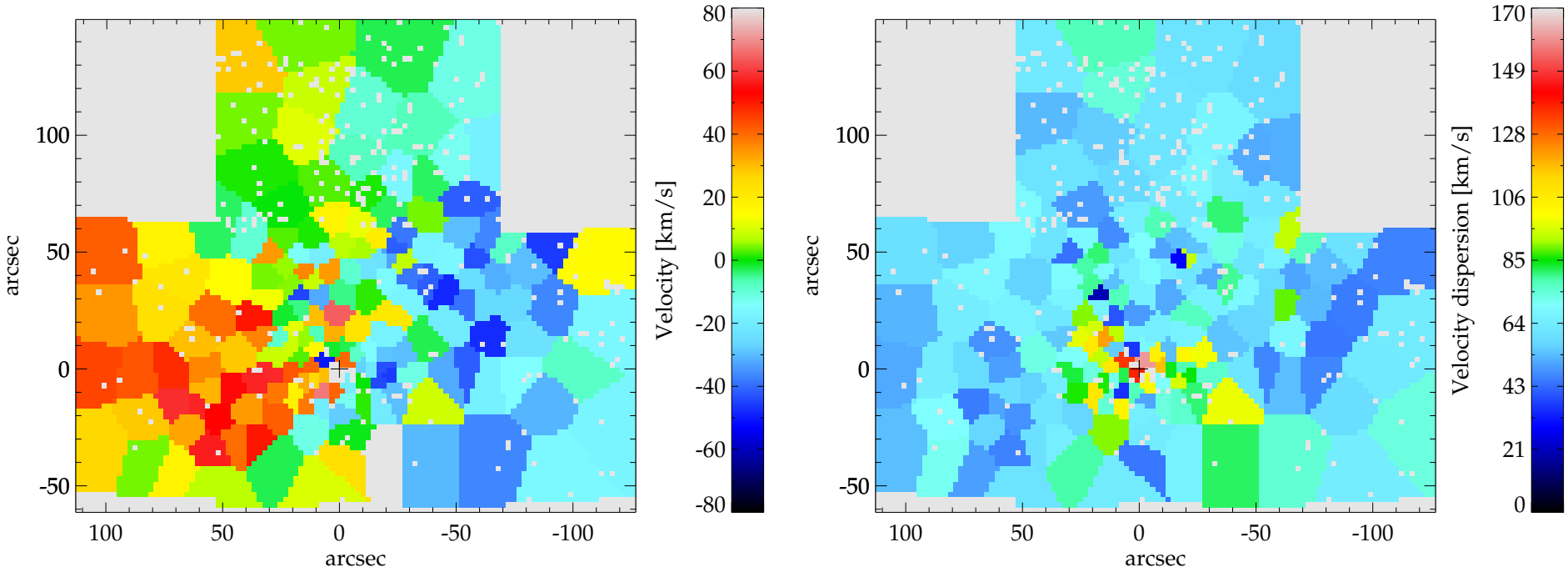
2MASS point source catalog
(Skrutskie et al. 2006)

SIRIUS/IRSF catalog
(Nishiyama et al. 2006)

Only Stars with
K > 11.5
1.5 < H – K < 3.5



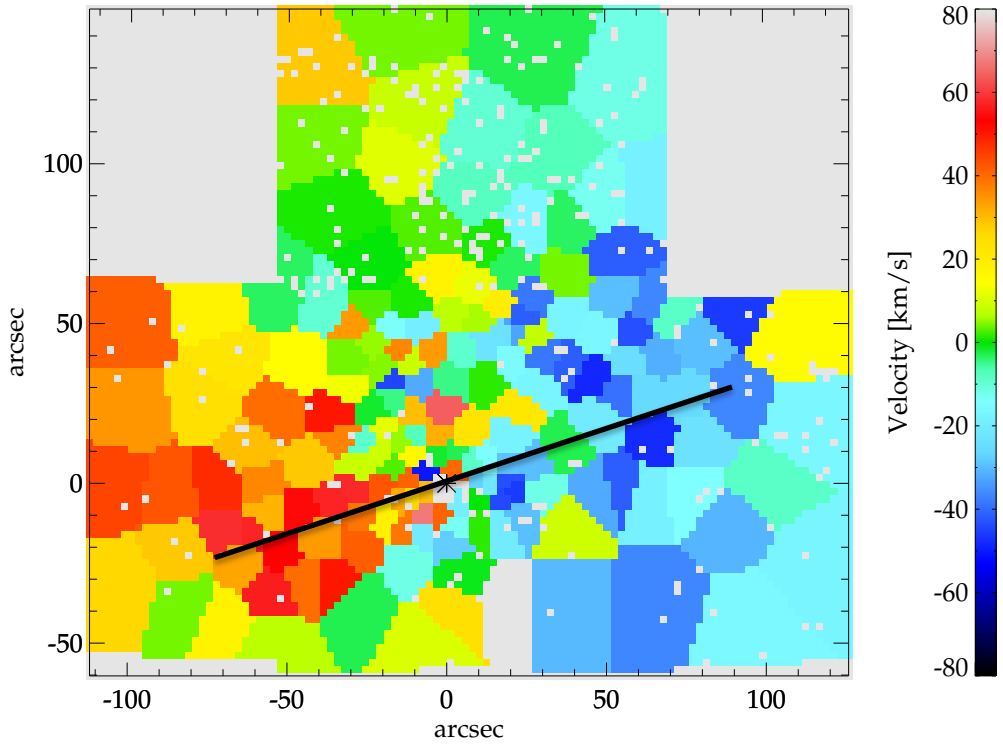
Kinematics of faint stars



Feldmeier et al. submitted

Voronoi binning (Cappellari & Copin 2003)
pPXF fit to stellar CO absorption lines (Cappellari & Emsellem 2004)

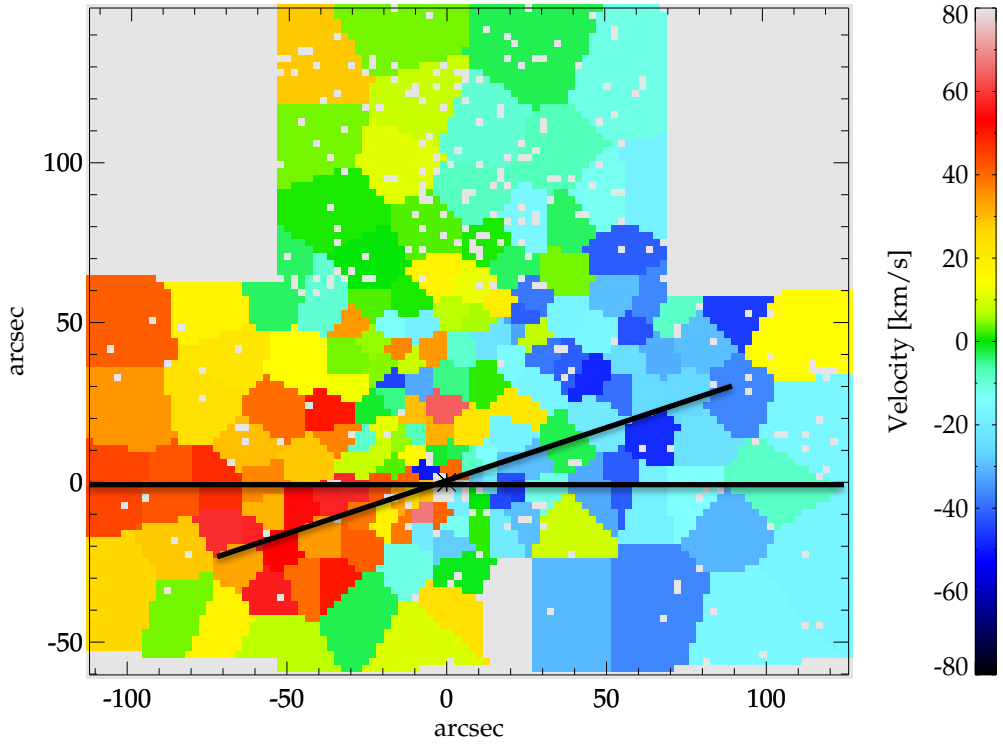
Kinematics of faint stars
Position angle offset



Highest velocity bins are not along the Galactic Plane

Feldmeier et al. submitted

Kinematics of faint stars
Position angle offset



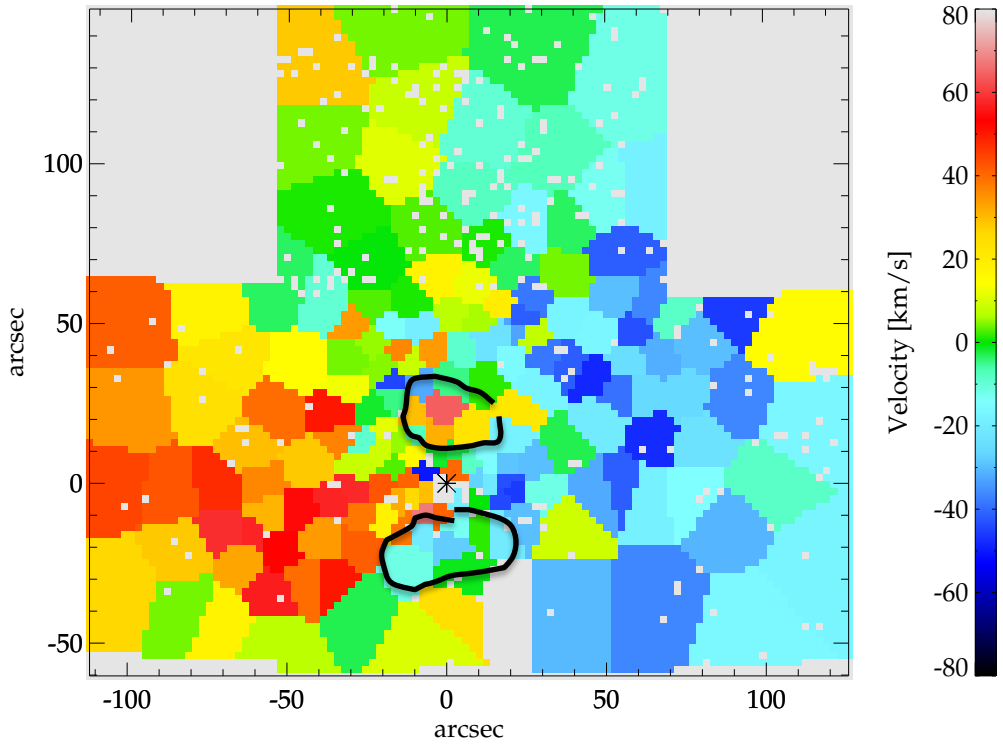
Feldmeier et al. submitted

Highest velocity bins are not along the Galactic Plane

Position angle of photometry:
$PA_{phot} = 0°$
(Schödel et al. submitted)

Position angle of kinematics:
$PA_{kin} \approx 9°$
measured with Kinemetry
(Krajnović et al. 2006)

Kinematics of faint stars perpendicular substructure



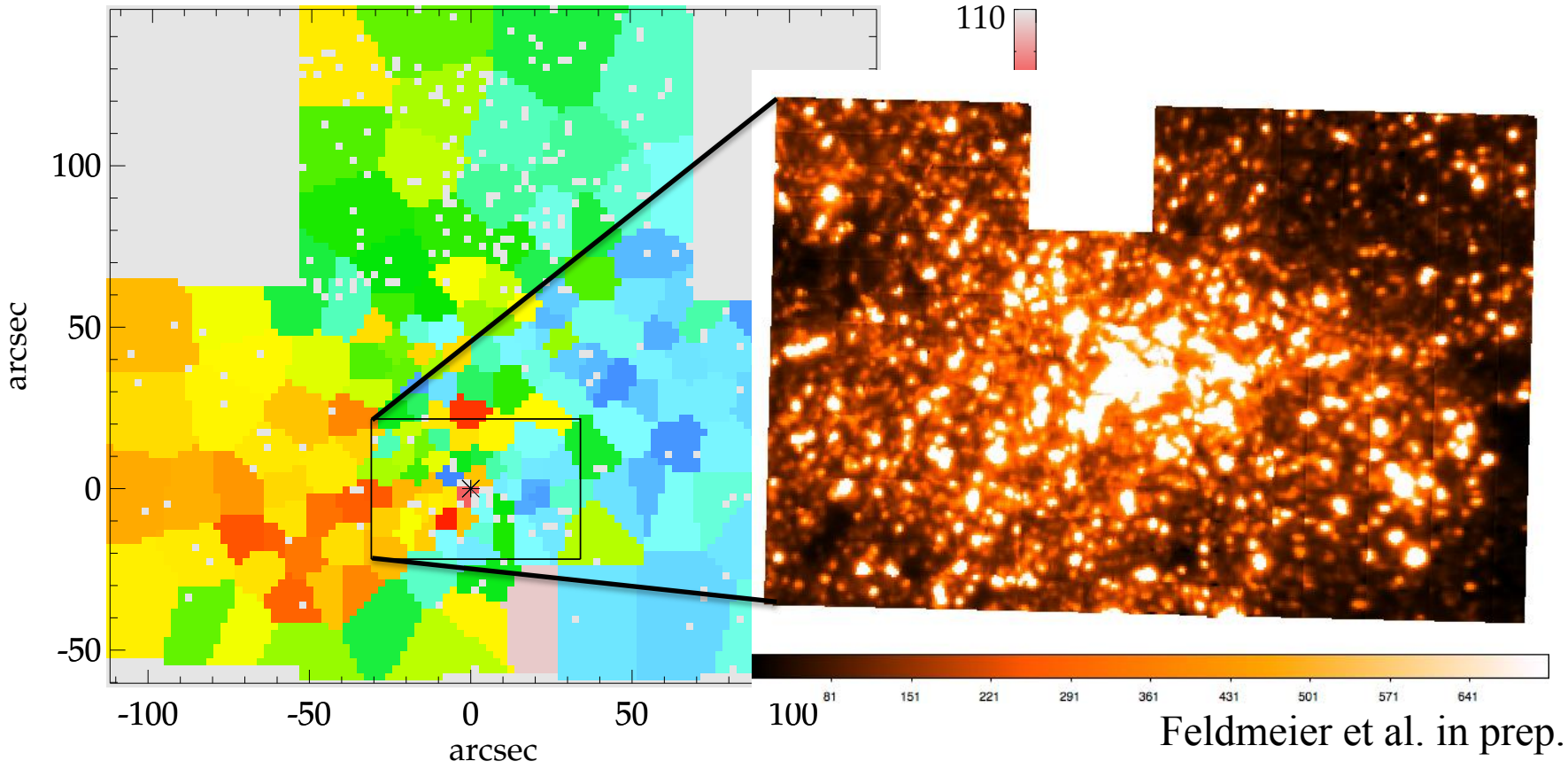
Feldmeier et al. submitted

Symmetric feature at
r ~ 20” (0.8 pc)

Disrupted remnant from an infalling star cluster?

Tidal disruption radius ~1pc
(Antonini et al. 2012)

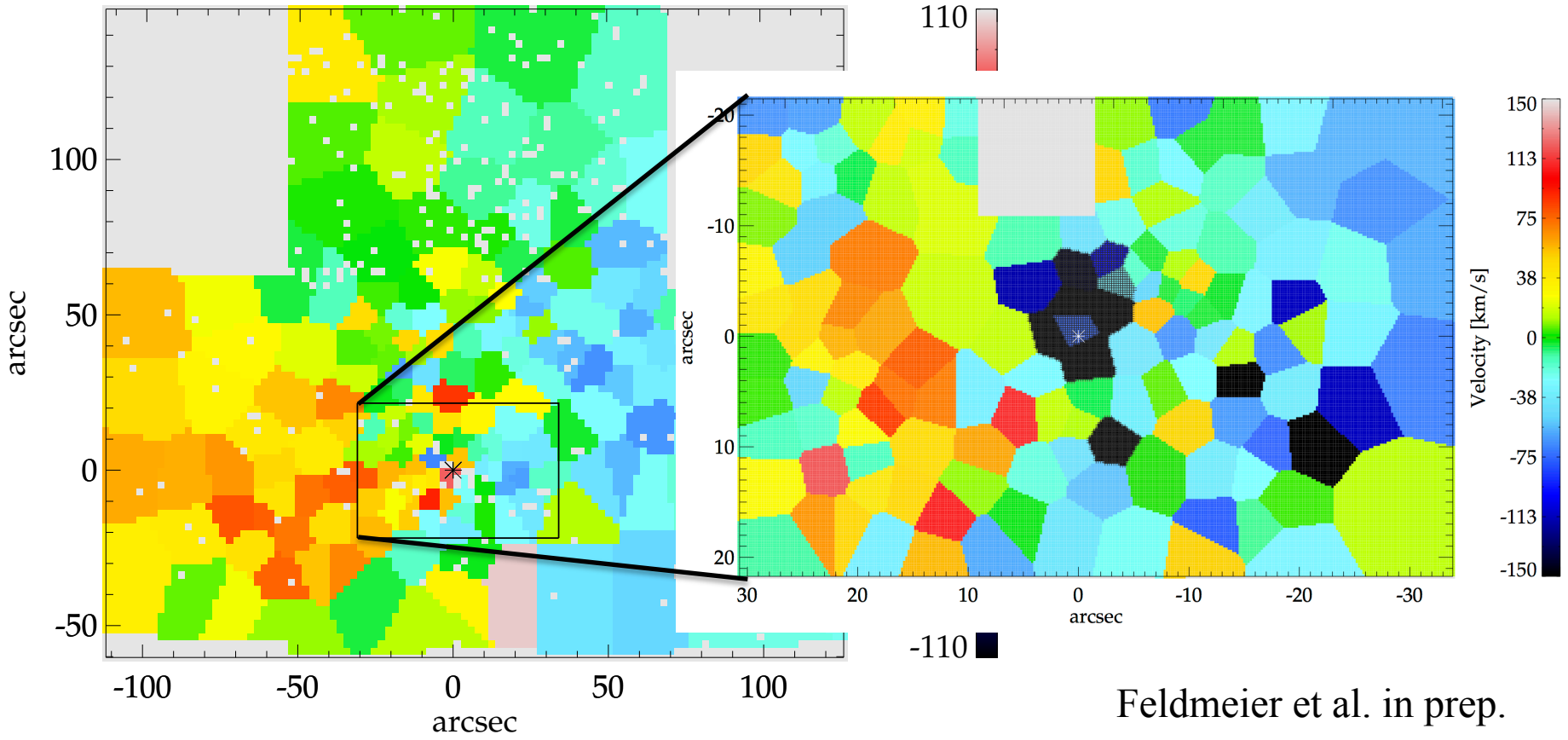
KMOS mosaic



Feldmeier et al. in prep.

KMOS mosaic field of view: 64.9” x 43.3”, full K band

KMOS mosaic



Feldmeier et al. in prep.

KMOS mosaic field of view: 64.9” x 43.3”, full K band

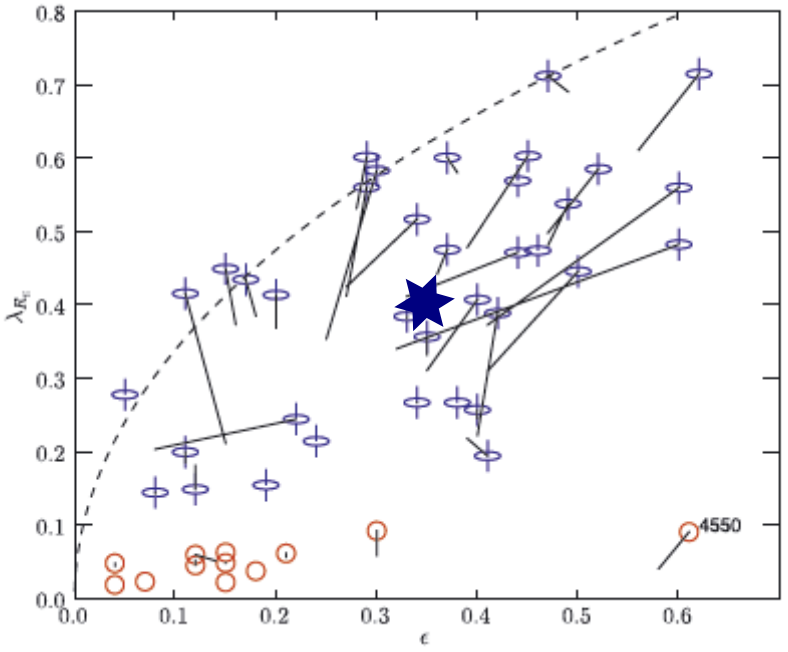
Kinematics of faint stars
Anisotropic kinematics

Specific angular momentum λ (Emsellem et al. 2007)

- Dimensionless parameter to quantify ordered/random motion (v/σ)
- Ellipticity $\varepsilon_{phot} = 0.35$

  (Schödel et al. submitted)

Emsellem et al. 2007:
Dashed line: isotropic oblate rotator seen edge-on
Blue: fast rotator
Red: slow rotator
Blue star: Milky Way nuclear star cluster



Summary & Conclusions

- Spectroscopic observations of 11 arcmin^2 of the Milky Way nuclear star cluster
- Kinematic position angle offset and symmetric perpendicular substructure at r ~ 0.8 pc
- Support for cluster infall scenario
- Anisotropy at large radii